PLAYING TO THINK CRITICALLY: A DELPHI STUDY ON DIGITAL GAMES FOR CRITICAL THINKING

by

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THESIS

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Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree except as specified.

Signed: Stanislav Khanin

Ханин С.

Date: August 14, 2022

Ethical Approval

NAZARBAYEV UNIVERSITY

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Ethics decision
1 message

GSE Research committee <gse_researchcommittee@nu.edu.kz> Tue, Jul 10, 2018 at 3:49 AM

To: Stanislav Khanin <stanislav.khanin@nu.edu.kz>, Michelle Irene Somerton <michelle.somerton@nu.edu.kz>

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Dedication

to Ira for her support, love, and humor

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Participating experts, your effort was enormous. Our field definitely has a future with such dedicated people as you are.

Abstract

As advocated by many researchers, policymakers, and educational authorities, critical thinking, in its many forms and definitions, is a key to sustainable development, life, and career readiness, and therefore an essential component to be embraced by educational systems. One of the ways that the development of critical thinking could be supported is through the medium of digital technology and digital games. Current research on the relationship between digital games and critical thinking is in its infancy and this study aims to cover this research gap. This thesis explores the position of international subject-matter experts (SMEs) to present a comprehensive picture of how digital technologies and games can be used as a medium to develop critical thinking. The research employs a research design based on the "contributory" Kantian Delphi method that was chosen to provide as many perspectives on the nature of an under-researched phenomenon as possible. The study included three Kantian Delphi rounds deploying three anonymous questionnaires. Thirty-six SMEs joined Round 1 (22 SMEs—Round 2, nine SMEs—Round 3), all with diverse professional backgrounds related to education and technology. Participants included teachers, game developers, researchers, methodologists, and other specialists working with digital technology in education. The findings of the study demonstrate that SMEs conceptualize critical thinking in various ways. These differences were evident when analyzed with the theoretical framework of this study. SMEs' definitions of critical thinking fit within the psychological (17 SMEs), philosophical (9 SMEs), and educational (8 SMEs) traditions of thought as theorized by Sternberg (1986). The majority of SMEs' accounts of critical thinking included cognitive skills, judgments, and dispositions (23 SMEs), with some of them also exemplifying critical action (6 SMEs). SMEs emphasized both the relevance of critical thinking to an individual's development (18 SMEs), as well as its importance to society (12 SMEs). At least 16 SMEs made connections to creative thinking, which, as discussed in this

thesis, may be an indicator of their inclusive perspective on the nature of critical thinking. In Rounds 2 and 3 SMEs proposed various elements, features, modes, theories, and considerations that participants believe could support the development of critical thinking in digital technologies and games. SMEs disaggregated the phenomenon of digital games and critical thinking into many important considerations. These included pedagogical considerations, such as clearly stated learning goals, the presence of the briefing/action/debriefing learning circle, or the importance of collaborative learning. Content considerations involved one’s consciousness about the aspect of critical thinking that ought to be taught or in-game problems. Finally, technological considerations were represented but not limited to in-game feedback, games genres, playing modes, and game design. The results of the study suggest that these various considerations are inseparable from one another—they actively support and constrain each other. Each round of the study produced a report available at https://play2think.com. Finally, various stakeholders may utilize these findings with the Three-Phase model for critical thinking and digital games constructed from the research findings. The model represents how the various findings of this study relate to each other.

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Chapter 1: Introduction

1.1 Background

We live in a world that is fundamentally challenged by many critical issues. Ongoing military conflicts, ideological tensions, ubiquitous violation of human rights, ecological crises, pandemics, and sharply growing social inequality are the problems many generations of today and the future have to deal with. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) and Tang (2014) “the international community is urging an education that will help resolve the existing and emerging global challenges menacing our planet, while wisely tapping into the opportunities it provides” (p. 5). This is not to say that we did not have many of these problems before, rather at the current stage of technological development, humans are becoming ever more capable of destroying the whole planet. Reacting to that, UNESCO and Tang (2014) proposed to educate citizens in the spirit of global citizenship and sustainable development when engaging them “in critical thinking about complex global issues” (p. 20). It goes without saying that, if we want to survive, create, and develop as we live in this world, we simply do not have the right to be careless. We should think, and think critically, when we face problems in our personal life, our workplace, and globally. This thesis is examining the notion of critical thinking as a powerful tool for individual and social growth, and as an educational objective. Consequently, as I am arguing below, digital technology and, in particular, digital games, provide the prospective means to promote the development of critical thinking.

The use of digital technology in education is an ever-growing field that is not surprising considering the rapid rate of technological advancement and the variety of potential learning benefits it may afford. Over the past 30 years, we have seen the emergence of a range of digital products and software developed or adapted for teaching and learning. The development of Massive Open Online Courses (MOOCs), immersive multiplayer games, virtual reality, and artificial intelligence (AI) provide new opportunities for teaching, learning, and research. Papers published by the Organization for Economic Co-operation and Development (OECD) and UNESCO also report on the recent trends in educational technology including smart technology that is based on artificial intelligence, learning analytics, robotics, blockchain, and game-based assessment (Duggan, 2020; OECD, 2021). At the same time, these developments raise many sociotechnical tensions including problems of environmental sustainability, the commercialization of education, and issues of privacy, inclusion, equity, and social justice (Selwyn, 2020, 2021a, 2021b; Tawil, 2020). Throughout the years of 2020 and 2022, the COVID-19 global pandemic has only made many of these challenges more evident (Tawil, 2020; UNESCO, 2020; UNESCO et al., 2020) and highlights the need to adopt a critical perspective on the ways in which educational technology is used in the present and into the future.

Critical thinking is considered to be an integral part of several frameworks advocating the skills needed for college and career readiness and successful living in the 21st century (Conley, 2011; The Partnership for 21st Century Learning, 2015; Wagner, 2008). For example, the Partnership for 21st Century Learning (2015) recognizes critical thinking as one of the “essential skills for success in today’s world” (p. 1). The importance of critical thinking is hard to underestimate. A key formal document in international education is the Incheon declaration, “The Education 2030 and Framework for Action”, which outlines the foreground directions of global education development (Incheon Declaration, 2015). This declaration was signed by over 1600 participants from 160 countries, including over 120 ministers, heads and members of delegations, the heads of agencies and officials of multilateral and bilateral organizations, and representatives of civil society, educators, youth, and the private sector (p. 5). The declaration states that the aim of the Sustainable Development Goal 4 “Education 2030” is to “ensure that all individuals acquire a solid foundation of knowledge, develop creative and critical thinking and collaborative skills, and build curiosity, courage and resilience" (p. 26).

Critical thinking is conceptualized very differently depending on what scholarship grounds an author comes from. The American Philosophical Association (APA) assembled an authoritative panel of 46 subject-matter experts to come up with a definition of critical thinking built on a consensus of experts (Facione, 1990). It produced a landmark Delphi report providing the following definition:

> We understand critical thinking [CT] to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. CT is essential as a tool of inquiry. ... While not synonymous with good thinking, CT is a pervasive and self-rectifying human phenomenon. The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical thinkers means working toward this ideal. It combines developing CT skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. (p. 3)

Based only on that definition one may recognize that critical thinking may be defined in terms of cognitive skills (Chance, 1986, p. 6; Ennis, 1962, p. 8; Halpern, 1998, p. 450; McPeck, 1981, p. 8), reflective judgment including some elements of metacognition and self-regulation (Bailin et al., 1999, p. 287; Ennis, 1985, p. 45; Halonen, 1995, p. 78; Lipman, 1988, p. 39); or propensity elements including dispositions of a critical thinker (Bailin et al., 1999; Ennis, 1985, p. 46; Facione et al., 1995; Halonen, 1995; Halpern, 1998; Paul, 1992), perfections of thought (Paul, 1992, p. 10), and emotions (Brookfield, 1987; Dunn et al., 2008). Nevertheless, critical thinking scholarship is not limited to these elements and some authors also propose to use the term “criticality” which emphasizes the need for a critical action (Barnett, 2015; Davies, 2015; Johnston et al., 2011). Davies and Barnett (2015) define criticality as a wider sense of critical thinking extending to an individual’s participation in society: “critical thinkers do more than reason; they also *act* [emphasis added] ethically on the basis of their reasoned judgments” (p. 16). Also, the APA Delphi report definition (Facione, 1990) does not include concerns of critical pedagogues who claim that critical thinking is primarily about changing society (Belenky et al., 1997; Ellsworth, 1989; Freire, 2000; Giroux, 2013; McLaren, 2010)—in other words, realizing and reforming how capitalism, neoliberalism, gender, and other agendas shape the way we think, teach, or live.

These varying elements and the concerns of authors working within ‘critical scholarship’ demonstrate that this space is disputed, conceptualized differently, and consequently, the concept is applied and exercised differently. Since the inception of the critical thinking movement agenda in the early 1970s, theoretical and empirical research has emerged out of philosophical, psychological, and educational schools of thought (Lai, 2011; Paul, n.d.; Sternberg, 1986), extending also to the agenda of the criticality and the critical pedagogy movements. It has been roughly 50 years, but today it is still generally conceded that critical thinking is a missing link in education and a perennial objective that doesn't lose its appeal to educators.

Effective communication, problem-solving, decision-making, the mastery of content, civic consciousness, career, and life require critical thinking. And these elements were and are what schools and universities are believed to promote. Over time, there have been more than 684 empirical studies that have taken up this topic as their objective to identify which teaching strategies help develop critical thinking (Abrami et al., 2015), and there were a number of scholars whose comprehensive scholarship was used to guide critical thinking instruction (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956; Ennis, 1989; McPeck, 1990; Paul & Elder, 2006).

1.2 Statement of the Problem

While the body of literature on the development and theorization of critical thinking is quite advanced, there is still a lack of research and applied scholarship pertaining to critical learning mediums. It is striking because many scholars (Bell et al., 2011; Harlen & Deakin Crick, 2003; Law et al., 2008; Moreno, 2005; Ng'ambi & Johnston, 2006; Subran, 2013) present evidence suggesting that critical thinking can be effectively supported with the use of digital technology, which can offer students a range of experiences and tools for learning. Among the variety of digital technology solutions, digital games stand out as a unique learning environment. As Gee (2013) suggested, digital games are, in essence, "learning systems" (p. 1), which can offer the opportunity for a number of game principles to be incorporated into learning, and be used as a medium of deep, active and critical learning (Gee, 2004, p. 59).

The thesis of my work is that the development of critical thinking can be successfully supported through the playing of digital games. To understand this thesis, we can split it into constituent parts. "To play" means to move or act freely within a more rigid structure (Salen & Zimmerman, 2003), which is a digital game in the case of this research. Uniting both, we can use the term *game play*. Salen and Zimmerman define it: "Game play is the formalized interaction that occurs when players follow the rules of a game and experience its system through play" (p. 3). In this thesis, I focus on the activity of playing games, on their constituent elements, and on the creation of games in relation to how these may help in the development of critical thinking.

The claim that digital games can help in developing critical thinking is based on empirical evidence that games are powerful means to support problem-solving (Liu et al., 2011; Spires et al., 2011; Yang, 2012). Digital games can also be understood as an environment that can support the development of reflective and questioning minds (Frasca, 2001; Gee, 2004), and, consequently, believed to promote critical thinking (Childress & Braswell, 2006; Doolittle, 1995; Frasca, 2001). Yet, the research concerning digital games as a means to promote critical thinking is in its infancy, and there remain many important questions to be answered.

This study unites existing theoretical and empirical data to approach the notion of critical thinking as conceptualized by SMEs working in the field of digital technology and education. When this question is being answered, other questions will arise, such as what kind of techniques, elements, or pedagogies may facilitate the development of critical thinking, and, if they do, what can SMEs tell us about digital games as a means to educate critical thinkers? These are all important lines of inquiry if we want to harness the power of digital technology and games to prepare students facing the challenges of the 21st century.

It appears that there is a long way to go, and the research gap should certainly be addressed to empower practitioners, learners, policymakers, and game designers in their practice and decision-making. The task of the development of critical thinking is of high priority, and there should be a departing point for those who introduce and use digital games for learning purposes. This study may be a basis for further research, projects, and games, and undoubtedly there is an urgent need to be well-informed on this question. Finally, as I am arguing through this study, the Kantian “contributory” Delphi method is the most reasonable approach to address this research problem. The Kantian Delphi method is distinct from the well-known consensus-oriented Lockean Delphi method in the way that it enables a researcher to build a comprehensive picture of the phenomenon without losing positions that were not endorsed by the majority of participants. The data collected through Delphi questionnaires and the research website was analyzed qualitatively and quantitatively with the use of coding and categorial grouping as well as with descriptive statistics.

1.3 The Purpose of the Study

Having outlined the gaps in the research field, it is possible to present the purpose of the study which will guide us to formulate research questions and present subsequent methodology. The purpose of the study is to explore the position of international subject-matter experts working in the field of digital technology and education and present their collective vision over the matter of digital games as a medium to promote critical thinking.

1.4 Research Questions

The following research questions provide the focus of the research study:

RQ1: In what ways do SMEs in the field of digital technology and education conceptualize critical thinking?

RQ1a: What are the differences in the ways that SMEs conceptualize critical thinking?

RQ2: Do SMEs believe critical thinking can be developed using digital technology?

RQ2a: In what ways do SMEs believe that critical thinking can be developed using digital technology?

RQ3: Do SMEs believe that critical thinking can be developed using digital games?

RQ3a: What do SMEs believe are important elements needed for digital games to develop critical thinking?

1.5 Rationale and Significance of the Study

Digital technology has impacted many areas of our lives, from communication to transportation, shopping, banking, and the way we access and process information. Educators all over the world use digital technology as a supportive tool to present pedagogies that are engaging, experiential, more visual and interactive, and promote collaboration and content creation. Digital games are among this technology and represent powerful means for active and critical learning (Gee, 2004, p. 207). Their engaging and learning principles exceed those in many other learning environments, allowing learners to be committed (p. 208) and persistent in their practice, and to be exposed to experiential learning and problem-solving.

Educators assume responsibility for the way technological advancements are used in their practice, and it is a matter of paramount importance to support their decision-making. When the general public, educators, and researchers support the idea that critical thinking should be taught at schools, there is still a lot to be done to make this goal attainable. When we already know that playing digital games can motivate and engage students in learning (Gee, 2004), we still lack understanding of how to use this vehicle effectively to promote and support the development of critical thinking. Then the argument is evident: We need to explore and understand the ways in which we can harness the power of games for critical learning.

The results of the present study will have implications for various stakeholders including game developers, educators, researchers, methodologists, and policymakers. Providing practitioners and game designers with rich information from field experts is crucial as it empowers the field to grow and flourish. If we can provide some direction on how to use games and understand the principles that underpin the development of critical thinking, practitioners will be empowered to experiment, discover, and propose new ways of effective learning through them. Building on the results of this study, the research community will have a chance to experiment with various variables to emerge from the present research study. The relationship between digital games and critical thinking may be further examined in future studies when the exploratory work as such would be available for researchers' consideration. Finally, the findings will raise awareness of this topic for methodologists and policymakers, which would surely pave the way for methodological recommendations introduced at schools and policies aiming to promote critical thinking.

The results of this study are of relevance to the wider educational community as the experience sought in this study is not limited to a certain locale or occupation. At the same time, this study is also particularly important in the Kazakhstani context. The plan for the distribution of the experience of Nazarbayev Intellectual Schools (a group of Kazakhstani schools designed to be incubators of innovation) claims that the foremost priority will be given to the development of pedagogical mastery (Nazarbayev Intellectual Schools, 2012). The project implies the nationwide conduct of a professional development program including seven modules, where two of them are focused on the teaching of critical thinking and the use of ICT and digital technology for better teaching (para. 7). Undoubtedly, the Kazakhstani educational system values the importance of critical thinking and digital technology and strives to educate practitioners on how to introduce, use, and promote them. In this regard, this research will be of a practical matter to inform teachers' practices and professional development policy in Kazakhstan.

This study will also contribute to a better understanding of how digital games for critical thinking should be used in various learning settings, including school, tertiary level, and nonformal education. Finally, the research outcomes will be published in an accessible form for various stakeholders to inform their practice and decision-making.

1.6 Theoretical Framework of the Study

After a careful review of theoretical and research literature, the theoretical framework of the study was adopted. The framework consists of two models: (a) Davies's (2015) model of critical thinking in higher education that deals with critical thinking and its conceptualization; and (b) the Technological, Pedagogical, and Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) that builds a bridge between critical thinking and its development through the use of digital games and digital technology. In order to move further and present the framework itself, it is important to define what I mean by theoretical and conceptual frameworks in this study.

There is not a consistent and clear definition of a theoretical framework agreed upon by researchers (Given, 2020). Given defines a theoretical framework as "any empirical or quasi-empirical theory of social and/or psychological processes, at a variety of levels (e.g., grand, mid-range, and explanatory), that can be applied to the understanding of phenomena" (p. 870). Kivunja (2018) suggests that theoretical framework comprises theories in the field of research which one plans to use to provide "a theoretical coat hanger for … data analysis and interpretation of results" (p. 46). Thus, in this study, a theoretical framework is understood as a structure comprising theories and concepts, which I draw upon to analyze and interpret the data, to decode a meaning contained within it. The theoretical framework presented below was adopted after careful review of research and theoretical literature, my acquaintance with different models, and is built with the purpose of making meaning of the phenomenon under investigation. This study employs a theoretical framework built upon two models. The first is Davies's (2015) model of critical thinking in higher education (Figure 1), and the second is the Technological, Pedagogical, and Content Knowledge (TPACK) framework (Figure 2) developed by Mishra and Koehler (2006). Although TPACK is called a conceptual framework by its authors, I view TPACK as a part of the theoretical framework of my study. The theoretical framework is a considerable part of a yet bigger conceptual framework present within my study, which also includes my ontological and epistemological stance and methodological considerations. In doing so I take the position of Kivunja (2018) who defines a conceptual framework as the "total, logical orientation and associations of anything and everything that forms the underlying thinking, structures, plans and practices and implementation of your entire research project" (p. 47). While Davies's model and TPACK do not incorporate the whole scope of reasoning underlying this thesis, they vastly inform how I understand critical thinking, digital learning, and the use of games for critical thinking. They drive the way I structure literature, interpret the data, and communicate findings to participating experts and thesis readers. Here I will explain each model, outline what they do, why they were chosen, and how these models relate to each other.

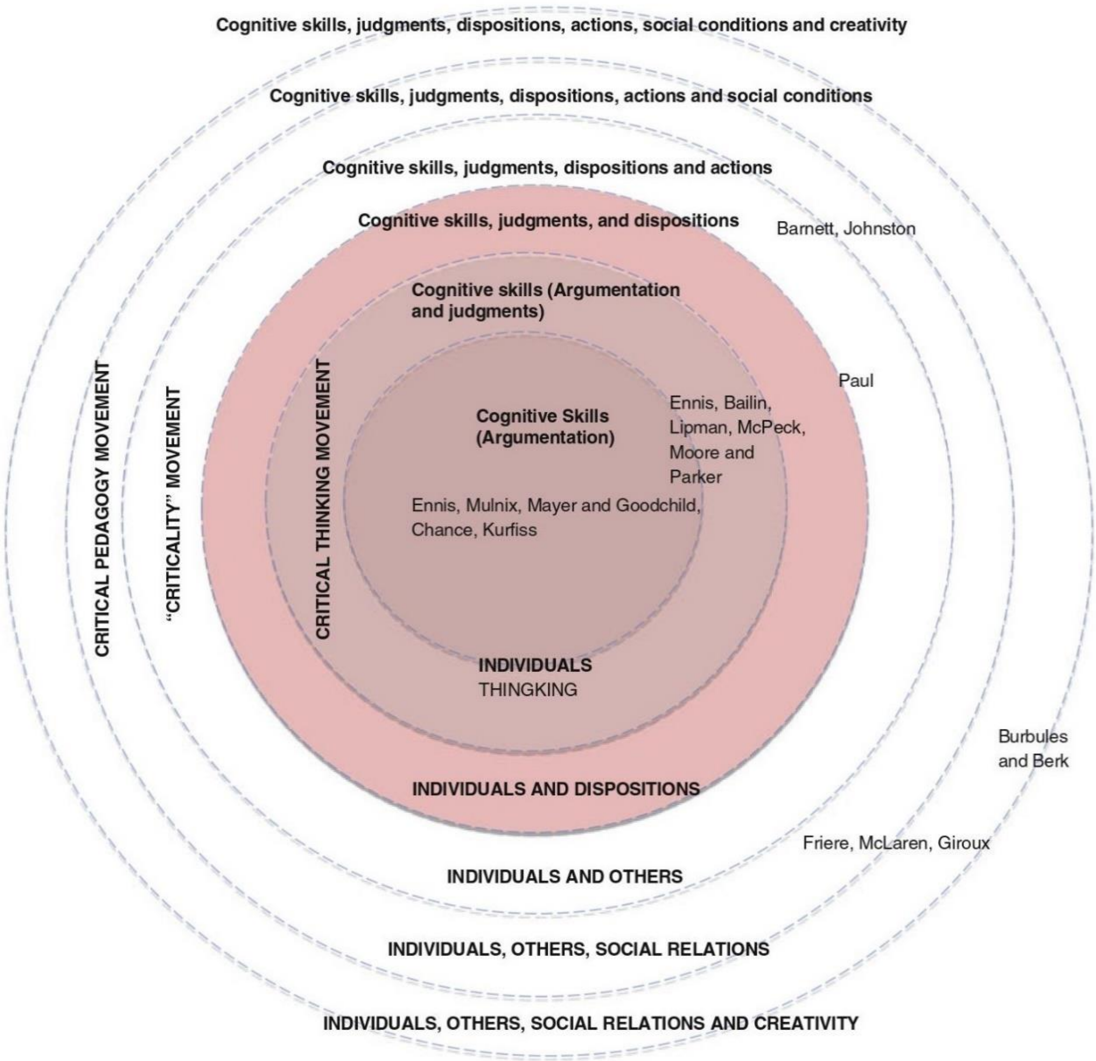
My initial literature review structure was built around concepts and themes related to critical thinking. I overviewed several models of critical thinking, including the taxonomy of educational objectives and its later version (Anderson et al., 2001; Bloom et al., 1956), Collegiate Learning Assessment (Sadler, 2010), APA Delphi (Facione, 1990), Paul-Elder (Elder & Paul, 2008a), and Ennis's (2015) models. Nevertheless, none of them could provide a broader and inclusive picture of the theories present in the field and were limiting in one sense or another. The reviewed models served to provide a cognitive foundation for judgment formation and decision-making, which is important but still is not a complete picture of what critical thinking may be. On top of that, theories coming out of the critical thinking movement, including Bloom's taxonomy and Ennis's model, were criticized for being overly rationalistic and ignoring other forms of knowing—emotions, feelings, and experience (Belenky et al., 1997). The critical pedagogy movement was criticized for serving European, white, male, middle class, Christian, able-bodied, thin, and heterosexual people (Ellsworth, 1989). Also, as Davies (2015) rightfully mentions models emerging from the critical thinking movement place an emphasis on critical thinking at the individual level—the development of an individual's skills and dispositions—and fail to include social relations and critical action. With the development of my theoretical understanding, I came upon Davies's (2015) model which usefully pulled together relevant theory about critical thinking from a comparative and relational perspective that aligned with the objectives of my study.

Davies (2015) proposes a model of critical thinking in higher education, where he carefully represents the voices of different theorists to map concepts and theories which are central to critical thinking scholarship in higher education. Although Davies contextualizes the model in the higher education sector, the theories and concepts of critical thinking contained within span across the historical and contemporary scholarship of critical thinking. Thus, for the purpose of this research, the Davies's framework is not limited to the field of higher education, or to a particular age group of participants. My study does not focus solely on formal or traditional learning spaces, and investigates the phenomenon of digital games for critical thinking in a variety of learning contexts. Even with this broad focus, Davies's model serves as a useful framework in exploring the concept of critical thinking, and for the organization and analysis of the data collected in the three rounds of the present study.

Davies stresses that many positions on critical thinking are a valuable addition to our understanding of the concept, its shape, limitations, and area of application—although differently, they all define one phenomenon (p. 82). His model is styled as the Bohr-Rutherford model of an atom (see Figure 1). The model has six concentric circles radiating out of the "historical" core: the critical thinking movement mainly consisting of philosophers who generally defined critical thinking as cognitive skills, judgments, and dispositions (affective domain), and were concerned with creating taxonomies of the concept. The three inner circles represent the critical thinking movement. We can also see that these inner circles have a focus on critical thinking at the individual level—skills and dispositions of an individual; while the fifth and sixth circles focus on critical thinking at the social level—individuals in relation to others in a wider social and educational context, and critical pedagogy’s focus on the social context itself. The fourth circle is an intermediate one, as described by Davies, as it encompasses the criticality movement, whose representatives are mainly interested in wider implications of critical thinking for higher education, tertiary institutions, and society at large (p. 85). One may also mention that criticality and the outer circles are built upon a “cognitive skills, judgments and dispositions” core, and add their unique focus, such as “critical action” in the criticality and “social conditions” in the critical pedagogy movements. These are the key elements defining movements, for example, criticality theorists are never satisfied with hypothetical critical thinking happening in a vacuum and demand action for critical thinking. Similarly, critical pedagogy is also about acting, but mainly about recognizing various oppressive powers which shape the agenda of education. Critical pedagogues are concerned with social conditions and their implications for education and thinking. The outer circle is introduced by Burbules and Berk (1999) who propose to include creativity as an additional element of criticality and critical thinking. For them, thinking in new ways—creative thinking—is an escape from programmatic agendas of movements as it allows one to question standards of thought, even things that make our thinking possible. Davies (2015) agrees with this line of thinking, although admits that this account of critical thinking was undeveloped and highly speculative at that point in time. The dotted lines of the model represent that the boundaries between each movement are blurred and by no means entirely separable, with authors and researchers taking cross-boundary positions. Dotted lines are also possible due to the introduction of the creativity or openness account of critical thinking, the last circle, this view keeps all previous accounts “open” to any new influence or rethinking (Davies, 2015, p. 81).

Figure 1

Davies's Visual Model of Critical Thinking in Higher Education



Note. "**INDIVIDUALS** THINGKING" [*sic*]. From "A Model of Critical Thinking in Higher Education," by M. Davies, in M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, p. 85), 2015, Springer International Publishing (https://doi.org/10.1007/978-3-319-12835-1_2). Copyright 2015 by Springer International Publishing Switzerland. Reprinted with permission.

One may also notice the names of key theorists corresponding to each circle. Davies (2015) suggests that some philosophers of the critical thinking movement changed and shaped their definition of critical thinking as they developed and extended research of this concept. For example, Ennis (i.e., 1962) who initially defined critical thinking as cognitive skills, went further to include critical thinking dispositions and judgments into his account. Therefore, he moved from the inner circle into the third circle of the model. Although initial definitions of authors in the inner circle were mainly about cognitive skills, these authors were sympathetic towards the judgment and dispositions dimension of definition, represented by the shaded color of three inner circles. One may also find Paul’s (2012) positioning on the model outside of three inner circles, a transitional figure, as he was the one to consider social implications of critical thinking: He believed that dialogical thinking, highly praised by critical pedagogues, is central to critical thinking (Burbules & Berk, 1999).

Davies’s (2015) model (see Figure 1) helps us to make sense of the collected data in many ways. According to Davies, the strength of this model is threefold. First, it brings together theories to show how they relate to one another. Second, the model promises rapprochement between the critical thinking and the critical pedagogy movements. This is possible by introducing the criticality circle in-between of them, where both parties can agree on certain important things. Like criticality theorists, the critical thinking movement may acknowledge the importance of action, and critical pedagogues may agree on the importance of a wider social context of critical thinking. Davies suggests that criticality theorists stay aside by not taking the political position of critical pedagogues, and not being satisfied by mere skills and dispositions of the critical thinking movement theorists. Third, Davies’s model offers a resolution for debate between scholars who believe that critical thinking is domain-specific, and those who support the general skills position, which I discuss in the “Domain specificity and teaching of critical thinking” section of this work. Accordingly, those who assume that critical thinking is about developing cognitive skills, reasoning, and dispositions may well agree that it is a general, pan-disciplinary skill and phenomenon. On another hand, if critical thinking is perceived as a matter of being socialized—as acting and participating in a specific discipline—then it requires special pedagogies and discipline-specific skills. According to Davies, both positions are correct with both conceptualizations constituting critical thinking scholarship. Depending on the situation, one rationale may be more important practically than another to win a debate, solve a problem, or engage with the community—for example, being able to effectively argue and prove your point may be as practically important as being able to critically participate in the community.

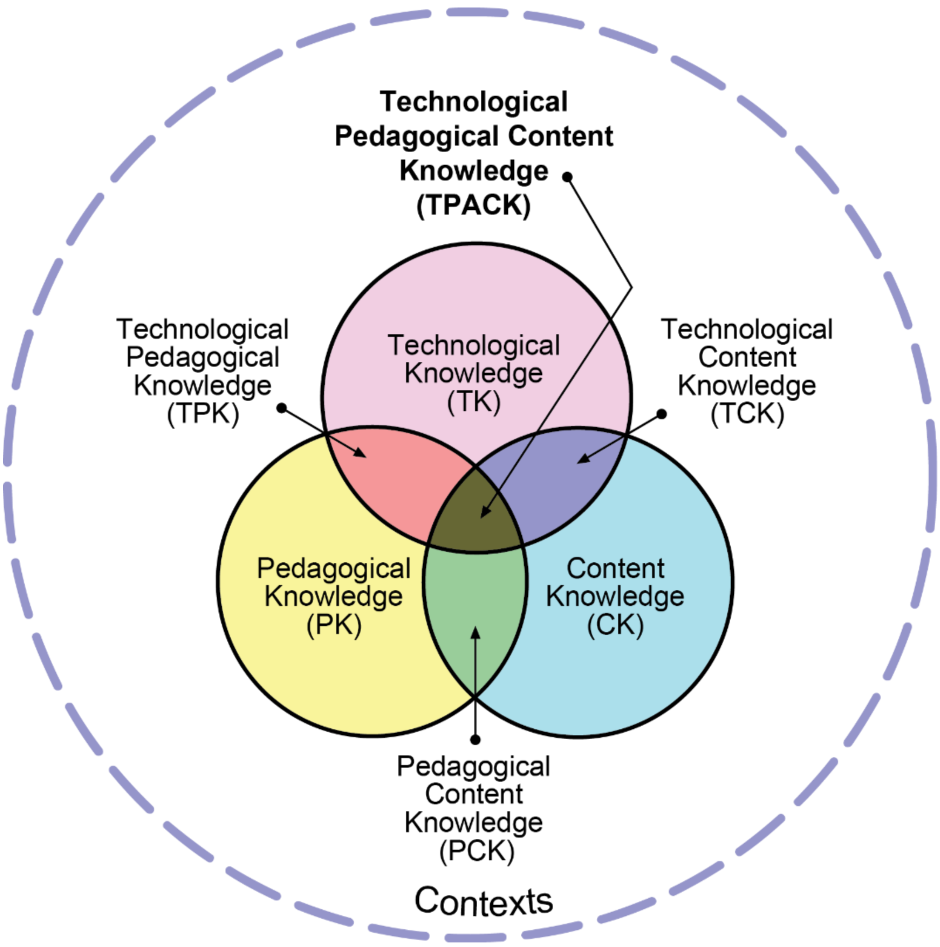
The model created by Davies (2015) indeed does a great favor to those who want to see the bigger picture of critical thinking scholarship. By analyzing key features of each movement, the author creates a language for discussion: whether critical thinking is an individual or social phenomenon (or both), what is the role of action, and what situations may need a particular approach to critical thinking. The model also rightfully emphasizes that defining, and then teaching critical thinking may be done in more than one way and that different conceptualizations are not necessarily mutually exclusive. As a whole, Davies's model provides an alternative: to view critical thinking scholarship as relating to different educational objectives and to use and understand the limitations or specificity of positions accordingly. Being open to alternatives and being conscious of the claims of those who disagree with one's position surely adds value, in essence, it is in the spirit of critical thinking.

Building on the advantages of Davies's model (2015) and its broad conceptual and theoretical scope, it was possible to understand collected data in terms of their key elements, underlying theories, and assumptions which could inform a definition of critical thinking presented by SMEs. To the extent possible, it also enabled me to attribute definitions of SMEs to a particular school of thought and to see how they differ or were similar to one another.

As this thesis concerned the teaching of critical thinking using digital technology, I found that Davies's (2015) model alone could not capture the technological and related pedagogical dimensions of the phenomenon under investigation. For this reason, the second model which constituted my theoretical framework was the Technological, Pedagogical, and Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). The TPACK framework postulates that the success of teaching with technology depends on the teacher's knowledge of elements in interaction: technology and content knowledge (TCK), pedagogy and content knowledge (PCK), technology and pedagogy knowledge (TPK), and, finally, understanding of the complex interaction between technological, pedagogical, and content knowledge (TPACK) to inform effective strategies in teaching practice. Mishra and Koehler suggest that teachers and researchers equipped with the proposed framework have a ground for scholarly dialogue about educational technology, research, and curriculum development (p. 1046). The use of technology in education is complex, multifaceted, and often an ill-structured domain, and the TPACK framework "considers how content, pedagogy, and technology dynamically co-constrain each other" (p. 1046). Let us stop at each component of the framework and briefly outline what it means.

Figure 2

Pedagogical Technological Content Knowledge: The Three Circles, Content, Pedagogy, and Technology, Overlap to Lead to Four More Kinds of Interrelated Knowledge



Note. From *Using the TPACK Image*, by M. J. Koehler, 2011, TPACK.ORG - Dr. Matthew J Koehler (http://matt-koehler.com/tpack2/using-the-tpack-image/). Copyright 2012 by tpack.org. Reprinted with permission.

TCK refers to the interaction of content and technology, e.g., what kind of information may be presented with the use of a particular digital tool or software solution, whether it is a visual, audial, or textual representation, or a mix of those. An educator needs to understand which specific technologies are preferable for addressing subject-matter learning and how the content influences and frames technology or vice versa (Koehler, 2012, para. 4). The notion of PCK was originally proposed by Shulman (1986): it is “an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction" (p. 8). In Shulman's conceptualization of PCK the transformation of the subject matter for teaching is central, as an educator interprets the subject matter, finds the ways to represent it, chooses instructional strategies, and adapts to students' prior knowledge. The TPK formula focuses on pedagogy in interaction with technology. According to Koehler et al. (2013) TPK is:

> … an understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies. (p. 16)

This interplay may limit or extend the kinds of pedagogies we use with digital technology. For example, learning with Massive Open Online Courses shifts focus towards pedagogies of self-driven learning and emphasizes dialogue and interaction between learners. We may also see the "contexts" element placed on the model, which refers to a variety of contexts and factors where the interplay of TPACK happens: individual teachers, grade level, school-specific factors, demographics, culture, among other factors (Koehler, 2012, para. 3). Altogether, the task of teaching critical thinking, becomes an interplay of content, pedagogy, and hosting technology—games—in each contextual case. In their variety, digital games accommodate different kinds of content and support certain pedagogies. They also offer learning principles that drive our way of teaching with them.

The TPACK framework works in interaction with Davies's model of critical thinking. The SMEs' concept of critical thinking presupposes what and how should be learned—it connects to the content and pedagogy. Digital games are technologies with particular features, advantages, and limitations: They support and constrain content and pedagogies of critical thinking. Davies's model naturally informs the content and pedagogy circles of TPACK, when theories concerning learning with games connect to and constrain how critical thinking can be taught through this medium. This study unites the understanding of data built upon Davies's accounts of critical thinking and the TPACK framework. The way the research questions of this study are answered is informed by the structural and theoretical vision provided by this framework. The lens of this theoretical framework helps to identify variables of the study and their relationships to each other and provides a language for discussion and formation of problems.

1.7 Operational Definition of Key Terms

Digital technology represents a wide range of technological, program, and subsequent methodological solutions, which, in this study, are used in educational settings, not only to support learning itself, but also to create solutions, and further provide insights into the function and utility of digital technologies themselves.

Digital games are a collective term for games played on computers, smartphones, tablets, mobile devices, or video game consoles such as PlayStation, Xbox, or Nintendo. Digital games already include such terms as video games and computer games. While the word "digital" relates to the environment in which games are played, the concept of "game" itself can be defined as: "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" (Salen & Zimmerman, 2003, Chapter 7, p. 11). Games are a subset of play (Chapter 22, p. 2) that can be defined as "free movement within a more rigid structure" (Chapter 22, p. 4). Please, see Section 2.16 in this thesis for a more detailed definition of a digital game. It is also important to acknowledge that digital games themselves may not lead to critical thinking; rather the act of playing digital games may serve this end. In different parts of this thesis, I focus on games and their constituent elements, on playing games, and on creating them. Please, read this thesis with this distinction in mind.

Subject-Matter Experts (SMEs), as proposed in this study, are a pool of 100 international experts including teachers, game and educational software developers, researchers, methodologists, subject specialists, and other possibly relevant experts, who possess experience in both digital technology for education and critical thinking.

1.8 Positionality

Randolph (2009) suggests that dissertation writers should state their perspective: whether one takes a *neutral position* akin to the quantitative tradition in which one "present[s] the review findings as fact" (p. 3), or *espouses one's position* as an author of qualitative primary research. The latter option implies a reflection on one's own preexisting biases and prompts one to provide a discussion on how their position may affect their research.

In many sections of this research, I describe different schools of critical thought and the tensions between them. I then provide an overview of the debate between those who believe that critical thinking is domain-specific, and those who support the general skills position. When overviewing the works of scholars, I argue for different positions and reflect on what critical thinking and learning with games mean to me. Throughout this thesis, I adopt various positions on the nature of critical thinking, its manifestation, and the use of games; and I agree (and disagree) with other scholars in the field. I deliberately reflect on and espouse my position because I do not believe that neutrality, as defined by Randolph (2009, p. 3), is practically achievable.

The concept of neutrality raises many questions for me (see Holmes, 2020). Is it possible to be culturally and gender-neutral when analyzing data? A researcher may reflect on how one's cultural heritage influences one's interpretation of data, but can one really detach oneself from this culture to take a neutral position? In practice, can researchers reflect deeply enough on their own culture to take this neutral position? Or is it possible to think neutrally, not as a man or a woman? How can one detach oneself from the physical experience of being a man? We may imagine or attempt to do so, however, in practical terms, I believe that this may not always be possible. Ormston et al. (2014) provide an alternative position defined as “empathic neutrality”:

> Strive to avoid obvious, conscious or systematic bias and to be as neutral as possible in the collection, interpretation and presentation of data. However, we recognise that this aspiration can never fully be attained – all research will be influenced by the researcher and there is no completely ‘neutral’ or ‘objective’ knowledge. (p. 22)

I believe that a researcher is a part of the social world that they explore, and that reality is constantly co-constructed by existing social actors across time, space, and contexts. By saying so, I question the positivistic conception of objective reality.

This research may be influenced by many factors that make me a person. Throughout this research process, I have changed my worldview, grown in terms of professional experience, and been exposed to people and events that shaped my perception of this research. Toward the completion of this thesis, I became a game designer. I felt this experience was needed to understand my research field from within. I have taken effort to incorporate various ways of thinking and acquired knowledge. I believe, my cultural affiliations cannot be explained in terms of my ethnicity only, and are shaped by living most of my life in post-Soviet Kazakhstan, and extensive experience of traveling and living abroad. I would describe myself as a mix of many cultural and intellectual influences. For example, I use Russian and English as my primary means of communication with the world.

This research presents data shared by SMEs from many countries and regions of the world. I believe that my prior intercultural experience has enabled me to understand the message and concerns that these people share. However, I also realize that the socio-political realities of some SMEs are less familiar to me in comparison to the agendas of other post

Soviet countries and Eastern Europe. In this research, I argue that critical thinking can be culturally driven and acknowledge that my thinking has been both influenced by Western analytical thinking and the dialectical thinking of Asian cultures (see Section 2.12). My family background has strong ties to the academic community, labor workers, and farmers. By contemporary Kazakhstani standards I would be considered neither poor nor rich, thus I consider myself in a relatively advantageous financial position in comparison to many people in need. I discuss how critical thinking and social inequality relate to each other in Section 2.8.2. Being a fan and proponent of games in learning, I acknowledge that at times I was very enthusiastic about their use and applicability. I appreciate the feedback from my research advisors in reminding me to consider my stance and positionality.

My political views do not favor any particular stance. Notwithstanding, I am interested in learning how different forms of governance shape people's lives. What I am certain about is that I do not favor authoritarian or dictatorship regimes. I believe in the power of dialogue and a multitude of views, as this approach does not suppress the lives of people in our increasingly interconnected world. I acknowledge that there may be other dimensions of my life and personality that could potentially influence this research. I keep more personal reflections to myself. I acknowledge the fluid state of my beliefs and will continue to reflect on what it means to be me.

I view this thesis as a social action project undertaken in line with my convictions. Through my research endeavors, I have developed my own thesis drawing on the knowledge, empirical work, and experiences of scholars, teachers, and professionals. Ultimately, I believe the purpose of education is in empowering people to think for themselves, make ethical life choices, realize their potential, and prosper collectively.

1.9 Summary

The whole thesis is built around seven chapters. This chapter has outlined the research problem, the purpose of the study, made clear the research questions, and other key information required to understand the scope of this research. In Chapter 2, I present the literature review. It is structured conceptually and explores the notion of critical thinking, key tensions within the scholarly field, and finally, establishing a connection with digital technologies and digital games. In Chapter 3, I present the methodology and discuss justifications for choosing the Kantian Delphi method, participants, data collection, and an overview on data analysis. Based on the procedures established in Chapter 3 (methodology) I present three subsequent chapters corresponding to my three Kantian Delphi iterations. Each of these chapters includes findings and their related discussion. For instance, Chapter 4 (Round 1) is focused on SMEs' conception of critical thinking. Chapter 5 (Round 2) concerns SMEs' feedback on Round 1 and presents their thoughts on how digital technology and games can be used for the development of critical thinking. Chapter 6 (Round 3) is the final reflective Kantian Delphi iteration. It summarizes and clarifies the results of the previous two iterations. At this stage, SMEs could provide their concluding remarks regarding the phenomenon and the overall study. One of the outcomes of this research is the Three-Phase Model for Critical Thinking and Digital Games that is presented at the end of Chapter 6. Chapter 7 concludes my thesis. In this chapter, I present the key findings of my study, the implications, limitations, and my recommendations for future research.

Chapter 2: Literature Review

In Chapter 2, I provide a theoretical, empirical, and thematical review of the development and teaching of critical thinking. This chapter also illustrates how critical thinking connects to digital technology and digital games, and reports on research and theories that advance our understanding of the phenomenon. The theoretical framework discussed in Chapter 1 informs and structures this literature review. Thus, the following literature review sections relate to different facets of the theoretical framework.

Randolph (2009) suggests that literature reviews are typically organized using historical, conceptual, and methodological formats, or a mix of these (p. 4). My literature review is organized in the conceptual format (p. 4). This means that the organizational construct of the literature review is built around the concepts, in particular, the theoretical framework I have mentioned above. Additionally, I employ a historical organizational format in Sections 2.1–2.11. I demonstrate a broad range of critical thinking scholarship positions, provide an overview of debates, and how these varying positions relate to one another. Davies's (2015) framework informs the structure of these sections: Following the historical sequence of the field's development, this chapter begins with the critical thinking movement, and progresses towards later positions such as critical pedagogy and criticality. As comprehensive as it is, Davies's (2015) model cannot include all possible dimensions of critical thinking scholarship. As a result, where relevant, I introduce sections that expand upon the concept of critical thinking. For example, I have included "Critical thinking and culture" and "Ethical and moral dimensions of critical thinking" sections in this chapter. I believe these dimensions of critical thinking were not given enough attention in Davies's model. This aligns with my position that critical thinking scholarship is influenced by time, space and context.

Davies's model of critical thinking naturally informs the TPACK framework. While critical thinking positions inform the pedagogy and content of TPACK, they are also dynamically enhanced and constrained by digital games—the "Technology" of the model. Thus, the second block of sections introduces digital games as a learning medium, theorizes how games relate to critical thinking, and showcases available empirical evidence on the topic. This chapter synthesizes available theoretical knowledge and research findings to inform the data analysis and interpretation process thus making it possible to create tools for data collection.

It is important to clarify how I see the balance of empirical and theoretical data in this literature review. Following my writing, you will notice that in Sections 2.1–2.12 I provide a detailed theoretical account of critical thinking and focus less on empirical studies that document how critical thinking could be applied to inform pedagogical practice. This is a pragmatic decision, as my literature review supports me in answering the research questions. As Research Question 1 concerns SMEs' conceptualization of critical thinking, I focus on providing a broad picture of differing accounts of critical thinking. The latter Sections 2.14–2.16 inform Research Questions 2 and 3 by documenting how academics, practitioners, and researchers have used digital technology and digital games to develop critical thinking. Thus, apart from theoretical considerations, these sections feature empirical data informing Delphi rounds, questionnaires, and discussions.

2.1 What is Critical Thinking?

Defining critical thinking is not an easy task. One may understand this by simply looking at how many definitions there are. Numerous authors propose various definitions and argue about the conceptual clarity of their definitions and those of others. Of these various definitions, some include similar components, some stress the paramount importance of certain elements, and some attempt to refine and improve upon previous definitions. In the decade that the critical thinking movement began, Skinner (1976) already noted: “After reading the various definitions of critical thinking, it becomes clear that agreement upon a single, concise definition of this concept is difficult, if not impossible” (p. 293). Davies (2015, p. 47) notes that the variety of definitions developed in the 1970s and 1980s were perceived as a hindrance to clarity about the concept. It was also the case that picking one specific definition of critical thinking, and teaching critical thinking with that specific definition in mind, could be limiting (p. 48): How could one know whether they are holistically teaching critical thinking or just teaching a component of critical thinking? It is a valid concern, responding to which Mullnix (2012, p. 464) suggested that without clarifying the concept of critical thinking and choosing a definition, educators are left in uncertainty and may, possibly, teach something which is not critical thinking at all. At this point, one thing is clear: Defining critical thinking is a practical matter and educators need a concept and theory to use in their teaching.

One way of defining critical thinking is by saying what it is not. Fortunately, there is little dispute between the field authors on what critical thinking is not. Critical thinking is not purposeless thinking (McPeck, 1981, p. 3), but instead, it is goal-directed and purposeful; it is not random thinking (Bailin et al., 1999), but thinking which relies on standards of adequacy and accuracy; it is not accidental or unintentional thinking, rather it is an “intellectually disciplined process” (Scriven & Paul, 1987, para. 3). Critical thinking is also not equal to good, independent, intuitive or logical, reflective, or metacognitive thinking (Davies, 2015, p. 46)—these kinds of thinking may constitute critical thinking, but, for example, thinking independently may or may not result in thinking critically. We can say the same about rational (McPeck, 1981, p. 12) and creative thinking (Elder & Paul, 2008a, p. 4). It should be noted that critical thinking is conceptually different from higher-order thinking which is a vague term and by its definition is not identical (Davies, 2015, p. 46). Finally, critical thinking is not problem-solving and decision-making as “problem solving, decision making, etc., are best seen as arenas in which critical thinking should take place rather than as other kinds of thinking to be contrasted with critical thinking” (Bailin et al., 1999, p. 288). According to Davies (2015, p. 46), problem-solving requires making a judgment in order to complete a task or a problem but may not adhere to the standards of critical thinking.

2.1.1 Schools of Thought

As I have noted earlier, many authors have attempted to define critical thinking. Lewis and Smith (1993) and Sternberg (1986) proposed that these definitions generally come out of philosophical, psychological, and educational schools of thought. They stress the differences among these schools of thought.

For instance, the philosophical tradition dates back to Aristotle and Plato, and much later to Paul (2012) and Lipman (1988) who exemplify the traits of the ideal critical thinker. This approach brings together the traits, characteristics, and criteria of a critical thinker which a person should strive to attend; essentially, it is about the highest standards of thought and action. As Sternberg (1986) noted, the philosophical tradition considers the critical thinker in an ideal environment where such limitations as lack of time, information, and motivation are usually not present (p. 5). However, Sternberg did not view it as a limitation of the approach, but rather that the philosophical tradition had an important focus to outline, specifically, “the maximum potentials of critical thought” (p. 5). Accordingly, I explain how Paul (1992) pictured the image of the ideal critical thinker, listing the “perfections and imperfections of thought” (p. 10; see Section 2.7). As a reference, we can consider Lipman’s (1988) definition derived from a philosophical school of thought, wherein critical thinking is “skillful, responsible thinking that facilitates good judgment because it 1) relies upon criteria, 2) is self-correcting, and 3) is sensitive to context” (p. 39).

The psychological tradition is mainly concerned with how a person thinks critically under personal and environmental limitations (Sternberg, 1986). Mainly based on empirical research and, more specifically, psychological experiments (p. 6), this approach seeks to "define critical thinking by the types of actions or behaviors critical thinkers can do" (Lai, 2011, p. 7). This position, mainly held by cognitive psychologists, was challenged for its oversimplification of the complex concept of critical thinking. For instance, as Sternberg (1986, p. 6) explained, when approaching critical thinking as to be measured and used in a psychological experiment, the concept of critical thinking is reduced to a number of disconnected procedures and steps. Indeed, the critique has to be taken into consideration if we are to accept that critical thinking is not simply the sum of its parts (van Gelder, 2005). Definitions of critical thinking coming out of the psychological tradition include Halpern's (1998) version, specifically: "[critical thinking is] the use of those cognitive skills or strategies that increase the probability of a desirable outcome" (p. 450), and Sternberg's (1986) version, specifically: "critical thinking comprises the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts" (p. 3).

Finally, the educational school of thought offered a more practical definition for the task of critical thinking development. The most prominent representative of this tradition is Bloom and colleagues' taxonomy of learning objectives (Bloom et al., 1956) with its later revision (Anderson et al., 2001). Bloom et al. suggest that when a student encounters a problem or situation, one needs to find an appropriate technique and bring necessary information to deal with it. They recognize that it is called critical thinking by some, and they label it as "intellectual abilities and skills" (p. 38). These intellectual abilities and skills include comprehension, application, analysis, synthesis, and evaluation (p. 204–207), where the latter three are usually perceived as higher-order cognitive skills and make up critical thinking (Chirgwin & Huijser, 2015). The revision of Bloom's taxonomy (Anderson et al.,

2001) made it explicit that critical thinking is not included in the taxonomy because it cuts across rows, columns, and cells of the taxonomy table (Anderson et al., 2001, p. 270). The overall purpose of the taxonomy is not to define critical thinking, as it is about educational objectives which when stated as skills or abilities, may or may not constitute critical thinking. Nevertheless, many educators still use the taxonomy to teach critical thinking by relating the taxonomy's cognitive skills with critical thinking.

Although the educational approach is based on years of educational experience and observations of student learning, there are two points to keep in mind (Sternberg, 1986). First, as Sternberg noted, these theories lack epistemological clarity, making it harder to evaluate and use educational theories on critical thinking (p. 7). Second, as he also observed, they are not rigorously tested as psychological and philosophical counterparts: "Educational theories are often not subjected either to the logical tests of philosophical theories or to the psychological tests of the psychological theories" (p. 8). For Ennis (1993), it is also clear that defining critical thinking as the top of Bloom's taxonomy of educational objectives (Bloom et al., 1956) is a rather limiting exercise. He is convinced that Bloom's taxonomy weakness, apart from listing concepts that are "too vague" (Ennis, 1993, p. 179), is in its hierarchical ordering, as these concepts are interdependent and require one another to be in operation: "although synthesis and evaluation generally do require analysis, analysis generally requires synthesis and evaluation" (p. 179). Finally, the later revision of the taxonomy made the distinction between critical thinking and the taxonomy clear as mentioned above (Anderson et al., 2001).

2.1.2 Critical Thinking Research Waves and American Philosophical Association's Delphi

Yet another way to look at critical thinking concepts is through the perspective of "three waves" of critical thinking research. When introducing an edited book on critical thinking, "Re-thinking reason", Walters (1994) proposed a historical progression of critical thinking scholarship starting with a “first wave” conceptualization which was generally characterized by its “‘logistic’ bent” view in which a “good thinker necessarily aims for styles of examination and appraisal that are analytical, abstract, universal, and objective” (p. 1). The first wave is generally called "the critical thinking movement" and is used to refer to the tradition outlined above in contrast to the second and third waves (e.g., as used by Kaplan, 1991; Barnett & Davies, 2015, p. 14).

The “second wave” of critical thinking scholarship emphasizes that reducing critical thinking to logicality, as it is generally conceptualized by the first wave researchers, amounts to the reduction of the concept to a discrete set of procedures. Second-wave researchers expand the critical thinking concept to include imagination and intuition and challenge the position that formal logic may be universally applicable (Walters, 1994, p. 2). Second wave critical thinking is contextual: A thinker is always present in the act of thinking and thus any evaluation of the thinker’s fairmindedness should consider one’s “affective, theoretical, and normative presuppositions” (p. 2). In McLaren’s (1994) words, the second wave is “liberal humanist assertion that critical thinking be understood contextually” (p. xii).

In the forward to Walter’s book, McLaren (1994) proposed, nascent-at-the-time, a “third wave” of critical thinking scholarship which speaks to “critical pedagogy’s concern with reasoning as a sociopolitical practice” (p. xii). For a definition of critical pedagogy, see subsection 1.6 of this manuscript. According to McLaren, the distinctive difference between the second and third waves is that the second wave’s liberal humanist assertion that critical thinking is contextual does not account enough for the complicity of a thinker in relation to domination and oppression. Third-wave thinkers are criticalists who argue that “one’s intellectual labor must be understood ethicopolitically in the context of a particular political project” (p. xiii).

Walters and McLaren were not the only scholars who defined three distinct waves. For instance, Paul (n.d.) differently delineates these waves in “Critical Thinking Movement: 3 Waves. The critical thinking movement: 1970-1997: Putting the 1997 Conference into Historical Perspective.” Similar to Walters, Paul attributes first-wave theorists’ work to the domain of informal logic: “They tend to view reasoning and logic in a relatively narrow and technical fashion” (para. 4). Paul describes the second wave as composed of works of authors coming at critical thinking from different perspectives: cognitive psychology, critical pedagogy, feminism, from the standpoint of particular disciplines, or from the standpoint of what was purportedly missing in the first wave research agenda—emotion, intuition, imagination, and creativity (para. 5). He assesses the second wave projects as more comprehensive for their expansion of critical thinking beyond logic and rhetoric. Nevertheless, Paul concludes that apart from some exceptional work, research in the second wave was collectively “far less integrated, less coherent, and often more ‘superficial’” (para. 6) and lacking depth and rigor. From Paul’s perspective, the third wave “represents a commitment to transcend the predominant weaknesses of the first two waves (rigor without comprehensiveness, on the one hand, and comprehensiveness without rigor, on the other)” (para. 7). To note, there exists a major discrepancy between how scholars view the distinction between the second and third waves. This discrepancy reflects the different agendas in critical thinking scholarship. McLaren’s third-wave critical thinking is “emancipatory” (Kahlke & White, 2013, p. 22): It aims to liberate people from “white supremacist capitalist patriarchy” (McLaren, 2010, p. 1). Paul (n.d.) takes another position: He does not claim that critical pedagogy should lead the way of the third wave, rather the comprehensive multidisciplinary approach of the second wave should be developed with greater rigor.

All of these waves are mentioned in this literature review. While their boundaries seem to be uncertain (only the first wave appears to be agreed upon), they expose tensions and differences between the research agenda of critical thinking scholars. There are also two more arguments in relation to the three waves to consider. First, Kahlke and White (2013) urge us to not look at waves strictly as historically consequential developments of critical thinking scholarship, but rather as traditions with proponents of certain ideas to be found across different times (p. 22). For example, McLaren's third wave does not necessarily follow after the second wave, particularly as it emanates from much earlier ideas about critical thinking stated in Freire's "Critical Pedagogy" published in 1968. Second, Davies and Barnett (2015, p. 8) suggest that the works of many scholars, which I also mention in this thesis, do not easily fall into one wave, but deal with concerns relevant to more than one wave. These authors believe that academic work openly critical of critical thinking itself makes a modest step toward the third-wave conceptualization of critical thinking. This is therefore aligned with the overall three-wave conceptualization of critical thinking research as conceived by Paul (n.d.).

As evidenced by the literature, in the 1970s and 80s, there were a considerable number of definitions of critical thinking and a lot of debate generated by critical thinking scholars. In light of these developments, there was an attempt to bring clarity to the concept and come up with a definition agreed upon by multiple experts in the field. The American Philosophical Association (APA) assembled a panel of subject-matter experts and in 1990 produced the landmark Delphi Report defining critical thinking (Facione, 1990). You may find the definition from that study in the background section of Chapter 1 of this thesis.

While this definition was probably the best attempt to find a compromise between the varying conceptions of critical thinking, it is still the case that it does not include many other dimensions of the scholarship, nor does it lend itself easily into educational decision-making and critical thinking instruction (Davies, 2015, p. 48). As Davies posits, the Delphi Report's definition is one kind of critical thinking, rooted in argumentation and judgment formation (p. 48).

Of course, all definitions have certain limitations, and it is difficult to come up with a definition satisfying every need. Paul and Elder (2006b) suggest that it is not the best strategy "to put too much weight on any one definition" (p. 452), instead they present several definitions emphasizing what they bring to the scholarship. A similar idea is put forward by Davies (2015) who suggests that the miasma of definitions of critical thinking do not lead to clarity themselves—they should be analyzed and deconstructed. Davies's (2015) model of critical thinking in higher education does this, and I have used it as part of the theoretical framework to guide my way through the scholarship of critical thinking.

Among the various elements present in the APA Delphi definition, Davies (2015) distinguishes the following: critical thinking as skills in inference making and argumentation, as reflective judgment formation, and as attitudes and dispositions. These can be broadly categorized into cognitive elements (skills of argumentation, inference-making, and reflective judgment) and propensity elements (attitudes, dispositions, and emotions; Halonen, 1995). The account on critical thinking that I am building in this thesis starts with definitions falling into the above-mentioned categories: They belong to the research agenda of the first wave of the critical thinking movement. In the same manner, as in Davies's model, I also introduce dimensions missing in the APA Delphi Report's definition, thus, extending our understanding of critical thinking.

2.2 Critical Thinking: Age and Developmental Perspective

Before we proceed to different conceptions of critical thinking and elaborate on how critical thinking may be taught, it is important to clarify the boundaries. Specifically, this relates to when critical thinking or its components may start to be developed and what should be taught at a certain age.

While it may sound like common sense that teaching should correspond to the developmental level of students, the developmental division linked to particular age milestones remains to be an open question. Experts of the Delphi Report provide a general recommendation: “From early childhood people should be taught, for example, to reason, to seek relevant facts, to consider options, and to understand the views of others” (Facione, 1990, p. 15). While critical thinking is the desired goal from early childhood, the Delphi Report does not help educators practically to assist children to reach such desired goals.

Having already described the cognitive components of critical thinking such as the ability to analyze arguments or argumentation skills, it is reasonable to assume that some of them may be harder to attain than others in the developmental trajectory of children. For example, when touching upon age groups and thinking abilities, we may refer to Piaget’s stages of development. For instance, the development of the theory of mind, presented by Piaget and Inhelder (1958) in The Growth of Logical Thinking from Childhood to Adolescence gave a systematic account of the cognitive development of the mind. This considerable work presented four stages of cognitive development associated with particular ages. At the first stage—after the appearance of language—symbolic and preconceptual thought are being developed (Piaget, 2005, p. 122). This stage lasts up until around 4 years of age and then gives way to stage two. This is characterized by the development of intuitive thought. From the ages of 7–8 to 11–12 “concrete operations” (p. 122) are being developed in stage three, i.e., “operational groupings of thought concerning objects that can be manipulated or known through the senses” (p. 122). Finally, the mastery of “formal or hypothetic-deductive operations” (Piaget, 1964) or abstract reasoning—which are essential for critical thinking—begins only at stage four, at the age of 11–12 (Piaget, 2005, p. 122). As Piaget (1964) described this stage, the child “can now reason on hypotheses, and not only on objects. He constructs new operations, operations of propositional logic, and not simply the operations of classes, relations, and numbers. He attains … more complicated group structures” (p. 177–178).

However, the developmental model of Piaget had been challenged on several grounds. Gelman (1985) is not convinced by the Piagetian theory stating that “young children’s competencies are more like older children’s than once assumed … cast[ing] serious doubt on the hypothesis that age differences in performance reflect fundamental differences” (p. 538). Gelman is also convinced that preschool children possess mental structures which are to be developed and are already in place, rather than absent as Piaget proposed (p. 537). An additional challenge to Piaget’s stages of development is the evidence that even at the college level, some students do not attain the formal-operations stage of thinking (Kennedy et al., 1991). For instance, Blasi and Hoeffel (1974) examined the relationship between the development of formal operations and the development of the adolescent personality, as postulated by Piaget and Inhelder (1958). Blasi and Hoeffel (1974, p. 360) concluded that the concepts of “possibility” and “reflectivity”, which Inhelder and Piaget (1958) consider as essential aspects of formal operations, have a variety of meanings. Thus, this ambiguity makes it hard to sustain Inhelder and Piaget’s claims that the development of the adolescent personality is primarily formal operations dependent. Blasi and Hoeffel (1974) summarize the empirical data available at that time: “… a rather large percentage of individuals of normal intelligence and of average social background, not only at the age of adolescence but also in adulthood, do not seem to function at the formal operational stage” (p. 348).

Acknowledging these challenges, Piaget (1972) published Intellectual Evolution from Adolescence to Adulthood, wherein he attributed differences in the mastery of formal operations to the cultural environment and areas of one’s interest. In particular, Piaget suggested testing the account of formal operations in domains that are central to the child’s “areas of functioning” (p. 1). By doing so, he indirectly acknowledged that the age when formal operations come into play is not 11–12 years old, but rather a variable unit. Nevertheless, he stood firm in terms of the developmental nature of his theory. In a much later overview of Piaget's developmental theory, and in particular the stage of formal operations, Kuhn (2008) also noted that the substantial empirical evidence available today does not support the claim that "the various competencies alleged to be components of formal operational thought, when they do appear, emerge together as a tightly structured whole" (p. 51). In general, this is to say that the process of cognitive development in adulthood may be an uneven process with no exact starting age at which formal operations are developed well enough to proceed to critical thinking.

For now, let me draw on several empirical studies suggesting that some skills contributing to critical thinking may be associated directly with the cognitive achievements of preschool children. There is empirical evidence that children of an early age partially engage in cognitive processes similar to those of adults. For instance, in three experiments, Koenig and Harris (2005) demonstrated how in conflicting situations 3 and 4-year-old preschoolers evaluate the accuracy of information based on a previous record of an adult informant being correct or purposefully inaccurate in their assertions. There were 39 children in Experiment 1, 42 in Experiment 2, and 38 in Experiment 3. The results of that study illustrated that both 3 and 4-year-old children could distinguish between accurate and inaccurate informants. However, only one 4-year-old could extend this judgment to predict the informants' future assertions, seek information from a more accurate source, and endorse the informants' claims (p. 1274). In addition, the participating children were able to distinguish between ignorant and knowledgeable speakers to selectively trust them. Finally, children preferred knowledgeable informants when learning the names of new objects and receiving new instructions. When the children used only a small number of tools to distinguish the credibility of an informant, this study showed that they were mastering the appraisal of an informant’s past and future trustworthiness (p. 1276). Yet another study on a similar theme published by Jaswal and Neely (2006) showcased how 3 to 4-year-old children evaluated the credibility of a person. The results of the study revealed that children were more likely to treat an adult as a credible source of information rather than their peers. However, when the status of the adult was compromised by some counterevidence, children switched their preference to peers as more credible sources (p. 758). The ability of young children to identify a person’s trustworthiness suggests that a foundation for complex cognitive processes contributing to critical thinking is developed in early childhood. Thus, for educators, this evidence implies that critical thinking can be approached from an early age in its component parts, which later may contribute to what is meant by critical thinking holistically. While the studies presented above did not describe how to teach critical thinking at such an early age, they do give some direction for future experimentation and a different perception of children's intellectual abilities.

Piaget and Inhelder’s (1958) four stages of cognitive development assist us in constructing an understanding of yet another important theory to be considered in relation to age and development. For instance, we had a chance to give a short account of Kuhn’s (1999) developmental model of critical thinking. As she suggested, the most relevant cognitive competencies to the purpose of developing critical thinking are second-order metacognitive, rather than first-order cognitive competencies (p. 17). In saying so, Kuhn argued that critical thinking largely relies on one’s awareness and mastery of one’s own thought. In this sense, Kuhn saw knowledge from a perspective of a constructivist theory of mind, where knowledge is a product of one’s mental activity, and human beings are capable to create a variety of valid reality representations (p. 22). As already mentioned, her developmental account of critical thinking consisted of three meta-knowing dimensions: metacognitive, metastrategic, and epistemological meta-knowing. Kuhn stated that metacognitive knowing (that is fundamentally about what things we know, and how we know them) and metastrategic knowing (that is the realization of the existence and continuous application of mental procedures focused on a certain aim) are rarely mastered and remain incompletely developed throughout life (pp. 18, 21).

At the same time, Kuhn (1999) postulated the development of epistemological meta-knowing to be crucial for one's critical thinking. In her account, an individual progresses through several levels of epistemological understanding throughout one's lifespan. The first one, realist understanding, considers assertions as some form of a copy of reality, a reality that is directly observable (p. 23). As Kuhn argued, at this stage, critical thinking is unnecessary. Indeed, there is no conflict of opposing views, and neither assertion is interpreted as a product of the human mind. In turn, the positive shift in cognition comes when a person sees the world and one's thinking from the absolutist stance (p. 22). At this level, assertions are taken as facts, which may be false or true, and are waiting for their confirmation by the evidence available. Consequently, the evidence here is something directly observable or provided by an authority. The problematic point is that knowledge in an "absolutist" stance is considered to be certain. Hence critical thinking is only needed to compare between simplified statements to determine the superiority of one of them. There is no understanding of how these "facts" are acquired, and what underlying implications there might be. Third, comes the "multiplist" position, as Kuhn described when somebody is exposed to the fact that experts do not come to an agreement on something, the logical implication out of this controversy is that every assertion, including one's own, has the same weight as anyone else's. It follows then that critical thinking is totally absent in the multiplist approach as there is nothing to evaluate and decide upon—if I said so, I am as right as everybody else. Finally, the "evaluative epistemological understanding" considers reality as not directly knowable; it questions the nature of reality itself and what is considered to be fact or evidence. Kuhn unpacked this as follows:

> Only a minority progress to an evaluative epistemology, in which all opinions are not equal and knowing is understood as a process that entails judgment, evaluation, and argument. … people have a right to their views with the understanding that some views can nonetheless be more right than others. (p. 22)

In evaluative epistemology, “Critical thinking is valued as a vehicle that promotes sound assertions and enhances understanding” (p. 23).

The implications of Kuhn’s developmental model of critical thinking, for the purpose of this thesis, is that it is hardly possible to say that one thinks critically if the metacognitive knowledge is not in place. As soon as a human leaves the realist stage of meta-epistemological knowing, there is a space for critical thinking development. Note that metacognition will be also discussed in relation to critical thinking in Section 2.3.2.

To conclude this section, it is still not clear when a human becomes capable of critical thinking in terms of chronological age. While some cognitive skills contributing to critical thinking may develop even in early childhood, it is still highly debatable when and in what order one attains skills needed to think critically: be them formal operations of Piaget or epistemological meta-knowing of Kuhn. One may read available evidence as inconclusive, but I believe that it does not restrain an educator aiming to teach critical thinking. Some skills contributing to critical thinking do develop early and their mastery is certainly of importance. Some skills and understanding may be attained later, and it is therefore reliant upon the educator as to how to develop the epistemological understanding of a learner.

2.3 Cognitive Elements to Critical Thinking

This section introduces critical thinking as viewed in terms of cognitive elements. Davies (2015) identifies two accounts relating to this conception of critical thinking, namely, critical thinking as argumentation and critical thinking as reflective judgment (p. 49). In the section afterward, I also introduce propensity elements to critical thinking, which together with cognitive elements constitute a "philosophical" lens of looking at critical thinking (Davies, 2015, p. 49). Before proceeding, one should be aware that accounts of critical thinking tend to cross borders taking elements and ideas from other accounts (p. 6). That is why I believe that many definitions coming out of the educational and cognitive psychology schools overlap with the "skills-based view" (Davies, 2015, p. 54) of critical thinking and are not only limited to the philosophical school. Finally, it is important to mention that definitions belonging to the three inner circles of Davies's model that follow, tend to focus on an individual's development (Davies, 2015, p. 85). Beginning from Section 2.8, we will examine conceptualizations of critical thinking that emphasize one's participation in society, citizenship, and relationships with others.

2.3.1 Critical Thinking as Argumentation (The "Skills" view)

When one hears about critical thinking there is an immediate temptation to add "skills" after "critical thinking." No wonder, after all, critical thinking viewed as skills in argumentation has been with us for the longest time since the inception of the critical thinking movement. As Davies (2015) defines it, critical thinking as argumentation involves "intellectual activity of identifying, analyzing and evaluating arguments and propositions" (p. 49). The theorists of the first wave (1970–1982) initially viewed critical thinking in terms of these skills. For example, Ennis (1962) defined critical thinking as "… correct assessing of statements" (p. 8), later incorporating into his definition reflective judgment formation (Ennis, 1993, p. 180). This account of critical thinking is also called "logicality" (Burbules & Berk, 1999) or "the skills-only view."

The importance of argumentation for critical thinking and virtually every field of human operation cannot be underestimated. Students are often taught to put forward their opinions, react to the thoughts of others, and be able to agree or disagree, or change an initial position. In one way or another and regardless of the domain of knowledge, students are taught and are expected to master these skills. Argumentation skills are crucial for learning, in work settings and when facing any problem. Strong argumentation skills naturally lead to capable decision-making, which is based on judgments derived from argumentation (Davies, 2015, p. 51). Davies believes that critical thinking in the sense of argumentation is a fundamental skill.

2.3.2 Critical Thinking as Reflective Thinking (The "Skills-and-Judgments" View)

The departure from the "skills-only view" marks a significant shift in how we think about critical thinking. Critical thinking as reflective thinking focuses less on the mechanics of argumentation and more on the reflective basis for decision-making and judgment formation (Davies, 2015, p. 51). There are a number of definitions representing this wider sense of critical thinking: Ennis (1993) defines critical thinking as "reasonable reflective thinking focused on deciding what to believe or do" (p. 180), Bailin et al. (1999) define critical thinking as "thinking aimed at forming a judgment" (p. 287), and in Lipman's (1988) terms, critical thinking is "skillful, responsible thinking that facilitates good judgment" (p. 39). Davies (2015, p. 51) clarifies the important conceptual change present in these definitions: Standalone argumentation is not enough for critical thinking, because one may engage in argumentation without arriving at a judgment towards a decision.

Naturally, this account of critical thinking relates to metacognition. Metacognition can be defined as "cognition about one's own cognition" (Scheck & Nelson, 2005, para. 1) or "the monitoring and control of thought" (Martinez, 2006, p. 696).

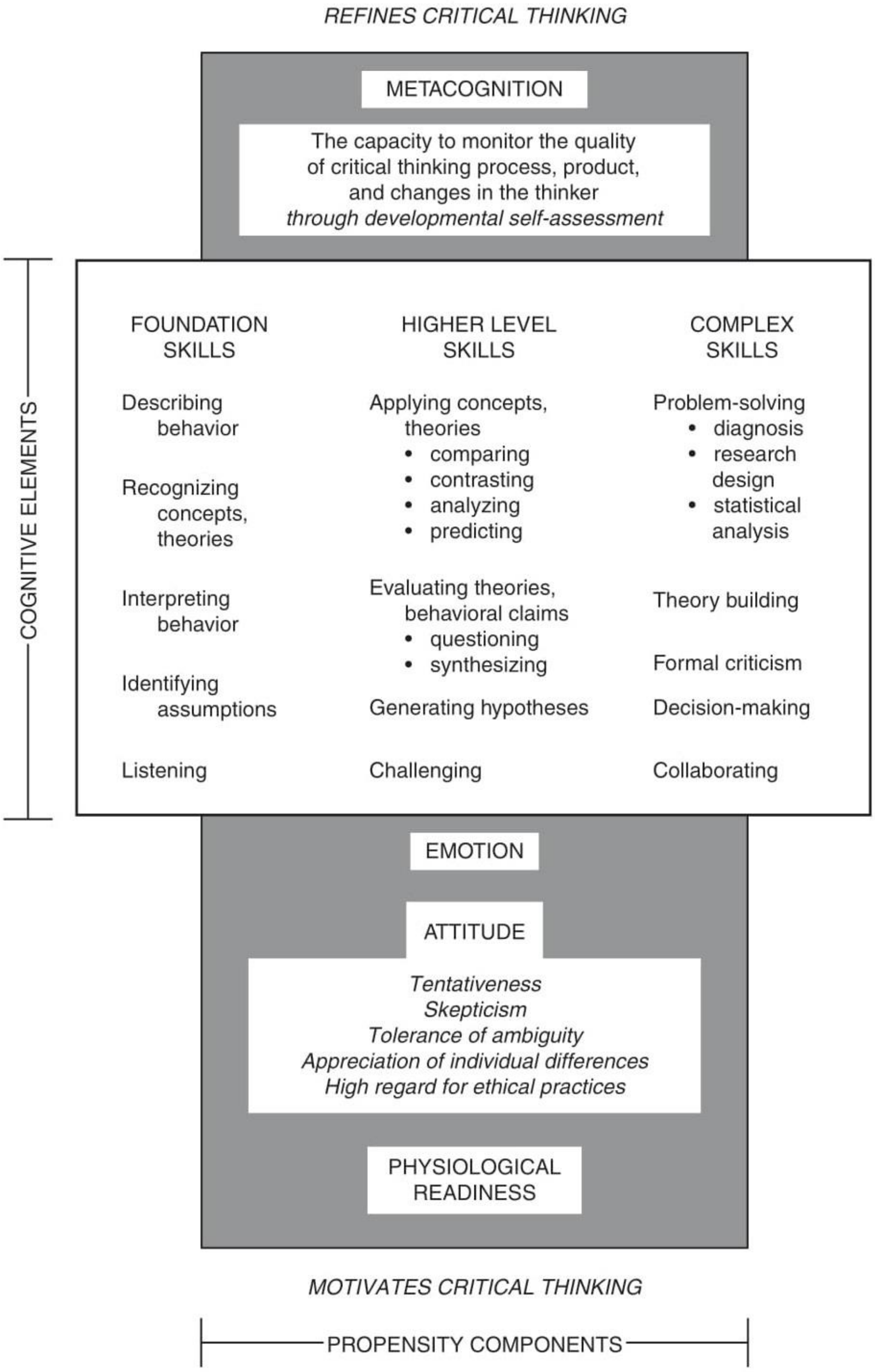
Kuhn (1999) brings together three types of meta-knowing described previously—the metacognitive, metastrategic, and epistemological forms, which are central to critical thinking. Her approach to critical thinking is developmental, in the sense that a person should progress through all the levels of meta knowing to be a critical thinker. For instance, she suggests that “the development of metacognitive understanding is essential to critical thinking because critical thinking by definition involves reflecting on what is known and how that knowledge is justified” (p. 23). Metastrategic skills can empower thinkers with consistent criteria of thought evaluation that are not time and/or context-dependent, and secure them from subscribing to things taken for granted or considered to be common sense (p. 23). Finally, the development of epistemological understanding stresses the importance of knowledge as the product of the human mind, and the subject of evaluation.

A metacognitive component can also be found in the work of Ennis (2015) who named it a “nonconstitutive but helpful” (p. 33) ability that ideal critical thinkers should possess. Halonen (1995) defined metacognition as the ability to “monitor the quality of critical thinking” (p. 80). Finally, the metacognition is also present in the APA Delphi Report’s consensus list of critical thinking cognitive skills, wherein metacognition is represented by the concept of self-regulation and the two subsumed skills of self-examination and self-correction (Facione, 1990).

Critical thinking as reflective thinking is as much about skills as it is about a reflective component. Cognitive skills may be categorized by Halonen’s (1995) approach who made it by borrowing Wales and Nardi’s (1984) taxonomy of critical thinking skills. Thus, they can be split into “Foundation” lower-level thinking skills, higher-level thinking skills, complex thinking skills, and metacognition, refining critical thinking (see Figure 3). Wales and Nardi suggest hierarchical treatment of these skills. Even if the boundaries of these categories may be challenged, the framework provides us with a description of a rich set of skills constituting critical thinking.

Figure 3

Halonen's Framework for Critical Thinking, Cognitive Elements, Metacognition, and Propensity Elements



Note. From "Demystifying Critical Thinking," by J. S. Halonen, 1995, *Teaching of Psychology*, *22*(1), p. 80 (https://doi.org/10.1207/s15328023top2201_23). Copyright 1995 by SAGE Publications. Reprinted with permission.

The “skills and judgments” view of critical thinking is also sometimes known as the “skills-based” view in recognition of the fact that both skills and argumentation are cognitive skills (Davies, 2015, p. 54). Because many definitions coming out of this category tend to focus on skills, this view was challenged as not sufficient for critical thinking. Papastephanou and Angeli (2007) question the use of the skilling discourse itself. As they build their argument, they cite Hinchliffe (2002) who suggests that skills usually mentioned in critical thinking definitions do not account enough for the context where they are employed. This is to say that the uniqueness and uncertainty of situations where problems occur presuppose that there cannot be one method or procedure which can be applied across different occasions (p. 193). Hinchliffe proposes “to think of the term ‘skill’ in an inclusive way, ranging from techniques that can only be learnt through repeated and sustained practice, to performances that are improvised and combine a range of techniques” (p. 196). Even though this kind of conceptualization of skill is more inclusive, Papastephanou and Angeli (2007) are skeptical about skilling discourse in general. In their position, this discourse primarily holds a strong affinity to performance rather than the problematization and critical evaluation of the ends to be achieved (p. 618). The authors suggest that thinking framed by definitions built solely around skills and purposive rationality can only be labeled “effective” as opposed to “critical” (p. 614).

To conclude this section, it is indeed important to take a critical stance on the skills we strive to incorporate into the definition of critical thinking, the goals critical thinking is meant to achieve, and the problems we are trying to solve via its application. When certain skills provide us a tangible way to think about how we solve problems, it does not mean that possession of these skills leads us to their usage. Most importantly, it does not mean that it leads to moral decisions and involves an appreciation of the epistemological dimensions of our problems.

2.4 Propensity Elements to Critical Thinking

The third circle of Davies's (2015) model introduces an account of critical thinking built around critical thinking skills, reflective judgment making, and dispositions of a critical thinker. It is a composite view, representing by far the position of the majority of critical thinking movement scholars. Geng (2014) conducted a content analysis of 64 definitions of critical thinking. The most common words used to describe the nature of critical thinking were "*judgment*", "*skills and dispositions*", "problem-solving", "information processing", "argument", "*metacognitive*", and "questioning" (p. 125). Notably, the common words in italics above belong to the cognitive domain of critical thinking. This section examines propensity elements to critical thinking, which makes the "cognitive skills, judgements, and dispositions" view distinct from its predecessors.

The ability to think critically by no means can be separated from the propensity to do so—emotions, dispositions, and traits of character should also be reflected in any attempt to define the concept. Dispositions can be described as affective states, and include attitudes as well as psychological readiness to engage in critical thinking (Davies, 2015). They are personal traits, habits of mind, and attitudes that make up for a "critical spirit" (Facione, 1990, p. 11). A critical thinker in this sense is someone who is not only able to perform analysis or arrive at a judgment but a person who is disposed to use skills and engage in thinking activity.

Skills in argumentation, reflective judgment making, and dispositions altogether make a composite view of critical thinking. Halonen's framework for critical thinking mentioned in the previous section is an illustrative example (see Figure 3). Apart from cognitive skills, it includes emotions, attitudes, and psychological readiness which, as she describes, motivate critical thinking (Halonen, 1995, p. 80). Definitions of critical thinking emerging from this composite view include:

- “the propensity and skill to engage in an activity with reflective skepticism” (McPeck, 1981, p. 8);
- “disciplined, self-directed thinking which exemplifies the perfections of thinking appropriate to a particular mode or domain of thought” (Paul, 1992, p. 9);
- “critical thinker is one who is appropriately moved by reasons” (Siegel, 1985, p. 75), where “appropriate movement” includes the reason assessment component and the critical spirit component (Siegel, 2016, p. 56);

The philosophical lens of looking at critical thinking also naturally involves dispositions as part of what is considered to be an ideal critical thinker. The APA Delphi definition can be attributed to the third inner circle in Davies’s model. This is because apart from cognitive skills and judgment-making components, it explicitly lists dispositions (Facione, 1990):

> The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. (p. 2)

The ideal critical thinker has also been depicted by Paul (1992, p. 10) in terms of a strong sense and sophistic or weak sense critical thinker. Paul builds upon four categories which help us identify the differences between the above-mentioned thinking types. First, he emphasized such elements as the “perfections and imperfections of thought” (p. 10). These general traits of thought include “clarity vs. unclarity,” “fairness vs. bias,” or “depth vs. superficiality” (p. 10). Furthermore, he argues that to avoid these imperfections of mind, a thinker should master their “understanding of and ability to formulate, analyze, and assess”

(p. 11) the problem, the goal of the process, the framework of reference or evidence provided; in other words, master “the elements of thought” (p. 10). When concentrating on the interrelations and the nature of these elements, a thinker would be able to understand not only the logic of one’s thinking, but also the logic of any domain of knowledge (p. 11). Finally, Paul (1992) brought seven “traits of mind” (p. 12) peculiar to the strong sense critical thinker: intellectual humility, courage, empathy, integrity, perseverance, sense of justice, and faith in reason (pp. 12–13). For example, he described intellectual courage as “The willingness to face and assess fairly ideas, beliefs, or viewpoints to which we have not given a serious hearing, regardless of our strong negative reactions to them” (p. 12). Paul viewed these traits working in interconnection with one another, and if learners were to acquire them, they should develop these traits of mind simultaneously.

Yet another propensity element that is also worth mentioning is emotions. In contrast to the opinion that critical thinking is pure reasoning above feelings and emotions, Brookfield (1987) suggests that emotions are central to the critical thinking process (p. 7). He argued that both positive and negative events trigger critical thinking: They cause us to question previously accepted assumptions and reinterpret our past ideas and actions from a new point of view. Thus, emotions caused by these events are not something impeding critical thinking rather they are forces that may fuel it and also a unit of analysis in and of themselves. Brookfield elaborates on his position about emotions: “… resistance, resentment, and confusion are evident at various stages in the critical thinking process. But we also feel joy, release, relief, and exhilaration as we break through to new ways of looking at our personal, work, and political worlds” (p. 7). He urges critical thinkers to not ignore emotions. Halonen (1995) suggests that surprise is at the basis of disequilibrium which triggers critical thinking—a thinker engages in critical thinking to escape the feeling of being off-balance or confused (p. 77). She also suggests that well-managed emotions facilitate critical thinking and contribute to making criticality habitual.

In addition to the dispositions mentioned above, I refer to Davies's (2015, p. 58) taxonomy of critical thinking dispositions: dispositions arising in relation to self, in relation to others, in relation to world, and those which do not easily fall into mentioned categories—other. These dispositions are represented in Table 1 below.

Table 1

Davies's Taxonomy of Critical Thinking Dispositions

Dispositions arising in relation to self	Dispositions arising in relation to others	Dispositions arising in relation to world	Other
Desire to be well-informed Willingness to seek or be guided by reason Tentativeness Tolerance of ambiguity Intellectual humility Intellectual courage Integrity Empathy Perseverance Holding ethical standards	Respect for alternative viewpoints Open-mindedness Fair-mindedness Appreciation of individual differences Skepticism	Interest Inquisitiveness Seeing both sides of an issue	Mindfulness Critical spiritedness

Note. From "A Model of Critical Thinking in Higher Education," by M. Davies, in M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, p. 58), 2015, Springer International Publishing (https://doi.org/10.1007/978-3-319-12835-1_2).

2.5 Domain Specificity and Teaching of Critical Thinking

We have already discovered that critical thinking may be defined as argumentation, reflective judgment making, and dispositions. One more example of this composite view is provided by Ennis (2015) who proposed a set of 12 critical thinking dispositions and 18 critical thinking abilities, which, from his point of view, make the “ideal critical thinker” (p. 32). For example, these criteria include a critical thinker’s disposition to “be well informed,” (p. 32) and the ability to “deal with fallacy labels” (p. 33). The advantage of such a stance toward critical thinking is that by listing specific skills and dispositions, Ennis (2015) made it possible to draw direct lines to the teaching of critical thinking. To put it another way, this perspective provided tangible elements for the subsequent teaching of critical thinking, rather than presenting something more cautious and generic. As Siegel (1990) noted, Ennis’s position became very appealing to the field for its “conceptual soundness and usefulness to education” (p. 68).

As this definition attempts to offer a comprehensive set of criteria for critical thinking, objections to the validity of such claims were made by two authors. McPeck (1990) refused to subscribe to this definition: “The vast array of problems, and types of understanding required, are simply too diverse to regard any set of specific skills sufficient for critical thinking in all or even most of them” (p. 26). To put it another way, the possession of any of these skills may or may not lead to critical thinking depending on the context and complexity of the problems one faces. Although this line of reasoning may sound appealing, the counterargument presented by Norris (1990) adds another perspective to the debate. In response to Ennis’s definition, Norris argued that: “there is no scientific legitimacy to grouping together a number of abilities and saying they go together to make up a larger ability” (p. 70). Furthermore, Norris does not support the polarizing claim of McPeck (1990): “There are no a priori grounds for maintaining that there cannot be a single set of underlying reasoning processes which combine in intricate ways to produce the immense variety of reasoning which we witness at the behavioral level" (Norris, 1990, p. 72). This is to say that Norris rather agrees that there is not enough empirical evidence to prove right or wrong any of these views. In his opinion, debates on definitions and generalizability of the concept "shade into empirical questions concerning the psychological nature of human mental abilities" (Norris, 1990, p. 74).

This disagreement lies at the heart of the debate on the generalizability of critical thinking: The question is whether critical thinking can be taught and used across several domains of knowledge, or it is a domain-specific phenomenon. McPeck (1990) is one of the central figures in this debate. Apart from providing a prominent position on critical thinking, McPeck contributed to the field by critiquing several notions associated with critical thinking and the prevalent views of critical thinking at that time. He was skeptical when critical thinking was defined as "reasoning ability," "argument analysis," or "everyday argument." McPeck argues that defining critical thinking as 'reasoning ability' presupposes that it is like the single ability to speak a certain language (McPeck, 1990, p. 4). Thus, he questions whether such a complex process as critical thinking may be described by binary options, like someone's possession of reasoning ability or its absence. McPeck concludes: "the phrase 'reasoning ability' does not denote any particular skill nor indeed any particular kind of skill" (p. 4), as the umbrella of "reasoning ability" may cover "all manner of cognitive phenomena" (p. 4). He extends on this by stating that "argument analysis" is also quite a limiting definition, because: "(1) argument analysis is always an ex post facto reconstruction of past reasoning; and (2) the major focus of argument analysis is to determine the validity of arguments, not the truth of premises or evidence" (p. 6). Finally, the "everyday argument" is a questionable term when used to refer to critical thinking as it does not appreciate the complexity of "everyday problems" with which humanity struggles (p. 12). This critique aligns well with what Davies (2015, p. 46) lists as things that are not equal to critical thinking (see Section 2.1 “What is Critical Thinking?”).

All this builds toward his major argument as McPeck (1990) rejects the position that critical thinking can be regarded as general skills. He states: “Purporting to teach critical thinking in the abstract, in isolation from specific fields or problem areas, is muddled nonsense; thinking of any kind is always ‘thinking about X’. Critical thinking cannot be a distinct subject” (p. 13). As the alternative, he offers to teach critical thinking through disciplinary domains (McPeck, 2017b, p. 34), emphasizing the epistemological underpinnings of each discipline (McPeck, 2017a, p. 31), their implicit inquiry traditions, and not mere accumulation of knowledge (McPeck, 1990, p. 17). This line of reasoning holds to the premise that in different fields different approaches, strategies, and things could be considered as good reasons.

The opposite to McPeck’s (1990) position is the one taken by generalists such as Ennis (1989) and Halpern (1998, 2001). Van Gelder (2005) argues that critical thinking is “intrinsically general in nature” (p. 43) and critical thinking skills are, by definition, applied in various domains, contexts, and so on.

One way to teach critical thinking from the perspective of generalists is to use informal logic. Informal logic holds on the premise that by understanding and improving thinking, reasoning, and argumentation, we can effectively solve many problems arising around us (Groarke, 2017). Informal logic, as opposed to formal logic, does not operate on abstract symbolic forms; rather, it concentrates on the content of expressions (Noddings, 1995). In order to improve our reasoning and argument construction, informal logic relies on such techniques as criteria for argument evaluation, fallacies, or deductive and inductive models of inference (Groarke, 2017). The application of informal logic techniques may be very appealing to educators teaching critical thinking, and some key figures in the field

(Ennis, 2015; Paul, 1990; Siegel, 1990) advocate for the use of such techniques for teaching critical thinking.

For instance, Ennis (2015), in his list of critical thinking abilities, highlights skills very familiar to the definition of informal logic given above: analysis of arguments (p. 32), the use of deduction (p. 33), and evaluation of judgments (p. 33). They all coincide with the informal logic agenda and essentially are about argumentation and reflective judgment. Paul (1990) and Siegel (1990) also do not deny that critical thinking can be facilitated when informal logic is exercised. They do not object to the argument, that when practiced in various domains, it is possible to transfer critical thinking skills among them. It is not to say that critical thinking can be taught in a totally context-free manner, but rather that informal logic may offer us some practical skills which may then be used in specific situations and domains of knowledge. In response to McPeck's critique of the generalist approach Siegel (1988) observes: "McPeck writes that 'knowing what an assumption is, and knowing what a valid argument is are far from sufficient for enabling people to engage in effective critical thinking.' I agree. But it helps. How much it helps is an empirical issue" (p. 21).

This debate clearly shows that the way critical thinking is taught is closely related to how it is conceptualized. Having only provided an overview of the three inner circles of Davies's (2015) model, we may already note that critical thinking can be taught as informal logic, as skills in argumentation, or inside a domain of knowledge by relying on epistemological premises of the discipline. In relation to this, Ennis (1989) proposed four models of teaching critical thinking which perceive subject specificity differently. He recognized these models as idealized types, and in reality, they are more likely to appear with deviations and possible combinations of traits.

First, the general approach attempts to teach critical thinking in a way that is separate from using subject-specific content (p. 4). It uses previously learned subject matter, the problems of a community, or political debates, but treats the content as something general, an object over which critical thinking should be exercised. This approach has the primary purpose of applying critical thinking in some real-life situations, not domain-specific contexts. The organizational forms of such an approach may be a separate critical thinking course or separate thread in the existing subject matter (p. 5).

The second and third types are infusion and immersion, which are both instructional approaches wherein critical thinking is taught through the subject matter. For the infusion type, critical thinking instruction is infused in the subject content, and skills and dispositions contributing to critical thinking are made explicit to students. Proponents of this approach are Glaser (1984), Resnick (1987) and Swartz (1987). For instance, Glaser (1984) maintains that abilities to think and reason should not be taught as “add-ons” (p. 83) to what is learned, but rather be explicitly developed through the process of learning. The immersion approach refers to the same thought-provoking instruction through the subject matter, with the only difference that the general principles of critical thinking dispositions and abilities are not made explicit (Ennis, 1989, p. 5). McPeck (1990) is a proponent of such a position. As Ennis noted, McPeck’s epistemological subject specificity holds the premise that different disciplines have different foundations of what is considered to be a “good reason” (McPeck, 1981, p. 22); therefore, teaching critical thinking is only possible through domains of knowledge. Departing from this position toward any generalized conception of critical thinking skills, would be considered invalid as critical thinking varies from one domain to another.

Finally, the mixed approach merges the general type of instruction with immersion or infusion approaches. This approach involves a separate thread dedicated to the general concepts of critical thinking, but also utilizes critical thinking instruction through the subject matter (Ennis, 1989, p. 5). Ennis claims that he and Sternberg (1987) are proponents of this approach. Another example of this approach would include Papastephanou and Angeli's (2007) position, who do not subscribe to the teaching of critical thinking as defined solely by skills and problem-solving. They picture the teaching of critical thinking where specific skills are taught within domains as they are unique for the tasks for which they are required (p. 618), and simultaneously they acknowledge that some critical thinking qualities and modalities relating to epistemological understanding may be taught as a general course. Papastephanou and Angeli propose to design a course of learning which aims to re-evaluate the things society takes for granted and as common sense. The authors elaborate that such an exercise "is crucial to critical thinking, because it gives the means for an immanent critique of criteriology, i.e. critique from within the cultural material of the lifeworld itself" (p. 619).

When the debate about various modes of teaching critical thinking may appear heated, we may note that Ennis (1989) added some conceptual clarity to the debate. First, he urged us to be cautious regarding the use of the term 'subject': If thinking is always about some subject or topic, it does not mean that critical thinking can only be taught through school subjects (p. 5). Second, Ennis pointed out that when the term domain is itself quite vague, it is also notable that it is hard to distinguish whether a problem lies in the field of one domain and not in two or three simultaneously (p. 6). In the end, this abstract categorization brings to the fore the need for research, which sensitively outlines the meaning of central terms such as "subject" and "domain," and distinguishes between three types of subject specificity. The first, "empirical subject specificity," as summarized by Ennis, is generally about three main postulates: (a) the importance of background knowledge for thinking in a given domain; (b) the unlikeliness of critical thinking transfer among different domains, until sufficient practice and instruction focused on transfer are in place; and (c) the unlikeliness of general instruction of critical thinking to deliver positive results (p. 5). The second type of subject specificity is "epistemological"; it has been mentioned in relation to McPeck's (1990) position above.

Finally, “conceptual subject specificity” is built around the notion that thinking cannot be about something general (McPeck, 1990, p. 13). The implications of Ennis’s (1989) work result in our awareness that teaching critical thinking is not only a practical task but also a huge array of research possibilities. Sound teaching is based on years of practice and research, and the research on teaching critical thinking surely adds meaning to this task. Ennis (1989) proposed to research the transferability of critical thinking and its particular dimensions, evaluation mechanisms, and the effectiveness of the four modes to critical thinking instruction. In fact, the differences in effect size between instructional strategies proposed by Ennis (1989) were examined in the meta-analysis study by Abrami and colleagues (2015). Their review included 341 effect sizes taken from experimental and quasi-experimental studies which looked at the standardized mean differences of critical thinking skills assessments. As the researchers described, all four strategies obtained significantly positive effect sizes, but the average effect size of categories did not significantly differ from one another (p. 297).

The same study by Abrami et al. (2015) also revealed that critical thinking skills and critical thinking dispositions, both generic and content-specific, may be facilitated across all educational levels and disciplinary domains when certain effective strategies are used. Researchers indicate three approaches to teaching which yielded significantly larger effect sizes than others. In particular, the use of dialogue (discussion), both in terms of the whole class format as well as teacher-led group discussions appears to improve the critical thinking skills attainment. The use of authentic or situated problems and examples also appeared to promote critical thinking skills, especially when problem-solving and role-playing methods were applied. In the end, the study also revealed that dialogue and authentic instruction are successful when combined, and the effect of these strategies is enhanced in the presence of mentorship. Notably, when mentorship was examined as a standalone strategy, the results were not especially strong. The authors concluded that mentoring may serve as a catalyst for the attainment of critical thinking skills when mixed with other instructional strategies.

Even as cognition and neurology are outside the scope of this thesis, it is pertinent to recognize that when attempting to teach critical thinking, one should have an appreciation of how learning occurs. Van Gelder (2005) proposes six key lessons from cognitive science that should be considered when teaching critical thinking (pp. 42–46):

- Acquiring expertise in critical thinking is difficult, and a teacher should not expect it to develop quickly. Rather it can be considered as a lifetime journey of learning.
- Mastery of critical thinking takes deliberate practice. Critical thinking must be studied on its own (this point created a heated debate as we have seen above).
- The transfer of critical thinking skills must be practiced if we want it to be applied across different problems (see Section 2.6 for a detailed discussion).
- Teaching critical thinking is both practicing it and learning its theory. Not teaching theory or overemphasizing theory relative to practice is a mistake (see van Gelder for a relevant learning contexts).
- Mapping arguments and teaching learners to do this can help in developing critical thinking (see Section 2.16.1 for related study).
- The mind is prone to belief preservation and a critical thinker should be aware of this phenomenon and try to compensate for it (this point directly connects to critical thinking dispositions that concern this phenomenon, see Section 2.4).

2.6 Transferability of Critical Thinking

The transferability of critical thinking is one of the key debates in the cognitive domain of critical thinking. Scholars within the critical thinking movement hold different views regarding the transfer of dispositions and abilities, which heavily influence their conceptualization of critical thinking. As discussed in the previous section, this conceptual difference perhaps influences the way critical thinking is taught more generally. While the previous section focused on domain specificity and the teaching of critical thinking, the current section complements that section by looking at the transferability of critical thinking skills across domains.

First, we should be clear about what transferability in the current context refers to. Researchers have asked whether or not transferability pertains to the utility of critical thinking skills within or between domains of learning (e.g., Lai, 2011). Researchers have also asked if one is referring to transferability between domains, what are the boundaries between these domains, and how do we define the term “domain” (e.g., Ennis, 1989)? This debate has generated a lot of questions, and here I take the position of Ennis’s who urged us from making unsupported claims until evidence based on exploratory research is presented (p. 7).

To provide an overview for this debate, let us start with Ennis (1989) who summarized the popular empirical view of those who believe that critical thinking is domain specific; he outlined their position towards transferability:

> (a) Simple transfer of critical thinking dispositions and abilities from one domain to another domain is unlikely; (b) However, transfer becomes likely if, but only if, (1) there is sufficient practice in a variety of domains, and (2) there is instruction that focuses on transfer. (p. 5)

As we may observe, proponents of the domain-specific approach are skeptical about critical thinking transferability, even though they do not deny it. For example, McPeck (1990) speculated that the transfer of skills taught generally will result in minimal transfer to multiple problem domains. Instead, McPeck posited that it was more likely that transferability would occur when critical thinking was taught through disciplinary domains. It should be noted that McPeck started his discussions on the nature of transferability with the phrase: “if my suspicions are correct” (p. 13). At the other end of the spectrum, there are some researchers who claim that critical thinking can be learned and taught as a general skill (Ennis, 2015; Paul, 1990; Siegel, 1990). These proponents hold on to the premise that abilities taught generally will be transferred across different domains and the specific problems one faces.

In the end, the question of skills transferability appears to be subject to further investigation. There is a lack of empirical evidence to determine whether or not skills, or indeed, what kind of skills are transferable across domain-specific problems, and how this process happens. In this sense, it may be wise to take the practical approach presented by Halpern (1998). Halpern believed that as far as we recognize the need for skills to be transferred, we can put our efforts to make it happen (p. 451), for example, by using explicit critical thinking instruction. Building on this view, van Gelder (2005) proposed to teach critical thinking as grounded in specific tasks, then challenge students to determine what kind of general activities and strategies they used and where else they could be applied to (p. 43). This raises an important discussion on the teaching of critical thinking with an explicit focus on transferability, rather than assuming that it will happen by itself. In this sense, Van Gelder's proposition relates to what Ennis (1989, p. 5) calls the infusion approach for teaching critical thinking. Specifically, the infusion approach is rooted in the subject matter with the skills, dispositions, and traits contributing to critical thinking all made explicit to the learner.

2.7 Paul's Critical Thinking: Weak and Strong Sense of Critical Thinking, Background Logic, and Dialectic thinking

When talking about the way critical thinking should be taught, it is worth emphasizing Paul's (Paul, 2012; Paul & Elder, 2006b) contribution to the field of critical thinking. In Davies's (2015) model of critical thinking, Paul is an outlier of the "skills" camp for his willingness to look beyond skills and dispositions to social ramifications and concerns

(Burbules & Berk, 1999, pp. 50, 53). A description of Paul's conception of critical thinking and his original contribution will now be provided.

We have already touched upon Paul's (1992, 2012) position (see Section 2.3 "Propensity elements to critical thinking") in which he lists traits of thought and mind which are central to critical thinking. Beyond that, Paul's approach incorporates almost every element of various critical thinking definitions that we have discussed hitherto. His approach covers the power of reason, its focus, the dispositions of a critical thinker, self-reflection, and critical thinking skills.

Central to Paul's (2012) approach to critical thinking is the notion of "background logic". Paul emphasized that the majority of critical thinking pedagogy primarily deals with the tip of the iceberg—things that are spoken or written. However, such an approach misses the important element of critical thinking—the underlying structures of "background thought, logical connections" (p. 61). Paul (2012) elaborated on the meaning of "background logic" by stating that "in the background of all thinking are foundational concepts, assumptions, values, purposes, experiences, implications, and consequences—all embedded in lines of thought radiating outward in all directions" (p. 61). When describing how background logic operates, he listed three categories of background logic that fundamentally influence one's point of view: the natural language a person speaks (e.g., English, Russian), the technical language learned at school (e.g., the language of physics, biology), and sociocentric practices which foster the meanings present in any social group (i.e., cultural norms, gentlemanly behavior; p. 65). Though all three categories influence one's perspective, according to Paul, "the only "neutral" background logic we have at our critical disposal is that of natural languages themselves" (p. 75). From his position, the other two modes (the technical language and sociocentric practices) are ideologically driven, and these modes stipulate what words are used, what attitudes are socially desired, and what behaviors are accepted. Consequently, Paul was convinced that our natural language "allow[s] us to abstract from ideologies, academic agendas, and social presuppositions" (p. 75). Therefore, the ability to distinguish between these different background domains (i.e., the natural language, the technical language, and sociocentric practices), understand what is linguistically implied by words, and identify what a social group denotes as the meaning of words are a key to the mastery of background logic. Paul (2012) synthesized his argument: If we are to approach background logic, we need critical thinking abilities

> to question the on-going stream of fostered definitions and social conceptualization, choices of basic concepts and categories that uncritically shape our daily thought and experience… ability to synthesize across these concepts and categories so that our "totalization," our summing up of people, facts, and events, represents characterizations to which we can give, and do give, conscious assent. (p. 75)

Thus, by mastering the command of the background logic, a thinker enables themself to combat egocentric and sociocentric thinking and become "a reasoner or fairminded critical thinker" (p. 77).

Paul (2012) discussed the pedagogical implications of his position with regard to the importance of unveiling the background logic to the task of teaching critical thinking. Paul makes two points in this regard as discussed in the following two paragraphs.

First, Paul was convinced that teaching as defined and driven by unconnected and isolated disciplines leaves little space for critical thinking (p. 63). From Paul's position, disciplinary knowledge is fragmented and does not address the complex and multidimensional problems people face in real life. The danger of compartmentalization of problems into disciplinary domains is related to what Paul describes as the demand to "professionalize" philosophy, making it procedural rather than dialectic. In such fragmentized schooling environments, people are more prone to internalize the basic worldview of their peers and society without questioning, looking for contradictions, or unveiling their background logic.

Second, dialogical and dialectical thinking were viewed by him to be substantial in uncovering background logic. Paul (2012) criticized the “over-fascination with formal procedures” (p. 62) of scientism and endorsed the philosophical point of view, which, in contrast, maintained that dialogical and dialectical thinking as fundamental modes of inquiry (p. 62). Specifically, according to Paul (2012) “Dialogical thinking refers to thinking that involves a dialogue or extended exchange between different points of view, cognitive domains, or frames of reference” (p. 318). At the same time, dialectical thinking “refers to dialogical thinking conducted in order to test the strengths and weaknesses of opposing points of view” (p. 318). According to Paul (2012), when dialogical and dialectical thinking are exercised, a thinker is able to probe the roots of ideas, move between various points of view (p. 318) and question the “nature of the question itself” (p. 62).

In certain ways, the position of Paul (2012) resembles the position of Socrates with his emphasis on self-knowledge and dialogue. For instance, Siegel (1988) summarized Paul’s position on the critical exchange more as a dialogue between opposing positions than as “a series of atomistic criticisms and deflections” (p. 13). Critical exchange is “global” (Siegel, 1988, p. 13) in the sense that it considers all possible alternatives and takes the matter as a whole, which is absent in an atomistic approach. Finally, as Siegel proposed, Paul’s perspective is Socratic in the way that a learner should know oneself, thus challenge one’s deepest beliefs and affiliations.

Burbules and Berk (1999) recognized Paul’s (2012) contribution to critical thinking scholarship, specifically for his consideration of the wider social concerns of the concept. They suggested that one of the key debates in critical thinking scholarship was about to which degree the standards of critical thinking, and the underlying concept of rationality, are culturally biased in favor of the masculine, Western mode of thinking (p. 6). In the section to follow we will talk about these concerns in greater detail. At this point, it is important to note that Paul's concept of critical thinking considered egocentricity and sociocentricity as a sophistic and weak sense of critical thinking (Paul, 1992, p. 10). Where egocentricity means the inability or unwillingness to consider other points of view or be always right, sociocentricity extends this meaning from “I am right!” to “We are right!” (Paul, 2012, p. 402). Sociocentricity results in the belief that one's religion, country, or race is better than another's. The cure for this disease, in Paul's words, is self-awareness. It is the willingness to recognize sociocentricity not only in members of the opposing group but to also notice when our behavior contradicts our self-image.

Paul's (2012) conception of critical thinking paves the way for further discussion on social dimensions of the concept. Sections to follow mark the shift from the central core of Davies's model, namely the critical thinking movement, into criticality, critical pedagogy, and ethical dimensions of critical thinking.

2.8 An Introduction to the Sociocultural Dimension of Critical Thinking and Its Wider Aspects

If we look at Davies's (2015) visual model (Figure 1) of critical thinking, we may notice that the three inner circles associated with the critical thinking movement are about the development of an individual's critical thinking. However, the outer circles of the visual model of critical thinking account for and incorporate wider sociocultural concerns and we may see it in the model as it gradually grows to include “others”, “social relations”, and “creativity” (p. 85). This section builds a background for criticality and critical pedagogy accounts of critical thinking. It also introduces wider social concerns which challenge the notion of critical thinking as imagined by the critical thinking movement.

2.8.1 Ethical and Moral Dimensions of Critical Thinking

> Not only can we not tell which argument is "best" by some logical or conceptual standards; neither can we assume that a bit of thinking is morally acceptable simply because it is adequate "critically". (Noddings, 2012, p. 67)

As we have seen it in previous sections, the definition of critical thinking has been developed in various directions: Philosophers defined it in relation to the ideal critical thinker; while the cognitive psychology approach focused on types of actions and behaviors critical thinkers do. Paul attributes these definitions and theorists to the first and second waves of critical thinking scholars (n.d.). The key elements of the critical thinking discourse of the first wave are well reflected in McPeck's (1981) definition: "the propensity and skill to engage in an activity with reflective skepticism" (p. 8). The first wave critical thinking movement largely defined critical thinking as a composite of skills, judgments and attitudes (Davies & Barnett, 2015). When it is clear that the first wave gave the momentum for the development of the critical thinking agenda, nevertheless, it still didn't encompass other wider aspects of critical thinking scholarship. There are a number of second wave theories and concepts dealing with critical thinking in its wider sense: critical pedagogy, Marxist critical consciousness, critical feminism, or the critical citizenship approach to curriculum. Davies (2015, p. 42) suggests that traditional philosophical definitions of critical thinking, those of the first wave theorists, do not help in debate on these various aspects of critical thinking scholarship. Reinforcing this argument, Davies and Barnett (2015, p. 9) state that critical thinking defined as skills and dispositions limits itself to the development of the individual only, and fails to include the sociocultural dimension of critical thinking. This section aims to look into the moral and ethical dimensions of critical thinking, discovers how it relates to social inequality, and builds a background for the criticality and critical pedagogy sections to follow, which should be considered if we mean to comprehend the concept fully.

Noddings (1995, p. 66) claims that the conceptual or epistemological debate around critical thinking may not be the central stage, and rather the most basic problems arising are moral. Can one be called a critical thinker if one does not resist evident evil or knows about its existence and does nothing? If one is moved by reasons to resist evil, where does one stop to not become evil oneself? These kinds of questions have always arisen in the face of humanity where critical thinking had to be exercised: the bombing of Dresden in World War II, or results of bloody revolutions which meant to overthrow oppressors and establish justice in societies. In relation to that, Martin (1992) brought up the point of deep consciousness on critical thinking, and warned us to be aware of sophists who skillfully manipulate ideas missing the key moral aspects of an issue:

> One does not have to attend esoteric lectures or conferences to encounter critical thinking gone awry. One need only look at public policy discussions on nuclear war where hawks and doves alike transform a problem of the fate of life on earth into questions of military technology and strategy about which they exercise their considerable powers of critical thinking. It is to be found also in discussions of medical ethics where expert physicians and philosophers turn real cases of birth and death that bring catastrophe into the lives of family members into abstract questions of “the patient's best interest.” (p. 164)

We do remember the case of the atomic bombing of Hiroshima and Nagasaki which was then justified by government officials, who were supposed to use their critical thinking for the sake of the people. If any thinking leads to devastation, then it is hard to categorize it as critical. Does critical thinking operate by principles which are alien to humanness? I doubt it.

Scriven and Paul (1987) also stress that thinking limited to selfish and pragmatic desires, cannot constitute the way morally educated individuals should act. According to their position, when one uses critical thinking in order to perceive one’s or a group’s selfish interest, critical thinking manifests itself in skillful manipulation of ideas (para. 7). People pursuing this goal tend to claim others to be idealistic when their own thinking is described as "intellectually flawed" (para. 7). In contrast, when one's thinking is dispositioned to be fair-minded and intellectually integral, it is usually considered of higher intellectual order.

Critical thinking manifests itself not only in academic domains, but also throughout all possible areas of human life: relationships, work, self-development, and political affiliations (Brookfield, 1987). Connecting to this matter, Sternberg (1985) introduced an important issue: Critical thinking as taught at school may not prepare critical thinkers in adulthood. Sternberg elaborates:

> The problems of thinking in the real world do not correspond well with the problems of the large majority of programs that teach critical thinking. We are preparing students to deal with problems that are in many respects unlike those that they will face as adults. (p. 194)

It is an appealing concern even in current times. Global heating, economic inequality, and the failure of governments to protect those who are in need, violent military conflicts, deceitful news, and political agendas all imply that an educational agenda should be about the real world and the challenges that surround us. It should be about critical action and not only critical skills and dispositions as meant in the individual sense of critical thinking development.

It is evident that there is a trend these days to view education narrowly in terms of economic development. This view closely relates to the human capital theory which is often used extensively in educational policy discourse worldwide: starting from national policy documents and reaching OECD (2019) and World Bank's (2018) educational efforts. When policies built on human capital theory emphasize an economic policy rationale, there is a justifiable need to balance this thinking and educate critical thinkers who can bring about a sustainable future, develop as persons, and learn how to peacefully and productively live in the world. There is a need to reflect upon these seemingly competing priorities: whether the primary goal of education is economic development, holistic development of a person, or something else? Brookfield (1987) demonstrates examples of those who ought to be considered as critical thinkers in adulthood: managers who challenge obsolete hierarchies, citizens who ask “inconvenient” questions and call for government accountability, and the viewers of news who challenge biased and overgeneralizing news (p. 4–5). Examples of critical thinkers these days would include whistleblowers who endanger their lives to tell the world about the abusive power, journalists who provide an alternative perspective despite government pressure, and people who are not afraid to ask “why?” despite the unpopularity of their opinion, and so forth. At the same time, from Brookfield’s position, a critically thinking adult is someone “who takes action to create more democratic, collectivist economic and social forms” (Brookfield, 2005, p. ix) and can “discern how the ethic of capitalism, and the logic of bureaucratic rationality, push people into ways of living that perpetuate economic, racial, and gender oppression” (p. ix). If we want our education systems to be critical, we also need to recognize how they have been shaped by power, privilege, and dominant groups, and act upon this knowledge. Thankfully, this debate is present in today’s educational discourse and is still growing strong since the rise of critical pedagogy in the 1980s.

Yet we may realize that emphasis on skills in critical thinking discourse may hide another danger. It is worth looking again in greater detail into Papastephanou and Angeli’s (2007) study, where they make reference to the “aporetic element” (p. 604) of critical thinking which is usually overlooked in the skilling critical thinking discourse. As they demonstrate, the language of critical thinking definitions is heavily influenced by skilling discourse, that relates to the rationalist and the technicist paradigms of thought.

Papastephanou and Angeli summarize that the rationalist paradigm assumes the distance from emotions, prejudice, and context, and does not critically reflect upon what it considers as "universally valid criteriology" (p. 605). In other words, the rationalist approach does not question criteria used to achieve knowledge and what is considered knowledge itself. The technicist paradigm went further to include the context or situatedness of critical thinking but made it with the only purpose to optimize goal achievement (p. 605). For instance, the language of the technicist paradigm is built around the notions of achievement and performance but lacks a critical stance over the need for the achievement of these goals. Authors summarize that the skilling discourse of critical thinking:

> • prioritizes purposive/strategic rationality,
>
> • neglects reason oriented to mutual understanding and its parameters (existential, ethical, political),
>
> • focuses on the approximation or achievement of goals ousting questions of desirability to a sphere of values that is separated from critical thinking as such,
>
> • identifies criticality with evaluation,
>
> • and wrongly identifies effective and critical thought. (p. 614)

Papastephanou and Angeli (2007) call for a paradigmatic shift and ascertain that the skilling discourse reflects the penetration and the rising importance of money, power, and the objective of success (p. 605). Ultimately, this discourse ignores the ethical dimension of critical thinking. In opposition, as they argue, the missing element in the skilling discourse is that the problem at stake should be questioned itself. It presupposes the critical stance towards things taken for granted: the way we frame the problem and choose the appropriate action. A critical stance, in this case, considers alternatives. However, what is the most important is that a critical stance includes additional rounds of self-reflectivity and questions criteria by which we judge what is considered to be knowledge and what kind of criteria are morally rather than effectively sound (p. 616).

Taking it all together, we can think about critical thinkers as people cautious to mass opinion, those who question and do not take things for granted and, therefore, are hard to manipulate. Critical thinkers are aware of their own thinking and can determine their beliefs as a part of the wider discourse, cultural norms, and presupposed truths. These people acknowledge the complexity and interconnectivity of things, actions, and processes in the world. Such acknowledgment results in the understanding that making an appropriate decision takes a huge mental effort of considering various possibilities and being open to different alternatives. Mastery of critical thinking skills and the presence of dispositions definitely makes sense when we talk about the individual dimension of critical thinking. However, there is also more to it—critical action, which I introduce in Section 2.9 ‘Criticality’. However, before we move there, it is important to add a crucial component to the current discussion: critical thinking and social inequality.

2.8.2 Critical Thinking and Social Inequality

So far, we had a chance to consider how critical thinking is conceptualized, and as a consequence, ought to be taught according to a number of prominent scholars. However, there is still a place for reflective scrutiny of the work of these scholars. Thus, an aspect of how this work relates to social inequality is examined in this section. The discussion to follow is guided by Weinstein (1993) who challenged Paul’s (2012, p. 509) and McPeck’s (1990) positions, and appraised the “reconfigured debate” (Weinstein, 1993, p. 117) on critical thinking— the one to replace the debate over general versus domain-specific critical thinking instruction.

To begin, Weinstein (1993) questioned the use of natural language as a “universal grammar” (p. 116) of critical exchange as postulated by Paul (2012, p. 75). While Weinstein does not deny the evidence from linguistics that the natural language has “a unitary linguistic capacity” (1993, p. 116), he stresses that it’s hardly imaginable to see one lifeworld shared by all people, even by people of the same society. Weinstein also suggests that there is not a single and exclusive mode of expression that would be descriptive of the lifeworld in general: “If our languages reflect our lives and our understanding, they differ in so far as our lives and understandings differ” (p. 116). That is to say that the natural language itself, as meant by Paul (2012, p. 75) to be a golden standard of “pure” or ideologically free meanings, is far from the reality in which we live. Indeed, this point is worth our consideration and, simultaneously, drives us to another implication of Paul’s work. For Paul (2012), to be a critical thinker is to enter a dialogue between opposing perspectives, to be open minded and exercise the traits of a critical mind. However, as Weinstein (1993) emphasized, the ideal speech situation, where everyone has equitable access to conversation and equality within it, is again too far from reality. Weinstein (1993) maintained that in reality, those who have access to education and those who possess power have a disproportionally better opportunity to make their claim: “This [ideal speech situation] is hardly ever true in the hierarchical contexts within which education takes place. The critical thinking professor armed with the paraphernalia of his or her craft stands above the discourse, not within it” (p. 117). The concern of Weinstein goes beyond this to conclude that education with critical thinking instruction, as seen by McPeck (1990) or Paul (2012), is still a limited practice because it fails to give voice to those who are oppressed, nonliterate, or technologically poor. Weinstein (1993) contends:

> How do “arguments” made in rap videos fare when subjected to critiques such as Paul's? What is his response to Peter McLaren's insight that “youth resist the dominant culture at the level of their bodies,” thus rendering suspect the sufficiency of

> discursive thought as the central vehicle for a critical pedagogy? Paul's concerns reflect the practice of educated and literate Americans. (p. 117)

And indeed, it is hard to say that Paul (2012) or McPeck (1990) are accountable for critical thinking education which is accessible to the children of low-income families or children in remote villages with a poorly equipped school. For those who are not born with access to quality education, critical thinking is not a dialogue to be engaged in with an open mind, rather, it is a struggle for survival. The belief that the public schooling system is made to deliver its promise to educate citizens and do it with a decent quality may rather be just a bold claim. In reality, the choices of what an educational system will look like, who will gain the most from it, and who will be deprived, could already be made for us. I would go further to say that many people are not even aware that they can influence the choice of what should be taught at school and why and how public money should be spent. Consider the statement published by Faure et al. (1975) in UNESCO’s report “Learning to be” on the delegation of authority:

> [formal democracy] is not capable of providing him [an individual] with an adequate share of the benefits of expansion or with the possibility of influencing his own fate in a world of flux and change; nor does it allow him to develop his own potential to best advantage. (p. xxv)

I believe it is quite illustrative that UNESCO, an international NGO based on state funding, moves this argument forward. Quality education, equal access, and critical thinking mean different things to different policymakers. This becomes clear when one compares military and education budgets of countries, teacher salaries, and workload. The solution proposed in the same UNESCO report was to take control over things that matter, and not delegate power to elected representatives.

In many ways, education needs the support of grassroots movements and organizations to take charge of the crucial aspects of education that public educational systems fail to deliver. In this regard, educators and researchers themselves also have a choice to make. The change to come needs educators and researchers speaking from the perspective of those who are silent, those who cannot speak for themselves, those who are deprived of the right to express themselves, and individuals from specific locales living with unique problems. Quality education is the integral right of every human being, and it appears that to deliver this promise, we should think outside the frames of many educational systems.

Thus, in drawing these elements together, we come to understand that one who aims to comprehend the concept of critical thinking needs to be aware that it does not happen in an academic vacuum, and there are wider sociocultural concerns and issues to be considered. Two perspectives on critical thinking which I introduce below incorporate these concerns. Without further ado, let us consider criticality and critical pedagogy.

2.9 Criticality

Criticality is a concept tightly connected to critical thinking involving students' critical reasoning, critical self-reflection, and critical action, which, altogether, can be conceptualized as critical being (Barnett, 1997, 2015). As Davies and Barnett (2015) explain, this concept has a stronger educational potential when compared to the traditional expression "critical thinking" and extends the vision of critical thinking to include an individual's wider identity and participation in the world (p. 15). Thus, it simultaneously departs from and further extends the concept of critical thinking as envisaged by the members of the critical thinking movement—first-wave philosophers (see Paul, n.d.; Walters, 1994, for three-wave categorization). Criticality acknowledges that apart from cognitive processes and the propensity to think critically, there should be an action dimension oriented towards our critical social being in the world (Davies & Barnett, 2015). These authors exemplify that criticality is:

> … a sense of "critical thinking" that extends beyond the individual and his or her cognitive states and dispositions to the individual's participation in society as a critically engaged citizen in the world. Note that it also includes a moral and ethical dimension to critical thinking. After all, critical thinkers do more than reason; they also act ethically on the basis of their reasoned judgments. (p. 16)

Davies and Barnett (2015) suggest that the work of McPeck (1981, 1990), Ennis (1962, 2015), and Paul (Paul, 2012; Paul & Elder, 2006b) focus on "what a critical thinker is or should be" (Davies, 2015, p. 17) when the work of those working with criticality is about "what a critical thinker does and can become" (p. 17). Therefore, the concept of criticality, as argued by Davis and Barnett, subsumes the concept of critical thinking. Criticality guides higher education professionals not only on how to teach cognitive strategies but also to critically reflect on the purpose of higher education and to envision what it may be. Criticality is about raising thinkers who live a critically conscious life and not only know how to think but also act.

Barnett (1997) extensively developed his vision of criticality in his book, Higher Education: A Critical Business. Like McPeck (1990, p. 13), Barnett (1997) thought that critical thinking must have an object (it should be thinking about something), nevertheless he did not agree that critical thinking should be limited to disciplinary domains (p. 65). His vision of criticality can be distinguished through two axes: the horizontal domains axis and the vertical levels of criticality (Barnett, 2015, p. 64; Table 2). Barnett recognizes three domains of critical thinking where a specific form of criticality is applied. With respect to the knowledge domain, one can critically reason about propositions, ideas, and theories. With respect to the self domain, one can engage in critical self-reflection. Finally, with respect to the world domain, it is proposed that critical action is needed. The vertical axis of the table includes levels of criticality ranging from basic operational skills to transformatory critique.

Table 2

Barnett's Levels, Domains, and Forms of Critical Being

	Domains		
Levels of criticality	Knowledge	Self	World
4. Transformatory critique	Knowledge critique	Reconstruction of self	Critique in action (collective reconstruction of world)
3. Refashioning of traditions	Critical thought (malleable traditions of thought)	Development of self within traditions	Mutual understanding and development of traditions
2. Reflexivity	Critical thinking (reflection on one's understanding)	Self-reflection (reflections on one's own projects)	Reflective practice ('metacompetence', 'adaptability', 'flexibility')
1. Critical skills	Discipline-specific critical thinking skills	Self-monitoring to given standards and norms	Problem-solving (means-end instrumentalism)
Forms of criticality	Critical reason	Critical self-reflection	Critical action

Note. From "A Curriculum for Critical Being," by R. Barnett, in M. Davies & R. Barnett (Eds.), *The Palgrave Handbook of Critical Thinking in Higher Education* (p. 64), 2015, Palgrave Macmillan (https://doi.org/10.1057/9781137378057). Copyright 2015 by Martin Davies and Ronald Barnett. Reprinted with permission.

Johnston et al. (2011) further developed and applied Barnett's (1997, 2015) vision of criticality to higher education. They also propose that transformatory critique is the highest ideal to strive for if one wants to attain a comprehensive and moral vision of criticality. Nevertheless, they argue that it is not always necessary and possible to be at the transformatory level of criticality at all times in all domains (p. 70). At times, instrumental criticality and problem-solving are sufficient, as it is not realistic to expect students to function at the highest levels all time. They also extensively develop contextual aspects of criticality in their framework for criticality development:

> We argue that any critical act will take place in a context comprising cultural, social, educational, developmental, disciplinary/field-specific, emotional, ethical, physical, cognitive and political elements which will themselves be in dynamic interaction and which will be mediated and (re-)created by the choices of individuals. Criticality is practised both individually and collectively; the two elements are inseparable. The individual self is central in this process. (p. 71)

Once again, critical thinking conceptualized in the philosophical tradition has little to offer if one wants to engage in critical thinking holistically, as it does not focus on the following aspects of scholarship: moral, ethical, cultural, political, the dimensions of critical action and being. The wider concept of criticality addresses these wider aspects of the scholarship to create a more comprehensive vision of critical thinking as a phenomenon and practice done by particular individual in a particular context. While not denying what a philosophical school has to offer, criticality extends our vision making the development of criticality, and, inclusively, critical thinking, a more obtainable goal.

2.10 Critical Pedagogy, Critique of Movements, and Beyond

Yet another account that emphasizes the sociocultural concerns of critical thinking is critical pedagogy. You may find it positioned as the fifth circle on Davies's model (2015, p. 85). Critical pedagogy is an important ideological approach extending the definition of critical thinking as initially conceived by the critical thinking movement. To stress the difference, Kaplan (1991, p. 362) argues that the first wave theorists took "critical" in critical thinking to mean criticism, e.g., identifying fallacies and imperfections of an argument. On another hand, the second wave theorists, and namely critical pedagogues, understood "critical" as an adjective, or, as critique, which meant identifying hidden dimensions of the meaning of which one may not be aware. Thus, critical pedagogy uses the adjective “critical” as applied in critical theory, a sociological theory inspired and built upon Marxism, phenomenology, and psychoanalysis. Kaplan summarizes: “The critical thinking movement teaches students to provide criticism of arguments, while the critical pedagogy movement teaches students to provide critique as a foundation for criticism of the world around them” (p. 362).

Some of the key critical pedagogy theorists are Freire (2000), McLaren (2010), and Giroux (2013). The key theme in their work is that education is an act of liberation from various forms of oppression—economic, racial, sexist—put in place by colonization, capitalism, and other oppressive powers. Educational institutions as they stand are not neutral harbors of learning, and critical pedagogues urge us to examine, critique, and change the values they promote. Giroux (2013) elaborates:

> I use critical pedagogy to examine the various ways in which classrooms too often function as modes of social, political, and cultural reproduction, particularly when the goals of education are defined through the promise of economic growth, job training, and mathematical utility. … I develop the idea that critical pedagogy is central in drawing attention to questions regarding who has control over the conditions for the production of knowledge, values, and classroom practices. (p. 5)

Higher and secondary education institutions are sites of struggle, political activity; places where pedagogy naturally connects with social problems, civic activism, and social responsibility (p. 6). Thus, the argument of critical pedagogy is that traditional education fails to recognize and act upon this sociopolitical reality and by doing so silently conforms to the norms in place.

For instance, critical pedagogy theorists recognize and critique the way education is framed by various oppressive powers, such as the white supremacist capitalist patriarchy (McLaren, 2010, p. 1), and how social inequality is reproduced through schools that serve as agents of capital (p. 3). Giroux (2013) contemplates that higher education these days is a hostage to “market-driven modes of accountability” (p. 8) and their activity is primarily viewed from the lens of economic profitability. Neoliberal public pedagogy, in his opinion, indoctrinates values of privatization, productivity, and capital accommodation, and, by doing. so removes the agenda of public values, critical content and civic responsibilities from education. Giroux also urges us to understand the forces of neoliberalism, neoconservatism, militarism, and religious fundamentalism that view young people either as a commodity or expendable material, especially the poor and youth of color (p. 177). One of the major lines pushed by critical pedagogues is that students should be educated not to solely supply the economic machine of capitalism, but rather to understand and act upon the realization of how market relations, consumerist culture, and other power formations degrade social states and restrict abilities of those who do not benefit from them.

Critical pedagogy theorists generally agree with Barnett that transformative action is intrinsic to criticality, but they take it a step further to state that transformative action is obligatory and without it, critical thought is not complete. Critical thinking in their positions is primarily about changing matters (Davies & Barnett, 2015, p. 9). As Burbules and Berk (1999) frame it:

> … changing thought and practice must occur together; they fuel one another. For Freire, criticality requires praxis—both reflection and action, both interpretation and change… Critical Pedagogy would never find it sufficient to reform the habits of thought of thinkers, however effectively, without challenging and transforming the institutions, ideologies, and relations that engender distorted, oppressed thinking in the first place—not as an additional act beyond the pedagogical one, but as an inseparable part of it. (sec. 3)

Therefore, critical pedagogy is needed to understand power relations, the sociopolitical context where education happens, and function to further reform education systems and enable students to see and act upon ubiquitous indoctrination causing inequalities.

Burbules and Berk (1999) also draw key distinctions between the critical thinking and critical pedagogy movements. As the authors put it:

> Critical Thinking is quite reluctant to prescribe any particular context for a discussion, Critical Pedagogy shows enthusiasm for a particular one—one that tends to view social matters within a framework of struggles over social justice, the workings of capitalism, and forms of cultural and material oppression. (sec. 4)

For the critical thinking movement, the stance of critical pedagogues is equal to indoctrination: Critical pedagogy questions everything, except its vision of "oppressed" reality. The critical thinking movement does not deny the need for social change, but it is hesitant to jump to conclusions about the real nature of reality around us, especially the social and political aspects of this reality. On the other hand, critical pedagogues would counter them emphasizing that the critical thinking movement's reluctance for concrete discussion and impartiality simply exist in the context of many conventional assumptions from the media and popular books, in a way that intentionally or not, teaches political conformity. The critical thinking movement examines particular claims and arguments but does not go further to examine the context of schooling which is framed by social norms operating in the background.

Apart from being criticized by each other, respectively, the critical thinking and the critical pedagogy movements were both criticized by feminists. As the majority of key theorists in both schools are men, the concern arises: whether these scholars were critical of how it may shape critical thinking discourse? For instance, the critical thinking movement was criticized for the "rationalistic" underpinning of its epistemology, prioritizing empirical evidence over other forms of knowing (e.g., experience, emotions, and feelings; Burbules & Berk, 1999, sec. 5), and differentiating from “women’s logic” (Belenky et al., 1997). In a similar fashion, the critical pedagogy movement was criticized for oppressive rationalism which serves European, White, male, middle class, Christian, able-bodied, thin, and heterosexual people (Ellsworth, 1989). As Ellsworth puts it, nonrational ‘Others’ are subjects of rationalism’s violence. The open dialogue of critical pedagogy functions through rationalism, which defined ‘Others’, assumed that they are known, identified, measured, and understood. Instead, Ellsworth proposes to move from critical rationalism to the politics of partial narratives. It is a poststructuralist thought which assumes that knowledge or reality pictured is best understood from the position of interest. Thus objects, nature, and ‘Others’ should be considered as partially known, and if critical pedagogy wants to fight oppression, it should not be a thought oppressor itself by relying on rationalistic underpinnings that push the dominant line of thought, assume that there are universally valid propositions.

The debate between movements that adhere to either philosophical critical thinking, criticality, critical pedagogy, feminism, or critical theory may appear to draw us away from any kind of clarity. Given these conflicting movements, one may view the different positions in a relative way. However, Burbules and Berk (1999) suggest that we should not settle for relativism (sec. 6). Instead, they propose to not abandon a dialogue between positions because of their “incommensurability” or heated tension, but seriously consider a difference as a condition of criticality, not labeling it as exotic or quaint. The authors suggest reflecting upon criticality as a practice—what is involved in thinking critically, what are the conditions that foster critical thinking, and so forth. Thus, by adopting this stance, one may come to the conclusion that neither the critical thinking movement nor critical pedagogy should exist only because they have supporters. In other words, these ideas should not become ideologies in and of themselves. If they do become such, the agenda of the supporters is often not open to be challenged—supporters do not reason about their stance, they believe in it. An important aspect of criticality is the ability to reflect on one's own views and assumptions. This includes reflecting on views about both critical thinking and criticality as features of particular historical and sociocultural contexts. Therefore, the views about critical thinking are not only individual- or group-related: They guide the choices and actions of people who interact with adherents of these views. Thus, one is responsible for how one's views and choices influence others. That is why views are inherently open to challenge, which is an important component of criticality.

Yet another deep aspect of criticality is proposed by Jacques Derrida, Gayatri Spivak, Judith Butler, and others (Burbules & Berk, 1999) who suggest challenging categories that we use to make our thinking possible per se. This includes challenging the black and white dichotomy of thinking, casting doubt about not knowing how to move beyond a certain point of view and imagining thinking which is not based on things that make our current thinking meaningful. Burbules and Berk suggest that the critical thinking and critical pedagogy movements are not flexible in this regard. In this sense, these perspectives on critical thinking are programmatic because they have a core that insists on particular thinking practices. Burbules and Berk argue that while having a well-shaped agenda may attract proponents, it can also limit these movements to not be deep and critical enough. As a possible solution, Burbules and Berk propose to look beyond the agendas of movements, which they coin, "Alternate Criticality" (p. 18). Davies (2015) labels this account of critical thinking as creativity or openness, which we will now examine below.

2.11 Critical thinking as Creativity or Openness: Opening a Debate

Many researchers draw a connection between critical and creative thinking (Bailin, 1990, p. 41; Burbules & Berk, 1999; Davies, 2015; Ennis, 1985, p. 45; Paul, 2012, p. 426; Paul & Elder, 2006b). An account of this connection may be generally outlined by the two positions presented in this section. Paul and Elder (2006b) and Bailin (1990) unpack the debate on creativity and critical thinking to prove that they are two sides of the same coin. Davies (2015) and Burbules and Berk (1999) introduce critical thinking as creativity or openness (CAC/O), focusing on connections between the various conceptions of critical thinking and the inclusive nature of the critical thinking concept.

Paul and Elder (2008b) introduce the divide usually portrayed in mass media: Critical thinkers are pictured as skeptical, negative, finding a fault in every trivia, and hypercritical, while a creative person is “a cousin to the nutty professor” (p. 3), spontaneous, emotional, living in a world disconnected from everyday reality. Authors disagree with this perception, stating that creative and critical thinking “are inseparable aspects of excellence of thought” (Paul & Elder, 2006a, p. 34). As they argue, “the mind’s generative power (creativity) and its judiciousness (criticality) can be separated only artificially” (p. 35), they fuel each other making an intimate interrelation of the intellectual making of things and judging them. The excellence of thought requires the mind to generate ideas, find solutions, and create new solutions when available ones cannot address an issue, which altogether is associated with creativity. At the same time, critical or judgmental thought is needed to examine these new ideas, juxtapose them with existing ones, try and test them against new criteria, and be critical about the quality of these newly created products. Paul and Elder conclude that “Critical thinking without creativity reduces to mere skepticism and negativity, and creativity without critical thought reduces to mere novelty” (p. 35). In the same manner, Bailin (1990) moves the argument forward: It is a flawed idea that creative thinking is a nonrational, nonlogical, strictly generative, and unconstrained type of thinking (p. 41). Rather, discovery and creativity “are grounded in critical thinking, which has both a generative and an evaluative component inseparably connected” (p. 41).

Davies's (2015) model of critical thinking incorporates creativity yet in a different sense, building on the work of Burbules and Berk (1999). Burbules and Berk see movements in critical thinking literature as examples of various ideologies, in the same manner as Marxism, fascism, and so on. Reflecting on Kellner's (1978) discussion of a "life cycle" of an ideology, they claim that ideologies are not simply a proposition or set of propositions, whose truth can be examined against the world. Rather, they have an appeal and persistence to people, because they account for a set of social experiences and concerns. To deny this appeal is to take a simplistic view on human nature—one may try to displace an ideology in minds of people and see that it is not an easy task. Burbules and Berk believe that both the critical thinking and the critical pedagogy movements, as ideologies, make the mistake of adhering to their concerns only, centering on themselves. With time passing, "the selfsame ideologies become "hegemonic," not because they change, but because circumstances change while the ideology becomes more and more concerned with its own preservation" (p. 20). They fail to acknowledge their limitations and the value of other views in the discussion on the nature of critical thinking. They fail to acknowledge other positions as valid contenders, and thus lack reflective skepticism about their own position. Burbules and Berk claim that proponents of programmatic movements cannot think differently, and Davies (2015) frames this necessary element of critical thinking as creativity or openness.

The recognition that critical thinking movements are ideologies opens the prospect of seeing criticality as "a way of being as well as a way of thinking, a relation to others as well as an intellectual capacity" (Burbules & Berk, 1999, p. 21). Critical being is not merely thinking about arguments, dispositions, and social relations. It is about living these views and regarding them as "perpetually open to challenge" (Burbules & Berk, 1999, p. 20), "to think anew" (p. 19), or being creative as Davies (2015, p. 78) puts it. It involves hardship and a willingness to engage in discussion on one's position and critically reflect on the ground from which one is coming from. For Burbules and Berk (1999), being open does not account for being relativistic, the position in which all views are equally valid, rather it is about recognizing that it is difficult to imagine universality of any set of views (p. 20). Critical thinking as openness or creativity also means viewing tensions between views as beneficial and exposing what certain positions can and cannot do (p. 19).

Davies (2015) embraces the above-mentioned stance on the nature of critical thinking and suggests that true critical thinking only occurs when “the whole fibre of one’s personality/physical body/consciousness/emotions as well as actions are involved” (p. 78). Davies goes further to speculate that our conception of “true” critical thinking may include facets of cognition that are not easily understood in terms of skills, dispositions, or actions. These facets may lay in the field of cognitive sciences and include intuitive thinking (p. 79). As Davies explains, intuitive thinking occurs when a substantial amount of reasoning, practice, and assessment of evidence has occurred. It is based on the expertise of a thinker and on the history of past decisions that are rooted in well-established critical thinking principles. Although there is little research carried out on the relationship between intuition and critical thinking, Davies believes that this is a promising lead.

Davies (2015) stipulates that “true” critical thinking is necessarily “open” in relation to all new influences (p. 79). Thus, it involves trans-critical thinking which means “thinking with the core of one’s body and being—not merely thinking intellectually” (p. 79). Thinking trans-critically does not mean thinking trans-rationally. Stating so, Davies agrees with Simon (1989, p. 61) who believes that intuitive thinking is not irrational, rather it is rational but does not embody a conscious analytical method of decision-making.

Davies (2015) introduces an account of critical thinking as creativity or openness (CAC/O) as the last circle of his visual model (Figure 1). In doing so, he makes the circles of the visual diagram dotted: This was done to imply that critical thinking as creativity or openness keeps all previous views on critical thinking “open”. This account of critical thinking is open to all influences. By contrast, the critical thinking movement communicates between positions only inside its shaded block consisting of three circles. As Davies concludes, this account is less articulated compared to the critical thinking movement position, but it does not make it wrong. Rather, it needs time, research, and further discussion to be maintained or rejected.

I perceive Davies’s account of critical thinking as openness not necessarily as a new account of critical thinking. Rather, I see it as another round of reflection on the scholarship. When one wants to think critically, one thinks metacognitively. I interpret Davies’s account of openness as thinking critically about critical thinking. I see this as yet a further step toward a deeper and more profound understanding of the concept. As Davies rightfully mentions, there can be dimensions of critical thinking that are not yet explored, and one way for the scholarship to evolve is to be open to new influences. At the same time, there is always a risk of overinflating the concept of critical thinking. It should define something specific. That is the purpose of having a concept in general. For some scholars within the critical thinking movement, the addition of the sociopolitical critique to the concept by critical pedagogues was conceded unjustified (see Section 2.10 for the critique of movements). These scholars suggested that critical pedagogues cross a line between teaching critical thinking and indoctrination (Burbules & Berk, 1999, p. 12). In their position, teaching critical thinking means allowing students to come to their own conclusions, yet critical pedagogues come close to predefining what these conclusions are. However, critical pedagogues had a valid point in claiming that so-called neutrality is not possible. For example, if you live in a political system your thinking is constantly shaped by this. This disagreement does not add clarity to the concept, however, it is of great value to the field that these debates exist per se.

They are a healthy dynamic within the field as they allow for arguments to be posited, questioned, and logically tested.

This end of this section completes the review of Davies's (2015) model and, at the same time, opens it to new ideas and other considerations which may be central to critical thinking. The next section is an addition of this kind. It considers how critical thinking interacts with culture.

2.12 Critical Thinking and Culture

Critical pedagogues and criticality theorists rightfully mention that critical thinking functions in an environment, society, it does not exist in an academic vacuum. It is the case that this environment may have a particular history of thought, what is considered to be deep thinking, or, in other words, local implications of thinking practices. This section of my thesis work discusses the relationship between critical thinking and culture and provides further implications of this relationship with respect to the task of teaching critical thinking.

To start with, one of the themes discussed in relation to culture and critical thinking is the difference between the Western analytical thinking style and the dialectical thinking of Asian cultures, for example, Chinese thought. Peng and Nisbett (1999) give an account of three major principles guiding the Chinese way of dealing with contradictions: the principle of change, the principle of contradiction, and the principle of relationship or holism (p. 743). First, the principle of change supposes that "reality is a process" (p. 743). Therefore, concepts describing reality are also subject to change, alteration and are not considered to be objective and fixed entities: "life is a constant passing from one stage of being to another" (p. 743). Second, the principle of contradiction states that reality is full of contradictions, which is the result of the constant change of reality. These contradictions coexist in everything—as bad and good, as old and new—and they balance and mutually control each other. Third, the principle of relationship or holism is described as the essence of Chinese dialectical thought and is a consequence of the principles of change and contradiction. This principle suggests that "nothing is isolated and independent, but everything is connected" (p. 743), and if we want to understand something fully, we should consider it as a whole—the phenomenon itself as well as its relation to other events or objects (p. 743). Otherwise, the understanding of something regarded in isolation is not deep. This is because any phenomenon always affects what is around it, and any phenomenon is always affected by what is around it. These principles of change, contradiction, and relationship form the core of Chinese dialectical thinking and guide the way they deal with contradictions: finding a middle way, not opposing two contradictory statements, and choosing the one that sounds reasonably appealing, but rather finding an answer which renegotiates these opposing perspectives.

In contrast, as Peng and Nisbett (1999) suggest, the Western thought rests upon three principles of Aristotelian logic: the law of identity, the law of noncontradiction, and the law of the excluded middle (p. 744). To be exact, these three laws state that (a) anything must be identical with itself—if something is true then it is true, 'A' is 'A' and nothing else, (b) the statement cannot be both true and false, in other words, 'A' is not ' −A', or (c) the law of the excluded middle holds that statements are either true or false, and there is no middle way of thinking about it. As Peng and Nisbett (1999) conclude, there is an evident conflict between "Eastern naive dialecticism" (p. 744) and the laws of formal logic. When the Eastern thought acknowledges that reality is in a constant change of one form of being to another, the Western logic emphasizes cross-situational consistency—A is always A. At the same time, Chinese belief would imply that the law of noncontradiction doesn't work in real life, as objects and events around us are not in the realm of concepts and abstractions (p. 744).

This epistemological insight into the cultural aspects of critical thinking is very important. Chinese dialectical epistemology as well as the Western formal logic shape the way one reasons about contradictions or perceives social concepts. Different ways of thinking about what is considered to be knowledge and reality give another spin on reflection to our critical thinking discussion. This is in line with Kuhn (1999) who insists that critical thinking is bound to epistemological meta-knowing of a person, as well as with Papastephanou and Angeli's (2007) position calling for "a profound consideration of the very standards we employ when we evaluate means, set our ends, and serve our commitments to values prior to our undertakings" (p. 611). Let us consider some empirical evidence on this matter.

When bringing these two understandings of what is considered to be deep thought in both cultures, Peng and Nisbett (1999) provide empirical evidence suggesting that Chinese and American students who participated in their studies do manage contradictions differently. The results of five studies demonstrated that Chinese students preferred dialectical ways of thinking when dealing with contradictions arising in social life and when faced with a contradiction in scientific matters. On the contrary, choices and solutions for problems of White American students were guided by the laws of noncontradiction, identity, and the excluded middle. The authors of the article conclude that both ways of thinking have their own advantages. On one hand, Eastern dialectical thinking suits well when applied to complex social problems, and on the other hand, the Western formal logic of thinking may work better for scientific exploration. As Peng and Nisbett summarize, the ideal thought tendencies are the combination of both styles.

The study of Lun et al. (2010) took into account the findings of Peng and Nisbett (1999) to explore cultural differences in critical thinking performance between Asian and Western students. Results from this study suggested that New Zealand European students scored higher than their Asian counterparts (studying at the same university) in terms of critical thinking performance. Students were also measured in terms of Dialectical Self Scale (developed by Spencer-Rodgers et al., 2015) which was associated with their cultural differences. Interestingly, findings suggested that dialectical self had no effect on critical thinking performance. Authors conclude that the difference in scores was mainly associated with English proficiency, as it could be easier for native English-speaking students to solve critical thinking problems in English (Lun et al., 2010). This assumption connects to Paul's (2012, p. 59) theorizing on background logic and its importance to critical thinking, which I discussed in Section 2.7. From Paul's position, the natural language a person speaks (e.g., English, and/or Russian) fundamentally influences one's point of view and perspective (p. 65). Although this is not limited to the natural language, the technical language learned at school (i.e., the language of physics, biology) and sociocentric practices and languages (i.e., cultural norms, gentlemanly behavior) could also be factors to consider when attempting to measure such a complex concept as critical thinking.

Interestingly, as the results indicate, the relationship between dialectical thinking and critical thinking was found to be culturally different: Dialectical thinking was only positively related to critical thinking for Asian students, not New Zealand European students (Lun et al., 2010, p. 611). In addition, Asian students tended to rely more on a dialectical thinking style, which, as hypothesized by authors, may propose a possible cultural difference in cognitive processes connected to critical thinking (p. 613).

Yet another study by Manalo, Kusumi, Koyasu, Michita, and Tanaka (2013) sought to find the relationship between culture-related factors and the self-reported use of critical thinking of undergraduate Japanese and New Zealand students. The authors hypothesized that the culture-related factors that could influence critical thinking were "self-construal", "study self-efficacy", and "regulatory mode" (p. 121).

First, building on the theory of Markus and Kitayama (1991), Manalo et al. (2013) proposed that "self-construal" (p. 122)—the perception of self in relation to others—of Asian cultures may lead to a lower use of critical thinking. This is to say that representatives of cultures with a high level of "interdependent self-construal" (p. 122) or collectivist cultures think twice before making their judgments aloud as they are cautious about social implications of their actions. On the contrary, people from Western cultures were characterized as individualistic and nonhierarchical, therefore, more prone to critical thinking (p. 122). The second theory related to the use of critical thinking was the theory of “regulatory mode” (p. 123) proposed by Higgins, Pierro, and Kruglanski (2008). In essence, this theory presupposes that people are driven by two basic self-regulatory modes—assessment and locomotion. Higgins et al. proposed that individuals in Japan are more likely to be pulled by the assessment mode which emphasizes the weighting of alternatives, use of the past experience, and the critical evaluation of alternatives to achieve the desired goal. On the contrary, people in the US were more likely to be predominant locomotion or action oriented (Higgins et al., 2008), therefore, less prone to critical thinking (Manalo et al., 2013, p. 123). Finally, based on available research Manalo et al. propose another cultural feature—the construct of “study self-efficacy” (p. 124). This construct provides space for another hypothesis: Asian students are driven by the fear of punishment, rather than belief in their own capabilities and, therefore, are less likely to use critical thinking.

Based on statistical analysis, Manalo et al. (2013) found that self-construal, regulatory mode, and self-efficacy all have an influence on students’ critical thinking use. However, their research suggested that the effect of these factors was dependent on the group of students (three groups of students coming from Kyoto, Okinawa, and Auckland). For the Auckland students, the positive impulse for critical thinking was driven by locomotion self-regulation (action-oriented) and self-efficacy. However, for the Okinawan students, the positive impulse for critical thinking was driven by both locomotion and interdependence-driven assessment (p. 129). The model of Manalo et al. (2013) suggests that these differences in the influencing factors do not limit students’ ability to exercise critical thinking (p. 129). Rather, as they speculate, Western students might exercise critical thinking as a manifestation of their self-efficacy, when Asian students could use critical thinking to weigh up alternatives, manage social conflicts, and evaluate past experiences.

What do these studies mean to the task of teaching critical thinking? First of all, as the above-mentioned studies suggest, this field is not researched sufficiently, and more questions should be answered before we better understand the relationship between culture and critical thinking. Secondly, studies demonstrate that cultural traits usually attributed to certain cultures are not necessarily present in students of the corresponding culture, and even when they do, an individual may be a complex mix of local and global cultural influences (Manalo et al., 2013). Also, the fundamental question arises: What do we mean by culture and how can we be sure that an individual or group of individuals indeed possess certain, unique cultural traits and not others? For example, Nederveen Pieterse (2009) claims that globalization mixes what some people consider to be distinct cultures and that culture instead is about "hybridization" (p. 54) and may be viewed as a "translocal" (p. 57) phenomenon. Thirdly, when theories about cultural features help us to understand that culture does matter when we talk about critical thinking, the results of the presented research do not support the hypothesis that some cultures are less capable of critical thinking than others. As evident in the literature, the impetus for critical thinking comes from different cultural traits for different students. Therefore, the task of culturally conscious critical thinking instruction is for a teacher to be aware of different ways of being, relationship to the world, and therefore thinking. It also should not be the case that a teacher comes with one's preconception of critical thinking and unilaterally imposes an assessment of critical thinking in line with one's own conceptualization. Manalo et al. (2013) suggest that a key to effective teaching and promotion of critical thinking is to negotiate the meaning of critical thinking between instructors, institutions, and students. Finally, in line with the conclusions reached in this chapter, educators should come up with teaching strategies that (1) work for students in general and (b) meaningfully address the specific needs of the group of students. This appears to be especially relevant considering that classrooms are generally not culturally homogeneous.

2.13 Critical Thinking: A Summary

This section completes the discussion and review of literature that frames historical and contemporary debates on critical thinking. We have covered the key critical thinking accounts presented in Davies's model and discussed wider concerns that surround the field. To this point, we have constructed an understanding of how critical thinking relates to one's developmental level, informal logic, domain specificity, metacognition, epistemological understanding, questions of ethics and morale, critical action, sociopolitical reality, feminism, emotions, and creativity. We also overviewed the pedagogical implications of these varying conceptions and views of critical thinking. While I extensively draw upon Davies's model of critical thinking in higher education, it should be noted that the model concerns the definition of critical thinking rather than how it ought to be taught. At the same time, as comprehensive as it is, this model cannot include all the prospective directions of critical thinking scholarship. I believe that Davies acknowledges this by including the outer circle of critical thinking as creativity or openness. He clearly states that critical thinking scholarship should be open to new influences and concepts that may relate to or constitute critical thinking. In my reflection on the model, I should also mention how Davies relates to the three waves of critical thinking scholarship. Davies uses Paul's (n.d.) differentiation between the three research waves, while there is an alternative delineation presented by McLaren (Kahlke & White, 2013, p. 22; McLaren, 2010, p. 1) that is not mentioned in Davies's work (also see Section 2.1.2). Based on Paul's (n.d.) three waves, Davies believes that "It [criticality] could be considered part of 'third wave' theorizing" (Davies, 2015, p. 68), while McLaren considers the emancipatory agenda of critical pedagogy as the third wave of critical thinking scholarship (Kahlke & White, 2013, p. 22; McLaren, 2010, p. 1).

Having built this bigger picture of the critical thinking scholarship, I leave this section open, as Davies does, open to new ideas and influences which may shape my understanding of critical thinking in the future. This is to say, my account of critical thinking is not definitive. I share the concerns of the second-wave theorists that critical thinking limited ‘only’ to skills does not account for its contextual nature (see Walters, 1994, p. 2). I also agree with criticality scholars who demand critical action and are not content with thinking alone (see Barnett, 1997; Johnston et al., 2011). The concerns of critical pedagogues (see Freire, 2000; McLaren, 2010) resonate with my being in a certain sociopolitical system which shapes my actions, thoughts, and many other aspects of living: how I relate to the state in terms of my political or social obligations, what kind of education I receive, or what kind of future I may have in the capitalist economy. There are a lot of factors to account for when conceptualizing critical thinking. This lengthy literature review is proof of that. I believe that it is important to leave this section with an attitude to question, consider, and act—question one’s thoughts, self, sociopolitical system, values, and understanding of the world. It is important to consider what other scholars bring into this field of scholarship and keep one’s mind open to new influences and ideas. Finally, to me, critical thinking is not only academic, but it is also about living and acting upon one's beliefs, understanding one’s cultural, social, or political affiliations, making ethical decisions, solving the world’s most complex problems, and the well-being of others. Applications of critical thinking are as many as there are contexts in which a person needs to engage in deep and reflective thinking leading to critical action.

2.14 Digital Technology and Education

Before we narrow our focus to digital technology and critical thinking, we should open a discussion on digital technology in education today and its challenges in the future.

If one were to comprehensively overview the whole field of digital technology and education, it would take at least several books. Papers published by the OECD and UNESCO report on the recent trends in educational technology including smart technology that is based on AI, learning analytics, robotics, blockchain, and game-based assessment (Duggan, 2020; OECD, 2021). As mentioned previously in my introduction, these developments also raise many sociotechnical tensions including problems of environmental sustainability, commercialization of education, privacy, inclusion, equity, and social justice (Selwyn, 2020, 2021a, 2021b; Tawil, 2020). Therefore, I propose to look at this field broadly at this point through the lens of the challenges currently faced as they expose the current state of affairs and suggest how technology is used or may be used in the future in education.

The global COVID-19 pandemic disrupted learning at schools and institutions all over the world. Not surprisingly governments in many countries considered technology as a vital link for learning and shifted quickly into distance learning. Initial optimistic discourse on digital learning and the future of education quickly disappeared as soon as evidence appeared that the move to digital learning was excluding learners and exacerbating existing inequalities (Tawil, 2020; UNESCO, 2020). Countries that could not financially provide digital connectivity and hardware used TV and radio as a substitute (UNESCO et al., 2020). These low-tech solutions were limiting as they often could not provide two-way communication, real-time interaction, or gamified learning, and, thus mirrored and exacerbated existing divides (Tawil, 2020, p. 2).

In the UNESCO paper for Mobile Learning Week 2020, Tawil (2020) documents the challenges of this quick shift into distance learning that emerged in the times of the pandemic: broken access to formal schooling due to students' inability to access education through the Internet and low-tech technologies, challenges posed by educators' skills in technology, learning dependent on families and their digital skills, the varying relevance of distance learning for students of different ages (e.g., early childhood learning), and the inability of technology to replace in-person human interaction. The author concludes that the uniformity with which countries turned to distance learning was rather remarkable—simply the provision of learning materials through a technological portal was clearly not enough (p. 6). Tawil questions whether there was a model "that would have given greater weight to inclusion and equity by being less reliant on technology that is far from universally accessible" (p. 6). Then, the argument follows that the educational technology community should work harder to ensure better and deeper learning with technology, reflect on the challenges and failures exposed by the pandemic, and make a plan for future research, advocacy, and actions in this direction. One way of looking at the future of educational technology is described below.

2.14.1 Sociotechnical Tensions

The UNESCO Institute for Lifelong Learning commissioned a paper authored by Selwyn (2021a) on the prospects of digital technology for lifelong learning. This paper reports on sociotechnical tensions that reflect the current state of affairs and suggests possible solutions for dealing with them. These tensions are environmental sustainability, tensions between commercial and the common interests, tensions between inclusivity and exclusivity, and tensions between personalization and collectivism.

As reported by Selwyn (2021a), the first sociotechnical tension is about the environmental sustainability of digital technologies in education—technology consumes a lot of energy for data processing and storage, rare minerals, and limited non-renewable material resources required to produce them (Maxwell & Miller, 2020; Thylstrup, 2019). With regards to the ecological crisis of global heating, this concern matters a lot and there is a definite need for action in this direction. As a solution, Selwyn (2021a) proposes that stakeholders rediscover the educational benefits of shared devices, production of recyclable and repairable devices, and encourage forms of “computationally constrained computing” that are not cloud-based reliant and usable in an offline mode (p. 3–4). The key theme of this thesis work is the use of games for critical thinking, which involves games being played on devices. Thus, it is also up to educational institutions and particularly educators to prioritize more sustainable devices over those that cannot be upgraded, repaired, maintained with lower financial investment, or require considerable energy consumption.

Consider the following case: As a researcher, I have been using research published electronically in journals as well as turning to Google Scholar to search for various articles related to the topic of my thesis. In general, when searching for topics such as “digital technology” and “critical thinking”, I was often presented with articles that included the word “iPad” in their title, which seemed interesting considering that the iPad is a type of tablet computer. The rationale behind the inclusion of the trademark as a result of my original search created questions for me. To my knowledge, iPads do not offer considerably different functionality to the alternative tablets that use android or windows operating systems. The touch screens, hardware, and capacity to run applications can be considered comparable. However, some argue that the ecosystem of a device matters—in other words, how devices and services on them relate to each other to provide a smooth user experience. It should be noted here that, the “holy war” between iOS and Android operating systems and devices has generated a lot of articles without a convincing winner (Muchmore, 2020; Palmer, 2021). To examine this pattern in the context of educational research, I did a quick search on the Education Resources Information Center (ERIC) database for “iPad”, and it returned 436 related articles with “iPad” in their title. However, the same search protocol in ERIC using the various alternative tablet names returned zero articles with Samsung, Huawei, Xiaomi, or Microsoft Surface tablets in the title. Now, let us move the argument further. iFixit (iFixit, n.d.) is a popular wiki-based site that offers repair guides for digital technology, household devices, cars, and so forth. The website also features technology disassembly ratings awarding devices a repairability score between 0 and 10. Ten is the easiest to repair. One may watch videos with iFixit engineers who disassemble devices and explain why they give a certain score to a device (iFixit - YouTube, n.d.). I collected data concerning 22 iPads released between 2010 and 2020: 17 of them scored 2, four devices scored 3, and one device produced in 2010 scored 6 out of 10 points on the iFixit repairability scale. One may argue that these scores are subjective, but they still make a point. We should also consider these scores in light of the efforts of Apple, Google, and Microsoft lobbying against the right-to-repair (Bergen, 2021; Chen, 2021; Godwin, 2021; United States Public Interest Research Group, n.d.). Collectively, many Apple devices bought by schools for teaching or used for research purposes would be considerably difficult and expensive to repair and offer limited upgradability—they would contribute to a growing body of electronic waste polluting our planet. From this standpoint, perhaps the non-intentional marketing of Apple devices via titles of articles in educational databases is worthy of further investigation. Technology giants such as Apple are businesses that function to make a profit, thus their involvement with education should be scrutinized at least only because one would think that education is primarily about learning and not profit.

The last point of the case I describe above illustrates another concern raised by Selwyn (2021a)—“tensions between the commercial and the commons” (p. 4). He argues that in the past 20 years we have seen big technology companies promoting corporate reforms in education—the promotion of personalized learning, data-driven learning, and so on (p. 4). To mitigate against these reforms, Selwyn proposes the establishment of national oversight mechanisms that would shape the educational activities of technology companies. Connecting back to the theme of my thesis, we know that Minecraft, which is extensively used at schools, is owned by Microsoft. This does not mean that Minecraft is inherently only a profit-making product. Rather it suggests that we should be aware that Microsoft may have its educational agenda and it has to be understood and reflected on by its recipients such as teachers, schools, and national educational institutions.

The tensions between inclusivity and exclusivity are related to two misunderstandings about technology (Selwyn, 2021a, p. 5). The first misunderstanding pertains to the notion that we all live in a profoundly “digital society” (p. 5), which is clearly not the case with 47% of the world’s population lacking access to the internet (International Telecommunications Union, 2019). Consequently, marginalized communities and vulnerable populations, including women, children, displaced individuals, refugees, are often particularly disadvantaged in terms of connectivity (International Telecommunications Union & United Nations Educational, Scientific and Cultural Organization, 2019, pp. 76, 78). There is also a digital skills gap between age groups, income level, sexes, and levels of educational attainment (p. 76).

The second misunderstanding pertains to the notion that technology serves as “a great leveller” (Selwyn, 2021a, p. 5) as if via access to quality content online will assist people to overcome preexisting inequalities and disadvantages. Selwyn argues that this is not the case and that digital technologies may advantage those who were already advantaged such as those who are well-educated, well-resourced, and without challenging life situations. Thus, Selwyn proposes that a shift into digital lifelong learning should address issues of equity, diversity, and overcoming disadvantage (pp. 5–6). This challenge also relates to the theme of my thesis, as one should understand that the use of games is associated with a certain financial burden; games that are comfortably played on devices of good quality, multiplayer games that may require a quality internet connection, and many games used in education are not free to play. Although digital games do offer great learning opportunities, I do not believe they should be viewed as a learning panacea. It is important that educators, as well as national governing bodies, consider whether or not disadvantaged populations will actually benefit from specific investments in digital games for learning.

The fourth sociotechnical tension suggested by Selwyn (2021a) is the one between personalization and collectivity. The values of “collectivity, community and conviviality” (p. 6) need to be given serious consideration as they cohere with the conception of education as a public good. Focusing on personalized learning can be problematic as there is the danger of defining learning in the narrow terms of individual freedoms and private goods. In the author’s perspective, it is a significant challenge to imagine a form of technology that does not limit the agency and autonomy of learners and educators, and at the same time, works for a greater public good. In his conclusion, Selwyn (2021a) proposes to pay closer attention to interdisciplinary approaches to reimagining technology that emphasize issues of inclusion, equity, and social justice: “respectful design”, “design justice”, “data feminism”, and “indigenous design” (p. 7). The use of games for critical thinking, as advocated in this thesis, relies on the presumption that educators would use games that bear the ideological assumptions of their creators. Educators would also, necessarily, need to reflect on their biases, assumptions, and thinking when utilizing these games. Thus, the main argument I want to emphasize from this discussion is that digital technology, as with any other human-created artifact, bears numerous connections with the environment within which it exists. Viewing digital technology in education as solely associated with the attainment of learning goals, could be somewhat shallow and disengaged with reflective thought.

Lastly, I would like to put forward another argument. Technology extensively helps us in decision-making. Artificial intelligence and machine learning help us in many spheres of our lives: from a search query to online chat bots, we rely on computer powers. While these advancements do empower us to be productive, they may also limit our decision-making. For example, Facebook and Twitter algorithms are tuned to provide their users with information that they think users will like and respond to, thus potentially causing people to stay in echo chambers of their current views (see Cinelli et al., 2021; see Nguyen & Vu, 2019 for an opposing argument). Another case is the Facebook–Cambridge Analytica data scandal that exposed how data can be exploited for targeted political purposes (Cadwalladr & Graham-Harrison, 2018). Therefore, the realization that technology is not a neutral tool is an important one, as it suggests that we need critical thinking to manage the application of technology.

I have briefly demonstrated that the four challenges described above are also relevant for digital games in education. As I argue in this thesis, games are a prospective learning environment, however, we should be aware of their limitations and the broader reality in which they exist. It is imperative for educators to move toward realizing these challenges and overcoming them in the spirit of quality education for all as a basic human right.

2.15 Digital Technology and Critical Thinking

> Knowing how to use ICT should go hand in hand with understanding how to bring about higher level thinking. (Harlen & Deakin Crick, 2003, p. 6)

This section takes a step further to introduce digital technology as a learning tool, one which can support the development of critical thinking. For this section, I deliberately do not start with the relationship between games and critical thinking, allowing myself to build a context before I proceed to the next section. Digital games are a subset of digital technologies. Various types of digital technology feature traits important for the development of critical thinking and it may be the case that these traits and features can be applied in digital games as well. For example, we will see below how discussion forums and wikis have been used to facilitate critical thinking. In fact, many games also feature forums and game wikis for players to enhance their gameplay. Realizing this interconnectivity, I consider it important to provide an overview of the available evidence on the relationship between digital technology and critical thinking. I do this first to carefully project these findings onto the next section about games and critical thinking.

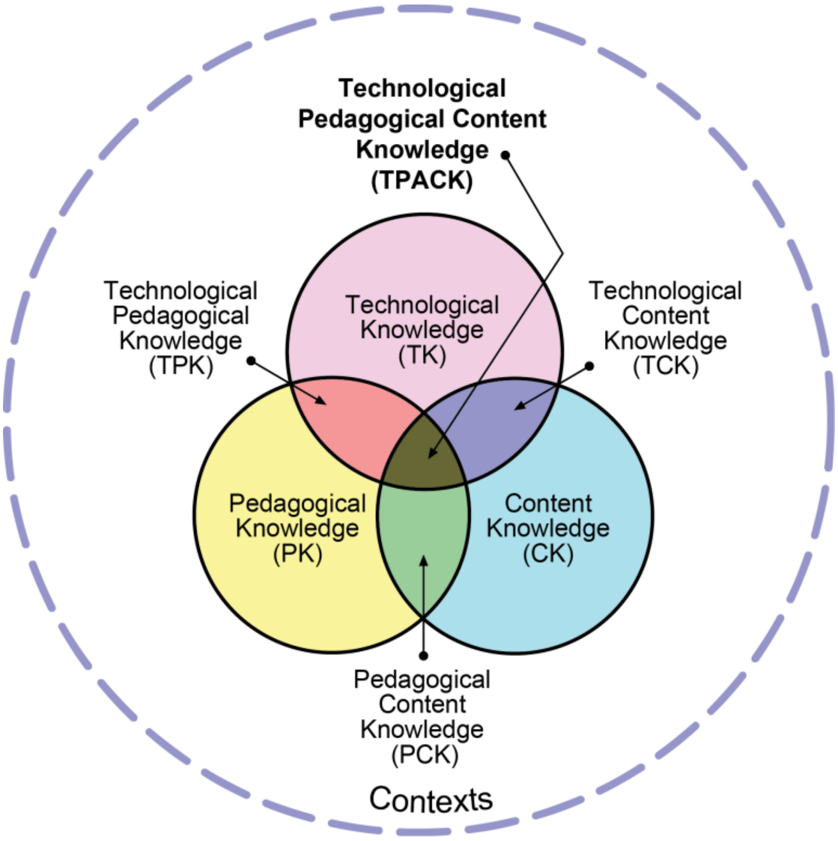
The theoretical framework used in this study is built upon the technological, pedagogical, and content knowledge (TPACK) framework and Davies's model. This theoretical framework allows me to break the phenomenon down into several circles of knowledge that can be then analyzed in relation to each other. It does exactly what theoretical frameworks do generally—gives a frame to deconstruct and analyze a phenomenon. In the case of this study, I focus on the analysis of the interplay between pedagogical, technological, and content knowledge (also see Section 1.6 "Theoretical framework of the study"). In my theoretical framework, Davies's model informs the pedagogical and content knowledge circles of TPACK (see Figure 4). For instance, Davies's model exemplifies different perspectives on critical thinking and, thus, informs the content circle of TPACK. In turn, the perspectives on critical thinking connect to the way that they should be taught, in other words, informing the pedagogical circle of TPACK.

The effective use of games with a pedagogical framework around critical thinking requires "developing sensitivity to the dynamic, transactional relationship between these components of knowledge situated in unique contexts" (Koehler, 2012, para. 3). This includes the transformation of what we conceptually know about critical thinking for the sake of its teaching, thus informing the overlap between pedagogy and content knowledge (PCK). It is also important to understand technological content knowledge (TCK): how critical thinking content dictates the technology to be used and why digital games are a desirable technology for a certain type of critical thinking content. Educators should bear in mind how teaching and learning change when games are applied. They should possess technological pedagogical knowledge (TPK). For example, what kind of instructional strategies work the best, what kind of learning modes one may use, and so forth. Finally, the intersection of PCK, TCK, and TPK merge into a bigger and finer perspective of TPACK. These components of knowledge (PCK, TCK, TPK) are situated in unique contexts be they formal, informal, or nonformal learning settings; commercial games or educational games; the developmental level of students, culture, sociopolitical environment, and so forth (see Figure 4).

As I argue above, Davies's model informs the pedagogical and content knowledge circles of TPACK (see Figure 4). Thus, when analyzing relevant research studies, we should be conscious about what kind of critical thinking a researcher is trying to develop or measure. In the literature review, we have already established that definitions of critical thinking vary extensively, with authors even proposing to go beyond this concept (see Barnett, 1997; Davies & Barnett, 2015). Research on the development of critical thinking through digital technology is no exception from this observation. For example, one may find Ng'ambi and Johnston (2006) not defining critical thinking but rather assessing the criticalness of questions posed by students. While authors did not elaborate on the concept, they extensively used the term "critical thinking skills" that, together with the focus on questioning, may relate to the first wave of critical thinking conceptualizations (Davies, 2015). Similarly, Lee (2004) conceptualized critical thinking as defined by the APA Delphi experts panel (Facione, 1990), thus listing critical thinking skills and drawing a connection to the first wave theorists. Being conscious about the conception of critical thinking helps to reflect on the limitations of the studies overviewed in this thesis, the comparability of the results of the studies, and their ideological standing. In the sections to follow, I make connections on how a certain study or theory may relate to the TPACK and Davies's models, thus placing discrete pieces of evidence or theories into a bigger picture of the phenomenon under investigation.

Figure 4

Pedagogical Technological Content Knowledge with Contexts Exemplified



Note. From *Using the TPACK Image*, by M. J. Koehler, 2011, TPACK.ORG - Dr Matthew J Koehler (http://matt-koehler.com/tpack2/using-the-tpack-image/). Copyright 2012 by tpack.org. Reprinted with permission.

Over the years, educators globally have emphasized the potential of digital technology to promote the development of 21st century skills (Law et al., 2008; Moreno, 2005). Critical thinking is one of the integral components of those skills. There are a number of studies reporting on the positive relationship between the use of digital technology and the development of critical thinking. Let us consider some of them.

Lowther et al. (2008) examined the effectiveness of a statewide technology program designed to provide full-time, on-site technology coaches to prepare teachers for lessons engaging students in critical thinking and facilitating learning with technology. The results of the treatment and control quasi-experimental study revealed that the experimental group students were significantly more engaged in student-centered learning such as experiential, hands-on learning, cooperative learning, and independent inquiry/research (p. 204). At the same time, the authors emphasized that the experimental group students were better able to demonstrate the application of critical thinking skills, which for some students resulted in higher performance in certain domain areas. Although, it remains unclear how critical thinking was conceptualized by the research authors. Potentially, the progress in critical thinking skills was related to students' improvement in achievement, higher engagement, participation in cooperative learning, and independent inquiry (p. 204). This study brings to the fore two important ideas we have already seen in TPACK. First, digital technology for critical thinking involves the engagement of both students and teachers with adequate technology. Therefore, support for the use of digital technology should be scaffolded to students and teachers, both key stakeholders in the learning process. Second, digital technology can empower higher-level thinking when relevant pedagogy is in use.

The use of 'a proper' pedagogy was also the theme of the study conducted by Ali (2012) who collected 389 responses in a survey of Malaysian polytechnic lecturers on their use of Information and Communication Technology (ICT) for the promotion of higher-order thinking skills. The study participants recognized the importance of ICT use for the promotion of higher-order thinking and also acknowledged that higher-order thinking teaching practices are influenced by the variety of teaching methods used. When the lecturers used and valued both student-centered as well as teacher-centered learning paradigms, Ali observed "'incongruence' between polytechnic lecturers' perceptions and their teaching practices" (p. xv). In support of this matter, lecturers reported that the effective promotion of higher-order thinking with technology necessitates professional development and training which, apparently, they were lacking (p. 135). Finally, Ali made use of the TPACK framework to identify the recommendations needed for instructional improvement at the participating institution (p. 140). When taking into account the results of this study, we should pay attention to the conceptual choice made by Ali—the author reports on the promotion of higher-order thinking skills, that, as discussed, are not necessarily critical thinking (see Section 2.1). Ali explains that higher-order thinking skills include analysis, synthesis, and evaluation of Bloom's taxonomy (Bloom et al., 1956) as well as "the ability to go beyond the information given, to inculcate a critical attitude, to have metacognitive intelligence, and to solve problems" (McLoughlin & Luca, 2000, as cited in Ali, 2012, p. 22).

As Khanin (2015) summarized in his master's thesis, there was a promising link between critical thinking and digital technology when technology was used to promote interaction, reflection, and collaborative work (Bell et al., 2011; Lee, 2004; Ng'ambi & Johnston, 2006; Subran, 2013). In support of this proposition, Subran (2013) presented a number of learning tasks to promote higher-order thinking skills with the use of blogs, wikis, and social networks. Subran believed that the above-mentioned tools are of great value "for teachers to present learning tasks that will influence students to pursue inquiries from different perspectives, assess the sources of their information, reflect on their findings, exchange ideas and adopt personal positions based on rational thinking" (p. 1). Research conducted by Bell et al. (2011) supported the use of learning tasks employed by Subran. When using Blogs and Wikis to support communication and collaboration, Bell et al. were able to facilitate the development of critical thinking of web-based postsecondary learners (p. 81). Among the most noticeable features of those tools were the social learning opportunities offered, such as peer learning. Overall, those tools empower learners to collaboratively create, critique and reflect on their own learning (p. 81). Bell et al. (2011) went further to suggest that the constructivist learning approach, which promotes students' active learning in a social context, is best suited for the matter of critical thinking development. Once again, the findings of multiple researchers in the area converge through the TPACK framework, which places each component into its respective knowledge pool and suggests their interdependence: This includes types of technologies (e.g., wikis and blogs) that can host certain pedagogy (e.g., collaboration, interaction, or reflection) to deliver chosen critical thinking content (e.g., looking at things from different perspectives).

The importance of an active social learning environment was also mentioned in the study by Ng’ambi and Johnston (2006) who reported on the constructivist approach, mediated by the use of an anonymous web-based consultative environment. This concerned the Dynamic Frequently Asked Questions designed to improve students’ critical thinking. In the authors' conceptualization, critical thinking could be demonstrated through the application of critical questioning and reflective thinking (p. 247) which may relate to critical thinking as reflective judgment discussed in Section 2.3.2. The authors concluded that the efficacy of the approach was evident in the interpretative study of the system’s data and questioning skills demonstrated through exam performance. In another study, Lee (2004) focused on ICT incorporated reading activities and found that the use of an ICT enhanced reading program, and subsequent online discussion forums, afforded considerable gains in interpretation, analysis, evaluation, inference, explanation, and self-regulation domains of critical thinking (p. 145). Note that the abovementioned skills constitute cognitive critical thinking definitions discussed in Sections 2.3 and 2.4. Elaborating on the nature of the reading program, Lee explained that the theoretical foundation of the study was based on Vygotsky’s (1981) social constructivist learning theory principles of a social constructivist classroom: “ICT was used to generate a meaningful social environment that allowed students to learn in groups through sharing ideas” (p. 41). An appreciation of the social learning environment connects to the interplay between the TPACK components where social learning fits into the pedagogical circle and dynamically interacts with technology and content.

Yet another study that demonstrates the advantages of digital technology includes research conducted by Kong (2015) who used the flipped classroom strategy to promote critical thinking in a 3-year-trial teaching period of an Integrated Humanities subject. The flipped classroom strategy involved “online pre-lesson learning preparation, in-class group discussion inside digital classroom and after-class extended learning using [sic] social learning platform” (p. 16). Based on the results of the critical thinking tests measuring students’ hypothesis identification, induction, deduction, explanation, and evaluation (Yeh, 2009, 2012), the pedagogical approach proposed in Kong’s (2015) research demonstrated statistically significant growth in all of the above-mentioned dimensions. As we may infer from this research, critical thinking was conceptualized and measured as several cognitive subskills that relate to cognitive definitions of critical thinking (see Sections 2.3–2.4). Kong reports that during the 1st year of study implementation, teachers were not supposed to deliberately design critical thinking questions but to rely on the spontaneous manifestation of critical thinking through subject learning. However, as Kong’s study (2015) proceeded, starting from Year 2, the teachers realized that it was better to “deliberately design critical thinking questions which interlock with domain knowledge learning on a theme-related basis, with a balance between the holistic development of critical thinking skills and the deep learning of domain knowledge” (p. 29). Both instructional strategies imply teaching critical thinking through the subject matter, and both appear to correspond with Ennis’s (1989, p. 5) classification of critical thinking instruction: “not explicit” critical thinking instruction of the infusion approach in the 1st year, and the “explicit” immersion strategy preferred by the study's teachers in the 2nd year.

In another article dedicated to the same study, Kong (2014) assumes that students’ success in critical thinking may be attributed to the deployment of four ways of developing critical thinking: sufficient time for students' thinking, sufficient time for students' discussion, guidance for students' group sharing, and explanation and guidance for students' reflection (pp. 163, 171). Another contributing factor could be the use of five perspectives on critical thinking in students’ worksheets: hypothesis identification, induction, deduction, the perspective of explanation for arguing ideas, and evaluation (p. 161). Discussing the implications of the research, Kong (2015) highlights the need for the appropriate pedagogical and technological support to engage students in personal learning, peer learning, and seek teacher support (p. 29). Teachers stressed the importance of small group discussion activities, while students expected teacher support for skill development through reflection. As reported, a school-based e-learning platform allowed students to efficiently acquire basic domain knowledge and try critical thinking processes without time constraints, while in-class use of Google Docs prompted collaboration, knowledge sharing, and diversified thinking perspectives. Kong’s study reinforces the idea for a need for a holistic understanding of how technology, content, and pedagogy shape one another.

Another insight in support of the use of digital technology for the development of critical thinking was presented by Ota (2014) who believed that Massive Open Online Courses (MOOCs) are a great platform for this matter. For instance, she explained that MOOCs provide an online interactive platform, where learners “… are able to access various educational resources, to obtain information, and to carry out discussion and dialogue with people all over the world” (p. 102). The author suggests that critical thinking is closely related to reflective and dialectical moments, thus proposing to exercise Socratic dialogue (see Section 2.7 for Paul’s dialogical and dialectical thinking) as a pedagogical manifestation of critical thinking before using MOOCs (p. 105, 108–109). Indeed, MOOCs, the way they were conceived by Downes (2012) and Siemens (2013), as means of connectivist learning, may aid learners in attaining critical thinking: “What we are trying to do with a MOOC is to create an environment where people who are more advanced reasoners, thinkers, motivators, arguers, and educators can practice their skills in a public way by interacting with each other" (Downes, 2012, p. 508). Nevertheless, one should be cautious when talking about the learning potential of MOOCs, as, since their inception, there was a misleading discourse about their revolutionary and game-changing nature. They were portrayed as the ultimate challenge to traditional higher education institutions, a free and democratizing source of a high-quality university education (Bulfin et al., 2014). Bulfin et al. suggest that news media discourse about MOOCs obscure the fact that the courses benefit already academically privileged students, which links back to the tensions between inclusivity and exclusivity (Selwyn, 2021a) as discussed in the section above. This discourse neither considers issues relating to the casualization, deprofessionalization, and outsourcing of academic labor nor acknowledges the fact that MOOCs were heavily sponsored by multinational corporations and venture capitalists. Finally, there should be a distinction made between connectivist cMOOCs (connectivist MOOCs that emphasize peer-to-peer relationships between students) and corporate institutionally focused xMOOCs—e.g., Coursera, edX—resembling traditional lecturer-centered approaches to learning (as explained by Stephen Downes in Cross, 2013, 1:01:42; Siemens, 2012; Stevens, 2012). Thus, when saying that MOOCs may be used for critical thinking, we should be aware of what kind of MOOCs we are talking about, their possible limitations, and the media discourse altering their objective perception.

A quantitative study conducted by McMahon (2009) in secondary Australian schools revealed that there is a statistically significant correlation between studying in a digital technology empowered environment and the development of critical thinking skills. Approximately 150 students with different lengths of enrollment at school participated in the case study, thus being exposed to a different level of technology-rich environments. Students' critical thinking was assessed by Ennis–Weir Critical Thinking Essay Test (Ennis & Weir, 1985), and their computer skills were measured by the Australian Schools Computer Skills

Competition. Results indicated that students whose computer skills were higher scored correspondingly higher on critical thinking activities (McMahon, 2009). This was the most significant for students whose computer programming skills and knowledge of Boolean logic were better. The length of time spent in the environment also had a positive nonlinear effect on critical thinking skills. McMahon suggested that the integration of technology in the learning process across all learning areas would help students attain higher levels of cognition in various contexts. Finally, as the author suggests, computer programming develops skills in logic, critical, and creative thinking. Looking at the generally positive results of this study, we nevertheless should be reflective of the study itself. For instance, McMahon measured critical thinking with the Ennis–Weir Critical Thinking Essay Test, which is based on Ennis's (1993) definition of critical thinking as "reasonable reflective thinking focused on deciding what to believe or do" (p. 180). There are two considerations when analyzing the results of such a study. First, this conception of critical thinking belongs to the "skills-and-judgments" view as categorized on Davies's model (2015) that may already limit critical thinking to not include critical action, relations to society, and wider aspects of critical thinking (see Sections 2.9–2.11). Second, the theme of assessment also imposes certain limitations. Critical thinking was measured by the instrument that ultimately defines how it is conceptualized. Thus, if one says that students scored higher in critical thinking, it means that students scored higher in the measured elements of critical thinking. One would argue that assessment of critical thinking reduces the concept to its measurable manifestations (akin to criticism of the psychological tradition of thought mentioned in Sternberg, 1986). To reiterate the key point in the introduction to this section, there is always a need to reflect upon how critical thinking is conceptualized and what this means to the results of a particular study.

In summary, this section has presented evidence in support of digital technology towards the development of critical thinking. There are two questions which the current research aims to answer with relation to digital technology and critical thinking. First, whether SMEs believe that critical thinking can be taught using digital technology. Second, in what ways critical thinking can be taught or promoted using digital technology as perceived by SMEs. This section demonstrates that there are common themes that unite the majority of the above-mentioned studies.

Within the theme of relevant pedagogy, critical thinking was observed when the following approaches were employed: collaborative learning (Ali, 2012, p. 79; Bell et al., 2011; Kong, 2015; Lee, 2004; Lowther et al., 2008; McMahon, 2009; Ota, 2014; Subran, 2013), student-centered learning (Kong, 2015; Lowther et al., 2008; Ng'ambi & Johnston, 2006), constructivist learning (Ali, 2012, p. 83; Bell et al., 2011; Kong, 2014, p. 161; Lee, 2004; McMahon, 2009, p. 279; Ng'ambi & Johnston, 2006) and discussion (Ali, 2012; Bell et al., 2011; Kong, 2015; Lee, 2004; McMahon, 2009; Ng'ambi & Johnston, 2006; Ota, 2014; Subran, 2013). While the list of possible pedagogical solutions and learning theories that explain students' progress in critical thinking may be much broader, we can surely acknowledge social learning as a key approach in this direction. The notion of what can be called the more relevant pedagogy ultimately connects to the need for teachers' competency development both in technology and critical thinking instruction, as well as to the development of students' IT literacy (Ali, 2012; Kong, 2015; Lowther et al., 2008). Second is the relationship between technology, pedagogy, and content. The studies presented above demonstrate a conscious awareness of these elements and posed questions relating to intersections in the TPACK knowledge circles. For example, if one conceptualizes critical thinking as reflective and dialectical (Content Knowledge), then MOOCs may appear to be a great technological medium for it to happen (Technology Knowledge), and thinking through Socratic dialogue may prove to be an effective educational strategy (Pedagogy Knowledge; see Ota, 2014).

Finally, this section connects to the following section on digital games and critical thinking. Digital games are a subset of digital technology: They can also accommodate social learning modes, collaboration, and discussion. Many games do feature these components. Not having strict visual, content, or form boundaries makes games flexible to be the way the creator wants them to be. This lack of constraints provides opportunities to feature elements and strategies that are valuable for the development of critical thinking. The next section takes the key findings summarized here and introduces games as a medium for critical thinking development.

2.16 Digital Games and Critical Thinking

This section builds upon the discussion of digital technologies as a learning tool for critical thinking and focuses on digital games. Here, as a preamble to my thesis work, I consider and connect theories that explain how games could act as a learning medium for critical thinking, and, thereafter, provide an overview of available evidence for how games relate to critical thinking. At this juncture, one may see that the majority of the TPACK components of this study have been reviewed. Thanks to Davies's model, we already have an idea of what critical thinking is and has the potential to be. We have an understanding of the kind of teaching practices and pedagogies that are associated with its effective delivery. Finally, we understand that the development of critical thinking with games involves the interaction of many elements; an interplay of content, pedagogy, and technology. This section maintains that digital games are a great tool for empowering students to think deeply and think critically and may be a suitable environment that is well suited for the pursuit of this goal. So, why would we use digital games for learning, and what is so special about them? Throughout this section, we will examine how different conceptions of critical thinking manifest themselves in games and why they relate to the intersections of the TPACK framework.

2.16.1 Learning Gains and Principles of Digital Games

Before we move on to examining digital games and their learning principles, it is important to briefly outline what I mean by digital games. Digital games are a collective term for games played on computers, smartphones, tablets, mobile devices, or video game consoles such as PlayStation, Xbox, or Nintendo (see Section 1.7). While the word "digital" relates to devices on which games are played, the concept of "game" itself can be defined as: "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" (Salen & Zimmerman, 2003, p. 11). Salen and Zimmerman unpack this definition by explaining that a system is a group of interacting, interrelated, or interdependent elements that form a complex whole (Chapter 5, p. 1). A game maintains a distance from what is considered "real-life"; thus a game is an instance of a conflict or contest that is artificial. In the authors' position, rules are the crucial part of a game as they determine what a player can or cannot do. Finally, games have quantifiable results—be it a victory, defeat, or some kind of a score which usually distinguishes a game from other play activities (Chapter 7, p. 11). It is also important to understand that games are a subset of play that can be defined as a "free movement within a more rigid structure" (Salen & Zimmerman, 2003, p. 4). The focus on 'play' in the title of my thesis is not accidental. One should be aware that digital games themselves may not lead to learning or critical thinking, rather the act of '*playing'* a game can. Whenever I refer to a digital game and critical thinking, one should be aware of whether I report on constituent elements of a game that were found useful, or on how a game should be played, or even, in some cases, I refer to the act of game creation as a critical thinking exercise. These are the facets of the phenomenon of my research that should be differentiated.

Rieber (1996) postulated that play and imitation are natural ways of learning in childhood (also see Piaget, 2007); but considering in some instances the complexity of games, even adults would need extensive critical thinking and problem-solving skills to play them successfully. The advancement of technology, the growing competition in the gaming industry, the variety of game types, the various forms of challenges, and the multiple play modes and forms of engagement have meant that the online world has grown exponentially. Inherent to these advancements is the competition for capturing new players to engage in specific games. These advancements have provided unique learning opportunities for both players and educators. Such innovations provide fundamental lessons of what constitutes good learning and how it should be designed. James Paul Gee (2013), a respected author in the field of digital games for learning, gave the title for one of his works as “Learning Systems, Not Games”. He maintained that good games are perfect examples of environments where advanced learning happens, and, as a consequence, he proposed to learn from a number of principles on which digital games are based, and use games themselves for learning purposes (Gee, 2004). Gee provides 36 learning principles of good games which I refer to extensively in this section and support with the relevant theory where possible.

One of the main advantages of games as Gee (2013) suggests is that they empower users to learn by doing, and learn from experiences (p. 149). From this point of view, a textbook can be considered the less effective educational technology, while games, in contrast, permit learners to experience things and engage in experiential problem-solving. Gee (2013) observed that texts are associated with actions, images, or processes that are happening in real life, and provide a showcase of the social practice that they are meant to represent. If a learner had a chance to experience these real-life dimensions first, they would better understand what the text in the book is referring to. This is to say that textbooks operate as manuals to the game (Edutopia, 2012): They document and describe the game, but, at the same time, they are hard to read and comprehend because they fail to construct meaning as a set of images, texts, symbols, abstract designs, and sounds (Gee, 2004, p. 210).

Gee continues to explain that if learning is focused solely on facts, it will not lead to the application of facts. In experiential learning, facts are used as tools to solve problems; therefore, they are retained as an instrument to learn new things and understand new experiences.

Experiential problem-solving is of interest to us. As we discussed earlier in Sections 2.1 and 2.9 problem solving may be seen as an arena where critical thinking occurs. As Davies (2015, p. 46) suggests, problem-solving involves making judgments to complete tasks, thus, potentially, if critical thinking standards are met, problem-solving can help in developing critical thinking.

The problem-solving component of games was emphasized in a number of studies, leading to various gains in students' learning (Granade, 2010; Liu et al., 2011; Yang, 2012). To some extent, learners need critical thinking to solve problems (Ennis, 1985; Facione, 1990; Halpern, 1998), and digital games challenge them in doing so. For example, Liu et al. (2011) did research involving 117 students in a simulation game that was designed to assist them in learning computational problem solving and was based on the notion of Papert's constructionism (Harel et al., 1991). As part of their research, Liu et al. (2011) sampled novice programmers taking undergraduate studies in a university in northern Taiwan. They summarized that, compared to traditional instruction, students who learned computational problem-solving with the use of digital games were more likely to perceive their learning experience as a state of flow, rather than that of boredom and anxiety. Interestingly, students' feedback connects well to the conceptualization of critical thinking as openness or creativity (see Burbules & Berk, 1999; Davies, 2015)—an alternative approach that opens critical thinking to intuition, creativity, or state of flow as described by Csikszentmihalyi (2009). If we are to consider flow as a form of "trans-critical" thinking (Davies, 2015, p. 79), then we may find games as a promising means to engage students in critical thinking in its wider understanding. From the analysis of students' feedback and their activity log, Liu et al. (2011) established that the simulation game helped students to engage in flow state experiences in which students were motivated to apply trial-and-error, learning-by-example, and analytical reasoning strategies (p. 1916).

Although, a word of caution should be expressed as the condition of flow appears to interact with other variables, such as the personal traits of learners. Flow can be defined as "a state of concentration so focused that it amounts to absolute absorption in an activity" (Csikszentmihalyi, 1990, p. 1). Hohnemann et al. (2022) reported the results of a study in which they examined how students experienced flow based on negative and positive feedback, and how their perception of flow was moderated by the locus of control and conscientiousness of participants. Hohnemann et al. draw upon the ideas of Rotter (1966) and explain that people with an internal locus of control believe that they are in control of events and experience them as an outcome of their behaviors, while people with an external locus of control tend to attribute their performance outcomes to external factors rather than their skills. The conscientiousness of an individual is manifested in the ability to control oneself, plan and organize behavior, and engage more in tasks (McCrae & John, 1992). Hohnemann et al. (2022) conducted an experimental study that involved feedback on a logical reasoning task. There were 240 participants in the online study who were randomly assigned to three feedback conditions (positive, negative, and no feedback). Participants then solved a follow-up task for which they reported the degree of their flow experience. Results of the study demonstrated that highly conscientious participants who received positive feedback had a positive indirect effect on task performance via flow experience. On the contrary, negative feedback resulted in negative indirect effects on task performance via flow for individuals, who had an internal locus of control or low levels of conscientiousness. The results of this study indicate that flow interacts with the personal traits of learners, and the connection between positive feedback and a feeling of flow should not be oversimplified (p. 6).

Additionally, increased intrinsic motivation was also a benefit of the use of digital games based on the constructivist approach. Similarly, Yang (2012) conducted a quasi-experimental study to investigate the effectiveness of digital game-based learning in secondary school. The results indicated that twenty 15 to16-year-old children from the experimental group showed a significantly better learning advancement than those in the control group. Specifically, children who played a city-building simulation game attained a higher level of problem-solving skills compared to no improvement in the control group with teacher instruction as the only method. In addition, the digital game-based learning resulted in better learning motivation in the experimental group. Finally, Granade (2010) suggests that interactive fiction can be used for teaching critical thinking. He documents the stories of two secondary school teachers who used text adventures to help students evaluate problems and their solutions. While they report both the success and failure of using text adventures in class, one of two teachers believes that interactive text adventures are well-suited for teaching in the classroom. Text adventures allow for pauses between each entered command, thus giving time to players to think, create a plan or solution to a given problem. Pauses also give space for direct teaching: A teacher may explain the concepts right at the time when it is needed, not breaking the narrative flow.

At this point, I want to bring to the fore research which revealed another important dimension of games for learning. The study launched by Spires et al. (2011) indicated that middle-grade students who played Crystal Island—a digital game that required solving a science mystery based on microbiology content—showed significant learning gains. The quantitative results suggested that students that were better at navigating in the hypothesis formulation space achieved higher learning gains and in-game performance when solving game problems. Based on the data available, the authors concluded that hypothesis testing strategies play a central role in digital game-based learning environments that involve problem-solving tasks. In fact, Gee (2004) would agree with this, he speculated that digital games allow players to engage in the process of "reflective practice" (p. 90). In this process, learners proceed through four steps: first, one probes the environment by clicking on objects, looking around, or engaging in action; second, based on the reflection on the process of probing or things that happen after that, learners formulate a hypothesis about what something could mean in a way useful for their purpose; third, players probe the environment with the hypothesis in mind to see the effect of one's action; fourth, and finally, players treat this response from the environment as feedback which consequently leads to acceptance of the hypothesis or its rethinking (p. 90).

According to Gee (2004), the process of reflective practice is at the heart of many areas of human competence such as arts, law, teaching, and biology. Reflective practice (or "adaptability", "flexibility") is what Barnett (2015, p. 64) attributes to critical action, and suggests that it is applied in the domain of the world (see Section 2.9). From Barnett's position, the term reflective practice belongs to the performative discourse as well as within a humanistic discourse of self-development and self-empowerment (1997, p. 135). He clarifies that "reflective practice operates on events and responses as they are encountered" (p. 135) and is based on a sense of professionalism. However, Barnett warns that the sense of critical thinking made available through reflective practice is still limited. It gives priority to practice but does not extend to ethical questions, the notion of truth in reflective practice is pragmatic—"truth is what works" (p. 138).

The process of reflective practice described by Gee is also akin to what is meant by reasoning and reflection in various definitions of critical thinking coming out of the critical thinking movement (Ennis, 2015, p. 32; Lipman, 1988, p. 40; Paul, 1992, pp. 9–10).

Hypothesis testing involves the evaluation of actions and their consequences. This naturally and implicitly teaches a learner about causal relationships. One important feature of games is that they allow for experiential trial and error for as many times as one wishes: A player takes enough turns and time to recognize a pattern or relationship by a series of trials and fails which, hopefully, eventually result in a problem solution.

Some more learning principles of good games which connect to what I described in the paragraph above are incremental and explicit information on-demand and just-in-time principles (Gee, 2004, pp. 210–211). I group these principles together to suggest that good games thoughtfully account for the cognitive load of a learner. The incremental principle means that learning situations are ordered in the early stages to lead to fruitful generalizations at later stages. Thus, learners' actions completing the final challenge are informed and supported by the whole body of increasingly challenging tasks and learned truths from prior experience. The principle of explicit information on-demand and just-in-time means that a learner is provided with the information required when it could be best understood and used in practice. One could also mention that many game objects are clickable and informative: Units contain information about their health, stamina status, points of experience, or parts of a legendary armor start to glow when all of them are collected and placed in the player's inventory. Gee (2004) calls it a principle of "material intelligence" (p. 210), which means that thinking, problem-solving, and knowledge are stored in these material objects, in the game environment. This frees a learner from unnecessary load and allows a player to engage with an object by combining one's own knowledge and knowledge stored within objects.

In fact, the learning principles of explicit information on-demand and just-in-time, and material intelligence have been tested in several studies and researchers reported positive learning gains associated with them. For example, Spires et al. (2011) used some of these principles in their study based on the Crystal Island game which I mentioned above.

Researchers made it possible to offset the working memory of students by introducing the worksheets into the task. This allowed learners to input information that was crucial to the task into one structured entry field. The use of worksheets provided space for improved problem-solving capacity and the construction of a broader perspective of the problem. This allowed for knowledge to be stored in long-term memory, and is also known as the process of schema construction (Sweller, 1988). Accordingly, Sweller, who introduced the theory of cognitive load, made a proposal that experts in the problem solving possess “schema” which is defined as: “a structure which allows problem solvers to recognize a problem state as belonging to a particular category of problem states that normally require particular moves” (p. 259). In contrast, novice learners who do not possess the same structures or schema are nevertheless required to use general problem-solving strategies, which account for a greater cognitive load. The idea that worksheets can store necessary structured information is a great example of the material intelligence principle. Although it was not clear from the paper whether a worksheet was an in-game artifact or distributed on paper, the point remains the same. Games contain a vast amount of information about different things which make their world: resources, narratives, interaction with objects, and so forth. Despite this, in well-crafted games, players navigate and manipulate the world as soon as they learn how to interact with objects and retrieve stored knowledge, in line with Gee’s (2004) principle of material intelligence (p. 210). Ultimately, these observations demonstrate how well the researchers understood technological allowances of the game, specifics of the content, and pedagogical means: The microbiology content was made tangible through the interactive and visual design of the game enabling students to build causal knowledge by formulating hypotheses and trying new things. Worksheets used to offload students’ memory and structure data are the embodiment of pedagogical knowledge fueling the TPACK intersection. The use of structured worksheets in this game resembles what van Gelder (2005) suggested to be a good technique for teaching critical thinking, specifically, the mapping of arguments and visually exposing their connections (see Section 2.5).

Consider another example. The study launched by Kolovou and Heuvel-Panhuizen (2010) proposed that digital-game-generated feedback successfully supported students in problem-solving when dealing with early algebra problems. Ninety-six fifth-grade students were assigned problem-solving tasks. During the pre- and post-tests, they had to solve algebra problems on paper and did not receive any feedback for their answers nor their problem-solving progress. On the contrary, between these pen and paper sessions, students could use a computer game to solve algebra problems, with the game providing them with situation-based feedback. When playing the game, they could detect and rectify their errors thanks to immediate feedback given by the game. The outcomes of the posttest indicated a better performance compared to the pretest. The main finding was that students were more successful in problem-solving in the online game rather than in the pen-and-paper mode. The final finding of the study suggested that game-generated feedback stimulated student-generated feedback. During the posttest, students were inclined to verify their answers, which was not evident in the pretest. This game demonstrated how the principle of explicit information on-demand and just-in-time was used to support in-game learning, which also resulted in out-of-game problem-solving mastery. More generally, the results of this study direct thinking into a possible connection between game-generated feedback and Socratic questioning—a method well acknowledged by critical thinking scholars and practitioners (Abrami et al., 2015; Ota, 2014; Paul, 2012, p. 360; Yang et al., 2005). While the power of Socratic questioning can be attributed to its interactive features (discussants listen to each other with one of them questioning or exposing contradictions), game-generated feedback may serve as a second voice of reason, as a discussant exposing connections, identifying contradictions, or probing one’s understanding. In other words, feedback may serve well in enabling reflective thinking. This is an element present in many cognitive definitions of critical thinking (see Section 2.3.2).

Gee (2004) claimed that game-generated feedback aids the process of action and reflection and ultimately leads a child to become a “self-teacher” who is training one’s mental networks of associations (p. 91). He explains: “Such reflection involves listening to the world as it “talks back” to your action, giving you feedback about the success or failure of that action in terms of your own goals and desires” (p. 91). From this position, feedback is a powerful tool that helps to form a hypothesis about the game world (or the problem one is exploring) and identify whether this hypothesis can sustain itself; it enables constant reflection. The relevance of feedback may be seen not only in terms of critical thinking that includes reflection but as more fundamental to the learning processes such as pattern recognition, as proposed by Gee (2004, p. 91).

Apart from the positive learning gains reported above for the study of games, some researchers also raised concerns regarding their actual learning benefits. Denham et al. (2016) summarized what they found in the literature as barriers to the adoption of digital game-based learning (DGBL) in formal learning environments. This summary included: “inconsistent empirical evidence, time constraints, limited resources, stigma associated with “play”, methodological flaws in empirical studies on games, and the lack of evidence-based best practices for the integration of games within the classroom” (p. 70). These challenges should be considered when one attempts to teach with digital games. Moreover, one should be aware of when the use of digital games did not result in learning gains. For instance, Lu and Lien’s (2020) study suggested that instructional designers and teachers should attempt to enhance students’ feeling of learning, playing, and self-efficacy. The findings of the study suggested that students who have a strong perception of playing but a weak perception of learning may not benefit from DGBL (p. 25). This idea is also evidenced in the research by Erhel and

Jamet (2013) whose experiment suggested that explicit learning instruction elicited deeper learning than the entertainment-based alternative. Results from their first experiment suggested that when the emphasis of DGBL was placed on the learning content, learners performed better in terms of comprehension. In the second experiment of their study, an emphasis on the playful learning content afforded improved comprehension performance only when the feedback was applied. These studies demonstrate that learning in games may be conditional with deep learning happening when there is explicit learning instruction and pedagogical scaffolding in place. Finally, another factor that may impede learning with games is teachers' preparedness to use games in their practice as they have to understand the complexities of DGBL and have to adapt their current learning practices to be used with digital games (McKenzi, 2020, p. 13; Plass et al., 2015, p. 258).

This section has described potential learning gains that can be attained by playing digital games. These gains may be explained by the nature of games that build on different learning principles. Gee (2004) provides at least 36 learning principles of good games that manifest themselves in the research and literature as discussed in this section. Digital games are well suited for problem-solving (Granade, 2010; Liu et al., 2011; Yang, 2012), they empower learning by doing (Gee, 2013, p. 149), allow for hypothesis testing and reflective practice (Kolovou & Heuvel-Panhuizen, 2010; Spires et al., 2011), increase learning motivation (Yang, 2012), and may trigger the perception of learning as flow (Liu et al., 2011). However, it is important to mention that digital games should not be viewed as a universal learning solution that can be easily applied across any subject domain, class, or institution. Instead, learning with games is a complex process in which success is dependent upon many factors including: (a) the technological, pedagogical, and content knowledge of teachers, educators, and game designers; (b) students' learning profiles; (c) the specific game in use; and (d) many other factors.

2.16.2 Theories Pertaining to Learning in Digital Games

I have provided an overview of several studies and learning principles pertaining to what other scholars consider to be good games to start a discussion on theories and fields of knowledge that may help us to understand how learning in games operates. Before we proceed to look into some of them, it is important to clarify that games may be very different—text-based games, simulations, puzzles, and so on—their worlds and the learning principles that they adopt may vary considerably. When a particular theory can help us to understand a phenomenon of learning in a certain game e.g., the cognitive load theory and worksheets used with Crystal Island, the same theory and example may not be suitable for explaining the phenomenon of another game with a very different philosophy and application of learning principles. With this understanding in mind, I propose to look into some theories which appear to appeal to a bigger picture of learning in games.

Spires et al. (2011) suggested that learning happening in their science mystery game could be best understood through the lenses of three theories: activity theory, narrative-centered learning, and cognitive load theory (p. 456). Activity theory is probably the most general one as it attempts to capture central truths about how humans think and learn. Activity theory is derived from Vygotsky's cultural–historical approach (1981) to learning and was mainly developed by Leont'ev (1978) and Luria (1976) in the 1920s and 1930s. The theory suggests that learning is shaped by social practice, expanding to other people and artifacts that mediate the learner's interaction with reality (Cole & Engestrom, 1997; Kaptelinin & Nardi, 2009; Spires et al., 2011). It is to say that learning is not something confined only to an individual's mental processes, but it is connected to interactions with other learners and things that are involved as integral parts of learning. In Crystal Island, activity theory was enacted as students were involved in shared tasks with tools that could potentially produce learning: tips from in-game characters, posters, textbooks, and tests in the laboratory (Spires et al., 2011, p. 459).

The idea that learning and thinking are not confined to an individual's mind is also evident in other areas of current research used to understand learning in games. Gee (2004) suggests that work on "situated cognition" and New Literacy studies (p. 8) describe well the ways in which well-designed video games are learned and played. Situated cognition assumes that the meaning of signs in the game is situated in the embodied experience (p. 209) and "meaning/knowledge is distributed across the learner, objects, tools, symbols, technologies, and the environment" (p. 211). Right away, we can say that this idea is well reflected in the learning principle of "material intelligence" (p. 210), which states that thinking, problem-solving, and knowledge reside in the objects. A body of work in New Literacy studies also argues that reading and writing should be viewed not as mere mental processes but as social practices with economic, political, cultural, and historical implications (p. 8). Gee speculates that different texts require different types of literacy: One does not read a legal text the same way one reads a rap song (p. 14). Law and rap music are different domains that bear different economic, social, political, and cultural rules, norms, and backgrounds. In the same way, Gee proposes to look at games as encompassing different semiotic (symbols, texts, pictures, etc. communicating distinctive types of the meaning) domains and, thus, cultural, political, and social implications. I shall expand on these ideas a bit later when discussing how critical thinking relates to digital games.

My understanding of learning in games is shaped by these theories and I believe that they are important precursors to the subsequent discussion on digital games and critical thinking. Critical pedagogy, criticality, and critical thinking as openness emphasize social relations (and power structures in the case of critical pedagogy; Davies, 2015). Social relations place critical thinking in context and shape its agenda and application. In the same manner, games, and the learning happening inside of them, are a reflection of social practices and the world around us. It has been argued throughout this thesis that critical thinking defined only as cognitive skills is a limiting exercise because it is confined to an individual's development and mental processes (Davies, 2015). If we are to develop critical thinking through games, we may try to look at games within their inherent social, political, and cultural contexts. Games can be seen as human artifacts bearing an ideology and certain assumptions about the world. Therefore, problem-solving in games takes on a different meaning as it becomes a practice that can be reflected upon. Moreover, the principles learned inside such games can be used inside and outside game settings.

There is a learning principle that I believe is central to critical thinking and digital games. Gee (2004) frames it as the principle of active and critical learning (p. 207). To give an account on this principle, he brought the notion of a semiotic domain which in essence is: "any set of practices that recruits one or more modalities (e.g., oral or written language, images, equations, symbols, sounds, gestures, graphs, artifacts, etc.) to communicate distinctive types of meanings" (p. 18). For example, semiotic domains may denote rap music, the World of Warcraft, cellular biology, or nuclear physics. Consequently, when we are to learn a new domain and learn through the active learning perspective, "we learn to experience (see, feel, and operate on) the world in new ways" (p. 23). We also create affiliations with those who understand and value this semiotic domain and become part of its wider community. Finally, we gain resources and skills for future learning in this semiotic domain, and probably in related ones. For example, if one wants to play the puzzle game Portal, one needs to explore and learn the laws of this world, learn to "read" signs denoting particular meanings: the color of portals, the purpose of repulsion gel, and so forth. Through a series of trial and error, a learner actively interacts with the world and builds an understanding of the semiotic domain of Portal. An experienced Portal player may find it easier to play other puzzle games, in other words, finds connections to other semiotic domains.

When active learning occurs, one may proceed to critical learning which gives one an appreciation of a learning domain as a structured and complex system of interrelated components, and empowers one with a meta-insight into the learning domain (Gee, 2004, p. 23). Unlike active learning, critical learning is always a conscious appreciation, reflection, manipulation, or critique of a semiotic domain at a metalevel. In critical learning, a learner must see and appreciate a semiotic domain as a design space: internally as a system of interrelated elements constituting the content of the domain, and externally as ways of thinking, acting, and relating that constitute identities of people who belong to that domain's affinity group (p. 40).

Taking the same example of Portal, a learner gets insights into the operation of the world as a whole, learns to skillfully manipulate the environment to solve problems, realizes why narratives lead a certain way, and recognizes why in-game elements are placed in a certain order. Critical learning may result in creative ways of problem-solving and, more certainly, enable an appreciation of the world on the metalevel. While not necessarily to the same depth but perhaps somewhat akin to the level of appreciation that the persons who created the problems in the game had.

For Gee (2004), learning and thinking at a metalevel about semiotic domains (alone and in relation to each other) as design spaces, constitute critical learning and thinking (p. 43). He elaborates that semiotic domains are human cultural, historical, and political creations that are designed to make people think and manipulate them to act a certain way. These domains prompt people to learn, and subsequently, adopt certain types of identities. As such, society can be conceived as a net of these varying identities, where people grow different levels of affinity to ideas, adopt certain ways of thinking, and enact particular behavior associated with them. They build certain relations in society, some of which may have important implications for social justice—for example, the identity of the working class. If a game nurtures a kind of identity that is built around successful problem-solving, moral decisions, or collaborative play, then a player is privileged to live these carefully crafted identities which otherwise would not be experienced or practiced in out-of-game life.

The principle of active and critical learning occurring in well-designed digital games connects well to critical thinking as reflection, epistemological understanding, and metacognition. While the reflective component is evident in many definitions of critical thinking, the attainment of an epistemological understanding is very akin to McPeck's (1990), Kuhn’s (1999), or Papastephanou and Angeli’s (2007) positions on critical thinking. In this sense, digital games may be a great learning tool and critical thinking space, as they allow players to modify an environment, challenge its rules, and relate to other semiotic domains of human living. Another important connection to be made is that semiotic domains, including those experienced in games, are culturally, historically, and politically affiliated (Gee, 2004, pp. 8, 44). Such meta insights into semiotic domains connect to the agenda of critical pedagogy which similarly does not perceive learning as it is, but tries to look at how learning is shaped by power. Overall, the view on games as a space for active and critical learning affords a great promise for critical thinking to happen as we know it in Davies’s (2015) model (Figure 1). In the paragraphs to follow, I switch from theoretical and conceptual matters to research that focuses on the relationship between digital games and critical thinking.

2.16.3 Digital Games and Critical Thinking: Empirical Evidence and Theoretical Considerations

Findings from a number of studies point to the connection between digital games and critical thinking (Childress & Braswell, 2006; Doolittle, 1995; Frasca, 2001; Halpern et al., 2012; Song, 2008; Yang & Chang, 2013). For instance, as early as 1995, Doolittle (1995) presented empirical evidence in favor of interactive computer games to support the development of critical thinking. Doolittle reported on the use of computer riddle exercises, which were developed to allow players to solve problems without the pressure of social judgment and without getting completely stuck (p. 34). His students were also involved in solving interactive-fiction problems on a computer, where they were participants rather than passive recipients of a story. One thing he emphasized was that for games to not be frustrating, there had to be the sequencing of tasks' difficulty and hints. The preliminary data Doolittle collected over the course of his quasi-experimental study was based on over 8 years of his practice. While introductory psychology students did not show significant gains, students in the critical thinking courses and Summer Academic Study Program showed statistically significant gains in the Cornell Critical thinking test and in the Ennis-Weir critical thinking essay test. Doolittle's comments on the games' difficulty and hints resonate with my own experience. I have experience with the game, Terraforming of Mars. It was a board game with complicated gameplay which I studied for at least an hour and could not understand how to play it. There were too many rules to keep in mind, cards to deal with, and resources to manage. Although complicated, the game seemed interesting to me, and I downloaded its computer version where one can play against a computer. The game turned out to be much easier when the computer game took control over the environment and rules. I did not need to study a paper instruction as I could play it and experience game logic firsthand. For the first two trials, I played the game with hints enabled, which explained to me what the game was expecting me to do. The shift into digital format made the learning experience more enjoyable and manageable, and I could successfully play a board-game version of the game later.

In another study, Frasca (2001) suggested that video games can be “a powerful representational form that encourages critical thinking, personal empowerment and social change” (p. 114). He maintained that simulations as a representation form, unlike narrative, “have the potential to represent reality not as a collection of images or texts, but as a dynamic system that can evolve and change” (p. ix). As he noted, simulations are not free of the creator’s bias who designed them in a particular way, but what makes them better than narratives is that players are free in their options to consider the way the game should be played: “the goal of the player would be to analyze, contest and revise the model’s rules according to his personal ideas and beliefs” (p. 113). Frasca proposed two cases of videogame use that are based on the main characteristics of Augusto Boal’s (2008) Theater of the Oppressed, and would empower learners to challenge game rules (p. 113). In part, Boal’s Theater of the Oppressed builds upon Freire’s (2000) Pedagogy of the Oppressed who did not conceive education without a student going through the process of self-awareness in personal and social terms (see Section 2.10). Taking this idea, Boal (2008) creates a participatory theater, where an audience can engage in discussion and reflective practice about a problem being portrayed by a play.

Using Boal’s theater principles, Frasca (2001) introduced “The Sims of the Oppressed”—a possible game modification that would allow players to create game characters and share them in a network. By doing so, this mode would enable learners to critically reflect on characters’ traits: their credibility in relation to real life, and the behavior of other characters in relation to a built character model. It would also allow players to engage in discussion about characters and create their improved versions which may seem more or less plausible depending on the reasons provided. Another hypothetical game model proposed by Frasca is “Play My Oppression”. For this approach, he proposes picking a topic for discussion—for example, "I have trouble telling my parents that I am gay"—and creating a forum of interested individuals. After the forum is created, the topic is broken into several subproblems, which may be depicted in games: the insults of peers, self-perception, and relation to society. With these themes in mind, players modify existing video games to represent the oppressive situation and a possible way out. These “oppressive games” (p. 100) may be about one problem at a time, but necessarily have several player-made versions representing various visions of a problem solution, or experience of being in this role. Players discuss these games on a forum which ultimately fosters their critical thinking. Although Frasca’s cases may have or had some serious limitations (e.g., time-consuming, some programming skills needed), he puts forward an important idea: Certain philosophy, in this case, Theater of the Oppressed, could be applied to existing software to enhance its potential as a medium for raising one’s consciousness (p. 86). Connecting to the central theme of this thesis, Frasca’s work represents how an approach to critical thinking may be introduced in digital games. For instance, some ideas of critical pedagogy and dialectical thinking take shape in characters, actions, and players who collectively play and foster their thinking on a problem. Thus, other games may have a different conception of critical thinking, which we should definitely acknowledge when considering them.

At the same time, Frasca’s (2001) study brings to the fore the importance of ethical and cultural dimensions of critical thinking that should be present in games (see Section 2.8). The inherent themes of ethical importance provide space for critical thinking, which is not limited to skills and dispositions, but also the dimensions of criticality, emotions, and the sociopolitical structures that we live in. There is also a connection to cultural modes of critical thinking to be explored in games. Reference to Frasca’s hypothetical game model, “The Sims of the Oppressed”, mentioned above, is useful when considering cultural differences in critical thinking. For example, one may create characters of Western (formal logic) and Eastern (dialectical thinking) origins of thinking (see Peng & Nisbett, 1999) to expose their cultural modes of thinking in a game context. What would be considered a successful Sim based on these two models? How would these Sims deal with problems and life contradictions? In fact, ethical and cultural dimensions are actively explored in digital games—for example, in serious games on environmental management (Madani et al., 2017), in games for social change such as “GRIS” or “Sky: Children of the light” (Games Archive, n.d.), or in the game exposing fake news techniques “Bad News” (Basol et al., 2020; Gusmanson, n.d.).

One use of digital games proposed by Frasca (2001) above was for learners to create small games representing certain social or personal problems. Yang and Chang (2013) used digital game authorship to enhance students’ concentration, engagement, critical thinking, and academic achievement. They made a 19-week-long experiment in which 67 students were split into experimental and comparison groups. Thirty-two experimental group students designed role-playing games based upon a biology course content while 35 students in the comparison group designed Flash animations based on the same biology content. The experimental results, using MANCOVA for pretest, posttest, and delayed posttest scores, demonstrated significant improvements in critical thinking skills which were measured by the Critical Thinking Test-Level I (Yeh, 2003). Although it was not possible to locate the English version of the test, it was described by Yang and Chang (2013) as using the following five subscales: recognition of assumptions, induction, deduction, interpretation, and evaluation of arguments (p. 337). The authors cite Moore and Parker’s (2009) definition of critical thinking as: “the careful application of reason in the determination of whether a claim is true” (p. 3). As for the theoretical basis for digital game authorship, Yang and Chang (2013) propose to look at the phenomenon through the lens of social constructivism. The theory suggests that students actively construct knowledge through their experiences, and collaboration with other students and teachers (p. 335). Authors note that the key elements of the social construction of knowledge to digital game authorship are collaboration, self-regulated learning, and "learning by doing". Altogether, this study enacts a certain conception of critical thinking: one that resembles critical thinking as reflective judgment (Davies, 2015) discussed in Section 2.3.2. Akin to the theoretical considerations presented above (see Section 2.16.2), this study also emphasizes the socially constructed nature of learning.

At this point, let us now turn to two important points about Yang and Chang's (2013) research. First, the authors address the TPACK connectivity insofar as digital games authorship (DGA) made it possible to deliver biology content while basing it on the ground of social constructivism and collaboration. Second, digital game authorship may be an appealing strategy for developing an epistemological and causal appreciation, and perspective taking—all the important elements contributing to critical thinking. In order to create a game, one needs to understand how things relate on a deeper level: What are the paths one can take in a game? What defines the completion of the game and how should one achieve it? What rules should be broken for the player to not be able to complete the game? Finally, the authors cite corresponding elements of game authorship complexity giving rise to the development and practice of critical thinking in the DGA: evaluation of relevant biology content; creation of believable and engaging characters, narrative, and conflicts; consideration of the game balance and resources such as Health Points scale (p. 342).

Operation ARA (Acquiring Research Acumen) is another great example of a game that teaches critical thinking and scientific reasoning (Halpern et al., 2012). The game utilizes interactive dialogues with avatars and, as the authors report, incorporates the best findings from the science of learning and serious games to produce greater learning gains. These learning principles include active engagement, evidence about human memory, and recall of information ("response generation", p. 94; "spacing effect", p. 95), individualized tutoring and reciprocal teaching, feedback as knowledge of results, and variability of problems and solutions. The game format was utilized to enhance motivation and engagement, and an intriguing storyline was additionally written to achieve these ends. Halpern and colleagues launched two studies to assess the learning gains achieved by playing Operation ARA. In the first study, there were students from three qualitatively different colleges and universities: 17 community college students, 66 state university students, and 53 private liberal arts college students. All the students took pre- and posttests that assessed their knowledge of research methods and scientific reasoning. After taking the pretest, students either played Operation ARA (n = 58) or were assigned to the control group without the game (n = 78). Results from this study suggested that students who played Operation ARA had higher proportional learning gains than those who did not play it. The second study assessed the effectiveness of the different types of tutoring conditions. There were 215 university students split into "high" and "low" prior knowledge groups. All of the students played Operation ARA, but when responding to the game questions, student subgroups received four different tutoring types: (a) no tutoring (control group), (b) vicarious tutoring in which the learner watched an avatar student being tutored by an avatar teacher, (c) adaptive tutoring in which the human learner was tutored by an avatar teacher, and (d) a teaching tutoring in which the human learner tutored the avatar student. Students took two short-answer tests to assess their long-term learning gains: the first, right after the tutoring sessions, and the second after a week delay. An interesting finding here was that students with the least amount of active engagement (vicarious), when compared to students with the most amount of active engagement (a teaching tutoring group), had a statistically larger decay over the course of a week. This suggests that tutoring conditions with higher student engagement produce more durable learning, in line with the learning principle of active engagement (p. 99). Overall, this study puts an important argument forward: Learning in a game is dependent on the type of learning principles involved, and effective use of a game also interacts with how students are tutored when it is used. The success of the game is also evident because various dimensions of TPACK were considered. Researchers introduced the game keeping in mind how the game interacted with the content and pedagogy, and they considered the context in which the game was used. The researchers also posit that a game format may be the best mode for enhancing long-term retention and transfer of scientific reasoning skills (Halpern et al., 2012, p. 99).

One thing evident across the examples of games for critical thinking presented above is that researchers emphasize collaboration whether inside a game, on a forum, or in a class (Frasca, 2001; Yang, 2012; Yang & Chang, 2013), and also highlight the socially constructed nature of learning (Frasca, 2001; Gee, 2004; Spires et al., 2011; Yang & Chang, 2013).

In 2006, Childress and Braswell (2006) wrote that Massively Multiplayer Online Role-Playing Games (MMORPGs), would blur the line between traditional face-to-face and online learning environments. They envisioned that, in time, digital games would grow in terms of interactivity and increased realism and would surely address critical thinking and problem-solving. The researchers projected that MMORPGs would be based on real-life problems and highly social learning. Furthermore, the authors proposed that MMORPGs could adapt to a variety of cooperative learning-based activities which exist in face-to-face mode. Song (2008) shared this position, stating that collaborative educational games are a good means to motivate critical thinking dispositions. In fact, this future is already here with contemporary games featuring complex storylines, multiplayer modes, and problems that require the collective effort of many players. Another insight on this matter is given by Gee (2004) who claimed that learning in collaboration is set up in a way that players consciously and reflectively think about their cultural models about the world, learning itself, and semiotic domain principles (p. 211). Digital games serve as the medium for learners to do so, when social affiliations, abilities, or identities of players are hidden behind avatars and game characters. They also give a foundation for self-reflection, allowing a player to understand one's strengths and weaknesses (Gee, 2004, p. 208). Altogether, collaboration proves to be an effective instructional strategy and game feature which gives space for many activities contributing to critical thinking.

Digital games are a powerful means to make learning engaging and experiential; they can also teach us much about good learning. There is evidence that digital games are used for the development of critical thinking, and they produce learning gains. Digital games can fuel critical thinking and empower individuals to facilitate social change (see Basol et al., 2020; Frasca, 2001; *Games Archive*, n.d.; Gusmanson, n.d.; Madani et al., 2017). Different genres of games may be used for critical thinking including simulation games (Frasca, 2001), games that have an engaging storyline (Halpern et al., 2012), or even authorship of a role-playing game may allow space for critical thinking (Yang & Chang, 2013). This section highlighted that games associated with critical thinking often include different forms of collaboration and build on the socially constructed nature of knowledge (see Frasca, 2001; Spires et al., 2011; Yang, 2012; Yang & Chang, 2013). Section 2.16 served its purpose to explore if digital games can be used to develop critical thinking and had identified the necessary elements required for digital games to develop critical thinking.

2.17 Literature Review: A Summary

It has been a complex task bringing together distinct fields: critical thinking, and digital technology and games. Nevertheless, the creation of the theoretical framework provided the means to structure and connect these fields. The theoretical framework builds upon Davies's (2015) model of critical thinking in higher education by including emerging dimensions in the field, and connecting these to the TPACK framework (Mishra & Koehler, 2006). The theoretical framework helps us to understand the phenomenon of digital technologies and digital games for the development of critical thinking and, ultimately, to answer the research questions.

The first part of this literature review concerned critical thinking and its various conceptualizations. Based on Davies's (2015) model of critical thinking in higher education, I outlined the scope of the scholarship, identified existing debates (see Sections 2.5, 2.10, 2.11), and discussed emerging trends in the field (see Section 2.11). There were several accounts of critical thinking presented in the first part of the literature review. At least three sections of the literature review contributed to our wider understanding of the concept of critical thinking: its relationship to culture, social inequality, and ethical dimensions (see Sections 2.8 and 2.12). The argument that could be taken away from this part of the literature review is twofold. First, conceptions of critical thinking may differ significantly, and it is important to be aware of the way critical thinking is conceptualized within research paradigms. Second, the scholarship of critical thinking is evolving, and includes new dimensions and ideas that have not always been associated or investigated in depth. This adds complexity to the concept and fuels debates that allow the field to grow.

The second part of the literature review addresses digital technologies and how they can be used to promote critical thinking. I have reviewed a selection of empirical evidence and key theories to arrive at two major findings (see Section 2.15 for a greater detail). There emerged a consistent theme of pedagogical practices that can be used to develop critical thinking. These include collaborative learning, student-centered learning, and constructivist learning. The second finding demonstrated a conscious awareness within the field of the relationship between technology, pedagogy, content, and the context in line with the TPACK framework. These findings are informed by the accounts of critical thinking presented in the first part of the literature review. The first part of the literature review assisted in deconstructing studies and theories on the use of digital technology for critical thinking.

Similarly, the TPACK framework provides a platform for exploring digital games and critical thinking. Previously, we examined some examples in which game developers and researchers considered the complexity of teaching and learning with games (see Halpern et al., 2012; Yang & Chang, 2013). Research suggests that it is crucial to look at learning with games as a multifaceted phenomenon, which builds upon considerations of content, pedagogy, technology, context, and their dynamical relation. The research and theoretical considerations provide us with a language to speak about games and their application for learning purposes. It is also important to look at games mentioned in the previous section as featuring a certain concept of critical thinking and enabling certain modes of learning. Viewed from this perspective, we may find that using games to teach critical thinking (e.g., aspects such as reflective judgment or criticality) would employ particular content and pedagogy. Similarly, games that build upon critical pedagogy would emphasize social transformation, the interaction between players, and critical reflection on social problems and practices (see Frasca, 2001). The assumption that I carry to the next chapters of this thesis is that professionals who develop or use digital games for learning share these varying conceptions and would design or use digital games in their practices in different ways. If one wants to teach critical thinking with games, one should be aware of one's own conception of critical thinking—its implications, possibilities, and limitations. Finally, we should be aware that acquiring expertise in critical thinking is a complex task (see van Gelder, 2005), and learning with games may not produce desired outcomes quickly. Being complex systems with many variables in place, games may not always result in learning (see Erhel & Jamet, 2013; Lu & Lien, 2020) as there can be impeding factors including time constraints, limited resources (Denham et al., 2016, p. 70), or teachers' preparedness to use games in their practice (McKenzi, 2020, p. 13; Plass et al., 2015, p. 258).

With this summary, I complete my review of literature concerning critical thinking and digital technology and games. I step into the next stage of data collection to learn what many professionals who participated in this research think about games and digital technology, and how they conceptualize critical thinking and promote it in their practice.

The research questions that define the focus of this study are:

RQ1: In what ways do SMEs in the field of digital technology and education conceptualize critical thinking?

RQ1a: What are the differences in the ways that SMEs conceptualize critical thinking?

RQ2: Do SMEs believe critical thinking can be developed using digital technology?

RQ2a: In what ways do SMEs believe that critical thinking can be developed using digital technology?

RQ3: Do SMEs believe that critical thinking can be developed using digital games?

RQ3a: What do SMEs believe are important elements needed for digital games to develop critical thinking?

Chapter 3: Methodology

In Chapter Three, I present the methodology of the study. I outline the method used for data collection and offer a rationale for its application. In this chapter, I also include data related to the participants, research site, and data analysis procedures. Finally, in this chapter, I discuss ethical considerations needed to be addressed to protect the rights of the participants and the researcher.

3.1 Research Design

This study employs the Delphi method as the research design. It was chosen to collect information from subject-matter experts (SMEs) in order to get their perspectives on how they conceptualize critical thinking and how digital technology and games can be used as a medium to teach or promote critical thinking. In this section, I will argue that the Delphi method is the best suited to answer the research questions.

After the review of the literature, it was clear that there is a lack of empirical research concerning the development of critical thinking through the use of digital games. Various authors had the chance to draw connections between digital games and critical thinking. It was certainly the case that when digital games possess some elements and functionalities suitable for developing critical thinking, further investigation was necessary. It was suggested that additional investigations be carried out to explore what is currently known, then generate and propose hypotheses to be tested, and finally posit recommendations for further research to be conducted in the field.

The Delphi method, used in this study, is an iterative process that consists of several rounds where a group of experts participates to build a comprehensive collective vision of the phenomenon under investigation. In the Delphi method, the views of experts are gathered individually via questionnaires or qualitative interviews (Skulmoski et al., 2007). The results are summarized, analyzed, and circulated several times to allow experts to evaluate a group vision and, if needed, refine their answers. The process is discontinued when collected data reflects a broad range of alternative views on the issue and may be considered as a comprehensive overview of the phenomenon. It also should be stressed that the Delphi method is of great use when knowledge about the phenomenon or problem under investigation is insufficient for a given purpose (Adler & Ziglio, 1996; Delbecq et al., 1975). As Delbecq et al. (1975) suggested, the Delphi method is typically applied when there is a need:

> 1. To determine or develop a range of possible program alternatives;
> 2. To explore or expose underlying assumptions or information leading to different judgments;
> 3. To seek out information which may generate a consensus on the part of the respondent group;
> 4. To correlate informed judgments on a topic spanning a wide range of disciplines, and;
> 5. To educate the respondent group as to the diverse and interrelated aspects of the topic. (p. 11)

Linstone and Turoff (2002) propose the following general definition of the method: “Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem” (p. 3).

At this juncture, having made the case that the Delphi method is useful for addressing certain research problems, consideration for the data collection process also needs to be given. The method to be used in this study was intended to function as an exploratory technique in the sense that it allows for the incorporation of multiple positions of SMEs on the matter, and sheds light on various alternatives to be considered and thought through. At the same time, it is also important to maintain the depth of the collected data. For instance, qualitative research allows for an in-depth investigation of a question, as it provides the opportunity to understand the experiences and position of an individual (Merriam & Tisdell, 2016). However, the main limitation of the qualitative methods is that they do not function well when many SMEs' perspectives need to be solicited. On the contrary, quantitative questionnaires allow for more perspectives to be heard; however, when compared to qualitative methods, they provide rather shallow insight into the perspective of individuals. In fact, this type of difficulty can be addressed by employing a mixed methods research design because it enables the strength of both means of data collection and brings a more accurate and adequate understanding of the phenomenon (Biesta, 2012; Creswell & Plano Clark, 2011). In this sense, Delphi research design is flexible enough to include both quantitative and quantitative methods (Skulmoski et al., 2007). For example, the research conducted by Walker (2013) used the Delphi method as the research design of the study which aimed to establish the content validity of an evaluation rubric for mobile technology applications. Walker conducted four qualitative interviews with a representative sample of SMEs after several rounds of quantitative questionnaires were completed and revised (p. 93). As Walker suggested, these interview data were gathered to provide a deeper understanding of the research questions, and to inform future research in the field (p. 54). In this regard, this study employs questionnaires with open-ended questions to allow an in-depth perspective into SMEs' positions.

The research questions to be explored yielded two additional problems to be addressed. First, there was a need for interaction among various perspectives, where SMEs have a chance to propose their solutions as well as assess the positions of other experts. The justification for this criterion primarily connects to the “infancy” of the research field. In the absence of empirical evidence, emerging perspectives have the only comparative weight as judged by SMEs. When there are many alternatives in place, there should be a mechanism to make sure that positions expressed in the study are not limited to each participant and the researcher but inform all participants and allow for discussion. Thus, certain views of experts may be well supported by others, or on the contrary, a conflict between views of experts may expose underlying assumptions and problems associated with the research questions. Based on the results of the study, well-supported positions, components, traits, and opposing positions could inform future research, as it is of primary importance that they are verified. That also leads us to the second problem: Because the knowledge of the phenomenon may be dispersed between SMEs with varying professional experience, there should be a method to provide an equal right for different perspectives to be expressed and heard, regardless of the SMEs' authority or reputation. The overall requirements for the method to be used could be summarized as follows:

- It should address a variety of different alternatives giving them the same opportunity to be expressed and valued;
- The data collected should be deep enough, rich in description, and meaningful as to be of practical use by the end of the research;
- The varying alternatives should be in interaction with one another—SMEs should engage in a discussion of positions allowing them to agree or disagree on data presented.

As a result, the Delphi method is very well suited to the prerequisites of the study to be addressed. First, it allows for different perspectives to be heard, with a low risk of authority pressure if implemented through online anonymous surveys. Second, if open-ended and close-ended questions constitute surveys to be sent to SMEs, the data collected will include both quantitative and qualitative information. This arrangement is deep enough for meaningful analysis. Finally, the Delphi method allows perspectives to be in interaction with one another, thus exposing data that otherwise would be omitted, and allowing for the creation of knowledge that is based on collective wisdom.

It was anticipated that there would be qualitative interviews forming the fourth round of this Delphi. Initially, the fourth round was designed to get a deeper perspective into research questions. Qualitative interviews have been used in other Delphi studies (see Crotty, 1993; Dawson & Barker, 1995; Walker, 2013) for the same reason they are used in mixed methods research design: allowing greater flexibility in asking questions and follow-up clarifying questions, establishing a better understanding of what a participant meant, observing the emotional response, and so forth. For example, Dawson and Barker conducted five interviews following Delphi surveys “to gain feedback regarding the findings, particularly in relation to applicability and credibility of the results” (p. 122). However, the first two rounds of this Delphi elicited rich data making the need for interviews redundant. Responses gathered in the first two rounds and final comments received in the third round were enough to answer the research questions of the study and draw a bigger picture of the phenomenon under investigation. The number of Delphi rounds is determined by a researcher and judged appropriate under the circumstances of each study (Williamson, 2002, p. 211; Ziglio, 1996, p. 9), and is shaped by the attainment of a consensus, a saturation of data, or absence of new emerging themes. The decision to finish the Delphi iterations ultimately connects to the nature of the Delphi method chosen by a researcher (see Section 3.1.1).

It is also important to clarify that the Delphi method used in this study is a research design rather than a method alone—it informs and shapes data collection, data analysis, research procedures. In addition, there are philosophical considerations of the Delphi that drive the way I analyze findings. I examine them in the section below. For this reason, I take the position similar to Walker’s (2013, p. 80) who in his Delphi study also explicitly pronounces the Delphi method as the research design.

In summary, the Delphi method, adopting both quantitative and qualitative research methods, is very well suited to answering the questions in the study. This section examined the needs that research questions posit for the data collection and analysis and suggests the use of the Delphi research design. The next section extends my understanding of the Delphi method in terms of its philosophical and methodological foundations.

3.1.1 Philosophical and Methodological Foundations of Delphi

It is also important to understand that the Delphi method is not a standardized method used identically in various studies. Mitroff and Turoff (2002) hold that a scientific method bears a view of reality that it is conceived to measure or interpret, and the Delphi method is not an exception from this observation. This is to say that depending on what philosophical ground the study is built on, the study may serve different purposes, and the results themselves may be different. Therefore, aside from providing a deeper understanding of the method, the abovementioned authors state that the philosophy underlying Delphi has great practical relevance. This subsection primarily focuses on four philosophies that may drive Delphi, and thus the way it is generally implemented.

Mitroff and Turoff (2002) propose four philosophies that differently ground the Delphi method and its application. These are the Lockean Inquiring System (IS), Kantian IS, Hegelian or Dialectical IS, and Singerian IS philosophies. The Inquiring System here defines how one interacts with the data, theory, and which rules or heuristic principles one applies in the process of inquiry (p. 20). Let us briefly review these philosophies and draw links to the research questions presented in this study.

The first-ever Delphi method, introduced by RAND corporation, was an example of the Lockean IS. Mitroff and Turoff (2002) summarize Lockean IS as a system where truth is considered to be experiential, thus it resides totally in data (p. 20). The truth of content can be assessed when a complex proposition is reduced into simple observations in data, and, later, the validity of these observations is ensured by agreement between different human observers. The “raw data”, e.g., the simple empirical observations, in this model precede theory and are independent of it (p. 21) and thus a design of the Delphi questionnaire based on certain theories would be discarded in the Lockean IS. It is important to emphasize that Lockean IS is “consensual”—the validity of a judgment is dependent upon the degree of consensus between experts, and thus unpopular views or outliers are not considered in the overall agreement statement. The weakness of the Lockean IS as perceived by Mitroff and Turoff is primarily associated with its disconnect with theory. It means that simple empirical observations can be viewed as detached from an observer or theories which shaped one’s way of perceiving them.

Delphi is not Leibnizian in nature, as this IS views theory as something superior or preceding data. Leibnizian IS is about the production of formal models, which try to explain a phenomenon in a symbolic way, detached from the content that Delphi is meant to create. The truth of the formal model does not rest upon the raw data, and its validity is defined in terms of whether propositions can be justified through rational models or arguments (p. 23). Mitroff and Turoff mention this IS to stress that claims concerning the “unscientific” nature of Delphi may be made on grounds of Leibnizian IS. These claims don’t necessarily compromise Delphi, as Leibnizian models may have considerable flaws in social science. For example, it is questionable whether a model builder understood the model to the best extent of its nature, relations, and accuracy (p. 24). This is to say that human thought and social phenomena are not easily quantifiable and understandable in their complex set of relations, components, and differences, to constitute formal models which adequately mirror the state of things.

The Kantian IS gives the same weight to both theory and data and views them as inseparable and interdependent. The theory is built upon the data, and, simultaneously, it is not possible to collect any data without a theory of data collection in mind (p. 26). This is to say that, the truth is “synthetic” (Mitroff & Turoff, 2002, p. 25): it is measured by the ability of the inquiry model “(a) to associate every theoretical term of the model with some empirical referent and (b) to show that (how) underlying the collection of every empirical observation related to the phenomenon under investigation there is an associated theoretical referent” (p. 25–26). Kantian IS attempts to give as many perspectives on the nature of a phenomenon as possible and make a comprehensive overview—it considers at least two alternative theories explaining the phenomenon. Overall, Kantian IS differentiates itself from Lockean IS in the way that it is “contributory” (p. 27) in nature. Kantian Delphi allows for individuals with varying expertise related to a specific problem to build a larger, comprehensive picture of a phenomenon, incorporating the experiences and judgments of many people, while Lockean IS marginalizes outliers.

The Hegelian IS stresses the importance of a conflict between varying positions. In accordance with Hegel’s dialectic, a proposition is put forward, which is then challenged by a counterproposition. It is also synthetic in nature, as in Kantian IS, but it is built around the premise that the truth is born in a conflict between opposing positions. Hegelian Delphi builds two opposite theoretical models which may explain the phenomenon. Then they are related to data in the hope that this will identify underlying assumptions of both theories. As proposed by Mitroff and Turoff (2002), this deep insight allows a decision-maker to better consider phenomenon and be placed in a position where one may create one’s own interpretation of it, i.e., “creative synthesis” (p. 29). Authors propose that Hegelian Delphi is well-suited for complex “ill-structured” (p. 29) problems, such as policy-making, which, because of their nature, will trigger debate.

The final philosophy is the Singerian–Churchmanian IS which is a synthetic metasystem (p. 31). This philosophy includes all three aforementioned inquiring systems as submodels in its design. The Singerian–Churchmanian IS considers all ISs and their associated theories and directions for each case, and then determines which one is the best suited to address the problem at hand. In other words, it is a pragmatic system. Singerian IS even considers a model builder as an integral part of the system, and thus postulates the need to reflect on one's psychology and sociology (p. 32).

Having a brief overview of these models, I can relate them to this thesis's research questions. First, it is evident that Lock's model emphasizes the importance of consensus, and, by doing so, may limit our understanding of the current phenomenon. When experts in this study represent different experience groups and backgrounds, it will be a challenge to attain a consensus between let's say academics and teachers. The resulting consensus may be a compromise, but not a comprehensive picture of varying positions. The three synthetic systems presented above, i.e., Kantian, Hegelian and Singerian, are of great value as they address the limitations of Lock's Delphi. Hegelian IS is "conflictual" (Mitroff & Turoff, 2002, p. 29) in nature, thus it is greatly suited for decision-making processes, and worth the effort because of its practical orientation. It digs deep enough to not overlook elements of a phenomenon that then should contribute to a decision. In my position, Hegelian IS is not the best choice for the current study, as the purpose of this study is to draw a general picture of the phenomenon, i.e., understand how and in what contexts games may be used to promote or teach critical thinking. When the field is not researched enough, it is not a matter of decision-making but rather the task of this research is to inform future research and document existing strategies, understandings, and cases surrounding the use of games for the sake of critical thinking. Under these circumstances, the Kantian "contributory" (Mitroff & Turoff, 2002, p. 27) Delphi is better suited to address the presented research questions. The choice of a Kantian Delphi is a pragmatic one. It is what Singerian Delphi would do: analyze available ISs, and choose the one which better pursues the goal of one's research. The pragmatic choice of Delphi also reflects the ontological position adopted in this study—pragmatism as ontology (Creswell, 2014, p. 10). I find it hard to settle with one perception of reality. In my perspective, constructivism, post positivism, or transformative worldview all can be used to make sense of what is knowledge and explore the social world around us. Thus, by not subscribing to any of these worldviews, I stay open to examining whether any of them may be helpful in exploring a particular research problem.

Finally, knowing and acknowledging that I, as a researcher, am a part of the process of inquiry, I commit to reflect on my social position, cultural background, and other important things which shape my being. By doing so, I expect this study to be conscious of its roots and philosophical underpinnings and thus provide a comprehensive overview of the phenomenon under study.

3.2 Research Participants

A total of 89 international SMEs agreed to participate in the study. Out of them, 36 SMEs participated in Round 1, 22 SMEs participated in Round 2, and nine SMEs were in Round 3. Participant occupations included schoolteachers, technology and/or educational specialists working at schools, professors and academicians, games development professionals, a student, Ph.D. students and candidates, an educational software developer, a consultant-editor, an HR director, and a user experience professional. Section 4.1 gives a detailed account of the 36 participants who explained what they did professionally.

When designing the study, I identified four selection criteria of SMEs to ensure their adequacy for the purpose of this study. To put it another way, the sampling strategy applied was purposive sampling, where criteria included:

- relevant expertise in the fields of critical thinking and digital technology in education;
- the command of English sufficient to express one’s positions and understand the input of other SMEs;

- a diverse professional occupation; and
- a diverse regional location.

To start with these criteria, Hsu and Sandford (2007) reported that it is hard to define any set of standards concerning selection criteria of Delphi subjects. Nevertheless, there is still consensus about certain points, specifically the inclusion of SMEs. In the current study, the main criterion for inclusion is SMEs' expertise in the fields of digital technology in education and critical thinking. As noted by several authors (Adler & Ziglio, 1996; H. Jones & Twiss, 1980), competency in the matter of investigation is the key characteristic of SMEs. However, this competency is hardly a standard as it may be defined differently in various fields of investigation, various research cases, and by different researchers. If one perceives 4 years of experience to be enough to be considered as an expert in a field, it may still be the case that 1 year of dense experience may be of no less value for the research at hand. It is also questionable practice to measure experience in terms of certificates or formal degrees, as experience in the fields of games for learning and critical thinking is not only bound to institutions. Therefore, in order to approach this selection criterion meaningfully, SMEs were asked to participate only if they self-identify their competencies to be in the areas of digital technology in education and critical thinking, and were able to contribute to the study. I made a simple hypothesis that those who were not knowledgeable in the theme would not spend a lot of time answering questions outside of their expertise. This simple hypothesis was proven, as the data collected was rich in description, and related to theories of learning and practical experience. There was only one SME whose conception of critical thinking seemed not to be informed by any literature. This SME did not complete Round 1 and dropped out of the study.

Another criterion for participation in the research is the mastery of English level. Due to researcher's language proficiency, it was the preferable means of communication with

SMEs to collect the data and to allow communication among SMEs. Although it can be perceived as a limitation of the study, this was a pragmatic decision as the incorporation of different languages would mean an increased amount of time and effort to accurately translate provided information and further process it. Such an approach would be out of the scope for the thesis.

The application and use of games are not limited to educational institutions. Learning in games may happen regardless of whether a game was designed for learning purposes or made as an entertaining puzzle. The important point is that people who design, use, or research games may have different yet appealing points of view to contribute to this study. Thus, in order to provide varying perspectives informed by practice in different but connected to digital technology in education and critical thinking fields, the Delphi participants were expected to be teachers, game and educational software developers, researchers, methodologists, subject specialists, and other possibly relevant SMEs not limited to the listed occupations. In this regard, contributory Kantian Delphi has an edge over Lockean consensual Delphi as it:

> attempts to design a structure which allows many "informed" individuals in different disciplines or specialties to contribute information or judgments to a problem area which is much broader in scope than the knowledge that any one of the individuals possesses. (Mitroff & Turoff, 2002, p. 27)

The recruitment of experts was also defined by diverse regional inclusion. In this regard, several authors (Grosser & Lombard, 2008; Smith, 2004) mentioned that the notion of critical thinking may be understood differently in various cultural contexts. Therefore, this research aims to attract SMEs from various regions, although it is not the purpose of this study to research the relationship between critical thinking and culture. In fact, achieving an in-depth understanding of how culture interacts with critical thinking is quite a massive goal.

It would require an introduction of additional questions aiming to elicit cultural properties of SMEs or even designing a different study. This is not possible within the scope of this study and would inevitably shift the priorities of the research. However, the inclusion of SMEs from different parts of the world may possibly lead to a more comprehensive picture of how critical thinking is conceptualized and later incorporated or taught through digital games. Based on the analysis of the results of this study, possible hypotheses regarding critical thinking across cultural contexts may be posited. Thus, future studies involving a larger number of participants may examine the relationship between cultural background and critical thinking.

Two other important criteria pursued to attract SMEs were those reported by Adler and Ziglio (1996), namely, willingness to participate and sufficient time. The Delphi study requires an extended commitment time from SMEs. They are expected to participate in all rounds of Delphi that may be quite time-consuming. At each round, participation involves the requisite study of Delphi reports, and the completion of successive surveys. It is also expected that SMEs leave feedback on data provided by other SMEs. Therefore, the consent form (see Appendix B) was designed to make sure that a potential participant understood how long it may take to go through each round of the Delphi.

3.2.1 Sample Size and Attraction Procedures

The preferable number of SMEs to participate in a Delphi study varies depending on the context. Ludwig (1994) suggested that the number of SMEs is “generally determined by the number required to constitute a representative pooling of judgments and the information processing capability of the research team” (p. 52). The recommended number varies significantly from 15 to 20 SMEs for Ludwig (1994), and just under 50 SMEs proposed by Witkin and Altschuld (1995). The number may also be larger as in the case of Walker’s (2013) study in which he collected responses from 94 participants in the first round of data collection, and finished with a retained number of 65 experts in the third round. In this regard, Delbecq, Van de Ven, and Gustafson (1975) maintain that if a disparate group of experts is involved, the sample should include a much higher number of subjects. Finally, as Skulmoski et al. (2007) note, and as the general knowledge of statistics presupposes, when a larger sample is included, the results of the study become more convincing and the group error is reduced. Therefore, keeping in mind the variety of backgrounds SMEs are expected to represent, it was decided to launch a comprehensive participant attraction company and aim for 100 experts to agree to participate in this study.

In order to reach a large number of SMEs and hit the target of 100 participants, the participant attraction process was done through several media platforms. The contact data of potential participants were found on their academic profile webpages, LinkedIn profiles, games or critical thinking dedicated research units' webpages, Twitter communities, or in Skype communities of teachers and education professionals. Some of the participants were invited during conferences that I attended, and some participants were my colleagues, specifically, educators specializing in critical thinking.

First, a letter for participant attraction (see Appendix C) was designed which then was distributed to potential SMEs. Each letter or message was tailored to attract experts with different backgrounds—those who work in academia, in the IT field, school, or those who belong to a large community of Minecraft in Education users. Personal messages sent via Skype, Facebook or Twitter were also tailored to fit the format of the respective platforms. Overall, 409 emails, 63 Skype, and 24 Facebook messages with invitation links were sent to prospective SMEs. Additionally, there were posts on my Facebook, LinkedIn, and Twitter accounts (see Appendix D) that were updated several times to keep them appearing in the notification feeds of my subscribers or people I have in my social network platforms' contact list. In order to make the appeal for participation visual and informative, a short video for participants' attraction (see Appendix E) was also filmed and posted on YouTube, which was later attached to the posts on the abovementioned platforms.

A substantive number of potential experts were found on the Twitter list, specifically the Minecraft in Education Experts community. The list included over 3000 Twitter accounts of its members. In order to reach these people, I extracted publicly accessible data from their profiles into an excel file using a special browser extension. After that, I was posting calls for participation on my Twitter page every 4 to 5 days. These posts included a reference ("mention" in Twitter terms) to an expert or company's username in the body of the Tweet. Overall, over 2150 usernames were mentioned in my posts. Those who liked or retweeted posts were additionally contacted via direct message on Twitter.

The letters and messages sent to participants were encouraging them to nominate their colleagues for participation in the study. In other words, an online snowball sampling strategy was used to attract participants.

3.3 Research Setting

I conducted online surveys to gather data from SMEs using the Qualtrics online survey software. The correspondence with SMEs was carried out electronically via emails or through telecommunication applications or services. Data collected at each stage of the Delphi was analyzed and presented on the website created to serve as a reporting platform.

The website https://play2think.com was created with WordPress and several plugins, allowing for advanced visualization and interaction between participants and their data. For instance, participants were prompted to engage in interaction and leave any comments related to the presented content (see Figure 5). They were also invited to do so in each consequent survey hosted on Qualtrics.

3.4 Research Instruments

This section explains what research instruments were used in this study and how they were made.

This thesis involved the creation of three questionnaires. Questionnaire 1 was a mix of open-ended and closed questions of 18 items (see Appendix F). The primary aim of that questionnaire was to elicit SMEs' position regarding RQ1, RQ1a, and RQ2:

RQ1: In what ways do SMEs in the field of digital technology and education conceptualize critical thinking?

RQ1a: What are the differences in the ways that SMEs conceptualize critical thinking?

RQ2: Do SMEs believe critical thinking can be developed using digital technology?

Participants were asked to conceptualize critical thinking and give their perspectives regarding digital technology as the medium to promote critical thinking. Examples of questions include: "Could you tell how you understand critical thinking?", "Why does an individual need critical thinking?", or Likert-type scale statement "Critical thinking can be developed using digital technologies". The questionnaire is based on the literature reviewed in this thesis and relates to key concepts and questions of the critical thinking scholarship. For example, Question 10 was informed by Section 2.5 on domain specificity and teaching critical thinking:

Most likely, critical thinking is ...

- General skills and abilities, which can be taught/used across many disciplinary domains (e.g., reasoning ability mastered through the critical thinking course can be used when writing a literature essay and when doing a chemistry lab experiment)
- Domain and problem area specific (e.g., skills needed for critical thinking in natural sciences are different from skills needed for critical thinking in the humanities)

- Another position:
- I do not know

Questionnaire 2 was employed in the second round of the study and collected data relating to the following research questions (see Appendix G):

> RQ2a: In what ways do SMEs believe that critical thinking can be developed using digital technology?
>
> RQ3: Do SMEs believe that critical thinking can be developed using digital games?
>
> RQ3a: What do SMEs believe are important elements needed for digital games to develop critical thinking?

This questionnaire was a mix of eight open-ended and closed questions. For example, Question 1 was designed to answer RQ2a and related to thesis Section 2.15 on digital technology and critical thinking:

> What features/elements of digital technologies do you think can promote/teach critical thinking (e.g., their design, capacity for collaboration, etc.)? This is an essay box. You may explain.

Questions 2 to 6 of the same questionnaire addressed RQ3. For example, Question 2 related to the literature review's Section 2.16, "Most of you suggested that digital games can support the development of critical thinking (24 SMEs). Could you explain what you think are the features/elements of digital games that make them well suited for this task (e.g., feedback, problem-solving, etc.)?". Another question was created to address the theoretical stance of SMEs' as discussed in Section 2.16.2 "Is there an underlying philosophy/theory which you think makes digital games suitable for teaching/promotion of critical thinking?". Question 5 involved a multiple-choice format: "What setting(s) may be the most effective for the promotion of critical thinking through digital games?".

After Round 1 of the Delphi was finished, it was clear that the majority of SMEs had already agreed that digital games can support the development of critical thinking. This was evident after reviewing responses to Round 1 question: “What kind of digital technologies do you believe support the development of critical thinking?” Thus, RQ3 had been already answered and did not need to be posed again in Round 2.

Questionnaire 3 was introduced in Round 3 of the Delphi and was built as a reflective one (see Appendix H). Its purpose was to make SMEs reflect on the data shared before and consolidate their knowledge of the phenomenon. As an outcome of this questionnaire, I expected more refined data and a deeper understanding of emergent themes. SMEs could add final thoughts concerning any part of the Delphi. There was only one question, which was worded as follows:

> By now you have seen the results of Stage 2 and looked again at Stage 1 data.
>
> I ask you to provide your final thoughts and comments about everything you have read and done in this study so far. You may use these criteria to guide your answer:
>
> - Reflect on how the results of Stage 2 may have built on your conception of critical thinking from Stage 1
> - Are there any ideas you disagree with? Why perhaps?
> - What are your final thoughts about technology and digital games for teaching/promotion of critical thinking?
> - Leave any other comments about this study

The underlying logic for deploying the mixed questionnaires was to allow SMEs to answer open-ended questions first. Open-ended questions made it possible to elicit SMEs' positions that could be explained thoroughly and, at the same time, to a lesser extent influence their answers. After responding to open-ended questions, SMEs had a chance to engage with close-ended questions to rate or reflect upon findings derived from the literature review. When designing each questionnaire, I made every effort to ensure that the questions were not ambiguous, did not lead a participant to provide a particular answer, and included neutral and “I do not know” options. The questionnaires were piloted with graduate students and professors of my school, and, based on their feedback, were refined to collect more meaningful and accurate information.

Finally, based on the results of the three questionnaires, it was possible to introduce group vision reports. Questionnaires 2 and 3 also played the role of the feedback and communication platform serving the needs of Delphi iterations. In each of them, I included an additional section in which SMEs could leave comments. For example, the last section of Questionnaire 2, titled “Comments”, featured the following text entry:

> If you couldn’t do it on the website, you are invited to share your position here. Please, propose your comments, suggestions, raise a question, or agree/disagree with anything presented by you or your colleagues during the previous stage.

The produced reports were hosted on the website https://play2think.com and were accessible throughout the study. Apart from reporting data collected through questionnaires, the website also served as a primary instrument for SMEs' interaction with the data. SMEs could highlight any text and press CTRL Enter to leave their comments, reflection, agreement, or disagreement about any part of the report (see Figure 5).

Figure 5

A Screenshot From the Website Featuring Instructions on Delphi Procedures

How to proceed?

It is a Delphi study, which means that you are welcome to express your position about the information provided by you or your colleagues.

You may disagree, agree or propose anything else related to what you see on this webpage.

To do so, please, highlight a block of text you are referring to and press **CTRL+ENTER** to leave your comment.

You may leave as many comments as you wish.

3.5 Procedures

This section explains the procedures of Delphi designed to conduct this study. The general process of conducting a Delphi technique can be set out in three stages (Cohen et al., 2011, p. 357). As the authors recommend, the process of data collection starts with a request from the researcher to fill the surveys sent to expert participants. In the second stage, a researcher collects responses and "collates them into clusters of issues and responses" (p. 357). The collated report is then passed back to experts for their feedback, comments, further discussion, and identification of possible issues and priorities. In essence, experts are presented with a "group response" (p. 357) which may document similarities or differences. Experts are asked to react to it. Cohen et al. (2011) suggested that, when adopting this approach, an expert has a chance to agree with this report (i.e., move from small individual disagreement to a general group agreement) or indicate a more substantial disagreement with a group response. Finally, in stage number three, the process becomes iterative and proceeds until it is no longer needed.

Hsu and Sandford (2007) advise that the final point of Delphi is determined when the consensus is achieved, and it usually takes up to four rounds to collect the required information. While this procedural recommendation may work well for Lockean consensus-building Delphi, it should be stressed that the current Delphi reflects the contributory Kantian IS philosophy. In Mitroff and Turoff's words (2002), "the explicit purpose of a Kantian Delphi is to elicit alternatives so that a comprehensive overview of the issue can take place" (p. 27). Thus, when determining the final point of Delphi iterations, I strived to build a comprehensive overview of the phenomenon, and make sure that alternative positions were heard. In this regard, Delbecq et al. (1975) suggested that a two or three-round design is enough for most of the Delphi studies. In addition, Skulmoski et al. (2007) speculated that when the purpose of Delphi is not to build a consensus but to understand qualitative nuances, it takes less than three iterations with a homogeneous sample (p. 11). In this study, I took on a practical approach proposed by several scholars (Hasson et al., 2000; J. M. G. Jones et al., 1992) who maintain that the number of rounds is more of a pragmatic matter, and when more than three rounds are in place, there is a growing need to balance time, cost, and participant engagement.

To start with the actual procedures of my research, I contacted SMEs inviting them to participate in the Delphi study. The SMEs received messages and emails with the link to the study subscription form (see Appendix C). Following the link, they could read an informed consent form and agree or disagree to participate in the study (see Appendix B). If SMEs agreed to participate, they had to input an email address that would be used for communication throughout the study. After that, all 89 SMEs received another email with an anonymous link to the first questionnaire of Round 1.

I decided that the first questionnaire mainly dedicated to the theme of critical thinking and answering RQ1, RQ1a, and RQ2 would have one iteration (see Appendix A). During the first round, Questionnaire 1 was sent to SMEs. For the second round, together with group report one, Questionnaire 2 was sent to experts. Keeping in mind that the question of digital games as a means for the development of critical thinking is not an area that is well researched, it was decided to give extra space for SMEs to share their positions and reflect on others. Therefore, Rounds 2 and 3 were dedicated to the themes of digital technology and digital games in relation to critical thinking. It means that there were two Delphi iterations in place. Overall, the research consisted of three rounds—three questionnaires and three group vision reports sent to SMEs. The rationale for this decision was twofold. First, the main limitation of the Delphi method is that it is time-consuming and there is a high risk of a lower response after each iteration (Hsu & Sandford, 2007). In this regard, Witkin and Altschuld (1995) believed that no more than four questionnaires should be sent to the same experts. Secondly, it is evident from the literature reviewed that the question of conceptualization of critical thinking is already well-researched, such as the Delphi study of Facione (1990), and the matter of teaching through the means of digital technology is also better articulated throughout the literature. However, as the relationship between critical thinking and digital games is a considerably newer research topic, it may take more time and effort for experts to build a comprehensive picture of the phenomenon.

The overall procedures of the data collection and analysis performed are summarized step by step as follows (see Appendix A):

- The data collection and analysis stage started after the Research Ethics Committee gave its permission for the study to be implemented;
- A list of prospective participants was collated, and they received emails and messages asking to participate in this study (see Appendix C);

- During the first round, Questionnaire 1 aimed at eliciting SMEs' position towards RQ1, RQ1a, and RQ2 was distributed via an anonymous link through Qualtrics emails;
- The data derived from Questionnaire 1 were clustered and summarized, and constituted the Group Vision Report 1, https://play2think.com;
- During the second round, the anonymous link to Questionnaire 2 dedicated to RQ2a, RQ3, and RQ3a was sent to SMEs. SMEs also received the Group Vision Report 1;
- The results of Questionnaire 2 were summarized to constitute Group Vision Report 2, https://play2think.com/stage-2;
- During the third round, the anonymous link to Questionnaire 3 aimed at eliciting feedback and final comments on the results of the previous round and was sent to SMEs. Group Vision Report 2 was available at https://play2think.com/stage-2;
- The data from Questionnaire 3 were summarized to clarify and complement Report 1 and Report 2 produced earlier. SMEs were sent the final version of the group vision report.

The data collected through a number of Delphi iterations were collated, analyzed, and discussed in relation to the theoretical framework of the study.

3.6 Data Analysis

In the section below I explain how I analyzed the quantitative and qualitative data collected, and how I represented these data to SMEs. Reoccurring techniques of data analysis used in the thesis can be found in this section. However, some data analysis points belong in chapters dedicated to the corresponding round of each Delphi.

There were several open-ended questions throughout this study, which asked SMEs to provide an elaborate answer. For example, the first open-ended question of Questionnaire 1 asked SMEs to define critical thinking. All 36 SMEs participating in Round 1 wrote their explanations of the concept. The exact question wording was as follows:

> Question 3. Could you tell how you understand critical thinking? Perhaps you could begin by completing the following sentence: ‘To me, critical thinking is ______________”.
>
> In your definition, you can mention:
>
> - An example of your use of Critical Thinking in your setting that illustrates your concept of it;
> - Elements which are central to Critical Thinking and relation between these elements.
>
> This is an essay box. Please, explain your position thoroughly.

When I received the data, I had to make sense of it not only for the purposes of data analysis for the thesis itself, but also to produce a Delphi report out of the first round, which then would be used by SMEs to interact with the data and observe how it is collectively conceptualized by them.

The first action one may take when analyzing qualitative data is to use a theoretical framework of the study to code data and assign categories, build hierarchies, and then report on occurrence of certain codes, group ideas which resembled one another, those which conflicted, and report on original ideas (Miles et al., 2014).

For qualitative data analysis, I used the online service, ATLAS.ti Cloud. This service allows data to be coded, noted, and also provides great functionality when working with already assigned codes. One may look into the frequency of codes’ occurrence in the text, group them, and look only into excerpts from the text which correspond to a particular code or set of codes. Each open-ended question constituted a separate ATLAS.ti document which I coded and united codes into themes (see Figure 6). I also created a separate ATLAS.ti Cloud document including data from several questions paired with occupational data of an SME. This was done to introduce a continuity between different questions defining the same concept or aspect of a phenomenon. For example, there were seven questions relating to the concept of critical thinking which were grouped together to see a bigger picture of the SMEs' conception dispersed in several questions (see Figure 7).

Figure 6

Open-ended Question Coding in ATLAS.ti Cloud

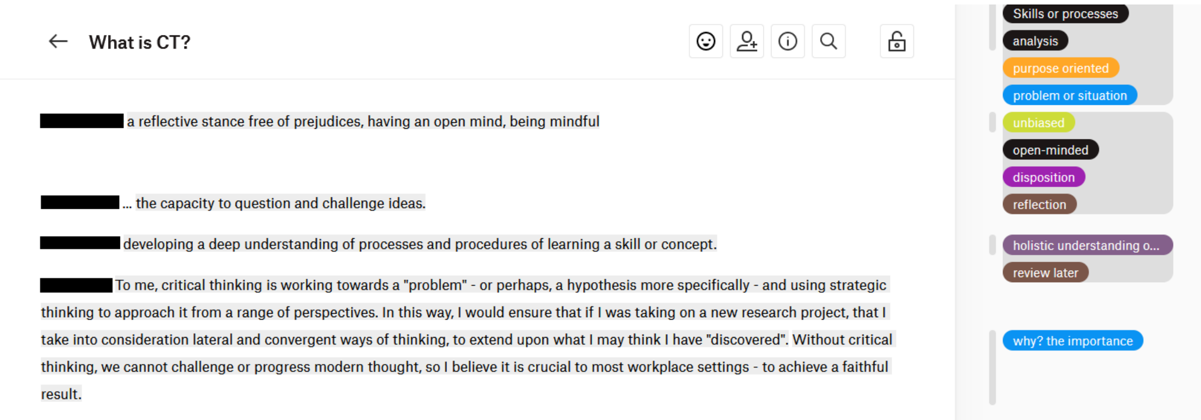
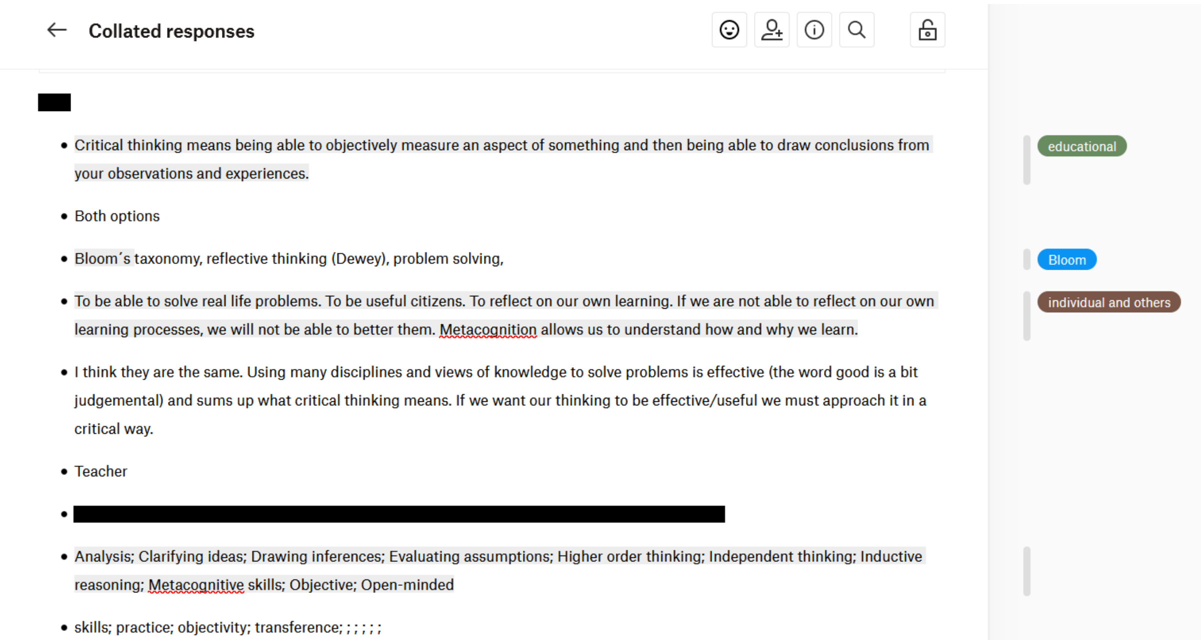


Figure 7

A Set of SME's Answers to Questions Relating to Critical Thinking Concept in ATLAS.ti Cloud



Note. ID and occupational data of this participant are hidden to maintain one's anonymity.

Having uploaded responses of the SMEs to Question 3 asking to define critical thinking, I started to analyze the data using coding and categorial grouping. The first thing which was clear about the definitions provided was that they were not uniform. Some SMEs would explain processes involved in critical thinking, others would explain why critical thinking is needed at all, many would bring dispositions of a critical thinker and others would outline a general stance towards things happening around an individual. At this point, the literature studied and theories examined played a crucial role as they helped me process data, create codes, and themes.

The list of codes for this question constituted 42 entries, including the "review later" code for entries that were not clearly worded and required additional consideration. When such codes appeared, I contacted a fellow academician asking her to read and explain what this entry means in her opinion. If our understanding matched, then the note was coded accordingly. Otherwise, it was coded after thorough consideration and discussion, keeping in mind that an excerpt's interpretation should be made very cautiously to ensure misinterpretations.

When it is clear that each definition was complete if it was taken as a whole, it was still the case that it did not make sense to list all definitions in a line and then present them in this thesis as they stand in a text or present the overwhelming amount of information to SMEs in Round 1 report. That is why to process these definitions and make them accessible for consideration of SMEs and readers of this thesis, it was decided that the analysis of the open-ended questions in this thesis would proceed in the following way:

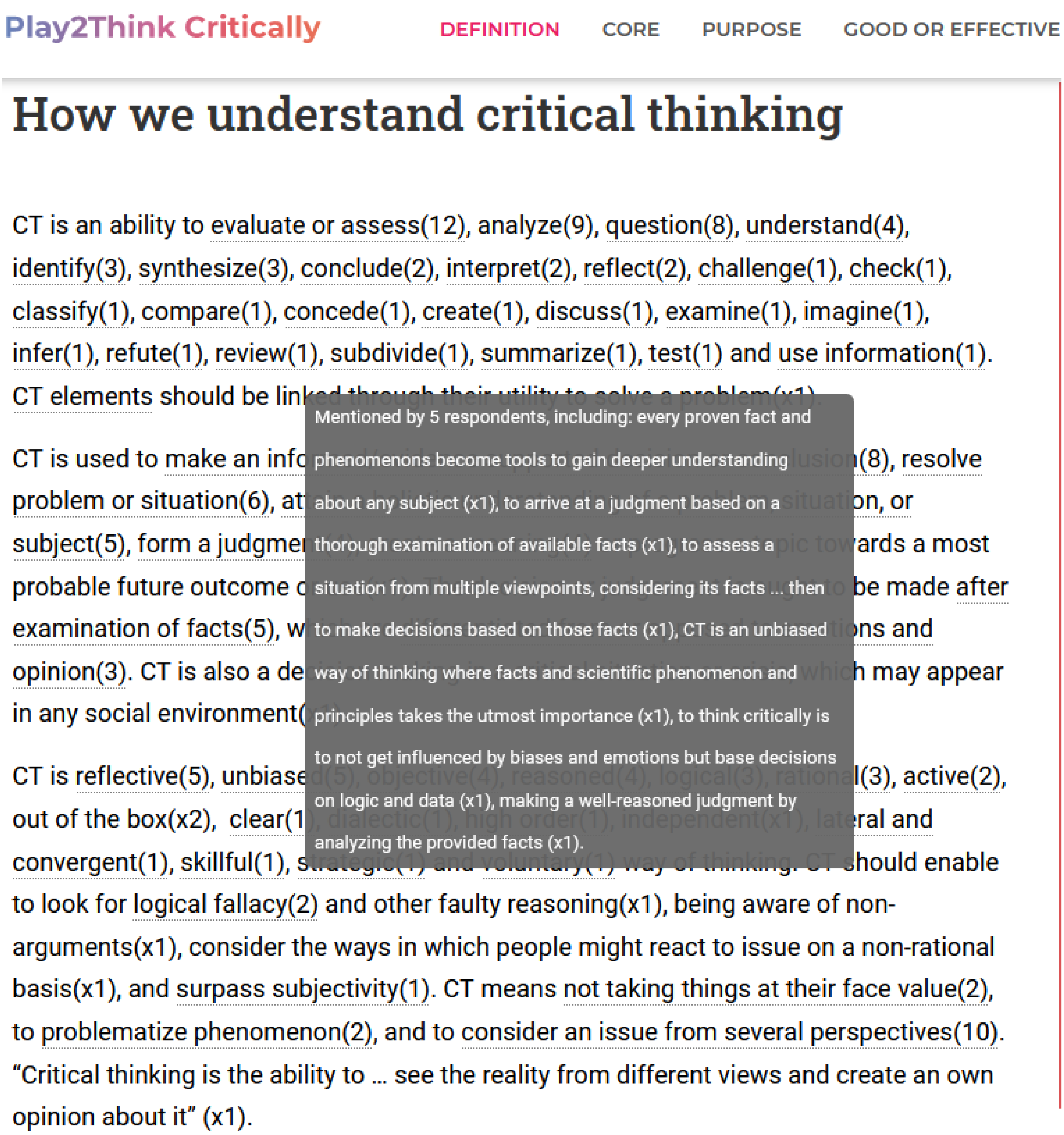
1) Code raw data;
2) Group assigned codes into categories;

3) Present a collated definition of critical thinking made of categories with each category including ideas grouped by their corresponding codes;
4) Indicate the frequency of certain codes' occurrence, so an SME may see how many times a certain idea was mentioned;
5) Make codes expose particular meanings assigned by participants. E.g., if one participant suggests that critical thinking is "to evaluate and analyze the situation", and another suggests that it is "evaluation of a problem", then it should be deducible out of the code "evaluate" that one SME meant evaluation of the situation and another problem.

Thus, it was decided to devise a visualization system, which would effectively present collected data, and in particular, address and reflect the nuances of the qualitative data analysis process as described above. The created website, https://play2think.com, served as a reporting solution. To start with, it was not technically hard to create a collated definition that uses codes and themes as an internal structure. However, the need to present particular meanings assigned by participants and as categorized by me in codes required the use of additional tools. In order to solve this problem, I used a tooltip plugin that allowed the text to be displayed when the cursor hovered over certain words or phrases in the website (see Figure 8).

Figure 8

Website Screenshot Representing Critical Thinking Definitions



In order to showcase the frequencies of certain codes’ occurrences, I introduced two types of notes which were used along the codes. First, a number in brackets after a word or expression stood for the number of SMEs who mentioned this idea or concept. For example, “analyze(9)” would mean that nine SMEs in one way or another believed that critical thinking was associated with the process of analysis. But it is still not detailed enough as one may need to know what “analyzed” is meant to mean, or what the particular concept or idea incorporates. That’s why one could see a second type of note: “Critical Thinking elements would include objective and unbiased analysis, informed decision making, and be able to communicate effectively”(x1); see Figure 8 above for this type of note. A number with the prefix “x” is meant to depict that this is an idea from an SME, specifically it is the closest paraphrase or quotation of the original message. Therefore, the distribution of different frequencies are depicted in several ways as per the following examples from the website:

- analyze(9): there are nine SMEs who mentioned this concept or idea, but it is an umbrella term that includes different aspects of the meaning. In other words, this text needs clarification. Therefore, the word is underlined, which means that if one hovers over it, one may see particular meanings assigned to this concept;
- “The basis of all scientific reasoning”(2): two SMEs suggested this idea. It is a direct quotation of one SME. One of the SMEs words were quoted as they best convey the idea of two experts. If one hovers over it, one may see what was said by the second SME;
- To not be vulnerable to propaganda(1): this word is taken from a larger piece of text and, and, although conveys the main idea, it needs further placement in its original context. One may hover over it to explore the context;
- “[CT] seems more like a way of approaching life, rather than certain heuristic list of things to check to form a judgment”(x1): this is a direct quotation, one SME shared this idea.
- We may apply the concept of critical thinking to a lot of different contexts(x2): that’s a paraphrase of two SMEs. This idea needs no further explanation. That’s why it has the “x” index.

The analyzed data was coded and grouped by themes. Codes were counted and represented as they stand in the definition. Tooltips were also added for ideas or concepts which needed clarification, and to give information about the context from where they were taken.

The quantitative data gathered in this study was mostly analyzed in terms of the frequency of occurrence. For example, one may find how many experts in Round 1 answered “yes” and “no” to the question “Is it possible to measure critical thinking?” (see Section 4.2.5). There were also questions generating a great amount of quantitative data e.g., Question 6 of Round 1 asking SMEs’ to provide a list of core critical thinking elements and Question 7 of the same round asking SME’s to choose 10 words that they think were the most relevant to the concept of critical thinking. In order to present the frequency of their occurrence for SMEs, I created frequency tables. These tables allowed website visitors to sort codes and elements alphabetically, and by the frequency of their occurrence (see https://play2think.com). In addition to the website, one may find these tables in Appendix J.

3.7 Ethical Considerations

This section addresses ethical considerations to be considered in this research in order to protect the rights of participants and the researcher.

Cohen et al. (2011) maintained that the advantages of the Delphi method include “clarity, privacy, voice and collegiality” (p. 358). As the authors go on to note, the Delphi method engages with the issues of anonymity, confidentiality, when disclosing relevant information and protecting participants’ privacy. In fact, it is a big advantage, as the Delphi method allows for positions to be expressed, when reducing “the effect of dominant individuals” (Dalkey, 1969, p. 16). On the other hand, as Dalkey suggested, the face-to-face group discussions more often lead to the degradation of the group estimate. At the same time, the geographical spread and the communication via emails, can reduce such deficiencies of group dynamics as manipulation or pressure to conform a certain viewpoint (Oh, 1974). Finally, Dalkey (1969) proposed that anonymity and group responses provide a way for shared responsibility which releases respondents from any inhibitions.

This study took every effort to follow the ethical code of social science research. For instance, SMEs received an informed consent form, which outlined the agenda of the research, the time required, and the mode of participation. SMEs were informed that they have a right to withdraw from the study at any moment of their participation without any penalty and that the data they provided would be kept securely.

The core of the Delphi study is the anonymity of participants. The link to the questionnaires distributed in emails was generic and nonpersonal, protecting SMEs' identity.

As part of the Nazarbayev University Graduate School of Education policy regarding the ethical conduct of a researcher, I completed the research ethics online tutorial—CITI training—and obtained approval to conduct my research from the research ethics committee. There were minimal risks associated with participation in this research.

3.8 Limitations of the Delphi Method

This section elaborates on the limitations of the Delphi method. I overview envisioned limitations and strategies applied to reduce their influence.

The primary limitation that I identified before the data collection was the amount of time consumed when using a Delphi methodology, for both participating experts and the researcher, together with the possible attrition of experts with each consecutive round (Hsu & Sandford, 2007). The engagement of SMEs is a crucial component, as Ludwig (1994) proposed the motivation of experts is the key to the successful implementation of a Delphi study. I have been arguing that, in order to keep the involvement of experts, the design of the study should be balanced with the lowest number of iterations of the Delphi while retaining enough rounds to build a comprehensive picture of the phenomenon. I acknowledge that attracting a relevant number of experts was a challenging task. In my study, 36 SMEs participated in Round 1, 22 SMEs in Round 2, and nine SMEs in Round 3. The decline in engagement goes in line with what was mentioned in other Delphi studies. I made every effort to attract as many SMEs as possible knowing about SMEs dropout observed in other studies. There was a massive attraction campaign with well-thought attraction materials and over 2600 potential SMEs were reached. I also implemented the strategy to ask most of the needed questions in two initial rounds of Delphi. While only nine SMEs participated in the reflective Round 3, most of the data was received during the initial two rounds. The dropout of SMEs is a limitation, but I believe that its magnitude was lessened by the actions described above.

Another risk reported by some authors is the potential of molding opinions (Cyphert & Gant, 1971; Scheibe et al., 1975). An experiment conducted by Scheibe, Skutsch, and Schofer (1975) proposed that the initial judgment of experts may be distorted if the researcher provides inaccurate feedback. Cyphert and Gant (1971) reported the same findings under similar treatment conditions. These researchers concluded that the Delphi method could "be used to mold opinion as well as to collect [data]" (p. 273). Witkin and Altschuld (1995) have also acknowledged that there could be "subtle pressure to conform with group ratings" (p. 188), which is a considerable drawback of the Delphi method. In this regard, Hsu and Sandford (2007) suggested "to be cognizant, exercise caution, and implement the proper safeguards in dealing with this issue" (p. 5). This possible limitation was kept in mind at each stage of this Delphi study. In this respect, extra caution was employed by using peer checking methods to ensure that the questionnaires and feedback provided to participants were not leading. At the same time, this Delphi is not consensual—there was not a purpose and strategy to come up to an agreement upon the phenomenon under investigation. Each SME could reflect on a position of colleagues by using the website reporting feature or by leaving comments in the second and third questionnaires. Throughout the course of three Delphi rounds, I received eight comments on Round 2, and 11 comments on reflective Round 3 (nine comments through Questionnaire 3 and three comments left through the website). The analysis of these findings indicated that SMEs did not choose to change their position after seeing what their colleagues shared. Overall, it means that this limitation had a lesser chance to emerge due to the contributory nature of this Delphi, and the use of peer checking methods.

One final challenge that arises when using the Delphi design is the assumption that all experts are of similar high expertise when this is generally not true (Altschuld & Thomas, 1991). Altschuld and Thomas proposed that some experts may possess a deeper knowledge about certain questions, while others have better expertise about other questions. Therefore, Hsu and Sandford (2007) cautioned that the Delphi method may result in general statements regarding an issue rather than specific related information (p. 5). In order to reduce the risk of this possibility, the attraction of experts was carried out as carefully as possible, ensuring that SMEs were suitable for the focus of this study. The depth of the collected data proves that this possible limitation was accounted for and mitigated.

Chapter 4: Round 1

This chapter provides a comprehensive overview and analysis of data collected during Round 1 of Delphi. It also draws implications and makes sense of data in relation to the literature previously examined and the theoretical framework of this study.

Round 1 of the Delphi study was designed to answer the following research questions:

RQ1: In what ways do SMEs in the field of digital technology and education conceptualize critical thinking?

RQ1a: What are the differences in the ways that SMEs conceptualize critical thinking?

RQ2: Do SMEs believe critical thinking can be developed using digital technology?

Also, Round 1 partially answers RQ2a: In what ways do SMEs believe that critical thinking can be developed using digital technology?

The results of Round 1 are organized in several subsections with headings corresponding to questions' numbers in Questionnaire 1 (see Appendix F). After the reporting of findings, Section 4.4 documents the analysis of data in relation to the theoretical framework of the study. Finally, Section 4.5 features a discussion on the findings of this round.

4.1 Questions 1–2, 15–18. SMEs' Background Information

In total there were 89 international SMEs who agreed to participate in the study. There were 59 participants who joined Round 1. However, the data analysis included answers of 36 SMEs as they answered at least Questions 1–3 of Questionnaire 1.

SMEs reported their regional background which can be found in Table 3. Some SMEs indicated cities, countries, or regions; some—region and city; some—country and city; and some SMEs—a country, city, or region alone.

Table 3

Countries, Regions, and Cities where SMEs Consider Themselves Local

Countries (number of SMEs who reported them)	India (5), USA (4), Finland (3), Australia (2), Canada (2), France (2), Germany (2), Kazakhstan (2), Netherlands (2), Spain (2), The United Kingdom (2); By one SME from the following countries: Albania, Austria, Belarus, Denmark, England, Italy, Japan, Malaysia, Mexico, Nigeria, Poland, Scotland, Taiwan, Turkey.
Regions (number of SMEs who reported them)	By one SME from the following regions: Almería, British Columbia, Capital region of Finland, Colorado, Florida, Louisiana, North Texas in the USA, Soviet Union, Victoria (Australia).
Cities (number of SMEs who reported them)	Bangalore (2), Paris (2). By one SME from the following cities: Almaty, Almerimar, Amsterdam, Astana, Baltimore, Busto Arsizio, Copenhagen, Denver, Glasgow, Istanbul, Johor Bahru, Lagos, Langley, Madrid, Manchester, Maryland, Melbourne, Minsk, Montreal, Nancy, New Delhi, New Orleans, Riyadh, Saint Petersburg/Leningrad, Shinjuku, Shkoder, Taipei, Tallahassee, Tampere, Varese, Vienna, Xalapa.

Twenty-eight SMEs also reported their highest level of education as shown in Table 4. The majority hold a master’s degree (15 SMEs) and Ph.D. (eight SMEs), followed by SMEs who have a bachelor's degree (four SMEs) and one SME who completed secondary education.

Table 4

The highest level of education of SMEs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Master's degree (e.g., Specialist degree)	15	41,7	53,6	53,6
	PhD or above (e.g., Candidate of Sciences, Doctor)	8	22,2	28,6	82,1
	Bachelor's degree (e.g., Diploma)	4	11,1	14,3	96,4
	Secondary education	1	2,8	3,6	100,0
	Total	28	77,8	100,0	
Missing	System	8	22,2		
Total		36	100,0		

SMEs were asked about their current occupation and how this related to the purpose of this research. Overall, SMEs constituted three groups: school-related professionals, higher-education-related professionals, and technology sector professionals. There were schoolteachers (including a teacher of physics, English, programming, secondary and primary school teachers), teacher assistant, curricular content developer, and school technology specialist responsible for technology in teaching and learning. Participants included professors and researchers specializing in digital sociology, game studies, game design, software engineering, engineering, philosophy, academic skills development, and research on video games for developing students' skills and competencies. Higher education was also represented by three Ph.D. students. The technology sector was represented by game development professionals (including educational games), a developer of learning experiences around video games, an educational technology company director, a technology integrator, and a digital content creator. Finally, there were a consultant-editor, human resources (HR) director, business development specialist in a technology company, and a user experience professional who self-identified their experience to be of fit to the purpose of this research. The presence of a wide range of professionals and their diverse regional backgrounds were highly relevant to this study as there were representatives of various groups who in one way or another deal with digital games—those who design them, those who use them in class, and those who have academic perspective on the phenomenon. Although SMEs provided a more detailed account of their occupation, the data to follow omits any information identifying them personally. Their general occupations can be found in Table 5.

Table 5

SMEs' Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Teacher	8	22,2	22,2	22,2
	Higher education professional	8	22,2	22,2	44,4
	Game development professional	6	16,7	16,7	61,1
	School related education and/or technology professional	3	8,3	8,3	69,4
	Technology sector professional	3	8,3	8,3	77,8
	Other	3	8,3	8,3	86,1
	PhD student / Researcher	3	8,3	8,3	94,4
	Student	1	2,8	2,8	97,2
	Educational technology company's professional	1	2,8	2,8	100,0
	Total	36	100,0	100,0	

In the first round, I asked SMEs to indicate how they see their background may best fit the purposes of the research. They were given four options: “Education”, “Technology”, “Education and Technology”, and “Other”. The majority reported that their background was in the field of education and technology (see Table 6). This was important as the experience needed to answer the research question lies exactly on the intersection of technology and education sectors.

Table 6

SMEs' Professional Background in Relation to this Research

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Education and Technology	24	66,7	85,7	85,7
	Education	2	5,6	7,1	92,9
	Technology	2	5,6	7,1	100,0
	Total	28	77,8	100,0	
Missing	System	8	22,2		
Total		36	100,0		

This data is complemented by the length of experience working in the fields mentioned above. The majority of respondents indicated they had 4 years or more in their corresponding field (22 out of 28 SMEs; see Table 7).

Table 7

Years of Experience in Profession or Activities Related to the Purposes of this Study as Reported by SMEs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Four years and more	22	61,1	78,6	78,6
	Less than 1 year	2	5,6	7,1	85,7
	Two years	2	5,6	7,1	92,9
	One year	1	2,8	3,6	96,4
	Three years	1	2,8	3,6	100,0
	Total	28	77,8	100,0	
Missing	System	8	22,2		
Total		36	100,0		

Finally, SMEs indicated how many years of experience they have had in their profession engaging with concepts of critical thinking. The majority (19 SMEs) had 4 years of experience or more engaged in activities related to the notion of critical thinking (see Table 8).

Table 8

Years of Experience in Profession Engaging with Concepts of Critical Thinking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Four years and more	19	52,8	67,9	67,9
	Less than 1 year	4	11,1	14,3	82,1
	One year	3	8,3	10,7	92,9
	Two years	1	2,8	3,6	96,4
	Three years	1	2,8	3,6	100,0
	Total	28	77,8	100,0	
Missing	System	8	22,2		
Total		36	100,0		

To summarize, SMEs were of diverse regional and professional backgrounds. The majority of SMEs had 4 years or more of expertise in the area of digital technology, education, and critical thinking. Most experts held a master's degree or Ph.D. (23 SMEs), four with a bachelor's degree, and one completed secondary education. The sampling strategy attracted experts who self-identified their expertise to be fit to share their knowledge concerning critical thinking and digital games. SMEs were of heterogeneous regional backgrounds and, thus, may hold different conceptions of critical thinking. This is intended to make the data more diverse, ultimately aligning with the purpose of Delphi in this study as this method was chosen to create a comprehensive picture of the phenomenon.

4.2 Conceptualizing Critical Thinking

There were three essay-style open-ended questions asked to SMEs in Round 1. They were asked about (Question 3) their definition of critical thinking; (Question 5) the reason why one might need it; and (Question 8) the difference between "good or effective thinking" and "critical thinking". Two questions collected information on theories and conceptual models which they believed shaped their understanding of critical thinking (Question 4 and Question 4.1). SMEs had two questions relating to the key components of critical thinking (Question 6 and Question 7). Finally, a block of Questions 9 to 12 dealt with different aspects of critical thinking, such as (Question 9) culture; (Question 10) domain specificity; (Question 11) assessment; and (Question 12) teaching of critical thinking.

This section reports on results collected from the block of 11 questions defining SMEs' conception of critical thinking. The findings presented below mirror those available on the reporting website (https://play2think.com) and were derived on the basis of the analysis procedures that are explained in Section 3.6.

4.2.1 Question 3. The Definition of Critical Thinking as Presented by SMEs

This section presents a collated definition of critical thinking as perceived by SMEs. This definition is based on SMEs' answer to Question 3: "Could you tell how you understand critical thinking?" and created as described in Section 3.6 "Data analysis".

Let us stop at each paragraph of the definition and briefly discuss the logic behind its grouping. The first paragraph starts with processes which in the opinion of many SMEs constitute critical thinking. Evaluation or assessment, analysis, and questioning were the most frequently quoted processes associated with critical thinking. Overall, there were 25 processes identified during data analysis. At the same time, it is important to note that SMEs mentioned these processes coupled with what they are meant to do. Most commonly these processes dealt with information, problem (or challenge, issue), or situation. It is also notable that one SME suggested that critical thinking processes should be linked by their utility to solve a problem, in other words, the problem dictates the processes to be used and not vice versa. This part of the definition is worded as follows:

> CT is an ability to evaluate or assess(12), analyze(9), question(8), understand(4), identify(3), synthesize(3), conclude(2), interpret(2), reflect(2), challenge(1), check(1), classify(1), compare(1), concede(1), create(1), discuss(1), examine(1), imagine(1), infer(1), refute(1), review(1), subdivide(1), summarize(1), test(1) and use

> information(1). CT elements should be linked through their utility to solve a problem(x1).

The second paragraph depicts an outcome-oriented dimension of this definition. Most SMEs suggested that critical thinking is needed to make an informed- or evidence-supported decision or conclusion; solve a problem; attain a holistic understanding of a problem, situation, or subject; make a judgment. It also mentions how decisions ought to be made:

> CT is used to make an informed/evidence supported decision or conclusion(8), resolve a problem or situation(6), attain a holistic understanding of a problem, situation, or subject(5), form a judgment(4), create a meaning(4) or progress a topic towards a most probable future outcome or use(x1). The decision or judgment is ought to be made after examination of facts(5), which are differentiated from or opposed to emotions and opinion(3). CT is also a decision making in a critical situation or crisis, which may appear in any social environment(x1).

The third and fourth paragraphs of this definition incorporate the affective domain of critical thinking: dispositions of a critical thinker and traits of mind. They also include macro-abilities and strategies critical thinkers use. Creative and divergent thinking are also mentioned there:

> CT is reflective(5), unbiased(5), objective(4), reasoned(4), logical(3), rational(3), active(2), out of the box(x2), clear(1), dialectic(1), high order(1), independent(x1), lateral and convergent(1), skillful(1), strategic(1) and voluntary(1) way of thinking. CT should enable to look for logical fallacy(2) and other faulty reasoning(x1), being aware of non-arguments(x1), consider the ways in which people might react to issue on a non-rational basis(x1), and surpass subjectivity(1). CT means not taking things at their face value(2), problematizing phenomenon(2), and considering an issue from

several perspectives(10). “Critical thinking is the ability … to see the reality from different views and create an own opinion about it” (x1).

CT requires flexibility: the ability to recognize your own a priori or beliefs, or that your views can be wrong, and be able to suspend them/alter judgment in the face of new information, facts(3). It is “a reflective stance free of prejudices, having an open mind, being mindful”(x1). CT is “developing a deep understanding of processes and procedures of learning a skill or concept”(x1). “It almost requires certain amount of cynicism and skepticism to [discern statements] based on emotions rather than facts”(x1). CT is when a child thinks outside the box and progresses from simple tasks [which form his imagination] to more challenging(1).

The fifth paragraph relates to a stance critical thinker may adopt and why one may need critical thinking: to learn, work, “challenge or progress modern thought” and other reasons as referenced below.

“[CT] seems more like a way of approaching life, rather than certain heuristic list of things to check to form a judgment”(x1). CT may be used to discern “fake news”(2) and “big claims” which have no foundation(1), “challenge or progress modern thought”(1), learn a language or anything else(1), construct arguments in higher education settings(1), or oppose counterfactual narratives when playing games(1). It is crucial to most workplace settings(1).

Finally, the moral dimension of critical thinking was also introduced in the sixth paragraph:

“Critical thinking is neither good nor bad when looked from a philanthropic point of view it depends on the individual or a group of individuals as to how they are leveraging the potential powers of critical thinking” (x1).

Critical thinking is also about effective communication(x1) and making others think about problem solution(1).

There are also three short definitions of critical thinking which were illustrative of the position of many SMEs:

- "Critical thinking is the ability to think clearly and rationally about what to do or what to believe" (x1);
- "Objective analysis methods" (x1);
- "The term 'evaluative judgement' is a neat alternative [for CT]" (x1).

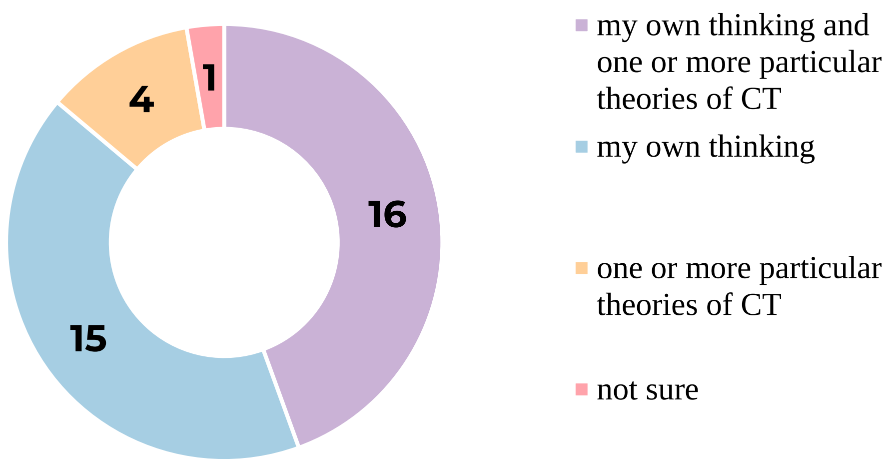
4.2.2 Questions 4, 6, 7. Theories Behind Critical Thinking and Core Critical Thinking Elements

In the text below I report on what influenced SMEs' conceptualization of critical thinking (i.e., particular theories, their own thinking, or both). I also list elements (i.e., operations, behaviors, performances, processes, outcomes, abilities, skills, traits, or dispositions) that SMEs considered to be central to the concept of critical thinking.

In response to Questions 4 and 4.1 SMEs clarified whether their concept of critical thinking was largely (a) a product of their own thinking; (b) a product of one or more particular theories of critical thinking; (c) both options; or (d) not sure (see Figure 9). Here, SMEs were prompted to list theories or conceptual models shaping their understanding of critical thinking if they chose options (b) or (c).

Figure 9

SMEs' Responses to Question 4: "My Concept of Critical Thinking is Largely a Product of … " (Number of SMEs)



We can see that more than half of SMEs (20 SMEs) answered that their concept of critical thinking was influenced by various theories. The most common one was Bloom's taxonomy with seven SMEs making reference. There were more theories and individuals mentioned only once, e.g., Diane Halpern's concept of CT, Michel Foucault's discussion of "problematization", or Hegel's dialectical philosophy (see Appendix I for the full list of theories and authors).

After providing their definition of critical thinking and listing relating theories, in Question 6 SMEs were asked to come up with items (i.e., operations, behaviors, performances, processes, outcomes, abilities, skills, traits, or dispositions) which they considered to be at the core of the critical thinking concept. They could type up to 10 core items. A number of experts identified questioning (10 SMEs), logic (7 SMEs), not taking things for granted (7 SMEs), operations with concepts (6 SMEs), open-mindedness (6 SMEs), reasoning (6 SMEs), and other less frequently mentioned items as core critical thinking elements (see Appendix J and Table J1 for the whole list of items).

Finally, Question 7 was adopted from Howe's (2000) comparative study on how critical thinking was conceptualized by teachers in British Columbia and Japan, it listed 50 critical thinking definers which were taken from the literature review and pilot study made by the author (p. 57). I have added the additional identifier "epistemological understanding" and let SMEs pick 10 of the most relevant to critical thinking words:

Question 7. These words have been used before to describe critical thinking. Choose 10 words that you think are the most relevant to the concept of critical thinking

These data suggest that more than half out of 29 responded SMEs believe that "identifying/removing bias" (16 SMEs), "open-minded" (15 SMEs), and "problem-solving" (15 SMEs) are the most relevant to critical thinking words. Less frequently mentioned items included "independent thinking" (14 SMEs), "analysis" (13 SMEs), "evaluating assumptions" (11 SMEs), "logical" (11 SMEs), "reasoning" (11 SMEs), and others. Overall, SMEs chose 47 out of 51 of the items presented (see Appendix J and Table J2). Four items were not chosen at all: "significance", "specificity", "student-centered", and "subjective".

4.2.3 Question 5. Why Does an Individual Need Critical Thinking?

Question 5 asked SMEs why an individual might need critical thinking. These data could be split into five broad categories which are nevertheless interwoven.

The first category belongs to more abstract aims of having critical thinking. The most frequent reasons were making decisions, dealing with problems, and reaching conclusions (13 SMEs altogether). Another theme mentioned in this category was to use critical thinking for identifying truth from fiction and falsehood (4 SMEs) and building a holistic understanding (4 SMEs). The full list of reasons with their frequency count for the first category looks the following way:

To make the best possible(1), judicious(x1), structured(x1), "informed(2) decisions about how to act or make a choice"(x1), decisions based on debate, discussion, and

> analysis(1), and not dictated by "emotions, blind belief in faith, and falsehoods"(x1) or "feelings and bias"(x1). "Critical thinking is the basis for logic and reasoning"(x1), for reaching conclusions based on extensive questioning(3). CT is needed to deal with problems(2): find new solutions(1), solve real-life(2) or complex(1) problems, respond quickly in a crisis situation(x1). To achieve a goal in a variety of ways by removing standards and frameworks(x1), think out of the box(x1). CT is required for identifying truth from fiction/falsehood(4), attaining a holistic understanding(4), creating a meaning(1), and "learning how to question all assumptions and claims before accepting any of them on face value"(3). It helps us realize "the multi-fold impact of interconnected things which leads to a conclusion/consensus"(x1). It "is the basis of worthwhile actions into the future – projection, forecast, etc."(x1). "Thinking clearly and systematically can improve the way we communicate or express our ideas"(x1).

The second category of reasons included concrete contexts and areas of application. SMEs mentioned the importance of critical thinking in higher education and scientific reasoning (3 SMEs), for success in education (3 SMEs), career (2 SMEs), and its applicability to a lot of different contexts (2 SMEs). The full list of reasons in this category is as follows:

> Critical thinking is "the basis of all scientific reasoning"(2). The "critical thinking approach is correlated with higher education"(x1), it is "at the heart of the philosophical roots of higher education"(x1). We may apply the concept of critical thinking to a lot of different contexts(x2) or topics, "especially complex ones like language, rhetoric or in computational thinking"(1). CT is needed to "be able to understand the world around"(x1) or "avoid arriving at a faulty understanding"(x1), and "to be able to act on that understanding to ensure human survival"(x1).

> "Being able to 'critically think' … will lead to more happy people who know what is their place in the world, city, job, family, etc."(x1), who can "navigate"(1) and "succeed in life"(x1), it is a "life-saving skill in the long run"(x1). CT is needed to succeed in education(3) and for adults to "have a great career"(2).

The third category is titled "individual dimension" and includes reasons in relation to the development of an individual. Some SMEs explicitly used the adjective "individual" when providing these reasons. SMEs believed that critical thinking enables conscious awareness (2 SMEs), helps to put aside personal bias (3 SMEs), and is needed for self-reflection (2 SMEs). The individual dimension can be summarized this way:

> CT "enables a conscious awareness in an individual"(2) "to not take things at their face value"(2), carefully consider information "before forming a part of our personal belief system"(x1), "put aside their own biases"(2) and "free an individual from preconceived beliefs"(x1). "It helps in self-reflection, self-monitoring, and being self-corrective"(x1), including reflection on our own learning(1). "With critical thinking comes the ability to be able to accept that there are multiple ways one is doing "wrong" or "inefficiently" in their personal lives, or their views on certain topics are subjective. It is fine to have any ideas, feelings, emotions and opinions, but one should know how and why they think or feel the way they do"(x1).
>
> CT is "essential to be an effective human being"(x1). CT is also "the basis for reaching a certain level of maturity"(x1), it "facilitates a personal transformation"(x1) and is needed to build oneself as an individual(x1), to have an opinion(2).

The fourth category of reasons was social. SMEs recognized the importance of critical thinking for social, cultural, and economic progress (3 SMEs), social justice (1 SME), and is considered to be one of the basic skillsets for modern citizens (3 SMEs):

> Critical thinking “is the engine of progress”(x1): social(x2), “cultural and economic”(x1). “It provides the impetus to generate change and innovation”(x1). CT is “required for sustaining and improving any functioning society [to achieve social justice]”(x1). CT is important(x1) and “vital for modern day society”(x1), it is one of the basic skill-sets for modern citizens(3). “If a society has enough people that can’t think critically, it also means poorly informed leaders will be elected and make decisions that impact people negatively (ex: Trump)”(x1).

Finally, SMEs provided a number of reasons belonging to the political dimension. SMEs suggested that critical thinking is needed to be protected from manipulation by politicians, media, companies, and governments (8 SMEs), be resistant to fake news (4 SMEs) and propaganda:

> To not be vulnerable to propaganda(1), fake news distributed in news outlets and social media(4), “unfounded political positions”(x1). CT is needed “to not be abused by politicians, media, governments, and companies who drive their own products, ideologies”(8). “If a society has enough people that can’t think critically, it also means poorly informed leaders will be elected and make decisions that impact people negatively (ex: Trump)”(x1), it also “resulted in increasingly decisive and damaging politics [the rise of populist views]”(x1). CT is needed “to not be a mere sheep in our totalitarian system where everyone is being brainwashed to comply”(2).

4.2.4 Question 8. A Difference Between "Good or Effective Thinking" and "Critical Thinking"

In Question 8 SMEs were asked whether they believed that there is a difference between "good or effective thinking" and "critical thinking". This question was primarily based on Section 2.1 “What is critical thinking?”. The data obtained landed into three key categories: (a) they are different concepts (22 SMEs); (b) there is no difference (2 SMEs);

and (c) can't conceptualize effective and good thinking or challenged their existence (4 SMEs).

The majority of SMEs believed that "good or effective" and "critical thinking" are different concepts (22 SMEs). The majority of SMEs suggested that critical thinking is a more deep or meaningful version of thinking as compared to good or effective thinking (10 SMEs). Some SMEs also proposed a hierarchical relation between these types of thinking (5 SMEs). Finally, there was some disagreement concerning the moral dimension of critical thinking (5 SMEs) and whether creative or imaginary thinking should be a part of critical thinking (6 SMEs). Below I present the grouping of SMEs' positions as presented on the report website. The text below has explanations, relevant headings, and frequencies of ideas' occurrence guiding one's reading:

> 10 participants describe critical thinking as a more deep or meaningful version of thinking, or/and as one which takes into account multiple perspectives compared to good or effective thinking.
>
> And one participant suggested that all types of thinking have a connotation of doing the thinking in a thorough and focused way.
>
> Good and effective thinking were described as: only thinking about a topic (x1), logical thinking (x1), the ability to make decisions based on quick judgements that often involve assumptions (x1), superficial (x1), anything from pondering wild possibilities to imagining different worlds (x1).
>
> Effective thinking was described as: the ability to reach a solution for a problem (3), thinking used in situations which do not require CT (x1), effective thinking may be convergent (x1).
>
> Good thinking was described as: "critical thinking is not necessarily associated with "good" (in value or moral sense)" (2), good thinking has a lot of subjective elements

(x1), good thinking can occur in imaginative, creative or other states that aren't necessarily critical (x1).

Critical thinking was described as: a deep thinking about solutions and creativity (x1), CT reaches the highest levels of thinking to solve problems and analyze them, find appropriate solutions; the ability to understand a problem, explain it and consider different solutions to it and its consequences (x1), the concept of CT refers to the logical processes for evaluating information (x1), critical thinking always involves the rational and multi-sided application of System 2 [as opposed to good or effective thinking taking place on System 1] (x1), CT is more about precise details so that the decisions are based on deductive logic (x1), critical thinking would involve perspective taking and in-depth communication (x1), critical thinking is not necessarily associated with what may be constituted as either "good" (in a value or moral sense) or "effective" (in a productive sense) (x1), CT is by its definition geared towards making a judgment (x1), CT involves more complexity [as opposed to good or effective thinking] (x1), CT is a hybrid of fact-based analytical thinking and subjective thinking but the subjective thought process is the later part of the critical thinking approach (x1), CT is divergent (x1).

Some of you [SMEs] explicitly proposed an option of the hierarchy, relationship, or subordination between critical thinking and good and/or effective thinking:

- Critical thinking can be good/effective or not, and good thinking can be critical or not (x1);
- Good thinking can occur in imaginative, creative or other states that aren't necessarily critical. However, if you want your thinking to be effective – critical thinking should always be a part of your strategy (x1);

- Critical thinking should be a subset of effective thinking. While critical thinking can be said to be effective, but it should not be the only form of thinking which are effective. For a very experienced person, intuition (hone through years of experience and critical thinking within the scope) can also be a good form of thinking (x1);
- Good or effective thinking is a subset of CT. All “critical thinking” is “good/effective” but not necessarily the other way around. Also, what is “good” for one party in a situation might not be the same from someone else’s perspective (x1);
- Critical thinking is one of the types of effective or creative thinking (x1).

Several experts proposed explicitly confronting positions:

- 3 participants introduce the dimension of consequences or the “moral” dimension of CT, in other words, thinking not only about how to achieve or solve the problem, but consider consequences. However, two experts suggest that the “moral” dimension is not necessarily a part of CT. We may also note that “logical thinking” is differently attributed to critical and effective thinking in these opposing responses. For instance, thinking without considering the moral dimension was qualified as logical only, but not critical. Vice versa, opponents of this position stress that critical thinking is logical thinking, which doesn’t not mean that it has to be moral in nature.
- There might be also a difference in whether creative or imaginary thinking should be a part of critical thinking. Here you may find the position of proponents (4) and opponents (2) [in essence, SMEs who are proponents of inclusion suggest that creative ways of thinking constitute critical thinking.

Their opponents believe that creative or imaginary thinking belong to the concepts of good or effective thinking, but not critical].

The second category was represented by only two SMEs who suggested that good or effective and critical thinking are the same:

- I think they are the same. Using many disciplines and views of knowledge to solve problems is effective and sums up what critical thinking means. If we want our thinking to be effective/useful we must approach it in a critical way (x1);
- No [there is no difference] (x1).

Finally, four SMEs constituted the third category of answers to this question. Three SMEs had challenges defining these concepts and differences between them:

- don't really know what good or effective thinking refers to, but it sounds like it could be in the same category as critical thinking (x1);
- I don't know what is meant by good or effective thinking (x1);
- Difficult to say depends on the material feed (x1).

One SME challenged the existence of good or effective thinking:

> There is no good or effective thinking whatsoever. Nobody can tell you if there is a good/effective thinking because there is no bad or ineffective thinking. Critical thinking gives you the opportunity to think deeply/thoroughly about the information, it opens the doors to different perspectives (x1).

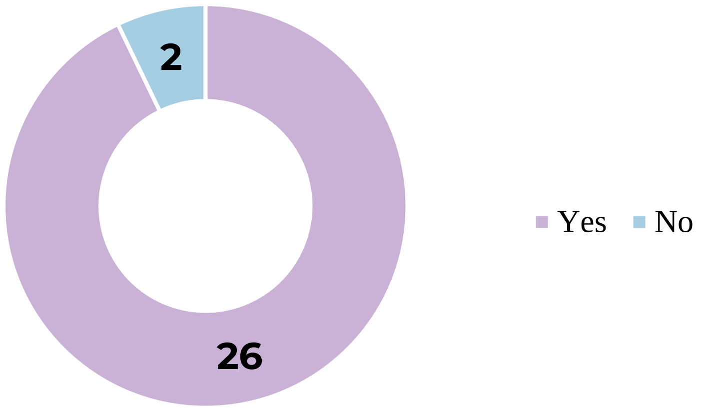
4.2.5 Questions 9–12. Measurement, Domain Specificity, Culture, and Teaching of Critical Thinking

The last subsection dedicated to the concept of critical thinking reports on the answers of SMEs to four questions.

Question 9 was designed based on literature review Section 2.12. The question was worded as “Do you think there is a relationship between culture and critical thinking?” and gave SMEs three response options (a) yes; (b) no; and (c) I do not know. The overwhelming majority (22 SMEs) believed that there is a relationship between critical thinking and culture (see Figure 10).

Figure 10

Do you Think There is a Relationship Between Culture and Critical Thinking? (Number of SMEs)

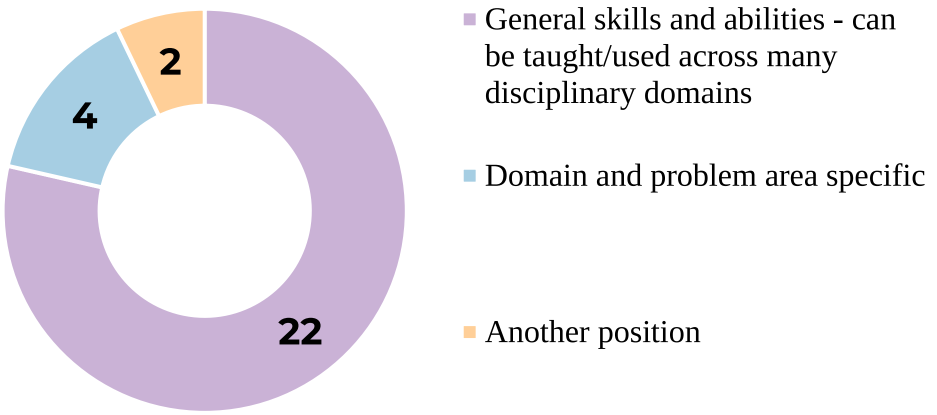


Question 10 was built upon discussion from the literature review’s Section 2.5 about domain specificity of critical thinking. SMEs were asked whether critical thinking is most likely (a) general skills and abilities that can be taught/used across many disciplinary domains, (b) domain and problem area specific, and (c) another position (see Figure 11). The majority of SMEs believed that critical thinking is about general skills (22 SMEs) and four SMEs suggested that it is domain and problem area specific. Two SMEs proposed a different position, with one of them describing a view resembling the position of critical thinking as (a) general skills and abilities:

- Developed by applying skills learned in different domains (i.e.: seeing creatively in photography, thinking creatively in philosophy, writing critically to express observations and thoughts).
- Critical thinking involves making judgments based on reasoning: students consider options; analyze these using specific criteria; and draw conclusions and make judgments.

Figure 11

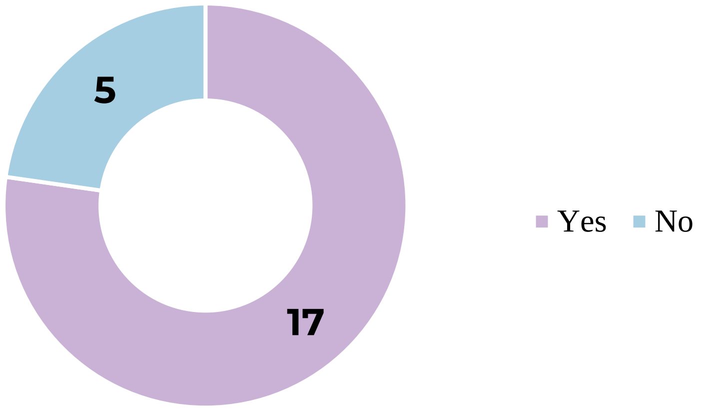
Most Likely Critical Thinking is … (Number of SMEs)



Question 11 was informed by literature review Section 2.1.1 "Schools of thought". The measurement of critical thinking primarily connects to how it is conceptualized and may vary between different accounts of critical thinking. The question was worded as "Is it possible to measure critical thinking?", and gave SMEs three response options (a) yes; (b) no; and (c) I do not know. Seventeen out of 22 SMEs believed that critical thinking can be measured (see Figure 12).

Figure 12

Is it Possible to Measure Critical Thinking? (Number of SMEs)



Question 12 also dedicated to the critical thinking concept asked SMEs whether critical thinking can be taught. It was informed based on Section 2.5 of this thesis. It also connected to related discussions in other sections of the literature review dedicated to particular accounts of critical thinking and their pedagogical implications. SMEs were given three response options: (a) yes; (b) no. The reason for that is ...; and (c) I do not know. All 27 SMEs who responded to this question answered that critical thinking can be taught.

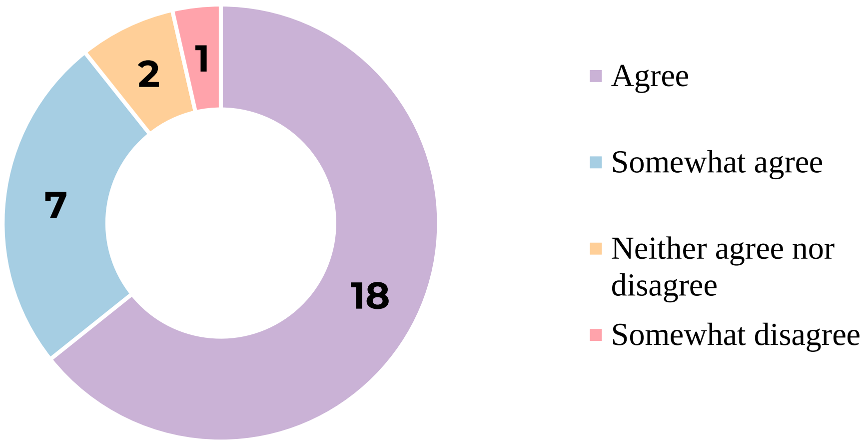
4.3 Questions 13–14. Critical Thinking and Digital Technologies

Questions 13 and 14 of Questionnaire 1 were created to elicit SMEs' position in relation to RQ2: Do SMEs believe critical thinking can be developed using digital technology? and, partially, RQ2a: In what ways do SMEs believe that critical thinking can be developed using digital technology?

Question 13 was a statement "Critical thinking can be developed using digital technologies" with Likert-type scale response options of (a) disagree; (b) somewhat disagree; (c) neither agree nor disagree; (d) somewhat agree; (e) agree; and (f) I do not know. In the note to the question, SMEs were also explained what is meant by digital technologies in this question. These data indicate that the majority of SMEs agreed with this statement (7 SMEs "somewhat agree", and 18 SMEs "agree"), with only two SMEs being neutral and one answering "somewhat disagree" (see Figure 13).

Figure 13

"Critical Thinking can be Developed Using Digital Technologies" (Number of SMEs)



Following the previous question, in Question 14 SMEs were asked about what kind of digital technologies they believed might support the development of critical thinking (see Appendix K for the full report). It was an open-ended question allowing SMEs to write any options. The most cited digital technology was digital games (24 SMEs), with experts specifying the kind of games and the importance of some features. Minecraft was mentioned three times here. Some responses included:

- Coding games: Like code Monkey, Frozen in Code.org, and Minecraft Education Edition (x1);
- they [games] would be most effective in cooperative environments (x1);
- if they can provide access to multiple ways of viewing issues, and show systemic consequences of decisions (x1);
- in the right game, critical thinking is required to advance – the learning activity is built into the game (x1);

- digital games through their experiential interactive nature (x1);
- To be noted they [games] can also be used negatively (a blog can spread disinformation) (x1);
- MMOs, “match three” games/apps, really any digital game with levels/consequences/scenarios (x1);
- Digital games are promising tools to teach critical thinking as they inherently promote systems thinking, decision-making, and interactivity. But again design is important, some digital games can be poor tools for teaching critical thinking as well (x1).

Another reoccurring theme mentioned by nine SMEs was that any digital technology solution may support the development of critical thinking when a proper pedagogy, design, or strategy is applied. Some responses included:

- all types of software, applications, and technologies. It depends on how the teacher uses these tools (x1);
- The tech itself has to be designed to give the user the ability/space/narrative moments to question ideas. Otherwise, tech itself won’t drive critical thinking. For example, a person who has mastered Excel Spreadsheet might not question the credibility of political information on the web any more efficiently than another web user (x1);
- Any digital technology that encourages problem solving will encourage users to engage in the process of critical thinking. Though one needs to be careful not to overstate the capacity of these systems to produce critical agents (x1);
- I believe all digital technologies can be designed to deliver pedagogy which promotes critical thinking. All but at the same time none of the digital

technologies can be used to teach critical thinking, it’s all on the design and strategy (x1).

The other common digital technologies were WIKIs (9 SMEs) and blogs (7 SMEs) with SMEs specifying that:

- they [WIKIs] would be most effective in cooperative environments (x1);
- can be used but would require more scaffolding i.e. the development and administration of learning tasks based on the blogs/wikis (x1);
- to be noted they [WIKIs] can also be used negatively (a blog can spread disinformation) (x1).

Discussion boards and forums were mentioned by four SMEs:

- discussion boards that support images can develop the critical eye through human interaction (x1);
- open feedbacks (x1);
- Board Games Forums (x1);
- group discussions (x1).

Finally, three SMEs mentioned Massive Open Online Courses specifying that:

- MOOCs are effective for this [supporting the development of CT], if they can provide access to multiple ways of viewing issues, and show systemic consequences of decisions (x1);
- To be noted they [MOOCs] can also be used negatively (a blog can spread disinformation) (x1).

There were also 16 other kinds of digital technologies mentioned once which can be found in Appendix K.

4.4 Relating SME's Conception of Critical Thinking to Davies's Model of Critical Thinking

The purpose of this subsection is to understand how these data answer two research questions focusing on critical thinking:

> RQ1: In what ways do SMEs in the field of digital technology and education conceptualize critical thinking?
>
> RQ1a: What are the differences in the ways that SMEs conceptualize critical thinking?

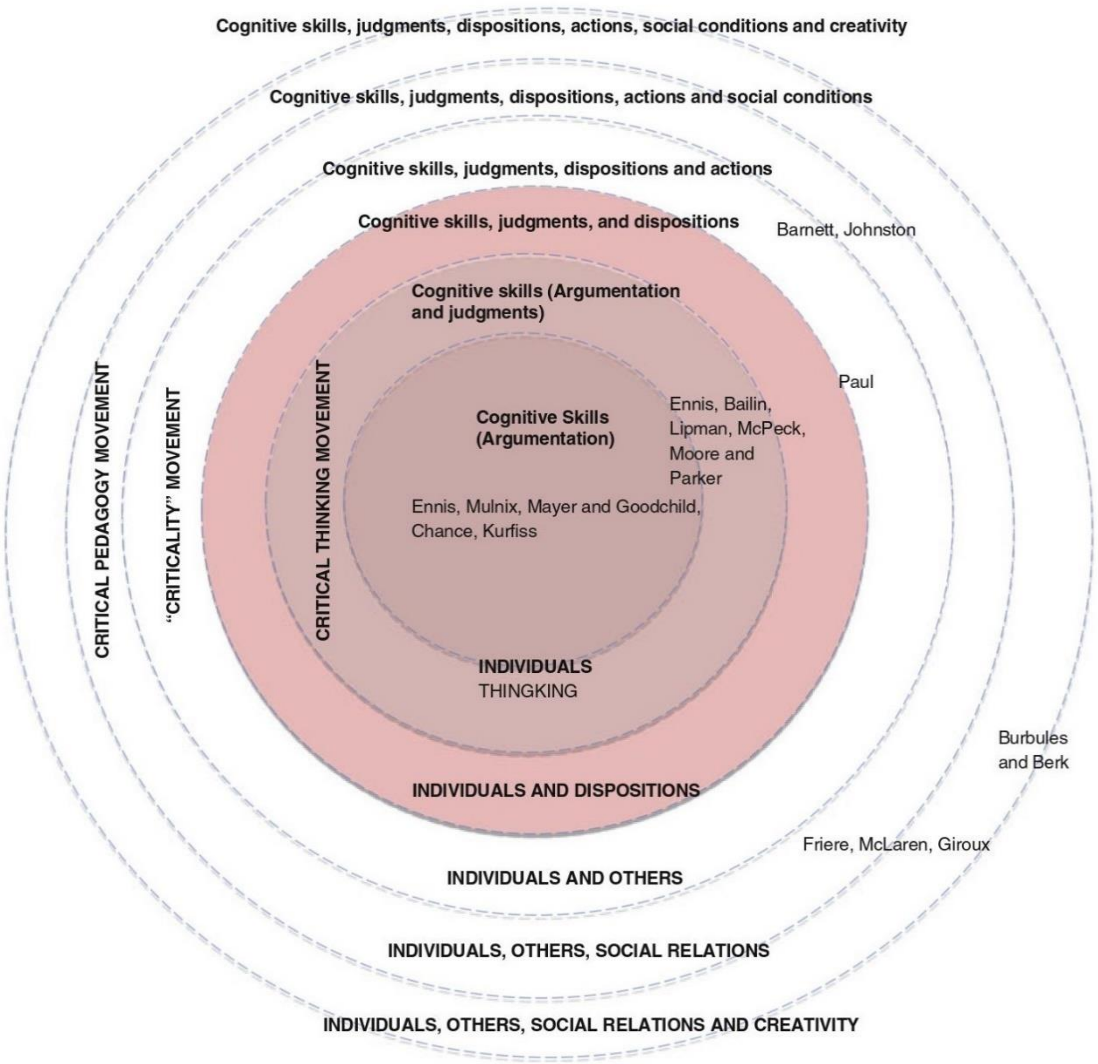
I have already presented what SMEs think about critical thinking and its aspects (Sections 4.2.1–4.2.5), but if I want to answer my research questions I need to understand it through the prism of the theoretical framework of my study.

It has been discussed extensively throughout the study how different approaches to critical thinking relate to one another, and, perhaps, the most comprehensive picture of critical thinking scholarship is presented in Davies's (2015) model of critical thinking in higher education. Davies's model constitutes the theoretical framework of this thesis and mainly drives the way critical thinking is understood in this study. The model is used to build the literature review.

I have described Davies's model in Section 1.6 "Theoretical framework of the study", and one can find a separate section dedicated to each circle of the model in the literature review. Nevertheless, for the sake of this chapter, I can shortly restate how Davies's model of critical thinking operates (see Figure 14 below). Davies's model of critical thinking in higher education represents several approaches to defining the concept. The model radiates from its historical core—three inner circles constituting critical thinking movement and its emphasis on critical thinking as skills, judgments, and dispositions (Davies, 2015, p. 64). It is also important to note that critical thinking as imagined by philosophers within the critical thinking movement is primarily about individual development (Davies & Barnett, 2015, p. 9). The fourth circle, namely, criticality introduces critical action as an integral component of critical being. Criticality scholars extended the scope of the scholarship to “Others” or sociocultural dimension—relation of an individual to others in a wider social context, critical citizenship, moral questions. The fifth circle is represented by critical pedagogues who critique aspects of contemporary sociopolitical systems and call for liberation from various forms of oppression—economic, racial, sexist—put in place by colonization, capitalism, and other oppressive powers. Finally, based on Burbules and Berk’s (1999) work, Davies (2015, p. 77) introduces the account of critical thinking as creativity or openness. This account opens the boundaries of critical thinking to include intuition, creativity, in other words, being open to change. Davies’s model makes it possible to see elements that differentiate accounts of critical thinking (e.g., skills, dispositions, actions, social conditions, etc.) and emphasizes accounts' individual or sociocultural orientation.

Figure 14

Davies's Model of Critical Thinking in Higher Education

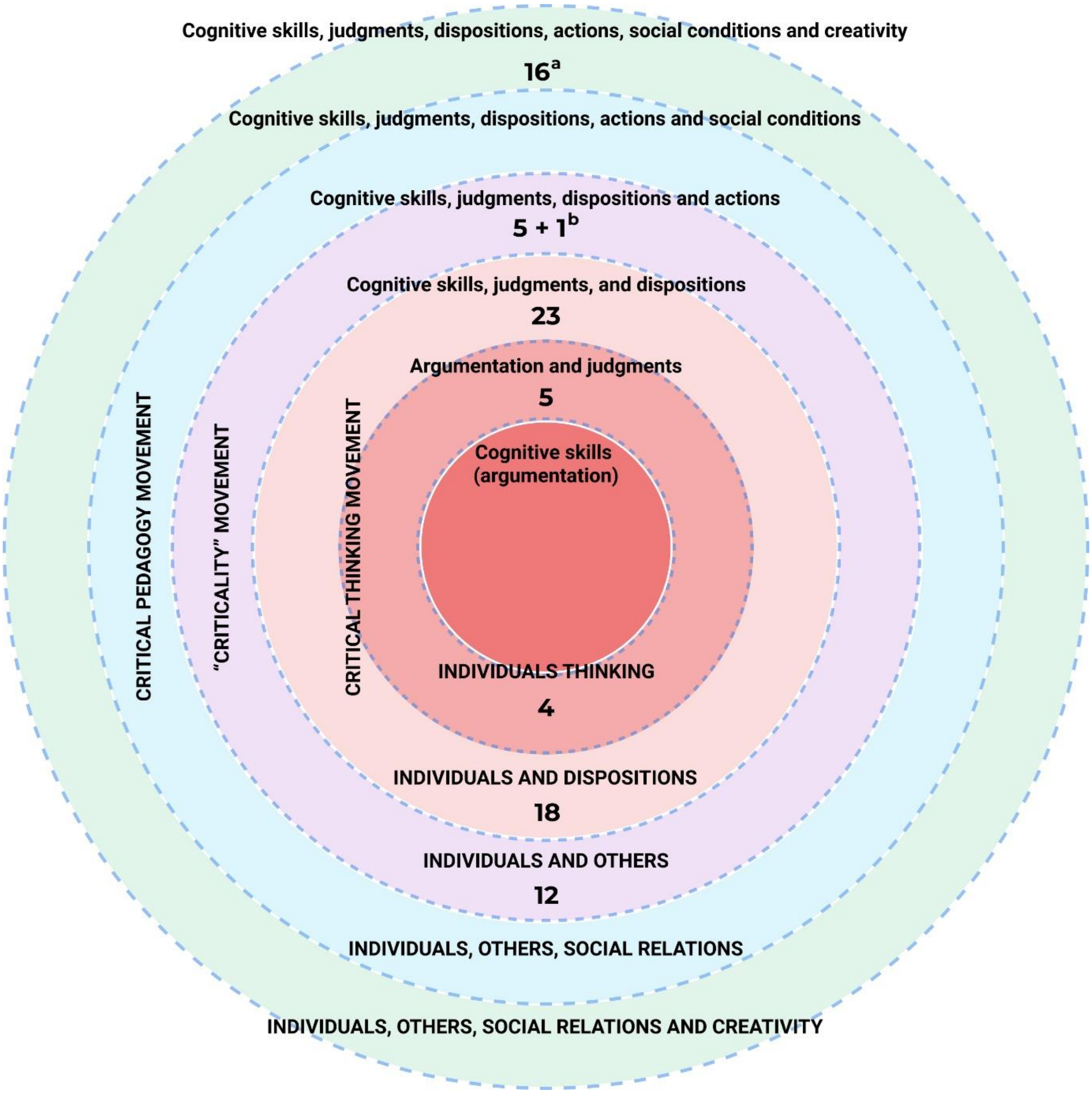


Note. From "A Model of Critical Thinking in Higher Education," by M. Davies, in M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, p. 85), 2015, Springer International Publishing (https://doi.org/10.1007/978-3-319-12835-1_2). Copyright 2015 by Springer International Publishing Switzerland. Reprinted with permission.

In Sections 4.2.1–4.2.5 I explained how different questions constituting Questionnaire 1 define the concept of critical thinking from various perspectives. Not one, but 11 questions reflected SME's definition of critical thinking. For the sake of discussion, I call this set of 11 questions an account of critical thinking, as opposed to the definition of critical thinking that is derived from the answer to Question 3 of Questionnaire 1. Altogether these 11 questions contained information relating to different sectors of Davies's model, thus building a wider picture of critical thinking as understood by SMEs. With this understanding in mind, I collated each SME's answer to these 11 questions, assigning a participant's ID to each set (see Section 3.6). The data exported from Questionnaire 1 was inputted into ATLAS.ti Cloud software and was coded as a whole, in relation to each sector of Davies's model. The list of codes was then quantified and placed within Davies's model (see Figure 15). Depending on how SME's definition related to the model's sectors, each answer was added to a corresponding counter. A detailed explanation of coding procedures and examples of elements in definitions are given in the section below.

Figure 15

SMEs' Definitions of Critical Thinking in Relation to Davies's Model



Note. Numbers in the model constitute the SMEs who had a particular element in their account of critical thinking. Adapted from "A Model of Critical Thinking in Higher Education," by M. Davies, in M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, p. 85), 2015, Springer International Publishing (https://doi.org/10.1007/978-3-319-12835-1_2). Copyright 2015 by Springer International Publishing Switzerland. Adapted with permission.

[a] Sixteen SMEs included creativity in their critical thinking accounts, but none of the SMEs extended their definition to include cognitive skills, judgments, dispositions, actions, social conditions, and creativity at once. [b] One SME did not include dispositions in their account of critical thinking but had an element of critical action.

4.4.1 Classifying Critical Thinking Accounts

Critical thinking concepts from the majority of SMEs' showcased elements usually present in definitions coming out of the critical thinking movement. In Davies's model, three inner circles depict key elements of this research wave: critical thinking defined as argumentation (the "skills" view), as reflective thinking (the "skills-and-judgments" view), and as dispositions (the "skills-plus-dispositions" view; Davies, 2015, p. 83).

The definitions of five SMEs included argumentation skills and reflective judgment making. Davies explains that the "skills-and-judgments" view or "reflective thinking" position focuses on a reflective basis for decision-making and judgment formation, it incorporates some elements of metacognition and self-regulation (p. 51). This position was well evidenced in SMEs' definitions, for example, a game designer suggested that critical thinking:

> … is a voluntary process of analysis, test and evaluation [the SME lists cognitive skills] that results in the production of meaning, much like the dialectic process of thesis, antithesis, synthesis. … Critical thinking involves suspending your own personal a priori or beliefs in order to perform an objective analysis [the SME adds reflective thinking].

Consider another SME's definition showcasing both skills (e.g., ability to question and interpret) and the reflective element: "CT is an ability to question what is, to imagine the implications of what is presented and to reflect on what we do, see, etc."

One may also note that there were no SMEs' definitions of critical thinking as argumentation only. In Davies's position, the shift from a focus on mechanics of inference making to a judgment formation is important as it marks a departure from pure "logicality" to include wider aspects of critical thinking in accounts to emerge later (Davies, 2015, p. 51).

The majority of definitions resembled the third inner circle constituting the critical thinking movement. Hence, definitions of 23 SMEs included all three elements constituting the "skills-plus-dispositions" view. Apart from skills needed to arrive at the reflective judgment, there were elements of the affective domain: attitudes and psychological readiness to engage in critical thinking. The most widely cited were dispositions to be open-minded (16 SMEs), thinking independently (14 SMEs), and affective state of constructive skepticism (9 SMEs). An example response that incorporated all of the elements mentioned is given by a senior lecturer at university: "Critical thinking is the capacity to reflect critically or 'problematise' a phenomenon. [Words which are the most related to critical thinking are:] Analytical skills; Consistency; Creative thinking; Epistemological understanding; Higher order thinking; Hypothesize; Inductive reasoning; Open-minded; Problem-solving; Reasoning". In this account we may see all elements at once: reflective thinking, cognitive skills (e.g., "analytical skills", "hypothesize"), and dispositions (e.g., to be open-minded, consistent).

Finally, six SMEs extended their conceptualization of critical thinking to include critical action, akin to criticality scholars. An example answer of an SME (a teacher) including the dimension of action would be:

> An individual needs critical thinking to succeed in life. Being able to use thinking abilities helps a person become open-minded and creative which is very valued at any stages [sic] of human life. Children who are able to think critically can succeed in education, and adults can have a great career. In my opinion, in [my country] critical

> thinking has never been encouraged until now. This resulted in whole generations of narrow-minded, ignorant people who simply do not know how to have an opinion. For that reason, I believe it is vitally important *to teach people how to think critically* [emphasis added] because this is important not only for the society, but for us as individuals.

One out of these six accounts did not include dispositions but had an element of critical actions, hence marked with a "b" superscript on the model (see Figure 15). One can also note that accounts of critical thinking that included critical action did not add into the criticality count. The first reason for that is because critical action or its manifestations were not given in the definition itself, but were mentioned in responses to other questions. The second reason is that SMEs did not explicitly state the necessity of action as an integral component of criticality or critical thinking. Thus, even if critical action was considered important, the data collected was not enough to suggest that SMEs' accounts were in the spirit of criticality as defined by Johnston et al. (2011) or Barnett (1997).

When placing each account of critical thinking on the visual model (Figure 14), Davies (2015) specifies that they can also be understood along the individual–sociocultural axis. Each circle of Davies's model specifies its core elements and individual–sociocultural orientation. Thus one may expect definitions coming out of the critical thinking movement to be focused on individuals or individuals and their dispositions (p. 52). Interestingly enough it was not the case in the definitions of SMEs. Let us take a look at how SMEs' accounts of critical thinking were placed on this axis of Davies's model.

There were 22 SMEs who believed that critical thinking is primarily about an individual's development. Definitions of 18 out of 22 SMEs included elements relating to an individual and one's dispositions (third inner circle), rather than focusing solely on an individual's development (first and second inner circles). Some definitions of this kind are presented below:

- This ability [CT] will allow *an individual* [emphasis added] to objectively use the information to come to an informed decision.
- Critical thinking is required to become a more aware *individual* [emphasis added].
- To me, critical thinking is the ability of *an individual* [emphasis added] to take into account multiple perspectives, consider multiple possibilities and reason with rationality while making any decision. To think critically is to not get influenced by biases and emotions but base decisions on logic and data.

The sociocultural dimension of critical thinking was represented in accounts of 12 SMEs. These SMEs attributed critical thinking to an individual's development as well as extending it to how one relates to others in a wider social or educational context. Examples of these definitions include:

- Bluntly, to really *know who one is* [emphasis added]. … Vulnerable people *do not question entities* [emphasis added] they deem to have some level of authority, but will act very defensively, and aggressively even, those close to them especially when someone questions something related to their identity or habitus.
- If we do not test certain theories, or reports, against debate, discussion and analysis - we endanger *our communities* [emphasis added] and *personal belief systems* [emphasis added] by consuming false facts to base future decisions on.
- *Society* [emphasis added] is built on human's ability to understand the natural world and to be able to act on that understanding to ensure human survival. *Social progress* [emphasis added] can only occur through the logical process of critical thinking.

One SME also mentioned in their response critical theory, which at the time inspired critical pedagogues:

> [CT is needed] to not be a mere sheep in our totalitarian system where everyone is being brainwashed to comply. [Core CT elements are:] open-mindedness; mindfulness; *willingness to let go of established beliefs* [emphasis added]; cognitive flexibility; ability to concentrate; logic; *immunity of social pressure and norms* [emphasis added].

Lastly, there were 16 SMEs who believed that creative and divergent thinking were central to the critical thinking concept. These 16 accounts are placed on the outer circle of the model—the one representing critical thinking as openness or creativity. A superscript “a” indicates that these accounts should be seen in this circle with a reservation. None of SMEs extended their definition to include cognitive skills, judgments, dispositions, actions, social conditions, and creativity at once. Thus, we cannot certainly say that 16 accounts of critical thinking belonged to this later perspective on critical thinking—critical thinking as creativity or openness.

All together, we can observe that numbers in corresponding circles do not match. When one would expect definitions coming out of the three inner circles to be mainly focused on an individual’s development, six accounts were incorporating the importance of critical thinking in a wider social context. This is in line with Davies and Barnett’s (2015) observation that many papers they studied to build a model could not be easily ascribed to a particular research wave, rather they addressed concerns relevant to more than one wave with researchers, authors, and commentators taking cross-boundary positions (pp. 6–8).

As it stands there are several problems with looking at SMEs’ data on the model (see Figure 15) as it is now. First, one cannot observe how an account of a particular SME is placed on different sectors of the model. This problem is addressed in the section to come. The bigger challenge emerged when I was coding definitions of critical thinking. Although 23 accounts were belonging to the umbrella of the “skills-plus-dispositions” view, these accounts differed a lot. Davies's model does not seem to account for these differences. When explaining the key accounts of critical thinking scholarship in higher education, Davies (2015) suggests that the account of cognitive skills and propensity elements constitutes the approach of looking at critical thinking with a "philosophical" lens (p. 49). As an example of the philosophical model of critical thinking, Davies (p. 43) cites Bloom's taxonomy of educational objectives and its contemporary version (Anderson et al., 2001; Bloom et al., 1956). He explains that philosophical models are used mostly in educating for critical thinking, and do not address "wider concerns of educators' attitudes to criticality" (p. 43). Davies's model captures these wider concerns by introducing outer circles of criticality, critical pedagogy, and critical thinking as openness.

In a different manner, Sternberg (1986) differentiates between philosophical, psychological, and educational schools of thought when defining critical thinking. For Sternberg, Bloom's taxonomy is a primary example of an educational school of thought (p. 6), one that is inspired by psychological and philosophical traditions (see Section 2.1.1). SMEs' accounts of critical thinking reflect these differences and it would be a problem to leave them under the philosophical umbrella as Davies (2015, p. 43) suggests. Interestingly enough, in another book and another chapter that mirrors the content of the model, Davies and Barnett (2015) introduce the section called "Three rival perspectives". In this section, the authors give accounts of philosophical, educational, and socially active perspectives on critical thinking (p. 6). The philosophical account in their position focuses on clear and rigorous thinking, logic, and metacognition. The educational perspective is concerned about how the development of critical thinking in an individual student may benefit wider society through the formation of a "critico-social attitude" (p. 6). Finally, the socially active perspective is a set of positions including critical pedagogy (see Section 2.10) and critical citizenship. The socially active perspective is interested in transforming society and views inculcation of critical attitude as a way to achieve this end.

One may note that psychological perspective is still not evident in Davies and Barnett's account of rivaling positions. Altogether, it creates controversy: on the one hand, Davies (2015) in his model of critical thinking in higher education neither specifies the schools of thought as defined by Sternberg (1986) nor three rival perspectives presented by himself and Barnett (Davies & Barnett, 2015, p. 6). On another hand, Davies and Barnett (2015) state that any book on the topic of critical thinking in higher education has to try to address tensions between the three perspectives (p. 6).

Thus, I argue that the addition of Sternberg's schools of thought to the model of Davies is the most tangible way to showcase differences in the conceptualizations presented by SMEs. Do I have other alternatives or say lenses to look at SMEs' accounts of critical thinking? One can try to connect them to critical thinking research waves extensively used in the field. However, they are ambiguous. Despite an agreement on what constitutes the first wave, there is less clarity about the second and third waves (see Section 2.1.2). For the same reason, for the sake of consistency, I do not add a counter to the "Critical thinking movement" section on Davies's model (see Figure 15). The critical thinking movement may mean the inclusion of three waves of research (Paul, n.d.), or, quite differently, primarily relate to skills, judgments, and dispositions as in the first wave conceptualizations (Davies, 2015). Davies's model addresses well the dimensions of critical thinking accounts—what kind of elements differentiate accounts from one another and represent their focus. However, as a theoretical model of the study, the model still leaves an understatement by not discussing presented tensions. Sternberg's schools of thought serve the needs of this thesis well by providing a lens to cover these grey areas.

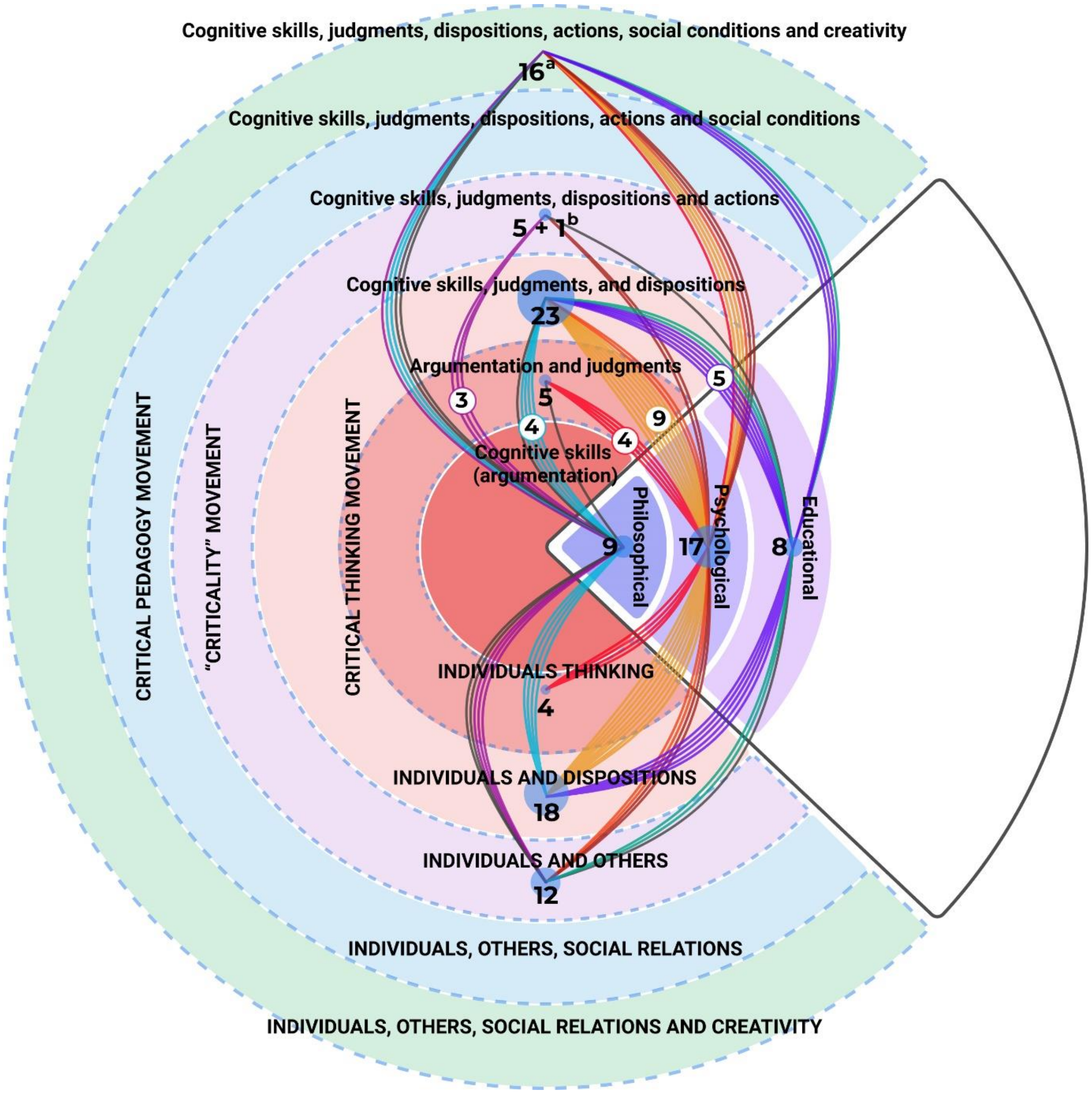
4.4.2 Sternberg's Schools of Thought on Davies's Model

The tensions presented in the previous section led to the inclusion of Sternberg's traditions of thought in defining critical thinking into Davies's model (see Figure 16). I also added colored lines representing the answers of SMEs. These lines connect schools of thought and particular aspects of SMEs' definitions. Now one can see how a definition of a particular SME is placed on the model. When accounts of several SMEs were repeating themselves in terms of their placement on the model, I highlighted corresponding lines in a similar color. This way one can differentiate between trends in data. Also by looking at counters binding lines of a similar color one can tell how many SMEs thought in a particular way. The revised model is presented below. Let us see how SMEs' definitions were categorized into corresponding schools of thought.

Sternberg's (1986) schools of thought were discussed in detail in Section 2.1.1. For reference purposes, I shortly give an account of each of them. In Sternberg's position, there are three traditions of theorizing critical thinking: psychological, educational, and philosophical. The philosophical school revolves around an ideal critical thinker and the traits they may possess (Lai, 2011). Philosophers focused their attention on requirements of formal logic systems, which may be thought of as models of competence, rather than models of performance for human thought (Sternberg, 1986, p. 4). The psychological tradition of defining critical thinking is concerned with how critical thinking happens under the limitations of the person and environment (p. 5). Critical thinking in this tradition is defined in terms of actions and behaviors a critical thinker does (Lai, 2011, p. 7). Finally, the educational tradition takes elements both from the psychological and philosophical definitions to equip learners with skills needed for problem solving, decision making, and concept learning (Sternberg, 1986, p. 6).

Figure 16

SMEs' Accounts on Davies's Model With Sternberg's Schools of Thought Incorporated



Note. Regular numbers constitute the SMEs who had a particular element in their account of critical thinking. Numbers placed in white circles depict the number of SMEs who had a similar account of critical thinking. Adapted from "A Model of Critical Thinking in Higher Education," by M. Davies, in M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, p. 85), 2015, Springer International Publishing (https://doi.org/10.1007/978-3-319-12835-1_2). Copyright 2015 by Springer International Publishing Switzerland. Adapted with permission.

[a] Sixteen SMEs included creativity in their critical thinking accounts, but none of the SMEs extended their definition to include cognitive skills, judgments, dispositions, actions, social conditions, and creativity at once. [b] One SME did not include dispositions in one's account of critical thinking but had an element of critical action.

To place an account of critical thinking into Davies's model, I had to collate SMEs' answers to 11 questions about critical thinking (see Section 4.2) and analyze them as a set. Generally, it was a two-step process. First, I collated SMEs' answers to seven questions about critical thinking in ATLAS.ti document—Questions 3, 4, 4.1, 5, 6, 7, 8 (see Section 3.6). This way I could code raw data and create categories informed by different circles of Davies's models: codes included "Individual", "Others", "Skills", and categories were "Philosophical", "The Skill-Plus-Dispositions view", and so forth. On the next step, I created a spreadsheet with the list of SMEs and indicated whether an account of a particular SME had individual orientation, was tied to a particular school of thought. This spreadsheet also included answers to the other four questions about critical thinking not initially added into ATLAS.ti document: Questions 9, 10, 11, and 12. These four questions were "yes and no" type questions or multiple-choice ones.

It is important to note that SMEs' definitions were ascribed to a particular school of thought based on the answer to Question 3 "Could you tell how you understand critical thinking?". Although other questions also related to different aspects of the critical thinking account, the definition of critical thinking as conceptualized by an SME was given in Question 3. Other questions of Questionnaire 1 informed different domains of Davies's model. Let us look at the main trends found in data after its analysis with the modified framework.

4.4.2.1 Philosophical School of Thought on Davies's model. There were nine SMEs whose definitions of critical thinking fit within the philosophical definitions as defined above and in Section 2.1.1.

For instance, a game development professional defined critical thinking as: "The ability to recognize that your views can be wrong, and to always stay open to change them as new facts appear. Being aware of common fallacies and non-arguments". There was an evident connection with critical thinking as logical thinking—a reference to fallacies and arguments analysis (see Figure 17). We could also observe elements of the affective domain in this definition: being open to change one's position, recognition that one's views can be contested, be wrong. Altogether, this definition relates to the philosophical school of thought with its interest in logic (Davies & Barnett, 2015, p. 6; Sternberg, 1986, p. 5) and preoccupation with the ideal critical thinker (Lai, 2011, p. 5). One may see in Figure 17 below how this definition and other questions relating to critical thinking were coded to arrive at this categorization.

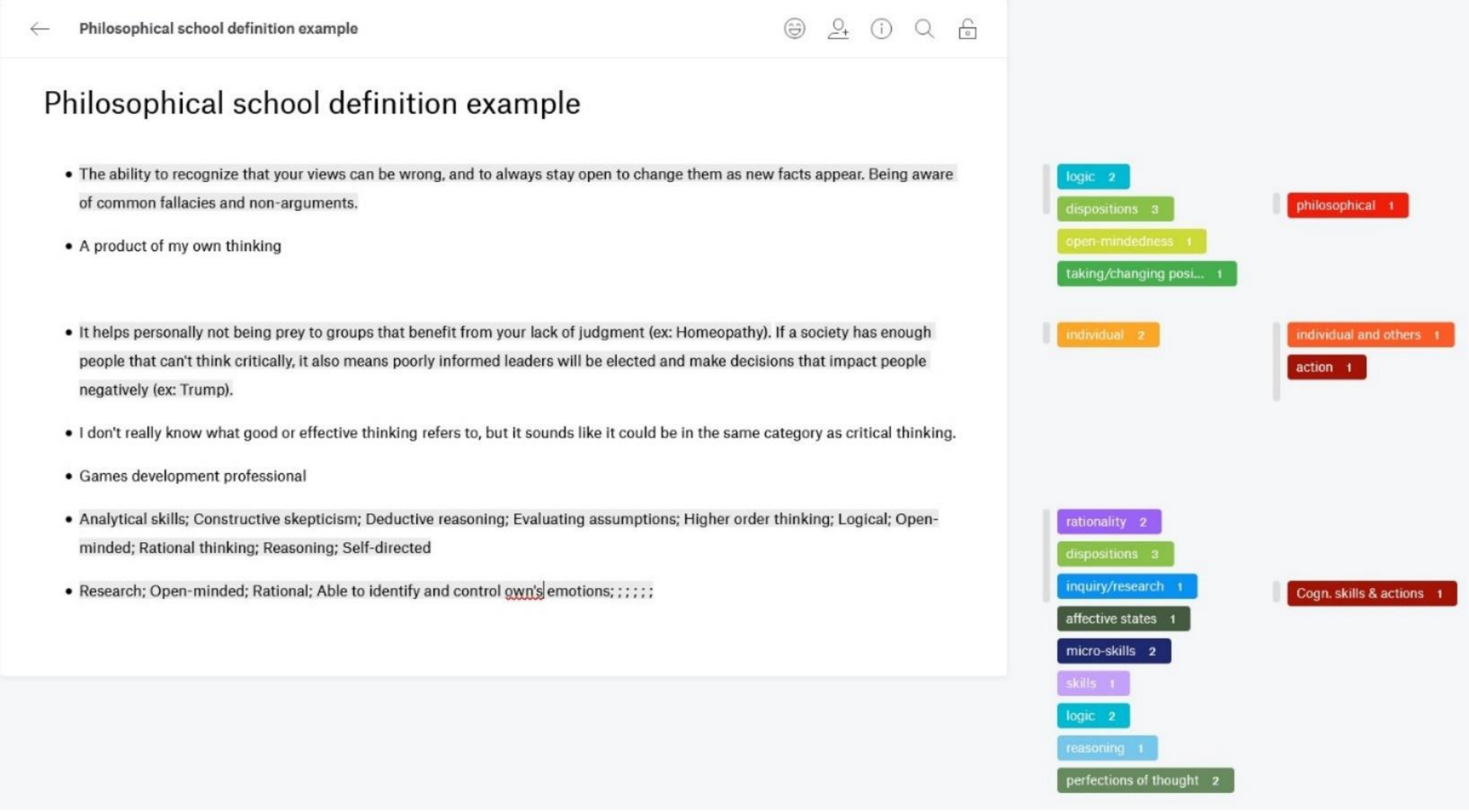
Another definition categorized as belonging to the philosophical tradition was given by an academia lecturer: "[CT is] the capacity to reflect critically or 'problematise' a phenomenon". The SME clarified that one's account of problematization was inspired by Foucault's writings. When choosing 10 of the most relevant words to describe critical thinking (Question 7), among others, the SME chose epistemological understanding. The core critical thinking elements in the SME's position were (Question 6): "abstraction; operationalising concepts; interrogating philosophical assumptions; interrogating methodological assumptions; playing with ideas at conceptual boundaries; challenging orthodoxies that do not adequately explain complex phenomenon". On top of that, the SME mentioned that critical thinking is about consistency and being open-minded: reference to an ideal critical thinker, qualities one should strive to obtain. Altogether, this account of critical thinking is primarily about how one orchestrates macro-processes and micro-skills, understands one’s mind, thought, and action. The interrogation of philosophical assumptions, critical reflection, and epistemological understanding classify this account as fitting within the philosophical tradition on my theoretical model.

Interestingly, the distinctive difference between psychological and philosophical accounts is well presented in the words of an SME defining critical thinking in a philosophical manner:

> To me, critical thinking is *more than just a set of rules to think with* [emphasis added]. It almost requires certain amount of cynicism and scepticism to be able to look past "click-bait" titles on the news, to realize which statements in and out of games, academia and everyday life are based on emotions rather than facts.

Figure 17

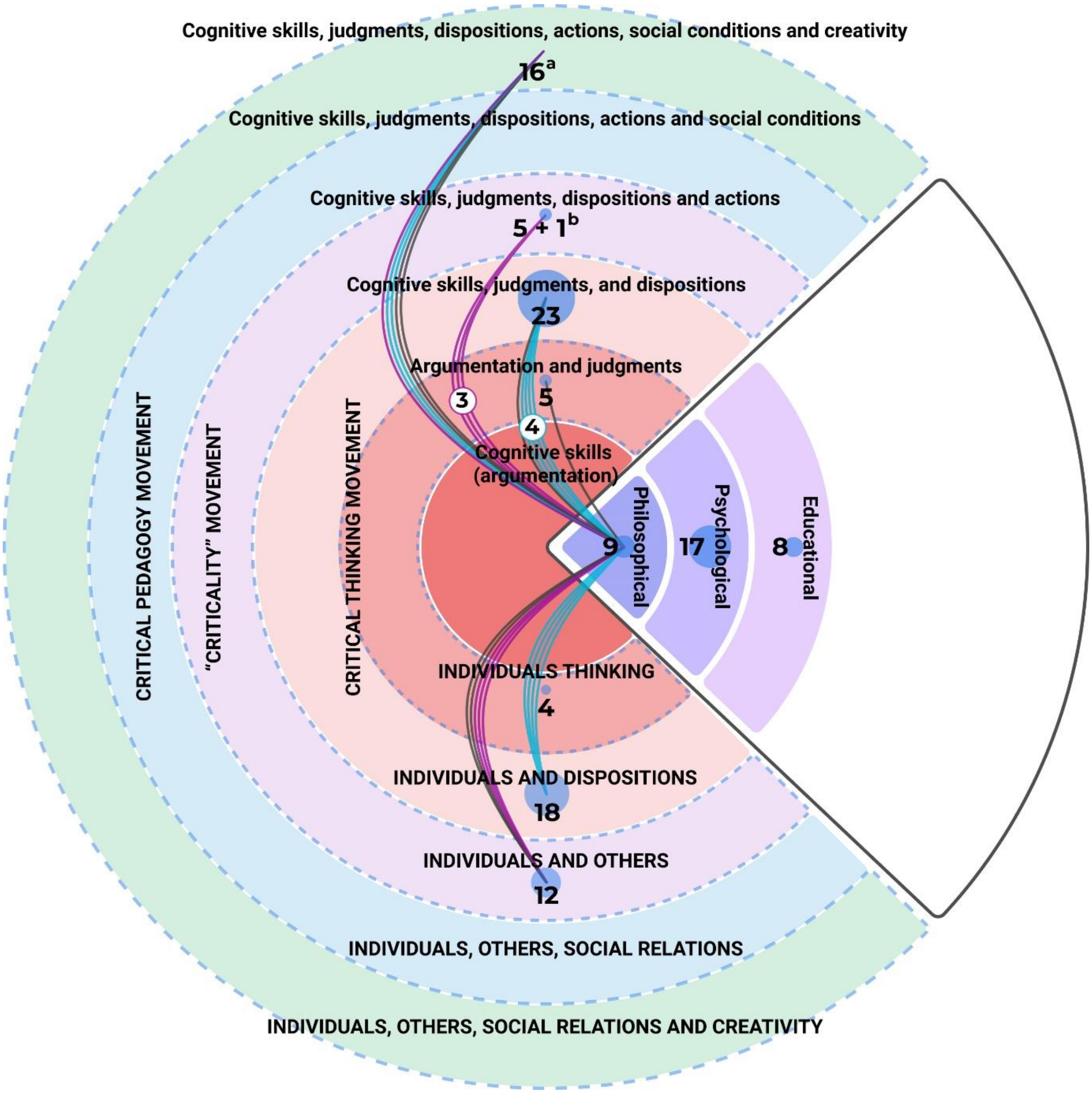
An Example Coding of a Philosophical Definition of Critical Thinking



When we can see how a particular definition may be plotted on the model, we should also consider a bigger picture looking at how philosophical definitions of different SMEs related to one another. For ease of representation, we can isolate philosophical definitions on the model (see Figure 18).

Figure 18

Philosophical Definitions of Critical Thinking on Davies's Model



Note. Regular numbers constitute the SMEs who had a particular element in their account of critical thinking. Numbers placed in white circles depict the number of SMEs who had a similar account of critical thinking. Adapted from "A Model of Critical Thinking in Higher

Education," by M. Davies, in M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, p. 85), 2015, Springer International Publishing (https://doi.org/10.1007/978-3-319-12835-1_2). Copyright 2015 by Springer International Publishing Switzerland. Adapted with permission.

[a] Sixteen SMEs included creativity in their critical thinking accounts, but none of the SMEs extended their definition to include cognitive skills, judgments, dispositions, actions, social conditions, and creativity at once. [b] One SME did not include dispositions in one's account of critical thinking but had an element of critical action.

There were four philosophical definitions creating a group of SMEs who defined critical thinking in terms of cognitive skills, judgments, and dispositions with a primary concern with individual's development and one's dispositions. Two of them believed that critical thinking is also about creativity (see two strong cyan lines connecting to the upper dimension of the model).

Another group of three philosophical definitions was different as they extended their conceptualization of critical thinking to include critical actions and relation to others in a wider social context (dark magenta lines). One of these SMEs made a connection to creative thinking.

There were also two other definitions extending their scope to social relations and creativity, but differently exemplifying elements of skills, judgments, and dispositions.

4.4.2.2 Psychological School of Thought on Davies's model. Definitions relating to the psychological school of thought were the most common. Seventeen definitions fit within this account of critical thinking.

I analyzed each account following the procedures explained in Section 4.4.2. Let us take a look at an example definition belonging to this account of critical thinking (see Figure 19). A Ph.D. candidate focusing on gaming defined critical thinking as: "The ability to consider an issue from a [sic] several perspectives while taking into account often conflicting information. The purpose is to arrive at a judgement based on a thorough examination of available facts”. This definition features several key components that fit it within the psychological tradition. Firstly, this answer exemplifies the actions a critical thinker takes such as considering an issue from several perspectives, taking into account conflicting information. Secondly, this definition has a strong affinity with the view of critical thinking as cognitive skills, judgments, and dispositions. The focus on judgment formation is explicitly expressed in the second sentence. Overall, this definition does not focus on an ideal critical thinker, it does not touch upon standards of thought, nor it extends to the potentials of critical thought.

Consider another example of critical thinking definition given by a public high school teacher:

> To me, critical thinking is the careful review and analysis of a topic at hand that results in the breakdown of the causation, correlations, connections (both intentional and abstract), and the progression of the said topic towards a most probable future outcome or use.

When asked why an individual might need critical thinking, the same SME elaborated: “A person needs critical thinking to make informed decisions about how to act or make a choice”. This definition well resembles Sternberg’s (1986) definition that can be classified as belonging to the psychological tradition of thought: “[CT is] the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts” (p. 3). The definition cited above does not involve an ethical dimension, it neither lists traits that a critical thinker may possess nor suggests how an individual could or should think ideally. Rather, it lists actions that a thinker performs—review and analysis.

In the same manner, as in the previous section, I isolate psychological accounts of critical thinking on Davies's model (see Figure 20). The most recurring conceptualization of critical thinking between all three schools of thought was shaped by cognitive skills, judgments, dispositions, and focus on an individual's development. The example psychological account given above belonged to this group of accounts. As a whole, there were nine accounts of this kind found in the data. Three of them made a connection to creative thinking implying that it is one of the most relevant words to the concept of critical thinking.

Four accounts of critical thinking were narrower in scope as they had cognitive skills and judgments mentioned in them but did not extend to affective domains of critical thinking. These accounts were about an individual's development and one of them made a connection with creative thinking.

At last, four other accounts were repeating less frequently. All four extended the need for critical thinking to wider social concerns, “others”. Two of them featured cognitive skills, judgments, and dispositions, and two extended it even further to include critical actions. Three out of four accounts made connections to creative thinking.

Figure 19

An Example Coding of a Psychological Definition of Critical Thinking

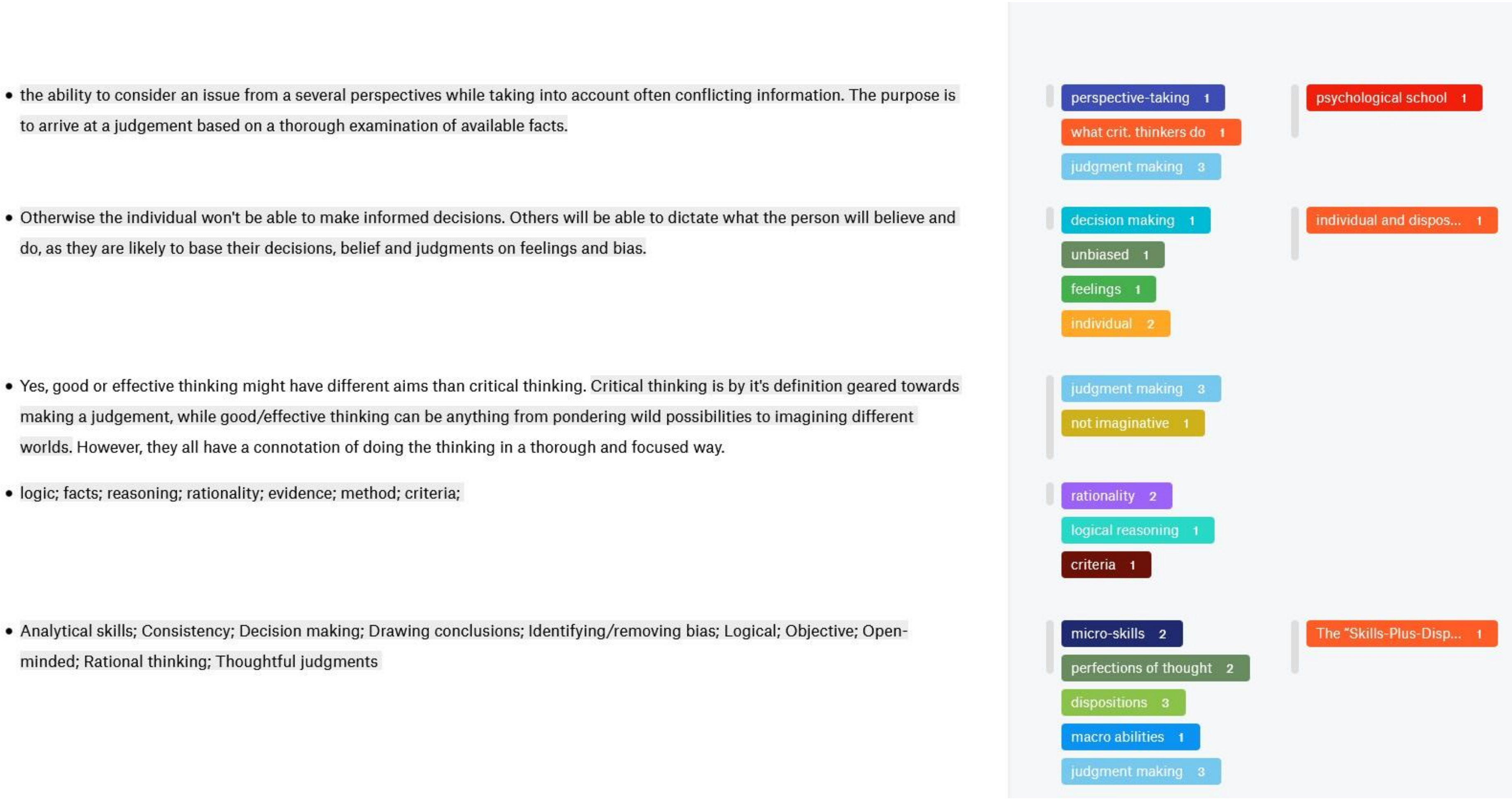
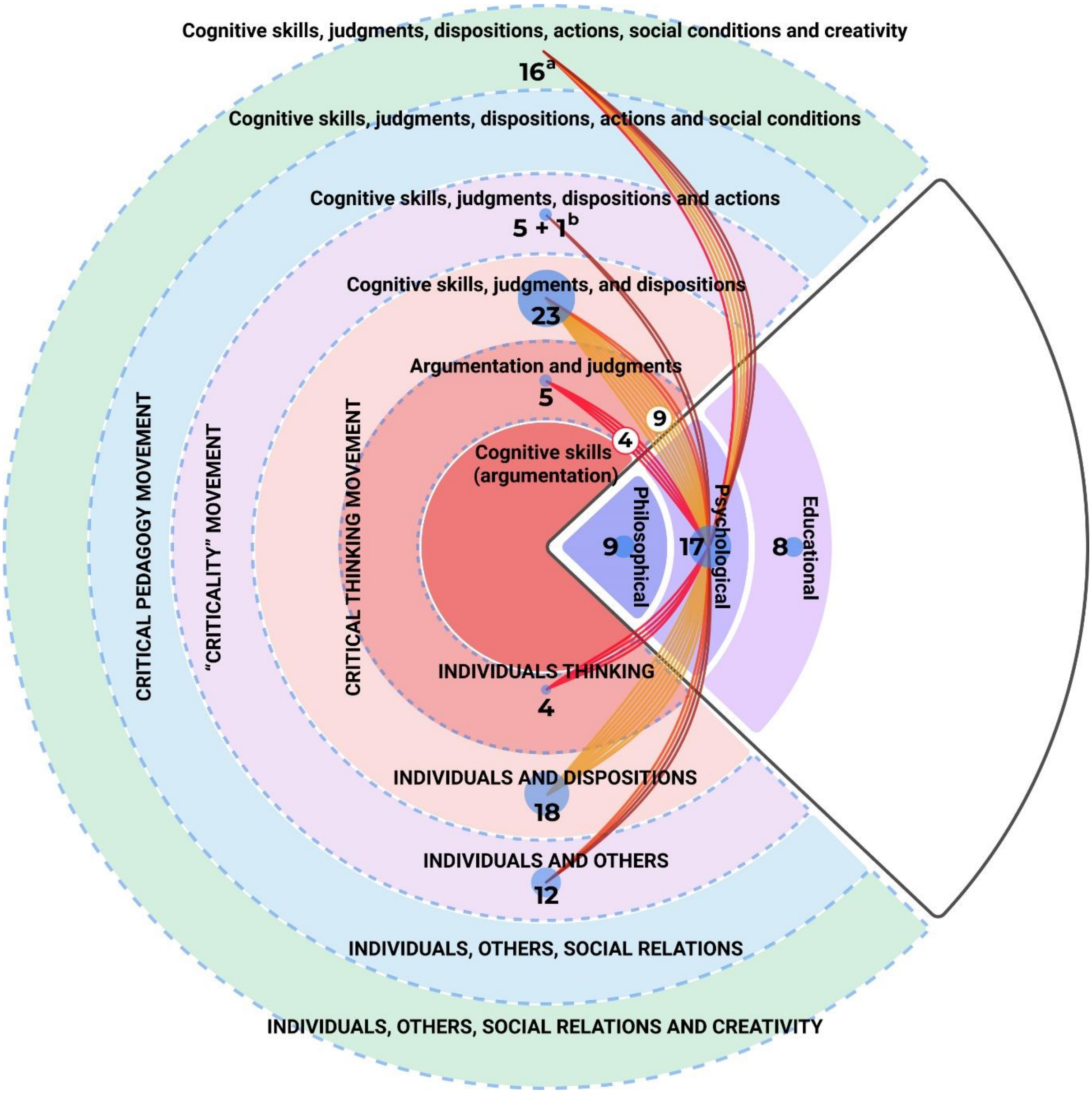


Figure 20

Psychological Definitions of Critical Thinking on Davies's Model



Note. Regular numbers constitute the SMEs who had a particular element in their account of critical thinking. Numbers placed in white circles depict the number of SMEs who had a similar account of critical thinking. Adapted from "A Model of Critical Thinking in Higher Education," by M. Davies, in M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, p. 85), 2015, Springer International Publishing (https://doi.org/10.1007/978-3-319-12835-1_2). Copyright 2015 by Springer International Publishing Switzerland. Adapted with permission.

[a] Sixteen SMEs included creativity in their critical thinking accounts, but none of the SMEs extended their definition to include cognitive skills, judgments, dispositions, actions, social conditions, and creativity at once. [b] One SME did not include dispositions in one's account of critical thinking but had an element of critical action.

4.4.2.3 Educational School of Thought on Davies's model. There were eight critical thinking definitions categorized as belonging to the educational school of thought. An exemplary definition is of a primary school teacher: "[CT is] Developing a deep understanding of processes and procedures of learning a skill or concept".

Although short, this definition is illustrative of how critical thinking is conceptualized for learning settings—it is about learning a skill or concept. Simultaneously, it has actions or "processes and procedures" one does; in some way, it resembles psychological definitions concerned with how a critical thinker performs under personal and environmental limitations, what one does to solve problems. This account is accompanied by answers to other questions which can be found in Figure 21. We can also see elements pertaining to the educational school of thought present in answers to Questions 6 and 7: "cooperative learning", "sharing concepts with others", "explanations of processes and procedures", and "analysis of experiments".

Although the decision on whether to categorize certain accounts of critical thinking as educational, psychological, or philosophical was taken based on SMEs' answers to Question 3, the educational agenda was well represented in answers to Questions 6 and 7. For instance, two SMEs chose "cooperative learning" and one SME chose "active participation" as one of 10 words and phrases relating to critical thinking the most (Question 7). In responses to Question 6 asking to list elements at the core of the critical thinking concept, SMEs mentioned: developmental level, involvement, zeal, project activity, long answer responses, constructing understanding visually, building models, explanations of processes and procedures, implementing innovative approaches to answer a question, sharing concepts with others, analyze experiments, and so forth.

Not surprisingly, Bloom's taxonomy of educational objectives was mentioned by seven SMEs as a theory informing their definition. Some of them presented critical thinking definitions relating to philosophical and psychological schools of thought, and three SMEs to the educational school. Although some SMEs had elements relating to learning in their critical thinking accounts, only eight SMEs explicitly defined critical thinking in the context of learning goals and educational settings.

I have isolated educational definitions on Davies's model and present them in Figure 22. Five accounts were featuring similar elements: cognitive skills, judgments, dispositions, and orientation on individual and one's dispositions. Three of them made a connection to creative thinking implying that creativity is one of the most relevant words to the concept of critical thinking.

Three SMEs had accounts extending to wider social concerns or "others" with two of them having elements of cognitive skills, judgments, and dispositions and one account extending to include critical action. One of these SMEs chose creative thinking as one of the most relevant words to the concept of critical thinking.

Figure 21

An Example Coding of an Educational Definition of Critical Thinking

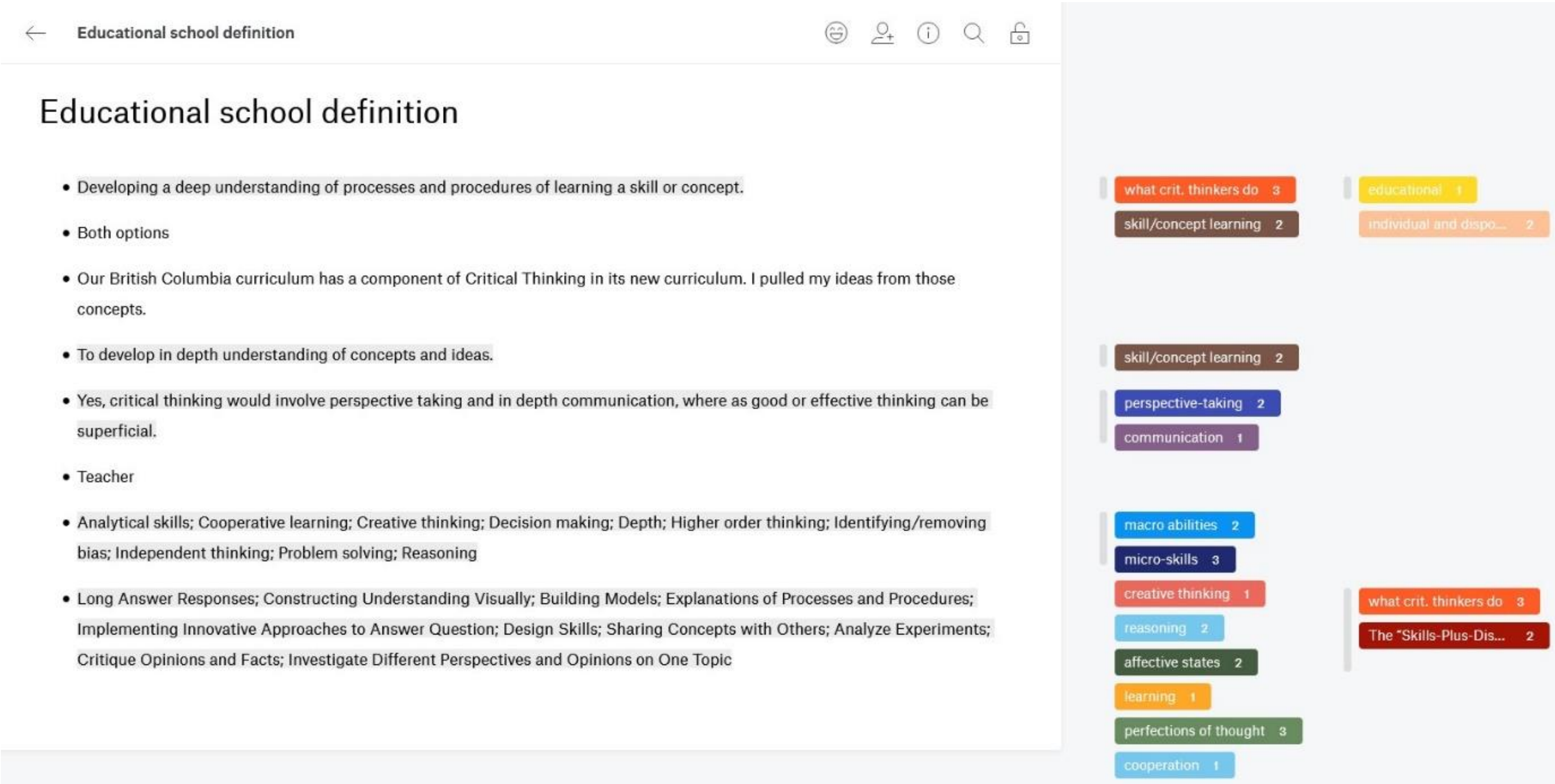
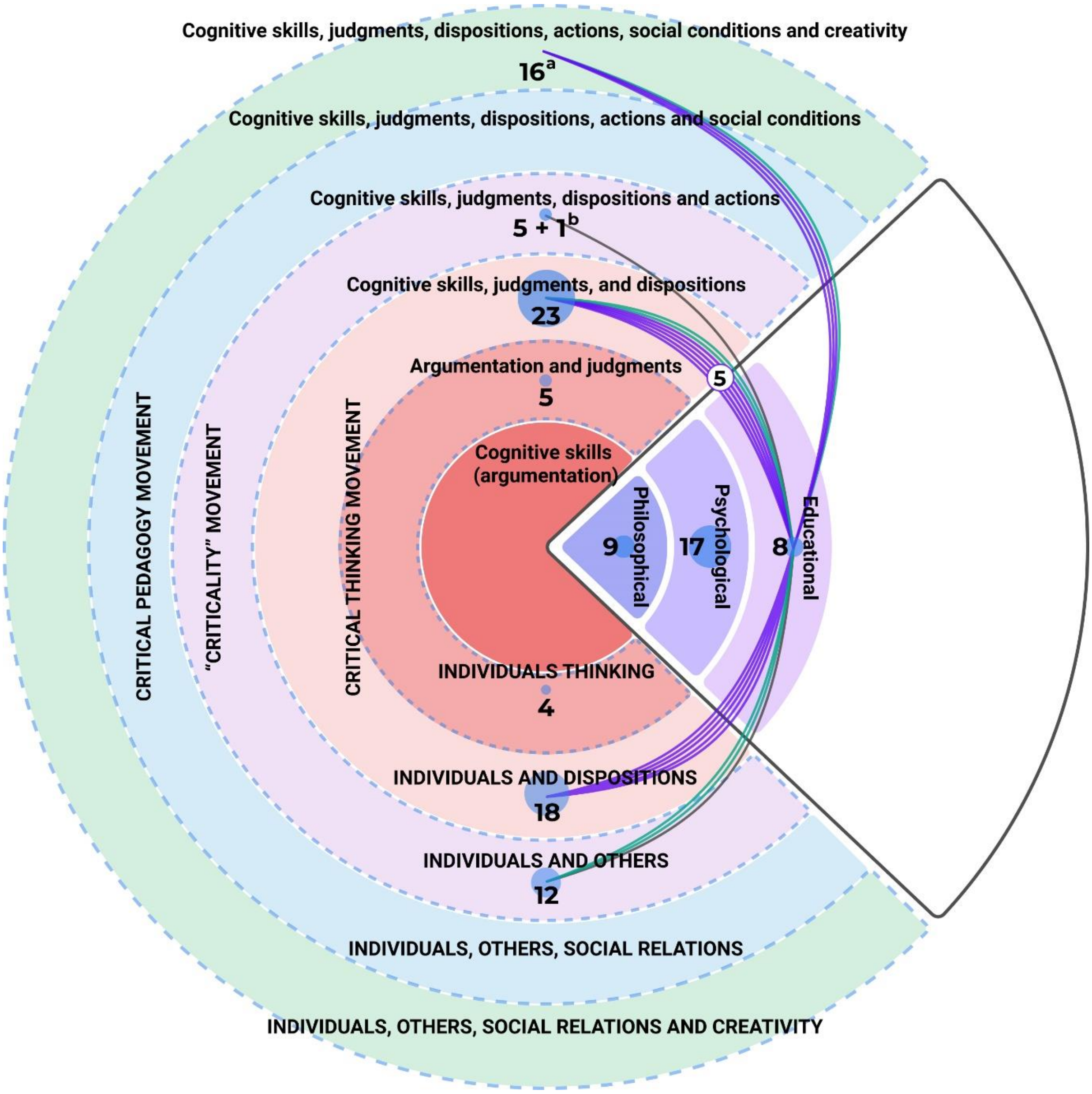


Figure 22

Educational Definitions of Critical Thinking on Davies's Model



Note. Regular numbers constitute the SMEs who had a particular element in their account of critical thinking. Numbers placed in white circles depict the number of SMEs who had a similar account of critical thinking. Adapted from "A Model of Critical Thinking in Higher Education," by M. Davies, in M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, p. 85), 2015, Springer International Publishing (https://doi.org/10.1007/978-3-319-12835-1_2). Copyright 2015 by Springer International Publishing Switzerland. Adapted with permission.

[a] Sixteen SMEs included creativity in their critical thinking accounts, but none of the SMEs extended their definition to include cognitive skills, judgments, dispositions, actions, social conditions, and creativity at once. [b] One SME did not include dispositions in one's account of critical thinking but had an element of critical action.

4.5 Discussion

This section is an analytical one. The previous sections gave answers to questions about what critical thinking is and how SMEs' accounts were different. This section aims to discuss what it means in relation to the literature studied, the theoretical framework, and more generally to the phenomenon of this thesis: critical thinking in and through digital technologies and games.

4.5.1 SMEs' Conceptualizations of Critical Thinking on Davies's Model

First, we can definitely say that critical thinking as conceptualized by SMEs in this thesis is at least composed of cognitive skills, judgment-making, and dispositions. When introducing the model of critical thinking in higher education, Davies and Barnett (2015) argue that any attempt of creating such a model should embrace a long-standing focus on cognitive skills, judgments, and dispositions (p. 8). This is not simply a tribute to tradition, these elements are the core of how we speak about critical thinking. Any other account of critical thinking—be it critical pedagogy, critical citizenship, or criticality—is based on this core.

The next logical question to arise is if there is anything broader than this historic core of skills, judgments, and dispositions found in the data? Round 1 suggests that some SMEs conceptualize critical thinking in its wider sense. However, they have not explicitly articulated concerns of those working in critical pedagogy, critical citizenship, or criticality. Let us look at the data again; SME's account of critical thinking is a composite of answers to 11 questions about critical thinking as described in Section 4.2, while the definition of critical thinking is the answer to Question 3 of Questionnaire 1. In total, there were only six SMEs who extended their account of critical thinking to include critical action and 12 SMEs who incorporated wider concerns pertaining to participation in society and relation to others. When these accounts had examples of critical action and were connected to wider social concerns, definitions of critical thinking did not incorporate these elements. In my position, we cannot say that any account was close enough to criticality as conceptualized by Johnston et al. (2011) or Barnett (1997). For the latter, criticality is wider than critical thinking. Barnett (1997) argues that we should dispense with critical thinking as a core concept of higher education and replace it with the concept of critical being (p. 7). Critical being includes critical thinking but also extends to postulate the necessity of critical self-reflection and critical action (p. 7). Thus when critical thinking is “cognitive acts undertaken by individuals” (p. 16), criticality includes refashioning of traditions and transformatory critique in the domains of knowledge, self, and the world (p. 103). Taken as a whole, not one account of SMEs recognized the need for action as an integral part of what constitutes critical thinking. In other words, stating that critical thinking is needed for social change is one thing, but stating that acting upon critical reflection is necessary for critical thinking is a different idea.

There may be two ways to interpret these findings. First, one may say that SMEs were asked to define critical thinking, not criticality, and their answers should be treated as conceptualizations of critical thinking. Thus, when SMEs were asked why an individual may need critical thinking, they answered that critical thinking is needed for participation in society, justice, bringing change, and so forth—things that matter for both critical thinking and criticality. If I had asked “what is the difference between critical thinking and criticality?”, I might have received a different answer. The second way of looking at findings is to assume that SMEs were not aware of criticality as a concept and its conceptual boundaries, and thus formed an account of critical thinking that was inspired by a commitment to action about which they might have heard before. Altogether, not one SME said that thinking critically is not enough, and one needs a critical action on top of that. Therefore, I cannot say that any account of critical thinking presented by SMEs is a conceptualization towards critical being as defined by Barnett (1997).

Another interesting finding observed in these data was a stable presence of creative thinking. SMEs believed that creative and divergent thinking are among the most relevant to critical thinking words. One SME responded that the presence of creative thinking differentiates critical thinking from good or effective thinking. Although I placed 16 accounts in the outer circle of Davies's model that exemplifies critical thinking as openness or creativity (cognitive skills, judgments, dispositions, actions, social conditions, and creativity), one should look at it with reservation (see Section 4.4.1). None of the SMEs had all of the elements qualifying them to be included in this circle. Altogether, it leaves us with a bigger question: Did these SMEs have an account of critical thinking that was inclusive of different ways of looking at critical thinking, nonconventional and nonprogrammatic as Burbules and Berk (1999) and Davies (2015) imagined it? It is hard to answer this question with certainty. SMEs who mentioned creative thinking did not reflect on their definitions and conceptualizations the way Burbules and Berk (1999) and Davies (2015) did. They did not speculate on critical thinking research waves introduced by Walters (1994), McLaren (1994), or Paul (n.d.), nor on philosophical, educational, and psychological traditions of thought in defining critical thinking as proposed by Sternberg (1986). In other words, they did not position their definitions and accounts of critical thinking in relation to other accounts and ways of conceptualizing it. Not having this self-reflective piece about SMEs' stance leaves me speculating on their position in relation to critical thinking as openness and creativity. One possible interpretation of what I observe in these data is that SMEs did not think about their concepts of critical thinking in terms of schools, waves, and traditions—the way individuals who research critical thinking may think about it. Thus SMEs chose what they thought were the most important things to the concept of critical thinking, including creative thinking. This kind of conceptualizing may be interpreted as a manifestation of critical thinking as openness and creativity as put by Davies (2015, p. 77): SMEs were not limiting their accounts by introducing boundaries of movements, traditions, and critical thinking schools.

Another way of looking at creativity in SMEs' accounts is to understand its role through the works of scholars, whose theories or concepts were chosen by SMEs as informing their definitions. Twenty SMEs reported that their conceptualization was influenced by particular theories of critical thinking. For example, an SME refers to Bloom's taxonomy as a theory informing one's critical thinking definition. When we look into the original taxonomy, Bloom et al. (1956, pp. 162, 173) consistently speculate on the role of creativity in the synthesis category of their work. Looking at the inclusion of creative thinking into SMEs' accounts as influenced by Bloom's taxonomy, would mean a different thing, and it is not what Davies (2015, p. 77) meant by critical thinking as creativity or openness. The point of presenting these contrasting positions is a precaution as to not populate SMEs' accounts with meanings that may not be initially planted in them. I think that having creative thinking as one of the most relevant to critical thinking concepts is a promising connection. It means looking at critical thinking in a wider sense, not limited to logical and convergent thinking. Nevertheless, in the absence of SMEs' reflective stance on their own positions, it is hard to make a definite connection to what Burbules and Berk (1999) and Davies (2015, p. 77) described as critical thinking as creativity or openness.

4.5.2 Critical Thinking and Sternberg's Traditions of Thought

Probably the most dominant theme throughout the data collected in Round 1 is how SMEs' definitions of critical thinking are reflected within the traditions of thought as conceptualized by Sternberg (1986). There were nine definitions of critical thinking categorized as belonging to the philosophical, 17 to psychological, and eight to educational schools of thought. By examining and comparing these data we can see that SMEs' accounts of critical thinking incorporated varying elements cutting across different circles of the model (see Sections 4.4.2.1–4.4.2.3). Davies and Barnett (2015, p. 6) call it cross-boundary position taking as they explain that the philosophical, educational, and socially active perspectives on critical thinking are by no means separable, and researchers, scholars, and commentators may incorporate elements of these different perspectives in their accounts. The presence of this categorization in my data analysis is not just for the sake of itself, all three perspectives have their strengths and limitation. Being aware of them makes it possible to reflect on accounts of critical thinking reported in this thesis.

Let us look at the array of definitions found in data belonging to the psychological school of thought. The strength of psychological theories is that they show how people think critically under the limitations of the person and environment (Sternberg, 1986, p. 5). Their obvious benefit is that behaviors that constitute critical thinking definitions are of great value for practical purposes, i.e., behaviors are observable and measurable, and they are clear indicators of what kind of actions critical thinkers do and should do. Seventeen critical thinking definitions identified in this thesis achieve this end well. However, this strength is also a limitation of the psychological definitions as they may oversimplify the complex concept into a collection of disconnected steps and procedures, rather than acknowledging a complex orchestration of these processes (Lai, 2011, p. 7; Sternberg, 1986, p. 5).

Based on the analysis of critical thinking accounts of SMEs, I believe that the weight of this limitation is not that significant in this thesis. While SMEs' definitions were to a greater extent belonging to the outlined above traditions, taken as a whole, critical thinking accounts of SMEs had elements of different schools of thought. For example, 12 out of 17 SMEs' accounts that featured definitions belonging to the psychological tradition also incorporated dispositions and standards of thought. In fact, these dispositions and standards of thought to a great extent belonged to the philosophical tradition of thought: These elements are used to describe an ideal critical thinker (Lai, 2011, p. 5) and build models of competence (Sternberg, 1986, p. 4). Some other SMEs' accounts with the psychological definition of CT included epistemological understanding, dialectic process—elements also pertaining to philosophical conceptualizations. Theories and works influencing SMEs' understanding of critical thinking in this category (a group of SMEs whose accounts featured definitions belonging to the psychological tradition) were in one way or another belonging to the realm of cognitive psychology: Bloom's taxonomy (Bloom et al., 1956) mentioned by three SMEs, Halpern's (1998) concept of critical thinking that we used as a reference definition of the psychological school of thought, or design thinking that is a problem-solving approach based on a set of skills and strategies (see Linke, 2017). At the same time, it is important mentioning that the philosophical theorizing of critical thinking also had an influence over SMEs' accounts in this category—e.g., works of Glaser (1941) and Ennis (2015). A philosophy instructor stated:

> Critical thinking belongs to the realm of philosophy, after all. Aristotle, Immanuel Kant, David Hume, Bertrand Russell, Martin Heidegger, Ludwig Wittgenstein, just to name a few, are philosophers who have influenced my understanding of critical thinking. One influential theory is G.W.F Hegel's Dialectical Philosophy. Another influential theory is Stephen Toulmin's Argumentation Model that encapsulates the

critical thinking of argumentation in 6 processes: claim, grounds, warrant, quantifier, rebuttal, backing.

One may find the account above particularly interesting in terms of cross-boundary position-taking. The account of critical thinking showcased concerns of the philosophical tradition and relation to others, participation in society. However, SME's definition of critical thinking itself was mostly in terms of the behaviors and actions a critical thinker does, thus categorized as belonging to the psychological tradition.

Another characteristic of the psychological definition was that corresponding accounts were mostly related to the development of an individual and one's dispositions, rather than focusing on wider social concerns (only four SMEs made a connection to "Others" and two emphasized critical action). An insight into this trend is given by Sternberg (1986) who categorizes his critical thinking account as belonging to the psychological tradition. In his article's section "The relation of critical thinking to the external world of the individual", Sternberg gives examples of how two psychological traditions—his (1985) and of Bransford and Stein's (1993)—deal with the "external world". In Bransford's work "The techniques for problem solving are 'brought to life' through concrete instances, and readers are encouraged immediately to apply the techniques to problems they face in their own lives" (Sternberg, 1986, p. 15). In Sternberg's approach "students will best learn how to apply processes and strategies of critical thinking in their everyday lives if they use these processes and strategies in the broadest possible array of circumstances, ranging from the most academic to the most practical" (p. 15). As we may deduce from the wording, both accounts do not postulate the necessity of social action as a part of critical thinking (the way criticality scholars would). Scholars clearly distinguish processes and strategies that are, in essence, critical thinking and everyday lives and problems as areas of these strategies' application. This line of thinking is also well noted by Burbules and Berk (1999) and Davies (2015), where the latter suggests that “the authoritative definition of critical thinking [Ennis’s one] widely adopted by many in the critical thinking movement assumes—but does not formalize—commitment to action” (p. 73).

The last point relating to the psychological tradition definition of critical thinking concerns SMEs’ professional background, as one would expect it to influence their position on critical thinking. SMEs participating in this research were of diverse professional backgrounds; there were three larger occupation groups identified in these data: eight teachers, eight higher education professionals, and six game development professionals (see Section 4.1 and Table 5). SMEs whose definitions were categorized as belonging to psychological tradition represented a mix of various occupations: five higher education professionals and one Ph.D. student; three game development professionals, one technology sector professional, and one educational technology professional; three teachers, a student, an HR professional, and an editor. As one may see, SMEs whose definitions belonged to the psychological category cut across all major occupation categories present in the data.

The next group of accounts observed in collected data is those belonging to the philosophical conceptualization of critical thinking. This group among the others showed the highest commitment to looking at critical thinking in its wider sense—emphasizing how it relates to participation in society. SMEs’ accounts of critical thinking in the philosophical category vary in the ideas and influences they were built upon: from Michel Foucault's discussion of “problematisation” to the use of Socratic questioning, Ennis’s critical thinking, and Bloom’s taxonomy. Interestingly, SMEs demonstrated some insights relating to reflection on the concept itself. For instance, when reflecting on the difference between critical thinking and good or effective thinking, two SMEs suggested the importance of considering the impact of the conclusion one may make—not only solutions to problems but their consequences. This idea connects to and is well developed in the work of

Papastephanou and Angeli (2007) who call for critical scrutiny of the technicist paradigm built around the notions of achievement and performance but lacking a critical stance over the need for the achievement of these goals. Other SMEs in this category touched upon the epistemological dimension of the concept suggesting that critical thinking is about epistemological understanding and, in the words of one SME, "be[ing] able to see the reality from different views and create an own opinion about it". These ideas are also mirrored in works of critical thinking scholars who develop these ideas in great detail such as Kuhn's (1999) epistemological meta-knowing or McPeck's (1981) epistemological understanding of disciplines.

Finally, one SME made a connection with critical theory emphasizing that critical thinking is needed to "not be a mere sheep in our totalitarian system where everyone is being brainwashed to comply", "foster NEW ways of thinking and tear down established constructs" and be immune to social pressure and norms. While the SME did not incorporate an educational agenda into this account, it was an illustrative example of how critical thinking can be viewed through the lens of critical theory that influenced works of critical pedagogues such as Freire (1970), McLaren (2010), and Giroux (2013).

If I am to be consistent, I should also be critical of the philosophical definitions and look into how their potential limitations may showcase themselves in SMEs' accounts. As Sternberg (1986) suggests, one should be aware that the philosophical tradition focuses much on the ideal critical thinker, "not so much upon the requirements of critical thinking in the classroom, but upon the requirements of formal logical systems" (p. 3). Philosophical theories of critical thinking tend to build "models of competence" (p. 4) rather than "models of performance for human thought" (p. 4). While knowing the potential of critical thought is undeniably important, one should also know how critical thinking operates under the limitations of the environment and a person. It is hard to accurately assess SMEs' accounts of critical thinking from that side as they are limited to several questions. However, at least seven out of nine SMEs in this category included the behaviors and actions critical thinkers do: evaluating assumptions, identifying and removing bias, clarifying ideas, operationalizing concepts, problem-solving, identifying and controlling one's emotions, and so forth.

Finally, SMEs in the philosophical category came from diverse professional backgrounds: two higher education professionals and two Ph.D. students; two game development professionals and one technology professional; user experience professional and school curricular content developer. Interestingly, out of eight teachers who participated in this research, none had a purely philosophical conceptualization of critical thinking.

The last group of accounts found in these data belonged to the educational tradition. Sternberg (1986) suggests that educational definitions of critical thinking are based on years of observation of students' learning, but lack epistemological clarity as those belonging to psychological and philosophical traditions (p. 6). Among the limitations of different schools of thought, this one is the hardest to assess. The unit of analysis, in this case, would be SMEs' definitions of critical thinking with a reflective piece justifying the definition. The data collected in this research does not feature this reflective part, thus the assessment of this limitation is over the scope of this thesis.

Educational definitions of critical thinking found in this thesis demonstrated commitment to critical thinking as cognitive skills, reflective judgments, and dispositions. Interestingly enough, the number of SMEs who had critical action in their account did not match the number of SMEs who expressed wider social concerns of critical thinking application (see Figure 22). For instance, one would expect those who are concerned with the use of critical thinking for the good of society to call for critical action (as criticality theorists would do). At least three SMEs in the educational category focused on wider social concerns of critical thinking which were participation in society, and its relevance not only for an individual’s development. However, only one SME extended their account to critical action. This mismatch may mean that educators are still reluctant to call for action even if they were recognizing its social importance. This possible connection can be explored in future studies. The questions to be posed may ask whether a government agenda interacts with the academic freedom of teachers in educational institutions in particular countries and if it does, how it may differ between levels of the educational system (e.g., primary, secondary school, higher education, etc.).

As one might expect, Bloom’s taxonomy (Bloom et al., 1956) influenced educators’ vision of critical thinking as three SMEs in this category identified it as a theory informing their definition. In line with Sternberg’s description of the educational school (p. 6), educational accounts of critical thinking had elements relating both to philosophical and psychological schools of thought. SMEs consistently mentioned standards of thought and competencies they believed are at the core of the critical thinking concept: independent thinking, self-awareness, depth, completeness, precision, responsible thinking, accuracy, clarity, courage, and so forth. At the same time, similar to the psychological definitions, SMEs had behaviors and actions of critical thinkers listed: explanations of processes and procedures, critique of opinions and facts, investigation of different perspectives and opinions on one topic, evaluating assumptions, analyzing, questioning, applying, and so forth.

After examining these responses by profession, we can see that SMEs whose definitions were categorized as belonging to the educational school of thought were mostly teachers; six out of eight SMEs in this category. Additionally, there were one higher education and one game development professionals. While the presence of different occupations in the psychological and philosophical groups is highly speculative, the domination of teachers in the educational group appears logical. Six out of eight participating teachers defined critical thinking primarily through the prism of their occupation, and these definitions were about how critical thinking can be conceptualized in terms of learning, or teaching correspondingly.

4.5.3 Critical Thinking and Culture

Another interesting finding is the overwhelming agreement between SMEs that there is a relationship between critical thinking and culture. While this question was not primarily a focus of this thesis, it was envisioned that the inclusion of SMEs from different locales may result in richer data with varying perspectives on critical thinking (see Section 3.2).

Twenty-six out of 28 SMEs reported that there is a connection between critical thinking and culture and only two SMEs thought that they are not related. The connection between culture and critical thinking is already explored in research (see Section 2.12), which means that SMEs may know about the relationship or at least hypothesize that culture is a dimension to be aware of when speaking about critical thinking. However, it would be useful for future studies to explore the connection between critical thinking and culture in relation to games: Whether games consciously or not reflect cultural modes of thinking, are there particular games that are made with the purpose to utilize these varying modes, and if so how it is done?

Ultimately, this finding suggests that when researching and teaching critical thinking, we should be aware and reflective of the connection between critical thinking and culture. It should include some reflection on one’s conceptualization of culture and critical thinking. An educator may reflect on whether their teaching practices and views about critical thinking are driven by cultural modes of thinking. A researcher may reflect on their assumptions about critical thinking in light of belonging to a cultural group or a particular academic community with its history of thought and scientific procedures (e.g., Western education, Eastern education).

4.5.4 Domain Specificity and Assessment

Any account of critical thinking should also mention the long-standing debate between generalists and those who believe that critical thinking is subject specific (see Section 2.5). In their majority, SMEs participating in this study thought that most likely critical thinking is general skills and abilities which can be taught or used across many disciplinary domains (we may call them generalists). Only four out of 28 SMEs responded that critical thinking is domain and problem area specific. This data was derived from a closed-ended question and did not include SMEs' explanation of their choice. For this reason, this finding may mean several things in relation to the theme of this thesis.

First, the question of domain specificity primarily connects to the teaching of critical thinking (see Section 2.5). All SMEs thought that critical thinking can be taught. Ennis's (1989) types of instructional strategies are of great use to understand possible dynamics between the view on domain specificity and critical thinking teaching. For instance, generalists may see critical thinking skills and abilities taught through a general instructional approach (e.g., informal logic courses or a separate critical thinking course), or would try to use the mixed instruction approach (e.g., teaching critical thinking through subjects and as a separate course). Notably, all SMEs who thought that critical thinking is about general skills and abilities had critical thinking skills listed in their accounts of critical thinking. The necessity to develop these skills can be traced to proposed digital technologies, digital games, their genres, and elements that are believed to contribute to the development of critical thinking. It creates continuity between the two rounds of the research as in the next round, SMEs are asked about how critical thinking may be taught through digital technologies and digital games. In other words, this finding creates a connection between what critical thinking is in the position of SMEs and how it could be taught through digital technologies and digital games.

Second, the question of domain specificity also connects to the theme of transferability discussed in this thesis (see Section 2.6). If one implies that critical thinking is general skills and abilities, then one may accept the proposition that these general skills may transfer to different domains of knowledge and problems. On the contrary, proponents of the domain-specific view of critical thinking may argue that critical thinking is less likely to transfer as it differs across problems and domains of knowledge. In the end, the question of transferability also comes into the teaching of critical thinking as discussed before. One may choose a critical thinking instruction (pedagogical approach) aimed at transfer or pursue a domain-specific way to teach critical thinking rooted in disciplines and domains of knowledge.

Third, the theme of assessment also connects to the debate on domain specificity and teaching of critical thinking (see Section 2.6). Generalists may attempt to measure what they define to be critical thinking such as general critical thinking skills and abilities, their use, and manifestation. Simply put, a particular instrument of assessment defines to what extent a distinct critical thinking concept is developed in a person and may consequently shape critical thinking instruction. In our data, 15 SMEs who defined critical thinking as general skills and abilities reported that it can be assessed, while only three did not support this idea. On the contrary, two out of three SMEs who thought that critical thinking is domain specific reported that it cannot be assessed, and only one SME in this group said that it can be assessed. These findings converge with the literature review and the logic of generalists: there are critical thinking skills that are applicable across domains of knowledge and they can be assessed (Ennis, 1989, 1993). For example, Ennis (1993) documents several general-content-based tests of critical thinking: The California Critical Thinking Skills Test, The Ennis-Weir Critical Thinking Essay Test, and the Cornell Critical Thinking Test. It is also interesting that SMEs who believed that critical thinking is domain-specific did not think that it can be assessed. Their position could be a reflection of the state of the critical thinking assessment field more generally. For example, Ennis (1993, p. 182) could not find subject-specific tests of critical thinking, and only recent research seems to address their absence (see Tiruneh et al., 2014, 2017). Since it is a relatively new research development, the findings of this study may reflect the skepticism around subject-specific critical thinking skills assessment.

The theme of assessment also contributes to the appreciation of the complexity of the concept and its development. There are several ways of looking at this finding. One may say that critical thinking is such a complex concept, that any attempt to measure it will result in an oversimplification and reduction to skills and abilities (akin to criticism of psychological tradition of thought cited in Sternberg, 1986). Another way to look at the assessment is to embrace its practical relevance and try, to the best degree possible, to use it for teaching needs. Many scholars and organizations made measurement instruments (e.g., Collegiate Learning Assessment (CLA) by Council for Aid to Education, 2021; the Ennis–Weir critical thinking essay test by Ennis & Weir, 1985; Watson Glaser Critical Thinking Appraisal by AssessmentDay, n.d.) and one can also find works with the critique of these tools (e.g., Aloisi & Callaghan, 2018, on CLA; McPeck, 1990, on Watson Glaser appraisal; Ennis, 1993, on several measurement instruments).

One may see this section as a speculative one, as it is based on responses to two closed-ended questions. Nevertheless, it is an important one as it speaks to the core discussion that has engaged many scholars working in the field of critical thinking scholarship. As any other question asked to SMEs about critical thinking in this thesis, these two questions have practical implications. If we accept that digital technologies and games are mediums that are well suited for the development of critical thinking, then we should be aware of what kind of critical thinking is embedded or taught through them. This idea may be considered as the overarching point of this section. The conceptualization of critical thinking drives practice, application, and the teaching of the concept. Ultimately, it informs in what manner games and digital technologies could deal with critical thinking.

4.5.5 Conclusion

Round 1 has answered three research questions of the study:

RQ1: In what ways do SMEs in the field of digital technology and education conceptualize critical thinking?

RQ1a: What are the differences in the ways that SMEs conceptualize critical thinking?

RQ2: Do SMEs believe critical thinking can be developed using digital technology?

It also partially addressed RQ2a: In what ways do SMEs believe that critical thinking can be developed using digital technology? The data derived from this round and the findings discussed above open the way for Round 2 on critical thinking, digital technologies, and digital games.

The findings of Round 1 indicate that 25 out of 28 SMEs reported that critical thinking can be developed using digital technologies, with only one SME choosing “somewhat disagree” as a response. What is most distinctive is that SMEs mentioned digital games most often when suggesting the kind of technologies that can support the development of critical thinking (24 out of 28 SMEs). In particular, SMEs were reporting on the use of Minecraft, other specific games and their different genres. Also, in line with the literature reviewed in this thesis, SMEs emphasized the usability of WIKIs and blogs (see Bell et al., 2011; Subran, 2013), discussion boards and forums (see Lee, 2004; Ng’ambi & Johnston, 2006), and MOOCs (see Ota, 2014) for the development of critical thinking. We can also observe that nine SMEs suggest that any digital technology solution may support the development of critical thinking when an appropriate pedagogy, design, or strategy is applied (see Childress & Braswell, 2006, p. 194; Doolittle, 1995, p. 35; Frasca, 2001, p. ix; Halpern et al., 2012, p. 94; Song, 2008, p. 569; Yang, 2012, p. 368). This idea is extensively developed in Round 2.

In summary, Round 1 shaped the collective vision of critical thinking as conceptualized by international SMEs. Corresponding findings show that critical thinking differs from one SME to another. SMEs were taking cross-boundary positions incorporating elements of various traditions of thought including psychological, philosophical, and educational schools (see Sternberg, 1986) and several critical thinking accounts (see Davies, 2015). Additionally, when placed on Davies's (2015) model supplemented by Sternberg's (1986) classification (see Figure 16), the SMEs' accounts of critical thinking laid into five subgroups with a set of characteristic elements repeating through each of them (orientation on the individual–sociocultural axis, absence or presence of the distinctive features of criticality, critical pedagogy, reflective thinking).

This Delphi study presupposes the dynamics between different positions on critical thinking. In Round 2, SMEs provide feedback, critique, agree, or disagree with their colleagues' positions on critical thinking from these Round 1 findings. The need for Round 2 is justified by the clear agreement of SMEs that digital technologies and digital games can be used to develop critical thinking. Without further ado, we can proceed to Round 2 and its findings.

Chapter 5: Round 2

This chapter presents the data collected during Round 2 of Delphi and relates findings to the theoretical framework of this research. In this chapter I build on and extend the findings of Round 1 to answer the following research questions:

RQ2a: In what ways do SMEs believe that critical thinking can be developed using digital technology?

RQ3: Do SMEs believe that critical thinking can be developed using digital games?

RQ3a: What do SMEs believe are important elements needed for digital games to develop critical thinking?

There were 22 SMEs from the previous round who participated in Round 2. The results of this round are organized in several subsections (Sections 5.1–5.5) with headings corresponding to questions' numbers in Questionnaire 2 (see Appendix G). Additionally, I include Section 5.6 concerning Delphi interactions that documents SMEs' feedback about the results of Round 1 and the positions of their peers. The discussion of Round 2 findings can be found in Section 5.7. The Discussion also features the Three-Phase model for critical thinking and digital games constructed from the results of Rounds 1 and 2.

In Round 1 almost all SMEs agreed that critical thinking can be developed using digital technologies ("agree" and "somewhat agree"—25 SMEs; "neither agree nor disagree" —two SMEs; "somewhat disagree" —one SME). Additionally, SMEs provided a list of digital technologies that they believed support the development of critical thinking: digital games, WIKIs, blogs, discussion boards and forums, and MOOCs (see Section 4.3). Furthermore, some suggested that any technological solution may support the development of critical thinking when an appropriate pedagogy, design, or strategy is applied.

In Round 2 SMEs were briefed on the findings of Round 1 (see Appendix G) and asked to answer the questions of Questionnaire 2. The questions in Questionnaire 1 (Round

1) were constructed from the theoretical framework (see Section 1.6) and also from the literature review. The questions in Questionnaire 2 were aligned with the overarching research questions of the study, literature review, and also refined by the results and feedback from Round 1.

5.1 Question 1. Features and Elements of Digital Technologies That Can Promote or Teach Critical Thinking

Following Round 1 of Delphi, the first question of Round 2 asked SMEs "What features/elements of digital technologies do you think can promote/teach critical thinking (e.g., their design, capacity for collaboration, etc.)?" SMEs' responses to this question were qualitatively analyzed and split into several themes found in the data (see Table 9). These themes were also reported on the website page constituting group vision Report 2 (https://play2think.com/stage-2). The findings I report after the table are taken from this webpage as they also feature the frequency of codes identified in the data (see Section 3.6 for a detailed explanation of frequency indexes added to codes, e.g., "x1").

Table 9

Key Themes in Relation to Features and Elements of Digital Technologies for the Development of Critical Thinking

Theme	Description
Elements and features relating to digital games	The different digital games' elements that can be used in digital technologies
Collaboration	The capacity of digital technologies for collaboration between learners or with a teacher; digital technologies that allow collaboration
The underlying design and proper pedagogy	The underlying design of digital technologies and pedagogical considerations, one's ability to use technology properly
Feedback	The feedback that can be provided to a learner or player by digital technologies and games
Discussion and narrative-/storytelling based learning	Digital technologies give space for discussion and narrative-/storytelling

	based learning
Autonomous inquiry, an agency on the part of the learner	Digital technologies empower a learner to take an active position in one's learning
Perspective-taking	Digital technologies can be used to support perspective-taking
Display of systemic consequences and engagement	Digital technologies may serve to demonstrate systemic consequences; they engage learners
Elements mentioned once	Several elements mentioned once in the data

Ten SMEs reported various elements and features of digital technologies relating to digital games that were believed to promote critical thinking. Altogether, these elements and features constituted the first theme as it stands in Table 9 above. Some of the elements belong to other themes reported in Table 9, e.g., "feedback", but they are additionally included in the first theme as they were mentioned in relation to digital games specifically:

- making decisions based on several choices (2) or sources (x1), solving problems in multiplayer games taking into account different perspectives (x1);
- feedback (2) and resource management (2);
- collaboration (2);
- in-game "messy problems" with no fixed answer (x1);
- experiential knowledge through game mechanics, exploration, riddles (x1);
- create moments of productive struggle (i.e.: defeating a Boss on a video game) (x1);
- looking for a logical outcome, to "stop and think" (1);
- the connection of learning through the game with the real world, getting acquainted with modern tools, linking them with playing activities (x1);
- the intention behind the design choices of the game. The underlying story and premise of the game (x1). Gameplay (x1).

The next theme found in answers of seven SMEs was the capacity of digital technologies for collaboration and cooperation:

> The capacity of digital technologies for collaboration(6) and cooperation(x1) between learners or with a teacher(2) can promote/teach critical thinking. Collaboration elements give opportunities “to build a collective body of knowledge”(2), “allow for more discussion/narrative based learning”(x1), and “collaborative inquiry”(x1). In this regard, SMEs report on the use of collaboration boards (x1), Nearpod (x1), wiki pages (x1), and documents (x1).

Another theme echoing the findings of Round 1 was the underlying design of digital technologies that ultimately drives how critical thinking can be taught or promoted. This theme was found in responses of six SMEs:

> One of the most valued elements was a design feature(6) of digital technologies. While “technology itself is inert”(3), there should be a design that uses appropriate educational theories and relevant learning objectives(x1), provides students with “the tasks that reflect their current level of critical thinking skills”(x1). The role of an educator is central as one should be able to adapt and use technologies for the benefit of students’ critical thinking(2). One example of a design that builds on students’ critical thinking level is “Arguendo learning engine”(x1).

Responses of four SMEs emphasize feedback as serving to promote critical thinking through digital technologies and digital games. Immediate feedback to players’ actions was mentioned by several SMEs:

> Critical thinking can be promoted with “elements that create moments of productive struggle that provides immediate feedback with attempts to redo”(x1).

The other three themes mentioned by three SMEs each incorporated elements related to (the discussion was mentioned two times):

> Discussion(2) and narrative/storytelling-based learning(3)

Digital technologies' features that give space for discussion(2) and narrative/storytelling-based learning(3) were also labeled as important to CT. There was an opinion that collaboration and "AI can allow for more discussion/narrative-based learning"(x1).

Autonomous inquiry, an agency on the part of the learner (3)

CT can be taught/promoted if technology allows for autonomous inquiry(x1). DTs "bring in some agency on the part of the learner"(x1) and might "force students to turn to their own objective evaluation"(x1).

Perspective-taking (3)

Simultaneous use of different DTs' forms "make[s] it possible for students to look at things from different perspectives"(x1). In conjunction with nonlinear interaction features(x1), these elements promote critical thinking. Another position is that "technology often leads to 'right' and 'wrong' instead of embracing gray areas and ambiguity", hence there should be elements that allow for multiple solutions(2), students should be shown that there are no easy answers(x1).

Digital technologies were also believed to support critical thinking through the display of systemic consequences and their engaging qualities (mentioned by two SMEs each):

"Digital technologies can provide an opportunity for students to do systems thinking"(x1) and "display systemic consequences in an efficient manner"(x1). As well as engagement(2).

Finally, as this Delphi is Kantian in its nature, I report elements mentioned once in the collected data:

Project-based learning(x1), competition(x1), scaffolding(x1), evidence-based information(x1), usability(1), and "anything that involves, and/or requires, the person to "stop and think" even for a while"(x1).

5.2 Question 2. Features and Elements of Digital Games That Can Promote or Teach Critical Thinking

To follow up the line of questioning about digital games and critical thinking, SMEs were asked in Question 2: “Could you explain what you think are the features/elements of digital games that make them well suited for this task [development of critical thinking] (e.g., feedback, problem-solving, etc.)?” SMEs’ responses were analyzed and split into corresponding themes (see Table 10).

Table 10

Key Themes in Relation to Features and Elements of Digital Games for the Development of Critical Thinking

Theme	Description
Feedback, result-seeing, and opportunity to repeat a task	The feedback that games provide to players, and the related theme of trying and repeating when solving a game problem
Problem-solving and decision-making	Players solve problems in games and make decisions
Collaboration	The capacity of digital games for collaboration between players
Perspective-taking	Digital games can be used to support perspective-taking
Game mechanics and underlying design	The understanding of game mechanics contributes to critical thinking. The role of the game design
Resource management; math skills	Management of in-game resources; games’ use for the acquisition of math skills
Experiential knowledge	Games feature real-world problems; accommodate experiential knowledge
Elements mentioned once	Several elements mentioned once in the data

In line with responses to the previous question (see Section 5.1), the most recurring element reported by nine SMEs was feedback mentioned side by side with two more features:

> Elements of games contributing to CT were in-game feedback(9) and result-seeing(x1). Progressive struggle (x1) and “opportunities to repeat a task for better results”(2) were also contributing to CT.

One of the most cited features relating to critical thinking and digital games was their problem-solving component (mentioned by nine SMEs):

> "To resolve game 'puzzles', students have to use logical and objective analysis"(x1). In this regard, digital games also feature decision-making(x1). Games offer 'messy problems' with no fixed 'right' answer, which is an ideal environment for developing critical thinking(x1).

Akin to digital technologies, digital games were believed to be well-suited for critical thinking because of their collaborative features (mentioned by six SMEs):

> Among them were communication (x2), creation of something in common (x1), sociability (x1), responsibility for each other (x1), survival/success of an individual affecting the overall health of the community (x1), and perspective-taking through collaboration (x1).

> Less occurring themes were:
>
> Perspective-taking (4)
>
> The range of choices in games promotes perspective-taking(4) which also adds to CT. "Modern games promote perspective-taking capabilities as narrative-based games encourage decision making in tough and complex situations" (x1).
>
> Game mechanics (2) and underlying design (1)
>
> Understanding of game mechanics contributes to CT (x1); "game mechanics, exploration, riddles allow for experiential knowledge" (x1).
>
> "Underlying design [allows] players to take their time (more complex puzzles) or push[es] for intuitive decision making that tests the current ability to put in-game knowledge to practice" (x1).
>
> Resource management(2) and math skills(2)

Supporting the development of critical thinking in games is resource management(2)—such as health, money, and so forth. Examples of games with this element were Roblox, Minecraft, and Clash of Clans.

It was also reported that digital games are good for the acquisition of math skills(2).

Experiential knowledge (2)

For the benefit of CT, games connect with real-world problems and allow players to conduct safe experiments(x1). They accommodate "experiential knowledge through game mechanics, exploration, riddles"(x1).

There were also many elements of digital games or related ideas contributing to critical thinking mentioned only once:

- engagement(x1),
- genre(x1), and, in particular, narrative-based games(x1) were of CT value.
- the ease of use and intuitiveness(1);
- project-based learning (x1);
- "Digital games allow students to take an active role in their learning" (x1);
- learning of 21st century skills (e.g., with the use of Minecraft Education Edition) (x1);
- "sensory stimulation that promotes insight through mindfulness (see Sliwinski et al.)"(x1);
- "short-term vs long-term goals"(x1);
- "Digital games that don't give the student all the answers, but give them all the tools needed to get to the answers … " (x1);
- Deep thinking (x1).

One expert believed that games "… are still relatively new for such tasks [developing CT]. Thus this 'newness' [novelty] factor is a key element for a bit longer"(x1). The expert continued: “[games] are not yet at a point where they can replicate the kind of ‘open-ended games’ that reproduce the kind of complex adaptive systems known as complex/wicked environments”(x1).

5.3 Question 3. Philosophies and Theories Behind Digital Games for Teaching or Promotion of Critical Thinking

In response to Question 3 “Is there an underlying philosophy/theory which you think makes digital games suitable for teaching/promotion of critical thinking?”, 14 SMEs chose “Yes”, five SMEs “I do not know”, and one SME “No”.

The following list was compiled after SMEs were asked to name these theories and philosophies:

- Learner-centered theories (x1), including constructionism (x1) and constructivism (3);
- Game-based learning (x2);
- The Substitution Augmentation Modification Redefinition (SAMR) model (x1);
- “Heutagogical learning principles [and] almost anything underlying adult education practices” (x1);
- Flow Theory by Mihály Csíkszentmihályi (x1) [the concept of “flow”];
- Technology acceptance model (TAM) (x1);
- Creative and Playful Learning (x1);
- Bernard De Koven’s works (x1);
- Game theory (x1);
- Competency-based learning (x1);
- Survival (x1).

As well as:

- “Benson’s theory (2011) of language learning that happens outside the classroom might be adapted in connected to critical thinking skills” (x1);

- Attention capturing ability (x1);
- "The list [of theoreticians] … should NOT include some of the biggest proponents of this area, such as Prensky, whose work in almost purely non-scientific conjecture" (x1);
- "The voluntary attempt to overcome an unnecessary obstacle" – definition of a game from Bernard Suits" (x1);
- Imagination, connection with the real world, engagement. Games feature serious elements. Playing games is to be open to learning new things (1)

5.4 Question 4. Genres, Types, and Particular Games That are the Most Suited for Teaching or Promotion of Critical Thinking

In Question 4 SMEs were asked: "What genre(-s)/type(-s) of digital games or particular game(-s) are the most suited for teaching/promotion of critical thinking?" Based on SMEs' responses I could compile the following list of game types, genres, and particular game titles. One can also see the frequency of their occurrence depicted by numbers in brackets (see Section 3.6). The list goes as follows:

- Multiplayer games (collaborative games) (5). One SME specified: "Strategy / RTS may also be useful for similar reasons. Certainly potential to develop strategy, collaboration and other soft skills aligned to critical thinking";
- Role-playing games (RPGs) (5). One SME elaborated: "Role-playing games. They present a context in which to capture the students [sic] attention and provides [sic] learning opportunities within that same context. This represents a marriage of Critical Thinking with Social-Emotional Engagement with a lesson (x1)";
- Minecraft: Education Edition (3). The position of one SME who elaborated on their choice was: "… Firstly, I have been working in it for the third year now and I

can say that there is no border in it. [It] carries children 8-12 years old. In it you can study physics, electricity, man and the world, art, mathematics, programming - 3 languages, chemistry and much more, and most importantly, from all this you can make a variety of projects from ar [AR], cars, quests, tests, game locations and much more. Able to unleash fantasies and have educational tools";

- Adventure games (3) including choose-your-own-adventure(2). One SME elaborated: "Adventure/narrative games where the story is pieced together by the player(s) e.g. Gone Home, Edith Finch, etc. are ideal for this, especially where they offer conflicting viewpoints on how the story should unfold. e.g. reading the journals of characters in Tacoma (from memory) reveals a conflict between two characters and it's up to the player to determine who, if anyone, is at fault";
- Narrative/story games (3). An SME explained one's choice: "narrative/ story (incl. decision making) that inspires CT";
- Strategy games (3). See an excerpt from SME's response in the "Multiplayer games" bullet point above;
- There's no specific type of game (3). An exemplary position in this theme was as follows: "It Depends. Any genre could be useful depending on what you are teaching and how you are teaching";
- Educational games (2). An SME explained one's choice: "Educational games with a particular purpose to develop critical thinking skills - Arguendo platform";
- Puzzle-style games (2). An SME elaborated: "[Games that promote] experiential knowledge through game mechanics, exploration, riddles". Another SME provides an example: "more puzzle-oriented games such as Portal 2 are good at exercising a different form of critical thinking";
- Simulations (2). An SME specified: "Simulations based on difficult life choices".

Another SME provided several examples: “Simulations are particularly effective for broader uses. While still games, things like Civilisation, the Sims, Cities Skylines, Football Manager and so on still have massive potential. You can fail in them all, and you can face other real people, or computer bots”;

- Games that engage both thinking and feeling (2). See the “Role-playing games” bullet point above for more detail;
- Escape rooms (x1), Euro-board games (x1), resource management games (x1), “competition-based games, interactivity games and discovery games” (x1), survival games (x1), fighting games (x1), first-person shooters (x1).

The list above also contains more excerpts from SMEs’ responses (they are hidden in tooltips) and can be viewed on the webpage of Round 2 of this Delphi study (see https://play2think.com/stage-2/; heading “Genre(-s)/type(-s) of digital games and particular game(-s) that are the most suited for teaching/promotion of critical thinking”).

5.5 Questions 5–6. Learning Modes and Settings for Teaching Critical Thinking in Digital Games

In this section, I report on SMEs’ position regarding modes in which play may be effective for the development of critical thinking. After that, I also provide SMEs’ feedback on learning settings that may be the most effective for the promotion of critical thinking through digital games.

In Question 6 SMEs provided their feedback on modes in which games can be played for critical thinking advancement. The question was worded as follows: “What mode(-s) may be the most effective for teaching/promotion of critical thinking through digital games?” SMEs were also briefed on the meaning of ‘mode’ in this question:

> By “mode” I mean how these games are played. For example: with a teacher or without teacher’s guidance, when teacher and students are playing a game on

one/separate consoles or in a multiplayer/single-player modes, when the whole class plays a single-player game taking turns, any other mode(-s), or combination(-s) of presented options.

SMEs' responses were classified into five themes that I present as given in the report webpage of this study (see Table 11; https://play2think.com/stage-2).

Table 11

Key Themes in Relation to the Most Effective Learning Modes for Teaching/Promotion of Critical Thinking Through Digital Games

Theme	Description
Leading principles and factors when choosing a mode	There is not one mode, which would be the most effective, rather there are leading principles and factors when choosing a mode
Collective learning modes	Learning modes that support cooperation, collaboration, and group work
Briefing/action/debriefing sequence, and reflection	The importance of briefing/action/debriefing learning sequence, and reflection
Single-player mode and teacher's role	The use of single-player modes and the role of a teacher
Mentioned once	Modes mentioned ones and notes of SMEs

The biggest theme found in the responses of 10 SMEs is that there is not one mode, which would be the most effective, rather there are leading principles and factors when choosing a mode. These principles and factors are summarized in the list below, where modes:

- Should correspond to learning goals and objectives (5). For instance, chosen modes should be aligned with the purposes of learning, as it is easier to evaluate the impact of predesigned learning activities in formal and nonformal environments. In-depth interviews might help in the understanding of CT in informal learning in games (x1).
- Are driven by the design of the game (3);

- Correspond to the context of the problem being learned (2);
- Meet the needs of the user and educator (x1);
- Meet special learning needs (1);
- Meet the level of development of the [learning] program (x1) or learner's age, skills, strengths (x1);
- Are determined by classroom setting (x1);
- Are determined by the aspect of critical thinking to be taught, e.g., multiplayer for relationship-related or social CT, and guided playing for domain-specific problem-solving CT (x1);
- Are determined by the resources of the educational institution (x1);
- "All of them [modes that were given as example in the original question] might be useful if structured and designed well" (x1).

The next big theme is related to the collective learning modes. Seven SMEs elaborated on their choice:

- Cooperative mode (2), in particular, cooperative games with teacher's guidance (x1);
- Team/group work where a teacher takes different roles(2): an active participant (x1), observes and controls stepping back from the activity (x1), one who is responsible for debriefing/reflection (x1)
- Multiplayer modes where a teacher acts as facilitator (2);
- Collaborative mode with children playing on different consoles under the teacher's supervision and assessment of players' contribution (x1).

Note: In collaborative mode, there is an expectation of other players to be effective. It might be interesting to observe communication when playing collaboratively in the same room or different rooms (x1).

Another theme found in responses of five SMEs is the importance of briefing, action, and debriefing sequence, as well as reflection:

> It is also important to ensure that there is a learning scaffolding in place—briefing/action/debriefing sequence, and reflection (5). There might be different reasons to do so, as to “avoid faulty stealth learning” (x1), “ensure optimal learning” (x1), or “cement in the actions and reactions that the student encountered or performed in the game” (x1). This reflective debriefing may be achieved by posing questions, leading a discussion, and making students reflect on how they exercised critical thinking after they have played (x1).

The use of single-player mode was acknowledged by three SMEs. One SME elaborated on a teacher’s role when a child works independently:

> Games can also be played in a single-player mode (3) with a teacher facilitating conversation, and where students can compare work (x1). Another option is single-player games played without guidance (x1). Depending on the level of development of the [learning] program, at some lessons, the teacher is a key element and the child works independently, repeating after the teacher (x1).

Finally, there were three ideas mentioned once by different SMEs:

- A teacher should not be in the “game area”, rather monitor learning on the side (x1);
- All these modes [mentioned as an example] seem to be possible (x1);
- “Modes can be very different as in the public domain any actions, and limited [Depending on the level of development of the program]” (x1).

In Question 5 of Round 2 SMEs were also asked about learning settings: “What setting(-s) may be the most effective for the promotion of critical thinking through <u>digital games</u>?” SMEs were briefed on what I meant by each learning setting mentioned in this question (See Appendix G). Finally, it was a multiple-choice question and SMEs could pick several learning settings at once.

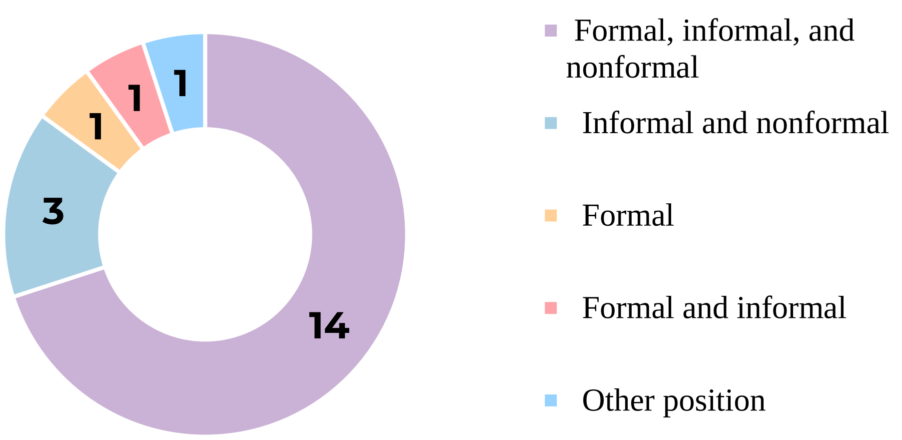
The results demonstrate that most SMEs believed that all provided learning settings may be effective for the promotion of critical thinking—14 out of 20 answered SMEs (see Figure 23). Two experts in this category chose “Other” and explained their positions:

- All three are appropriate depending on stated learning goals and objectives.
- This is context dependent. Not all games are good for all settings. And not all settings require a game.

The combination of informal and nonformal settings was chosen by three SMEs. Formal learning settings and the combination of formal and informal learning settings were chosen once each. One SME picked the option “Other” and wrote: “Anytime the collective attention of the student is engaged. When the student is experiencing ‘Flow’ as described by Dr. Mihaly Csikszentmihalyi”.

Figure 23

What Setting(-s) may be the Most Effective for the Promotion of Critical Thinking Through Digital Games?



5.6 Delphi Interactions

One of the distinctive features of the Delphi study is the interaction between participants. When participating in Delphi, one is encouraged to engage in a critical exchange of positions. SMEs in this study were asked to comment and discuss any idea or element that they observed in the provided reports (see Section 3.4). They could do so using a website functionality or leaving their feedback in the “Comments” section of Questionnaire 2.

Round 2 was the first opportunity where SMEs could share their feedback on the results of Round 1, in particular, through Group Vision Report 1 that could be found at https://play2think.com (see Appendix A). In Round 2 SMEs preferred to use the “Comments” section of Questionnaire 2, rather than using website reporting functionality.

There were seven comments about the results of Round 1 left by SMEs through Questionnaire 2 (Round 2). One expert stressed the importance of the context in which critical thinking is learned. They commented that cultivating critical thinking is opposed to a narrower activity of teaching it. The SME proposed to adjust the environment or context so that learning of critical thinking may happen in it:

> When looking at Critical Thinking with an objective lens of being an abstract skill, we sometimes lose context that defines how it is learned. The how is just as important as the how [probably “what” instead] and it is inalienably connected. So, the question then becomes not so much how do we teach CT through Digital Games (or other means), but more how to we cultivate it? For example, chickens can be taught to analyze and select the correct answer to a problem using technology. In reality, it is learning a pattern and not the practical application associated with the CT of problem solving. Teaching CT is like growing a plant. If the plant isn’t growing well, I adjust the environment (soil, planter, etc.) or the location (sun, proximity to other factors). If as a teacher I have adequately adjusted everything to nurture the growth of that plant,

> it could be said that I properly grew it. Or, to switch back to the non-metaphor, I cultivated the instruction involving SEL (Social-Emotional Learning) factors towards a student so that they adequately learned the CT skill.

Another SME commented that using games is time-consuming but an enterprise that is worth doing: “Use games in your training constantly, it takes more time to prepare, but your lesson at times becomes more interesting and productive”.

Two more SMEs noted that they were curious to see the data generated and did not find things they disagreed with:

- Overall, I have not found anything I strongly disagree with, or have the need to comment on. I am most curious to see this study progress forward, and will continue to take part.
- The answers from Stage 1 are an eye opener. I see many agreement with what I suggested.

Another comment was condemning the current educational system in one’s country and how critical thinking is taught:

> My position is simple. In our country, there is no clearly expressed work of a teacher on the critical thinking of children. There are few such people. It’s time to completely change the entire education system, and as a child, we played different games on the street until a certain age, until about 12, and completely build all the training in a game format. And when the child develops and understands and learns a lot, he will do other things with pleasure.

Aspects of first-person games were recognized in one comment from an SME who reports how Fortnite concerts were used to connect and celebrate music and culture:

> I think that Fortnite, and other first player videogames have a bad rap in schools, yet I think it would be lovely to bring aspects of first player games more into education.

> The idea of shooting other players would not be good, yet if players were shooting targets I think that would be fine. Also the recent dance parties in Fortnite are amazing. With the pandemic not allowing concerts, perhaps we need to look at models of teaching like the recent Major Laser or Mashmellow's [*sic*] concerts in Fortnite as an effective use to bring people together to connect and celebrate music and culture. Something to think about in this extraordinary time.

Finally, the last comment suggested that choosing a game was just a part of the work that should be in place to make critical thinking learning happen. One should be aware of how and who uses a game, and whether appropriate pedagogy is applied:

> I don't think there is a definitive answer to a lot of these questions. Games can be good in classrooms, and they certainly can promote critical thinking, it's not the case that a specific game in a specific class will definitely do this. So much of the effectiveness of games are in how they are used, who is using them, and the pedagogical scaffolding that has gone into the lesson.

These comments were quoted in Report 2 available at https://play2think.com/stage-2/. SMEs could read them and leave feedback in the next Round 3 as the Delphi process presupposes.

5.7 Discussion

This section interprets the findings of Round 2 to establish how they relate to what is already known about the phenomenon, and explain new understandings and insights that have emerged. Generally, it follows the structure of the sections above: focuses on digital technologies and critical thinking, and then on to digital games and the development of critical thinking.

In Section 5.7.1 I will discuss the main findings on how digital technologies may aid in the development of critical thinking that include the relevance of digital games, WIKIs, blogs, discussion boards, forums, and MOOCs. SMEs valued collaboration, feedback, discussion, narrative-based learning, autonomous inquiry, learner’s agency, perspective-taking, and engagement as elements contributing to the development of critical thinking. Finally, I open a discussion on the importance of pedagogical and content considerations that were reported both in the literature review and the data generated by SMEs.

In Section 5.7.2 I focus on digital games for the development of critical thinking. The key findings discussed in this section include the importance of feedback, problem-solving, collaboration, perspective-taking, design strategies and design features of games, experiential learning, narrative-based learning, and learner’s agency as features aiding critical thinking. I discuss the alignment between the genres of games and game elements that were believed to support critical thinking. This section also covers the theme of pedagogy and its connection to game design and learning modes.

In Section 5.7.3, I elaborate on a Three-Phase model for critical thinking and digital games that was developed from the findings of this research.

5.7.1 RQ2a: Digital Technologies for the Development of Critical Thinking

In Rounds 1 and 2 SMEs provided a list of technologies and their characteristics that they thought made them suitable for the promotion of critical thinking. This section analyzes the findings (see Sections 5.1–5.6) to answer RQ2a: In what ways do SMEs believe that critical thinking can be developed using digital technology?

The first theme I could identify after the data analysis was SMEs’ persistence in specifying that digital games, among other technologies, were promising for the development of critical thinking. Interestingly, digital games were the reference point in terms of features and elements supporting critical thinking when exploring how digital technologies may develop critical thinking (see Section 5.1). Therefore, this finding should be looked upon in greater depth by the end of this section and in the next as it speaks to my answer to RQ3 and RQ3a focusing on digital games and critical thinking.

Followed by digital games there were WIKIs, blogs, discussion boards, forums, and MOOCs (see Section 4.3) that were reported as technologies supporting the development of critical thinking. These findings align with the findings of other authors that were reviewed in the literature (see Bell et al., 2011; Lee, 2004; Ng'ambi & Johnston, 2006; Ota, 2014; Subran, 2013).

For instance, one SME emphasized that wikis may be the most effective in cooperative environments. Bell et al. (2011) would agree with this observation as they also emphasized social learning opportunities of blogs and wikis that were used to develop critical thinking in their research. Together with wikis, blogs were also a type of technology suggested by SMEs and used by researchers for the development of critical thinking (see Bell et al., 2011; Subran, 2013).

Discussion boards and forums were described to be of use for the development of critical thinking. SMEs explained their usability by allowing human interaction and feedback. These features of forums were applied in the research of Lee (2004) and Ng'ambi and Johnston (2006) who also stated their use for critical thinking development.

MOOCs were another technology reported as supporting critical thinking. For instance, one SME suggested their use if they "can provide access to multiple ways of viewing issues, and show systemic consequences of decisions" that is ultimately in the spirit of critical thinking. In my literature review, Ota (2014) believed that MOOCs can be a promising environment for critical thinking development if people have face-to-face dialectical experiences prior to using them (p. 108–109).

Interestingly, digital games, wikis, blogs, or MOOCs can be used negatively; in the position of one SME, we should be aware that blogs, for example, can spread disinformation.

This remark makes a connection to another theme that was the second most common answer to Question 14 of Round 1: What kind of digital technologies do you believe support the development of critical thinking? In response to that question, SMEs suggested that all kinds of technology can be used for the development of critical thinking as far as they meet certain criteria and are used in a particular way (see Section 4.3). For instance, one SME suggested that games should be designed “to give the user the ability/space/narrative moments to question ideas”. The same expert continues to warn us that “tech itself won’t drive critical thinking” and its mastery does not mean that one, for example, might or might not question the credibility of political information. This observation speaks to the concern about the negative use of digital technology mentioned at the beginning of this paragraph and simultaneously connects to the TPACK framework (see Mishra & Koehler, 2006). Effectively, technology may not help in developing critical thinking (or even can be used negatively) unless it accommodates or is designed to accommodate critical thinking content (technology and content knowledge, TCK), e.g., critical thinking was conceptualized as “to question ideas” by the SME above. Another SME covers an aspect of technological and pedagogical knowledge (TPK) when answering the same question: “all digital technologies can be designed to deliver pedagogy which promotes critical thinking”. In this SME’s position, there is a clear delineation between technology, how it is used, and its pedagogical application. The pedagogy and content knowledge (TPK) can be found in the words of yet one more SME: “anything [any digital technology] that engages people in a debate – but these need strong structuring and facilitation to draw out the areas of criticality”. The “areas of criticality” in SME’s opinion need pedagogical scaffolding: facilitation, structuring, and debate as a method to develop critical thinking. Lastly consider another response to the same question: “all types of software, applications and technologies [can develop critical thinking]. It depends on how the teacher uses these tools”. Taking it all together, there is a clear realization that having appropriate technology is just one piece of the picture. The successful use of digital technology requires knowledge and deliberate work on the intersection of content, pedagogy, and technology—TPACK.

The composite idea that technology itself is not yet everything that is needed to develop critical thinking is very important in answering RQ2a of this thesis. It means that some SMEs are conscious about the use of technology and speak to different aspects of learning with technology. It was well evidenced that they relate to different types of knowledge as conceptualized in the TPACK framework.

In Round 2 I asked SMEs two questions about features and elements of (a) digital games and (b) digital technology that can promote critical thinking (see Appendix G). After the analysis of answers, it was noted that most features and elements of digital technologies repeat in the list of features reported for digital games (see Appendix L). Additionally, when answering Question 1 of Questionnaire 2 about features of digital technologies for critical thinking, 10 SMEs were explicitly referencing game elements that they found helpful in developing critical thinking—e.g., "Elemnts [sic] from gane [sic] design, such as 4-7 choices, feedback, resource management". One reason for the inclusion of RQ2 and RQ2a was a hypothesis that knowing how digital technology may develop critical thinking will aid in the understanding of how digital games may be used for the same purpose. It was also about placing games in the context of digital technology as it would allow drawing connections between different types of digital technologies and their use for critical thinking. These data demonstrate an opposite trend as SMEs described more features, elements, and things to focus on for digital games rather than for a wider digital technology umbrella. One way to explain it is that SMEs were asked more specific questions about digital games—about their genres, learning modes, theoretical underpinnings, and so forth. While the findings effectively make an opposite connection from the one that was hypothesized when I initiated the study, it is still very important. If we want to learn about how to use different types of digital technologies for the sake of critical thinking, we should pay closer attention to what games have to offer. Throughout their history, digital games incorporate many elements and features that are valued for learning in digital technology more broadly such as feedback or experiential knowledge. Future research may look at the elements and features reported for digital games to establish whether they can be applied in particular types of digital technology aiming to develop critical thinking.

Findings suggest that SMEs valued collaboration, feedback, discussion, narrative-based learning, autonomous inquiry, learner's agency, perspective-taking, and engagement as elements and features of digital technologies that can contribute to the development of critical thinking (see Section 5.1). These findings are consistent with the literature regarding digital technology for critical thinking (Ali, 2012; Bell et al., 2011; Halpern et al., 2012; Kolovou & Heuvel-Panhuizen, 2010; Kong, 2014; Lee, 2004; Lowther et al., 2008; McMahon, 2009; Ng'ambi & Johnston, 2006; Ota, 2014; Spires et al., 2011; Subran, 2013; Yang & Chang, 2013).

The capacity of digital technologies for collaboration and cooperation between learners or with a teacher was valued as an element contributing to critical thinking. Researchers and authors whose work was cited in the literature review emphasize collaboration and cooperation as helpful for critical thinking learning methods (see Ali, 2012, p. 79; Bell et al., 2011; Kong, 2015; Lee, 2004; Lowther et al., 2008; McMahon, 2009; Ota, 2014; Subran, 2013). The appreciation of collaborative learning goes back to works of Vygotsky (1981), Leont'ev (1978), and Luria (1976) who emphasized that learning is shaped by social practices extending to other people and not limited to individual's intellectual efforts only (Cole & Engestrom, 1997; Kaptelinin & Nardi, 2009; Spires et al., 2011). This finding should be utilized tentatively as collaboration varies from case to case and may encompass different forms and engage various individuals. For example, in this research, SMEs reported on the use of collaboration in a virtual environment where students “build a collective body of knowledge” or engage in “collaborative inquiry”. For more examples of collaboration as meant in this study, please refer to Section 5.1 and Report 2 available at https://play2think.com.

Feedback to players’ actions and especially ‘immediate’ feedback was another feature recognized by SMEs. One SME suggested that critical thinking can be promoted with “elements that create moments of productive struggle that provides immediate feedback with attempts to redo”. One thing to be noted here is that feedback is initially viewed by SMEs in terms of playing a game. Nevertheless, feedback can be utilized for different technological means and one can safely state that the use of feedback is not limited to digital games. The learning potential of the feedback was also emphasized in works on digital games we have looked upon in the literature review (see Kolovou & Heuvel-Panhuizen, 2010; Halpern et al., 2012; Gee, 2004, p. 91).

Discussion-based learning was believed to help critical thinking, and we have seen above how this learning strategy was embodied into technology such as discussion boards and forums aided critical thinking (see Lee, 2004; Ng’ambi & Johnston, 2006). Perspective-taking, an element that is key to critical thinking, was also tied to the use of digital technology. Subran (2013) believed that blogs, wikis, and social networks can be of help in developing perspective-taking; research studies demonstrated the usability of blogs and wikis (Bell et al., 2011) and Google docs (Kong, 2014) for the same learning purpose. Autonomous inquiry and agency on the part of the learner were described by SMEs as helpful and grouped together as they relate to constructivist learning emphasized as useful for critical thinking in several studies on digital technology and critical thinking in my literature review (Ali, 2012, p. 83; Bell et al., 2011; Kong, 2014, p. 161; Lee, 2004; McMahon, 2009, p. 279; Ng’ambi &

Johnston, 2006). Narrative-based learning was reported as important for the development of critical thinking by SMEs and, correspondingly, was used in studies of Yang and Chang (2013) and Spires et al. (2011) on digital games and critical thinking. Finally, students' engagement was a learning outcome (Yang & Chang, 2013) and a learning principle (Halpern et al., 2012) in studies that aimed to develop critical thinking through digital games.

Collectively, these data indicate that critical thinking can be developed with digital technologies. The results of Round 2 and Round 1 demonstrate that digital games and some other technologies may work particularly well for this task. Simultaneously, there is a definite alignment between SMEs' positions and research reviewed in the literature that knowledge of technology should work in interaction with the knowledge of content (that is the conceptualization of critical thinking) and pedagogy around it. SMEs reported several elements and features of digital technologies—e.g., collaboration, feedback, perspective-taking—that may help in developing critical thinking, and many of these are reported as relating to digital games. Future research may look into the potential of artificial intelligence, apps for research and writing, chat-bots, concept maps, interactive courses, live streams, news websites, online learning platforms, simulations, TED talks, virtual and augmented reality tools for the development of critical thinking. All of these were mentioned by SMEs as prospective technologies to host the development of critical thinking. At the same time, there may be research investigating how such features and elements of digital technology as an opportunity for systems thinking, project-based learning, and competition may aid in the development of critical thinking.

5.7.2 RQ3a: Digital Games for the Development of Critical Thinking

This section is written to answer RQ3a: What do SMEs believe are important elements needed for digital games to develop critical thinking? It extends our understanding of the phenomenon building on the findings discussed in Round 1 that dealt with SMEs' conception of critical thinking and the findings relating to digital technology and critical thinking that can be found in the previous section.

In the position of many SMEs digital games have been viewed as prospective environments that are capable of enabling critical thinking. In the previous section, I argue that digital games’ elements and features can be of use in other digital technologies if one aims to develop critical thinking. This is well-supported by the data as we could observe an alignment between features of digital games and digital technology (see Appendix L) and SMEs' persistence in referring to the features of digital games when speaking about digital technology in general. Some of the elements and features that were considered important for both digital games and digital technologies have already been discussed in the previous section. Nevertheless, there is a need to flag key findings and discuss what they mean in relation to digital games specifically.

Overall, a critical analysis of data revealed two general trends. Firstly, there is an alignment between what SMEs believe is important for critical thinking in digital games and what the research literature reports on this phenomenon. Secondly, there were unexpected findings that contribute to building a bigger picture of how digital games may be used for the sake of critical thinking. I should start with what was already known and reaffirmed by SMEs and then move to the area of novelty.

There were several elements and features of digital games recognized as important for both digital games and digital technology that align with the literature review of this thesis. SMEs suggested that these elements may support the development of critical thinking: feedback (see Kolovou & Heuvel-Panhuizen, 2010; Halpern et al., 2012; Gee, 2004, p. 91), problem-solving (see Granade, 2010; Liu et al., 2011; Yang, 2012), collaboration (see Frasca, 2001; Yang, 2012; Yang & Chang, 2013), perspective-taking (see Frasca, 2001; Song, 2008; Yang, 2012), design strategies and design features of games (Childress & Braswell, 2006, p.

194; Doolittle, 1995, p. 35; Frasca, 2001, p. ix; Halpern et al., 2012, p. 94; Song, 2008, p. 569; Yang, 2012, p. 368), experiential learning (Frasca, 2001, p. ix; Yang, 2012, p. 376), narrative-based learning (Halpern et al., 2012, p. 96), and learner's agency (Halpern et al., 2012, p. 94; Song, 2008, p. 561; Yang, 2012, p. 375).

In the scope of this alignment between research literature and SMEs' responses, I feel I should emphasize some elements that provide us with interesting insights into their use. For instance, SMEs valued digital games for their problem-solving nature. One SME suggests: "Games, in particular, offer 'messy problems' - there is often no fixed 'right' answer, which is an ideal environment for developing critical thinking". The notion of a "messy problem" is of great interest as it reflects the connection of games to real-life problems that happen with many variables involved. One may consider the ecological crisis of global heating that cannot be understood and solved only in terms of ecology with a "one size fits all" approach—there are many concerns and parties involved. These kinds of real-world problems require critical thinking and games may be of great use in teaching players to deal with problems.

The next key theme that can be traced in answers to several questions of Round 2 is collaboration. Similar to the previous section on digital technology and critical thinking, SMEs provide specific examples of the use of collaboration. To start with, at least three SMEs propose social constructivism as a theory that makes digital games suitable for the development of critical thinking. Social constructivism developed by Vygotsky (1981) speculates that learning is a social practice that extends to people and other artifacts in learner's interaction with reality (Cole & Engestrom, 1997; Kaptelinin & Nardi, 2009; Spires et al., 2011). When the majority of SMEs do not explicitly mention social constructivism, there are traces of this important learning theory in many aspects of SMEs' responses—e.g., active learning, use of collaboration, learner's agency. SMEs add clarity to the question of collaboration by suggesting different modes of collaboration and how games feature it. For example, an SME suggests:

> A major component of these types of games [Clash of Clans] is that collaborative piece because you are not only trying to survive individually. Your survival/success affects the overall health of the community in these games, which promotes/teachers critical thinking.

I should note that the need for collaboration in many multiplayer games is not artificial, as something imposed by a teacher as a class activity. Collaboration naturally connects to game problems and advancement that can only be done by interacting with other players in trading, building, or discussing something together. Another expert explains that collaboration is a great tool enabling perspective-taking when solving a problem. As we have seen in the literature review, perspective-taking is one of the features constituting critical thinking (Ennis, 2015, p. 32; Halpern, 2014, p. 444; Paul, 2012, pp. 435–437). If one answer to RQ3a is collaboration, the modes of collaboration contextualize it. SMEs enumerate different modes of collaboration that exemplify a role of a teacher in them—facilitator, active participant, observer, guide (see Sections 5.2 and 5.5). According to SMEs, children may play in groups or on different consoles each.

The theme of underlying theories that makes digital games suitable for teaching or promotion of critical thinking generated some unexpected findings. Among proposed theories, one SME suggested that the flow theory developed by Mihály Csíkszentmihályi (2009) should be considered for developing critical thinking in digital games. This is a particularly interesting finding connecting to critical thinking conceptualized as creativity or openness (Davies, 2015, p. 77). Davies suggests that critical thinking as creativity is a “trans-critical” (p. 79) account of critical thinking that is open in relation to all influences, including the state of flow. The fact that one SME mentions this way of looking at critical thinking in games is promising as it may evolve into perceiving critical thinking as something bigger and more inclusive, not limited to the boundaries of critical thinking movements or schools.

The range of theories and philosophies proposed by SMEs reinforces the last argument. SMEs' answers featured creative and playful learning (Kangas, 2010), game-based learning, imagination, and others (see Section 5.3). Ultimately, this finding connects to the discussion in Round 1 on critical thinking as creativity (see Section 4.5.1). Many SMEs chose creativity as the most relevant concept to critical thinking. I argued that this choice may be understood differently and does not necessarily mean that SMEs' accounts of critical thinking may be classified as belonging to critical thinking as creativity or openness. Nevertheless, the findings of this round suggest that SMEs might have thought about critical thinking in wider terms. Either way, it is a promising direction for future research on critical thinking and digital games, where critical thinking is conceptualized as creativity or openness.

SMEs proposed several genres of games and game titles that they recognized as the most suited for the teaching of critical thinking. Both research literature and SMEs distinguish multiplayer games (see Childress & Braswell, 2006), role-playing games (see Childress & Braswell, 2006; Yang & Chang, 2013), narrative or story games (see Halpern et al., 2012, p. 96; Yang & Chang, 2013), and simulations (Frasca, 2001) as suitable for the development of critical thinking. On another hand, future research may investigate the fit of such genres as adventure and choose-your-own-adventure games, strategies, educational games, puzzle-style games, resource management games, survival, fighting, and first-person shooters for critical thinking development. Specific games that may be of use and interest for researchers are Minecraft and Minecraft Education, Gone Home, What Remains of Edith Finch, Portal 2, Civilization, The Sims, Cities Skylines, Football Manager, Fortnite, or Arguendo Platform (see how they correspond to their genres in Section 5.4).

Some of the proposed genres corresponded to games' elements that may support the development of critical thinking (see Section 5.2). For example, five SMEs proposed the genre of multiplayer games including Massively multiplayer online role-playing games, real-time strategies, and Fortnite that were explicitly associated with in-game collaboration. Additionally, three SMEs reported the genre of narrative games that were believed to promote perspective-taking (see Section 5.2). This correspondence is an important finding to discuss because SMEs demonstrate that they analyze and deconstruct the genre to distinguish its elements relating to critical thinking. This line of thinking allows not only the analysis of a potential fit of a particular game for the development of critical thinking, but also to hypothesize what games may work well considering the proposed connections. For example, a teacher may try to find narrative games knowing that they potentially can be used to promote perspective-taking.

The recognition of role-playing games (RPGs) is also one of the most common themes in data. One unexpected finding regarding RPGs was their ability to connect critical thinking and social-emotional engagement, as one SME proposed: "They [RPGs] present a context in which to capture the students attention and provides learning opportunities within that same context. This represents a marriage of Critical Thinking with Social-Emotional Engagement with a lesson". This observation is very specific: We have seen studies on digital games and critical thinking that emphasized engagement as an important variable when developing critical thinking (see Halpern et al., 2012; Yang & Chang, 2013), but these studies did not explore emotional aspects or specifically RPGs as a mean of social and emotional engagement and learning. Similarly, consider the remark of another SME whose answer to the same question about prospective genres was "activities that engage both thinking and feelings to a reasonable level". The theme of social and emotional learning (SEL) in games is a developing research direction that in many aspects interacts with critical thinking. SEL is about self-awareness and social awareness, about learning to behave ethically and responsibly whilst critical thinking also incorporates these elements (see Davies, 2015, pp. 51, 60, 66). Thus, the observation of the SME deserves a deeper consideration and may constitute a research question of potential study.

I have noted above that the research literature and SMEs propose that narrative games and simulations are suitable for the teaching of critical thinking. When SMEs do not speculate on these genres in comparison to each other, we may witness how they were chosen to develop critical thinking in two research studies. For instance, Yang and Chang (2013) reported that students who authored a role-playing narrative game improved their critical thinking skills significantly (see Section 2.16.3). In contrast to Yang and Chang's choice, Frasca (2001) speculates that "unlike narrative authors, simulation authors do not represent a particular event, but a set of potential events" (p. 113). Thus, in his opinion, simulation authors have to look at objects in their games as systems and consider laws that guide their behavior. Additionally, people who play these simulations must understand these models, contest and revise them according to one's beliefs and ideas (p. 113). In Frasca's position simulations authorship was better suited to develop critical thinking—critical thinking conceptualized through the prism of critical pedagogy, one that is about an epistemological understanding of a system. Yang and Chang (2013) viewed critical thinking in terms of skills and argument analysis—they quote Moore and Parker's (2009) definition of CT that "is the careful application of reason in the determination of whether a claim is true" (p. 3). The studies of Frasca (2001) and Yang and Chang (2013) demonstrate how different conceptualizations of critical thinking connect to considerations about certain genres that can be used for critical thinking development. SMEs' propositions of genres and elements are no exception from this observation, they are based upon how SMEs conceptualize critical thinking (see Section 4.4). This paragraph is placed in the discussion section for an important reason as at least 10 SMEs in one way or another propose that genre, type of a game or learning mode are important but hierarchically lower than learning goals and objectives set forward before the game can be adapted or created for critical thinking instruction.

The notion of the appropriate design of a game driven by learning objectives and other considerations was one of the dominant themes throughout Round 2. In the paragraph above, game authorship projects were implemented differently depending on researchers' conceptualization of critical thinking that also connected to the philosophy behind these games and genres of choice. SMEs' responses suggest that the choice of a game, its genre, and design features are a matter of interaction of many elements including learning objective, design of the existing game, the aspect of critical thinking being taught, and so forth. SMEs reported many elements in interaction specifying how a game may be used for critical thinking (see Section 5.5). The theme of game design as I collectively name these ideas and features was also the key theme in SMEs' answer to RQ2a about digital technology and critical thinking. We can see that these design considerations are more specific for digital games and extend to matters of inclusion, educational institution's resources, classroom setting, the developmental level of a student, and so forth.

One prominent theme connecting to the notion of relevant pedagogy was the importance of the learning loop of the briefing, action, and subsequent debriefing (see Section 5.5). Some SMEs specified that learning in games can be ensured not necessarily by play or learning mode used but by the presence of the above-mentioned learning loop. In particular, SMEs emphasized debriefing or reflection. For instance, one SME suggested:

> Learning should take place within groups with regular debriefings or "cool-down" moments where the student is not engaged in the game. These reflective moments cement in the actions and reactions that the student encountered or performed in the

game. This is best done as a collective (small group or large - depending upon the setting).

Interestingly, one reason to use this loop was to avoid “faulty stealth learning” as an SME speculates. In my literature review, Frasca (2001) proposed to deconstruct the simulation’s ideological assumptions and discuss alternative scenarios in simulations with their peers. Thus proposing a reflective exercise as an additional step apart from digital game authorship itself. This finding is of great importance as it suggests a concrete way of how learning in games may be scaffolded. This theme deserves a thorough investigation to determine whether other games for critical thinking incorporated the learning loop of the briefing, action, and debriefing.

As a whole, the theme of appropriate design has a strong affiliation with the TPACK framework (Mishra & Koehler, 2006) as it addresses the pedagogical, content, and technological features in the interplay between them. The presence of interaction between different game design features, pedagogical considerations, and features driven by critical thinking is of great importance as it allows us to see this broader picture drawn by SMEs. The TPACK framework as it stands now allows us to disaggregate the phenomenon of critical thinking developed through digital games. TPACK is of good use to make sense of these data. Nevertheless, it does not tell us how this interaction works for the specific phenomenon. For the sake of answering this research question and also for the practical matter of disseminating knowledge generated by SMEs in this study, I introduce the Three-Phase model for critical thinking and digital games in the section to follow.

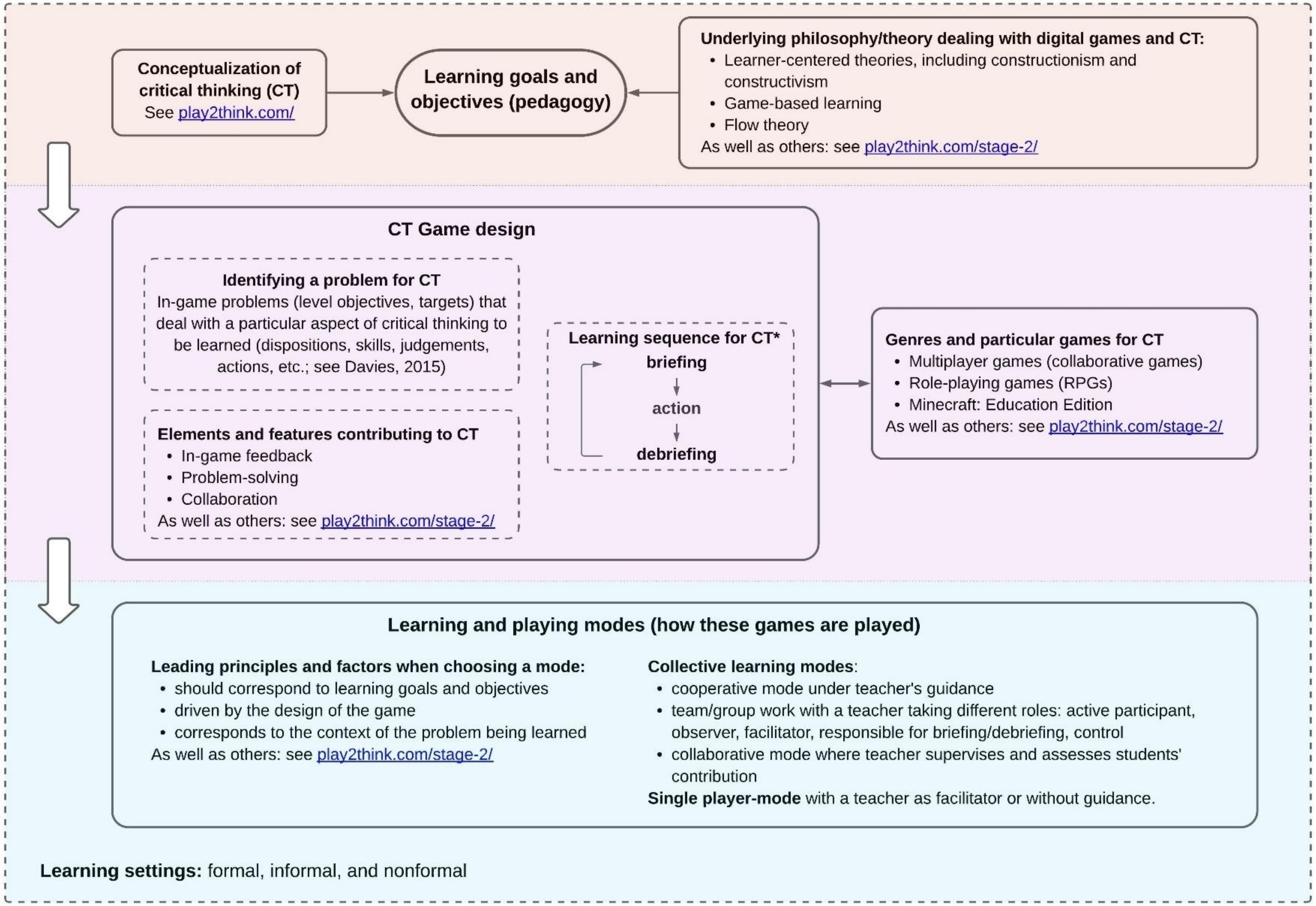
5.7.3 Three-Phase Model for Critical Thinking and Digital Games

In line with the last argument of the section above, the sheer amount of data generated by SMEs could be hard to process if given as it is in the form of reports that I provide on the website (see https://play2think.com/stage-2). As speculated in the introduction of this thesis, the research is built to inform practice: It is for teachers, game developers, and other practitioners who may benefit from the results of this research. The data collected demonstrated many relational features with genres, learning modes, elements, and features corresponding to each other.

After a careful analysis of the data and the findings from Report 2 (see https://play2think.com/stage-2), I created the following Three-Phase model for critical thinking and digital games based upon SMEs' answers in Rounds 1 and 2 (see Figure 24). The following model may be of use for educators who are adapting an existing game for critical thinking instruction in their class, for game designers who want to incorporate critical thinking into their games, and for researchers investigating the phenomenon of playing digital games for critical thinking. The use of this model may extend to the assessment of already existing digital games to determine how and what kind of critical thinking they may develop.

Figure 24

Three-Phase Model for Critical Thinking and Digital Games



Note. * Briefing-action-debriefing cycle also belongs to "Learning and playing modes" when it is used for an already developed game that is adapted or used for learning purposes.

The model consists of three phases that are informed by different parts of the data collected. It is organized this way to suggest hierarchical and consequential progression of considerations one should keep in mind when dealing with the development of critical thinking with digital games. To start with, it has been mentioned in responses to many different questions that learning goals and objectives determine the choice of a game, its design, or genre to be used (see Sections 5.4–5.5). For this reason, learning goals and objectives take the central position and are hierarchically higher than considerations of a game design, genres, and learning modes below, thus constituting the first phase. In the words of an SME: "… the tools, which are chosen, might be of different modes but they need to be aligned with the purposes of learning session/particular learning activity or game".

In the previous section, I put forward an argument: SMEs' propositions of genres, elements, or modes to be used are based upon how SMEs conceptualize critical thinking. Round 1 sheds light on their views about critical thinking and how different these may be. Thus, learning goals and objectives are naturally informed by SMEs' conceptualization of critical thinking. Whether these are skills of argumentation or dispositions of a critical thinker to be developed, they shape learning goals and objectives. At the same time, the development of critical thinking in games may be understood through the prism of learning theories and philosophies that make digital games suitable for this task. SMEs suggested learner-centered theories, social constructivism, game-based learning, and other theories as guiding their understanding (see Section 5.3). These theories also inform learning objectives and pedagogies. For example, consider a teacher who is guided by social constructivism, thus choosing methods and forms of learning that relate to this theory and guide critical thinking instruction such as active participation, social learning, and collaborative methods.

When one has put forward learning goals and objectives that are underpinned by an understanding of the critical thinking conceptualization and relevant learning theories, one may proceed to the second phase and consider game design elements and genres. Before reporting on these elements and their position in the model, I should briefly explain what I mean by game design in this model.

In the book Elements of Game Design, Zubek (2020) suggests that a game may be analyzed through the three levels that are (a) game mechanics and systems, (b) gameplay that is “the decisions, interactions, and activities that players are doing in the game” (p. 24), and (c) player experience that is “the player’s subjective experience of gameplay” (p. 25). These are the basic elements of game design, but games also include a number of other elements that are important for how the player will experience the game: visual design, in-game story, music, user interface, and so on (pp. 29–30). Game design is the totality of these elements. In this study, SMEs reported on different elements, features, and considerations that constitute game design and are believed to develop critical thinking. There are three inner parts in the “CT game design” block that is placed on the second phase of the model.

Firstly, many games feature problems to be solved; these are level objectives or targets a player tries to complete. Identifying a game problem for critical thinking instruction is partially about choosing critical thinking aspects to be learned. As one SME elaborated : “there is no best [learning mode], it is a question of what aspect of ct shall be taught, e.g. multiplayer is well-suited for relationship-related or social ct [critical thinking] and on the other hand guided playing is more for domain-specific problem-solving ct [critical thinking]”. Throughout the literature review and results of Round 1, we have seen that critical thinking takes different shapes starting with skills and dispositions and extending to criticality or critical pedagogy. Thus, it is important to have an alignment between learning goals and objectives and an aspect of critical thinking one wants to teach. For example, if the goal of the learning activity is to teach players how to determine hate speech and the objective is "by the end of the game players should be able to identify hate speech comments and differentiate protected characteristics that were attacked by hate speech", the aspect of critical thinking to be taught may be perspective-taking or skills of analysis and evaluation. Altogether, learning goals, objectives, and an aspect of critical thinking to be taught connect to the design of a game. These should be thought through by educators or game designers to create a particular player experience they want to deliver.

It is clear so far that learning goals and objectives as well as an aspect of critical thinking to be taught drive our choice of elements and features to be included in the game (see the second bottom element inside of "CT game design block"). These elements are feedback, in-game collaboration, problem-solving, or other components reported by SMEs (see Section 5.2). Using the hypothetical example of a game that teaches players how to determine hate speech, a game designer may consider the use of game-generated feedback that would suggest what went wrong in a game task or explain why the player's choice was right. When choosing a particular element, one may refer to the context of its usage in Delphi Reports 1 and 2 (see https://play2think.com).

The third block features a learning loop of briefing, action, and debriefing that five SMEs suggested in their answers to Question 6 of Round 2 (see Section 5.5). SMEs believed that this sequence should be used when designing a class with a game or when designing a game per se. SMEs stressed the importance of debriefing and reflection that allow, in the words of an SME, to "cement in the actions and reactions that the student encountered or performed in the game". Another SME suggested that this reflective debriefing may be achieved by posing questions or leading a discussion after students played a game. One should be aware that this learning loop may be used differently (see note to Figure 24), if one is a teacher and is using an already created game, one would plan a lesson to allocate time for briefing and reflection with students who would act in a game. Differently, a game designer may include this learning loop into the level design of an educational game itself—for example, using the game's feedback features as a tool of debriefing. In any case, SMEs considered this learning loop important for the development of critical thinking.

Another block that can be found in the second phase of the model is genres and titles of games SMEs believed to be of use for the development of critical thinking. One may find that multiplayer games, role-playing games, Minecraft Education, and other genres and games were proposed by SMEs (see Section 5.4). The block "Genres and particular games for CT" is connected to "CT game design" with a double-headed arrow that suggests an even hierarchical placement of these considerations and their common nature. The sequence of using these blocks at Phase 2 depends on a learning case. For example, a game designer may start with specific learning goals and objectives in mind and consider what game features, elements, and mechanics may be used to develop a certain critical thinking dimension. One's choice of mechanics, elements, and considerations would lead to framing the game in a particular genre that utilizes these elements. In essence, a genre is a set of game design elements that differentiate one set from another. In another hypothetical scenario, an educator may work the opposite way around. If one wants to analyze the fit of a particular game for a class, one may first identify its genre and learn what elements of this genre may be of help for achieving learning goals and objectives.

In the third phase, one is dealing with the learning and playing modes of potential games. Ten SMEs shared that there is not one learning mode, which would be the most effective, rather there are leading principles and factors when choosing a mode, such as correspondence to learning goals and objectives, design of the game, the context of the problem being learned, special learning needs and so on (see Section 5.5). These considerations drive how one may organize a class or design a game. For instance, special learning needs may require a longer period of time given to a player to complete the game task or choice of a game that matches a particular learning case. For example, Somerton (2015) designed a literacy app for children with autism that incorporated different evidence-based strategies known to support the development of reading comprehension. Evidence-based strategies such as visualization, inferences, anaphoric cueing, sequencing, and feedback were all part of the digital design elements to support the learning process. These included but were not limited to verbal and visual prompts to provide learning scaffolding, immediate feedback on learning tasks, an audio version of the text to assist an individual's potential processing bias, embedded dictionary function based on the word definitions in context with the text, rich visual graphics depicting characters and other features that are realistic in form (not cartoon).

Apart from listing the principles and factors that drive the mode to be selected, SMEs emphasized the use of cooperative learning modes with the teacher taking on different roles: as an active participant, observer, facilitator, or one who is responsible for debriefing or reflection (see Section 5.5). Single-player mode was also reported to be of help for critical thinking development.

Finally, the majority of SMEs suggested that the use of games in any learning setting—be they formal, informal, or nonformal—may fit the development of critical thinking. One SME elaborated: "all three are appropriate depending on stated learning goals and objectives". Thus, all of the blocks of the Three Phase model are placed in the box with a dashed line that is representing the learning settings in which these games may be applied.

Having described each section of the model, I should make several general notes on how to view elements of this model. First, the model works in conjunction with the Delphi reporting website (https://play2think.com). That means that elements given inside of each block of the model are provided for reference purposes to showcase the meaning of each block. There are frequent references to the website in the model, and one should always refer to it for further inspection of a particular element of the block and access to the full list of reported elements, features, and considerations. Second, elements in each block of the model are contextual. One should understand the context in which a particular element was mentioned. For instance, cooperation as a stand-alone element does not mean much, but if one proceeds to find it in the corresponding part of the website one would understand that a particular SME meant playing a game on the same console with a teacher’s guidance. The model’s blocks relate to headings of the report on the website, thus allowing the user to easily navigate between the model and reporting website. If one wants to see the context in which an element was mentioned, one can hover over a phrase or sentence to see a tooltip with an original message of an SME (see Section 3.6). Finally, when discussing each block of the model, I always make connections between blocks and phases suggesting that elements of the model are interrelated as they emanate from each other. White arrows on the left of the model suggest the progression of considerations through one phase to another, and the hierarchical order of these considerations.

The model presented above and the report website are practical tools built upon SMEs data that can be used by a variety of stakeholders mentioned at the beginning of this section. I complete the discussion section of Round 2 here with almost fully answered RQ2a, RQ3, and RQ3a. Round 3 of Delphi is built to allow SMEs to reflect on the previous rounds and provide their concluding remarks.

Chapter 6: Round 3

The last round of this Delphi study was a reflective one. At this stage, I already had group vision Report 2 produced (available at https://play2think.com/stage-2) and constructed Questionnaire 3 which was designed to elicit SMEs' reflection on the previous rounds and provide their final thoughts. As it was a reflective round, it was not aimed at a particular research question of this study but rather allowed flexibility to comment on any results or findings previously reported. In this chapter, I showcase the findings of Round 3 and feature a discussion.

As in the previous rounds, Questionnaire 3 was sent to all participating SMEs through Qualtrics emailing service with an anonymous link in each email. There was a considerable dropout of SMEs on Round 3 as envisioned by literature on the Delphi method and actual Delphi studies (Gordon & Helmer, 1966; Hsu & Sandford, 2007; Ludwig, 1994). As a result, nine SMEs participated in Round 3.

6.1 Question 1. SMEs' Final Comments and Thoughts

Questionnaire 3 prompted SMEs to reflect on the results of previous rounds. The only question of Questionnaire 3 had several subquestions that gave direction for SMEs' reflection None of these subquestions was obligatory. Question 1 was worded as follows:

> By now you have seen the results of Stage 2 and looked again at Stage 1 data. I ask you to provide your final thoughts and comments about everything you have read and done in this study so far. You may use these criteria to guide your answer:
>
> - Reflect on how the results of Stage 2 may have built on your conception of critical thinking from Stage 1
> - Are there any ideas you disagree with? Why perhaps?
> - What are your final thoughts about technology and digital games for teaching/promotion of critical thinking?

- Leave any other comments about this study

There were nine responses to Question 1 and after their analysis, I could identify several themes (see Table 12). For the full list of responses in their original formatting please refer to Appendix M.

Table 12

Key Themes in SMEs' Final Comments and Thoughts of Round 3

Theme	Description
Agreement or disagreement	SMEs shared their position on agreement and disagreement with other participating SMEs
Digital games and critical thinking	Reflection on the use of digital games for the development of critical thinking
Reflection on the study itself	SMEs shared what they thought about the study and participation in it
Gamification	SME spoke about the implications of gamification in education
Pandemic	How pandemic influenced their practices

The theme of agreement or disagreement with other participating SMEs and ideas shared in Rounds 1 and 2 was evident in answers of at least three SMEs:

- I have found that way more of the proponents of this approach are nevertheless as critical as I am, and the field seems to be in good hands. While I may disagree with some theoretical frameworks, good science is based on disagreements and finding out more.
- I think the results are in line what I expected them to be after Stage 1. There are [sic] nothing I disagree with, even if I would choose a different approach to utilizing or applying critical thinking through digital or video games.
- Being both an educator and also an avid gamer, I would say that the elements presented on digital learning from Stage 2's collation really do match my expectation of elements in digital games. There are omissions in terms of 'leaderboard/high score board' (for public show of competency or rank) and the 'save and load' (continue

anytime) element. Otherwise, the results from Stage 2 is [sic] expected as of the answers collated in Stage 1.

Some SMEs considered it important to elaborate on the nature of the relationship between digital games and critical thinking, on conditions that are needed for critical thinking to be developed, and so forth:

- Of course, much like with gamification, there are many pitfalls that must be avoided. Firstly, it must be fully understood what is "critical thinking" and what value does teaching it through technology or digital games bring to it. Forcing it because it is trendy is more harmful for both pre-existing projects or environments, and new alike. Secondly, when the aim of digital games is not purely to entertain consumers, critical thinking must be part of the design and applying phases from the very beginning. It is not enough to just slap something that resembles Wikipedia's definition of "critical thinking" loosely on top of something pre-existing.
- A game player does not necessary [sic] develop critical thinking by simply playing a game. They would need to be aware of the critical thinking patterns, suspend judgment on any belief or supposed knowledge, in order to apply those critical thinking patterns to understand issues, hypothetical or real.

  It would be a mistake to suggest that gameplaying alone makes a player a critical thinker. But, with additional pedagogical guidance or coaching, the player can learn to develop an awareness of their own thought processes and better utilize those thought processes for the purpose of understanding the world.
- The results are indicating the need - and value - of games designers and their cohort to learn more about and understand the implications of educational theory/theories.

  There is quite a lot of agreement about the need to design education contexts that make more use of games and simulations - indicating broader agreement about the problems with existing curricula.

- Digital games for education need to incorporate the elements like multiplayer, grouping of friends, live voice conversation kind of facilities to compete with current set of MOBA [Multiplayer Online Battle Arena] games and make an entry into the user's prime time of playing games.
- Critical thinking is a foundational basis for innovation. … Digital Games comes [sic] handy in making that skill developed in a learner in that there is a need to continually move and a reason to aim at a different level from the initial starting point. As the Stage 2 of this research detailed, the various viewpoints are in fact, different dimensions that digital games can be employed for critical thinking for the learner. And it is obvious that it is not an exhaustive list and [is] just limited by the respondents' own knowledge and experience.
- There are omissions in terms of 'leaderboard/high score board' (for public show of competency or rank) and the 'save and load' (continue anytime) element. Otherwise, the results from Stage 2 is expected as of the answers collated in Stage 1 [this excerpt from an SME is repeated above as it also falls under the "agreement and disagreement" theme].

From stage 2, the capacity of digital technologies for collaboration seemed to focus on board, near pods, wiki pages and documents. This is to disregard the most common gaming methods such as:

- Twitch/Twitter plays (or all variations of let's play together, where group of people jointly vote to choose the next move in a game)

- Discord - for sharing tips and discuss[ing] strategies during collaborative moments

- In-game collaboration - shown in Minecraft, Roblox and the likes commonly found in MMORPGs.

I personally still believe that digital games can be used as a technology to promote critical thinking. Although it must be used expertly to be an effective tool rather than as a distraction for learning.

Participating SMEs also shared their experience of participating in the study; they reflected on the study itself:

- As a result of this, I am very happy that I decided to take part in this, even though it at certain moments took a lotofmy [sic] time. This is good, important work.
- In some of the responses and insights found on the website, it is clear that the background comes forward quite fast. Some responses are more practical, especially from teachers/lecturers, whereas others are more in line of trying to formulate what is critical thinking in and of itself, and how games could be used to foster, teach, and utilize it.

  All in all, this study has been from my point of view rather fruitful and I feel honored to have been part of it. I shall await for any future updates about this, be it a presentation, lecture, academic publication, or the like.
- Looking forward to the product of this research. Thanks.
- Gaming for teaching is a new approach. It's interesting to know what people think, but would be more interesting to know what they do and how it works. Anything new, used right, can be good for CT development. I heard of an instance when maincraft [sic] was used to teach history and that was fascinating. I wish this study will have very useful findings.
- The dropout in participants from Stage 1 to Stage 2 seemed to be high, although I am unsure on what is the common number for such a Delphi study on digital education.

Interestingly, one SME also mentioned the concept of gamification that is about using game elements (competition, rewarding, etc.) in learning activities (as opposed to digital game-based learning where games themselves are used for learning). The implications of the pandemic were also discussed in their response:

> Because of the pandemic, I have had more opportunity [sic] than at any other time in my career to use games to increase critical thinking skills. Students have “gaming brains” and as an educator, I’ve had the opportunity to build gamification into the curriculum in a way I had not been able to do prior to the pandemic because I had more freedom than previously.
>
> Gamification taps into the mind of students in this era. Students now think in a Tik-Tok, Social Media influencer manner. It is incumbent upon educators to meet students where they are.

6.2 Delphi Interactions

A Delphi study presupposes an interaction between SMEs as they are encouraged to engage in a critical exchange of positions. SMEs in this study were asked to comment and discuss anything they observed in provided reports (see Section 3.4). They could do so using a website functionality or leaving their feedback in the “Comments” section of Questionnaire 3. Since I have already reported all comments left through Questionnaire 3, this section features only comments left using the website functionality (see Section 3.4).

There were two comments left at Round 3 using the website functionality. First, there was a comment about the response to Question 2 of Questionnaire 2 (Round 2) asking to name features and elements of digital games that SMEs found important for the development of critical thinking. The original message of an SME was: “To resolve the ‘puzzles’ [when playing Minecraft Education with a teacher], students have to use logical and objective analysis within the game rules [which will result in the development of critical thinking skills]". The feedback from an SME at Round 3 was the following: "This is problematic in the sense that puzzles may often, instead of fostering critical thinking, instead make students to just look for the "right answer" without actually critically reflecting on the task". This is indeed a relevant critique if one perceives puzzles as something predefined (with the predefined right answer to them). Thus, students may not engage in a reflective thinking process when dealing with this kind of task. This agrees with SMEs' insistence on debriefing and reflection as a learning scaffolding when developing critical thinking (see Section 5.5). On another hand, "puzzles" were enclosed in quotation marks possibly suggesting that the author of this comment did not mean them literally.

Finally, at Round 2 an SME proposed that one example of the theory that makes digital games suitable for the development of critical thinking could be the Technology Acceptance Model (TAM). In response to this proposition, another SME left a comment using website functionality "I find TAM to be a horrifically outdated model based on oversimplification, and would not list it here". The two comments left by SMEs were incorporated into their corresponding places on the website to allow other SMEs to relate to them (see https://play2think.com/stage-2).

6.3 Discussion

The findings of Round 3 were comparatively smaller than the data generated at Round 1 and Round 2. Most probably, two factors had their impact: the dropout of SMEs and data saturation. When there were 36 SMEs at Round 1, 22 SMEs at Round 2, only nine SMEs joined Round 3. As has been argued above, this phenomenon agrees with the dynamics of Delphi studies in general (Gordon & Helmer, 1966; Hsu & Sandford, 2007; Ludwig, 1994). Another factor that could take place was the saturation of data reached by the end of Round 2, presumably, SMEs did not feel that they had something additional to share. It could also be the case that SMEs did not have time to participate as Delphi is a time-consuming method.

Regardless of the small size of shared data, the results of Round 3 were a valuable addition to what has been discovered before.

The main findings of this round include SMEs' insistence on the importance of pedagogical and content considerations when using games for the development of critical thinking. SMEs also made valuable additions to the results of the previous round (see Section 6.3.1). In Section 6.3.2 one can find the discussion on SMEs’ reflective thoughts about the study, the pandemic, and the study’s results.

6.3.1 RQ3a: Digital Games for the Development of Critical Thinking

One of the key themes found in data was SMEs' insistence on the thoughtful use of digital games. An SME proposed: “it must be fully understood what is ‘critical thinking’ and what value does teaching it through technology or digital games bring to it”. SMEs emphasized once again that digital games per se may not be effective for the development of critical thinking. There is a need for pedagogical scaffolding and game design considerations that explicitly aim at developing critical thinking, in the words of SME: “It is not enough to just slap something that resembles Wikipedia's definition of ‘critical thinking’ loosely on top of something pre-existing”. This idea is also well-evidenced in the position of another SME:

> It would be a mistake to suggest that gameplaying alone makes a player a critical thinker. But, with additional pedagogical guidance or coaching, the player can learn to develop an awareness of their own thought processes and better utilize those thought processes for the purpose of understanding the world.

The theme of the necessity of explicit learning orientation of digital games was a concern of researchers in the literature review (see Section 2.16.1). For instance, the researchers warned that games with entertainment orientation may not result in learning if used as they are (Erhel & Jamet, 2013; Lu & Lien, 2020). Finally, SMEs suggested game designers to build their understanding of educational theories.

These findings converge and partially repeat the results of Round 2. The fact that SMEs emphasized them once again justifies the necessity of research-based instruments available for stakeholders to meaningfully use games for the development of critical thinking. The Three-Phase model for critical thinking and digital games was developed in this study to address this necessity. After the analysis of the data and publication of several Delphi reports it became evident that SMEs and the wider educational community should have the result of research in an accessible form.

Another important finding from Round 3 was that SMEs proposed additions to the results of Round 2 that they believed were missing there. An SME suggested that educational games would need such elements as a multiplayer, team playing, and live voice conversation to compete with the genre of Multiplayer Online Battle Arenas popular these days. Yet another expert felt that the theme of collaboration was not developed well enough focusing only on boards, near pods, wiki pages, and documents in Round 2. They felt that the most common gaming methods such as Twitch/Twitter plays, Discord, and in-game collaboration that can be found in Minecraft, Roblox, and MMORPGs were disregarded.

The theme of collaboration in games for the development of critical thinking was one of the key findings of Round 2 (see Section 5.7.2), and the additional feedback on this topic was valuable. Some comments of SMEs (like the two mentioned in the paragraph above) that addressed research questions of Round 2 were noted and placed where they thematically belonged in Group Vision Report 2 (see https://play2think.com/stage-2). This helped to alleviate the work with the model as its user may use the website to look for detailed explanations of categories mentioned in the model. SMEs' feedback on the study as a whole (see Section 6.1 and Table 12) was moved into the newly created webpage with the title "Results" that introduced the Three-Phase model for critical thinking and digital games.

6.3.2 SMEs' feedback on the study

Four SMEs left positive feedback about the study and were curious about its results. One SME commented: "All in all, this study has been from my point of view rather fruitful and I feel honored to have been part of it. I shall await for any future updates about this, be it a presentation, lecture, academic publication, or the like". There was an SME who reported that participation in this study took a lot of their time, remarking that nevertheless, they felt happy participating in this research as they considered it an important work. This last challenge was also observed by another SME who noted "the dropout in participants from Stage 1 to Stage 2 seemed to be high, although I am unsure on what is the common number for such a Delphi study on digital education". The challenge of a time effort needed from participants was envisioned at the study planning stage. I made every effort to make sure that more SMEs participated in this study (see Section 3.8). Also to make SMEs' participation meaningful and comfortable I invested a lot of analytical and design work into the reports available on the website (see https://play2think.com/):

- The considerable array of findings was represented in accessible chunks of data grouped by categories.
- Ideas that were repeating in answers of several SMEs were paraphrased and minimized to one phrase or a sentence with the original messages still available in tooltips (see Section 3.6 and Figure 8).
- SMEs could leave their comments about a particular phrase using an inbuilt website functionality—they could highlight a phrase and leave a comment by pressing a combination of keys on a keyboard (see Section 3.4 and Figure 5).
- Visuals and the design of the website were built under the consultation of a website designer.

These solutions may be used in future Delphi studies and guide the way of researchers in mitigating the Delphi method limitations, allowing participants comfortable interaction with a researcher and data.

SMEs expressed their desire to follow the results of the study and for this purpose, I created the Three-Phase model for critical thinking and digital games that I discussed before (see Section 5.7.3). The results of this study will remain available on the website (https://play2think.com) for the wider educational community.

Interestingly, one SME mentioned that the professional background of participants was evident in the responses: “Some responses are more practical, especially from teachers/lecturers, whereas others are more in line of trying to formulate what is critical thinking in and of itself, and how games could be used to foster, teach, and utilize it”. This reflective piece relates to the discussion and findings of Chapter 4 in which I explored how different professional backgrounds of SMEs related to their positions on critical thinking—definitions with elements of psychological, educational, or philosophical schools of thought (see Section 4.5.2). For instance, the educational school of thought is mostly characterized by the practical application of the critical thinking concept in learning settings (Sternberg, 1986), and, in line with the SME’s observation above, it was mainly represented in answers of SMEs who were teachers.

The theme of the COVID 19 pandemic was raised in the answer of one SME. They reflected: “Because of the pandemic, I have had more opportunity than at any other time in my career to use games to increase critical thinking skills”. This perspective connects to what had been discussed in this thesis as a rapid shift into digital learning in times of the pandemic (see Section 2.14). Learning in many countries suffered from the pandemic due to the low digitalization of educational systems, low level of school and teacher preparedness to teach online, increased pressure on families in providing learning for students (Tawil, 2020).

However, the remark of the SME may suggest that challenges posed by the shift into digital learning had a different impact on countries depending on their economic development and the development of educational systems. This observation reflects what has been called by Selwyn (2021a) the “tensions between inclusivity and exclusivity” (p. 5)—digital technology may exacerbate the divide between advantaged and disadvantaged communities (see Section 2.14). Once again, it is critically important to answer questions of inclusivity when speaking about digital technologies and games in educational systems. Stakeholders should understand advantages as well as limitation of such a learning environment.

Lastly, one SME commented that together with games they also employ gamification in the curriculum. While gamification differs from digital game-based learning, it is a promising direction for future research to examine how gamification may be used for the sake of critical thinking. Future research may build upon the findings of my study and explore what kind of game elements reported by SMEs may be transferred into the learning activities.

This section concludes the discussion on findings collected in Round 3 and, at the same time, completes the last round of Delphi iterations made in this thesis. The results of the last round are important for several reasons. First, they provide insight into the experience of SMEs and their participation in this study. These comments allowed establishing an attitude of some SMEs towards the theme of this investigation in general. The comments of SMEs, their challenges, and suggestions are noted and reflected in the reports (https://play2think.com/stage-2) as well as in the current section above. Second, some SMEs could provide their perspective on the study at its very last stage. These SMEs had access to all the data and could consolidate and reflect on what they had seen throughout the study. For this reason, the suggestions and notes made at this stage are of great importance. The next chapter of this thesis is the conclusion where I consolidate and reflect on the results of the whole Delphi study.

Chapter 7: Conclusion

This chapter concludes the thesis by highlighting the key findings of the study, conveying its broader significance, providing implications for various stakeholders, outlining limitations, and offering directions for future research.

7.1 Key Findings of the Study

The Delphi method used in this study provided a useful methodological framework and method of data collection. Throughout the course of the investigation, I was able to build a comprehensive picture of how digital technologies and games can be used to develop critical thinking. SMEs shared their thoughts without being pressured by the opinions of other experts as they were able to contribute equally in an anonymous format to the study. One of the key advantages of applying the Delphi was that it allowed for interaction between perspectives and set the tone for the nondefinitive nature of participants' answers. By maintaining this balance between anonymity and interaction, the Delphi method proved to be useful for researching phenomena that are not well defined nor understood. Specifically, the Kantian Delphi proved effective for building a broader picture of the under-researched area.

The findings of this study indicate that critical thinking is conceptualized differently by participating SMEs. Looking at SMEs' definitions through the lenses of Davies's (2015) model of critical thinking in higher education and Sternberg's (1986) schools of thought in defining critical thinking, I was able to establish that their definitions represented concerns of all schools of thought—inclusive of the educational, philosophical, and psychological schools as conceptualized by Sternberg (1986). The SMEs' definitions incorporated various elements identified in Davies's model (2015) such as cognitive skills, dispositions, actions, and creative thinking (see Section 4.4.2 and Figure 16). The most reoccurring conceptualization of critical thinking between all three schools of thought was shaped by cognitive skills, judgments, dispositions, and focus on individual development. One important note to be made about SMEs’ definitions is that the majority were open to including creative thinking (see Section 4.5.1), which may reflect their open stance on the concept itself, a position on critical thinking exemplified by Davies (2015) and Burbules and Berk (1999).

This study also establishes that from the position of SMEs, critical thinking can be taught with the use of digital technologies and digital games. Interestingly, digital games were viewed as a frontrunner for critical thinking development compared to other technologies, and SMEs usually referred to elements of games when speaking about digital technologies. More specifically, the Three-Phase model for critical thinking and digital games (see Section 5.7.3) reflects the key findings of Round 2 and showcases what SMEs believed were important elements that make it possible for digital games to develop critical thinking. These were considerations about the nature of critical thinking (what kind of critical thinking ought to be taught through digital technologies and games), and philosophical and theoretical assumptions about the use of games and technology for the sake of critical thinking. One of the main themes was the pedagogical scaffolding and the use of reflection in games. SMEs believed that games, per se, may not result in critical thinking and there should be additional learning activities that accompany playing (e.g., before game briefing and after play debriefing or reflection) or certain playing modes employed (e.g., play with a teacher’s guidance, collaborative play) to develop critical thinking. SMEs reported different elements and features that they believed could support critical thinking both in terms of digital games and in technologies more broadly. They also proposed certain genres and particular games that may serve this end well. Supporting the evidence from research provided in the literature review, the results of this study indicated that there was an understanding of the relational nature between the content (critical thinking), pedagogy (how critical thinking may be taught), and technology (digital games or other specific technologies). In this sense, the TPACK framework (Mishra & Koehler, 2006) used as a part of the theoretical framework of this study allowed me to analyze the data collected and trace connections and common threads between various ideas expressed by SMEs.

The outcome of this Delphi study has been carefully documented on a website that illustrates the positions of SMEs, the areas of agreement and disagreement, and their comments. The website should be used together with the Three-Phase model for critical thinking and digital games. The model provides a tangible tool for various stakeholders by indicating and orienting the relationship between the key findings of this research.

7.2 Implications of the Study

It has been argued that the theme of digital games and critical thinking is under-researched. Any researcher venturing into this field may find it challenging to put together what is known and what is yet to be discovered about digital games and critical thinking. Thanks to the methodological advantages of Kantian “contributory” Delphi, the results of this research can be used as a departure point for any future study on digital games and critical thinking. The findings of this study provide a broader picture of how SMEs in the field conceptualize critical thinking, what they think are important elements of games and digital technologies when developing critical thinking, and how these elements relate to one another.

The comments of SMEs also established that there is an interest in the results of this study. I took a practical stance and constructed the Three-Phase model for critical thinking and digital games from the research findings as a practical tool for educators, game designers, and researchers. Each stakeholder may use the model differently and build on the experience of other SMEs with a different professional background who contributed to these findings. Educators may use the model as a guide for choosing a game to be used in class and for creating instruction and pedagogical scaffolding to support learning. One clarification that I wish to make is that educators can use the results of my research on different levels. My study did not focus solely on a particular educational level or formal schooling. Questions of the study were tailored to address different concerns, different experts, and positions on the phenomenon. Game designers can use the model to develop educational games that are conscious of the aspect of critical thinking to be taught. They can design games with an awareness of the importance of aligning a critical thinking aspect with the game's pedagogical features. Ultimately, the model provides the means by which designers can develop games that achieve their desired goals. Finally, researchers who develop games to be used in their research have a practical guide for what should be considered, akin to how game designers are guided above. Finally, this study is also critical about the use of games for learning. The study suggests that policymakers and other stakeholders should become conscious of sociotechnical tensions surrounding the use of technology for learning (see Selwyn, 2021a). A policymaker may ask questions about how technology addresses inequalities present in society, whether the use of games is environmentally sustainable, and whether their use reflects the needs of society as a whole.

Many educational systems, including those in Kazakhstan, are advancing in terms of their technological capabilities and the shift into digital learning needs to be reflective, planned for, and implemented inclusively and sustainably.

Finally, when relating the findings to the various conceptualizations of critical thinking discussed in the literature review, one point must be emphasized. Not one SME recognized action as an integral component of critical thinking. This is particularly worrying in the light of many crises faced by humanity such as poverty, war, climate change, and the urgent need for action. The importance of critical action is paramount, and these results indicate that there needs to be a higher level of awareness to this dimension of critical thinking. This concern extends above the limited reference to critical action as SMEs did not speak much about the concerns of critical pedagogues, and reflected minimally on the concept of critical thinking itself. Since these findings document only the position of those

SMEs who participated in this research, my findings bring awareness about the scope of contemporary critical thinking scholarship, and on the dimensions of critical thinking that should be promoted through digital games. My findings justify the intention of my research, that is, to create a comprehensive picture of the phenomenon useful as a foundation for future research within this field.

7.3 Limitations

The limitations of the Delphi method and associated counterstrategies were addressed in Section 3.8 of this research. This section presents broader limitations that can be identified at the final stage of this research.

The results of this study are not intended to be generalizable. They draw a bigger picture of the phenomenon by revealing only what the voluntary participants (SMEs) thought on the topic. They may not necessarily reflect every position or perspective of the wider community who engage with critical thinking, digital technologies, and digital games simultaneously.

As well as answering the research questions, the findings of this study provide a platform for discussion. The Delphi method by nature is collaborative, and it welcomes participants to challenge positions of one another. In this sense, the level of interaction between SMEs achieved in this study could have been higher. Although I made every effort to ensure that this interaction occurred and was easy for SMEs to perform (see Section 3.4 and Figure 5), some further incentivization could have been implemented to maximize ongoing interactions. There are different ways to interpret the level of interaction between SMEs achieved in this study. The first explanation is that the study asked respondents to commit a considerably large amount of their time to participate. For the various rounds, SMEs were required to explore the reports, answer questionnaires, and comment on the input of other SMEs. That could have felt overwhelming and can be considered a general limitation of the Delphi method (see Section 3.8). Another possible explanation for the limited levels of interaction could have been that the intervals between each consequent round were long: there were 8 months between Round 1 and Round 2, and 13 months between Round 2 and Round 3. The amount of data collected in Rounds 1 and 2 was considerable, and in order to proceed to the next round, I had to analyze and categorize the data, and create a report that would be visually appealing and clear. In addition, the creation of the website that served as a reporting platform took a lot of time. Thus, participants transferring from each round of Delphi to another could lose the perspective of continuity and forget what they had shared at the previous stage. It would make it harder to reflect on their own position in relation to the position of other SMEs. Finally, the amount of interaction could have been an indication of the overall agreement between SMEs on the material they accessed in the reports. In other words, the majority of SMEs may not have felt that they disagreed enough with something in order to share and debate it. In this case, conceivably, the current amount of interaction may have also reflected the state of general agreement as opposed to a limitation.

The COVID 19 pandemic may have had an impact on the study. Although initially 89 SMEs subscribed to participate in this study, 36 participants joined Round 1. There were 22 SMEs who participated in Round 2 and nine SMEs who joined Round 3. Due to the pandemic, educators globally were pressed to move into digital learning and teaching which meant a higher workload of adapting their materials and practices into new learning realities. This could have resulted in SMEs being busier and devoting less time to participate in this study. At each stage of my research, I devoted a lot of effort to producing quality reports and enhancing the experience of participants, which I believe mitigated the impact of this limitation and resulted in the positive feedback of SMEs who participated in Round 3.

7.4 Recommendations for Future Research

Based on the findings of this study, there are many promising directions for future research. First, I propose that research be undertaken on how different cultures manifest themselves in critical thinking developed through digital games. This is because the research literature (see Section 2.12) and my findings (see Section 4.2.5) suggest that there is a connection between culture and critical thinking. Second, the findings of this research established that the majority of SMEs considered creative and divergent thinking as central to critical thinking concepts (see Section 4.5.1). It would be important to understand in better detail how experts in the field see the relationship between critical and creative thinking and ways this could ultimately be translated into digital games. Digital games provide great creative possibilities for players. Therefore, a better understanding of the relationship between creative and critical thinking would benefit game designers and educators using or creating games for learning.

The Three-Phase model for critical thinking and digital games designed in this research should be utilized by various stakeholders to understand the shortcomings and capabilities of the model. I would welcome feedback and comments from its users and commit to future developments of the model as our understandings of learning and digital games continue to grow. The academic intention of this study was to provide a foundation for researchers to explore the theme of critical thinking and digital games with particular game titles, expand theoretical understanding of the phenomenon, and conduct future research aimed at the generalization of knowledge. I believe that my study has achieved this end and offers numerous possibilities for a more detailed exploration of this important phenomenon.

7.5 Concluding Remarks

I want to conclude my thesis with a reflection on my position about critical thinking and digital games. My understanding of critical thinking evolved with the progression of this study. Before I entered the Ph.D. program, I was involved in at least two major projects on critical thinking. When I was asked then how I understood critical thinking, I usually quoted a piece of Browne and Keeley's (2015) definition of critical thinking that is "the ability to ask and answer critical questions" (p. 4). Five years later I am reluctant to give a one-sentence definition as I am aware of the many aspects and concerns that inform critical thinking scholarship. My position about critical thinking is still evolving but I am convinced that critical thinking should include moral and ethical dimensions, be more about criticality and critical action, and not be limited to logical thinking and argument analysis. Having said so, I am interested to explore critical thinking in its wider sense. The frontiers of today's critical thinking scholarship extend to its relation to intuition, creativity, the state of flow, and other phenomena that were not historically attributed to critical thinking. Surprisingly for me, the findings of this research suggest that SMEs actively refer to these new influences. This wider sense of critical thinking may be what Burbules and Berk (1999) called "the alternate criticality" (p. 18). In line with the authors' critique of the critical thinking movement and critical pedagogues, I am committed to being open and reflective about my stance on critical thinking.

One of the findings that did not surprise me was that only six SMEs spoke about critical thinking through the perspective of critical action. None of participating SMEs explicitly stated the necessity of action based on one's thorough thinking. Even though the results of this study cannot be generalized to a wider population of professionals working in the field of games and critical thinking, this is a disturbing finding. Many problems that humanity faces today need not only deep and considerate thinking, but they require educators to teach thinkers to act about these problems. I believe that academia and educators should focus more on this important component of critical thinking, which, arguably makes thinking critical.

I believe my understanding of digital games and their learning potential has been even more evolutionary over the course of this research, and I am still discovering and learning more about the various facets of this field. The literature review and findings of my study present a compelling picture of games as an environment for the development of critical thinking, and of course, not without the current limitations that I addressed in various sections of this research (see Sections 2.14, 2.16.1, 5.7.2, and 6.3.1). This study has also demonstrated to me that regardless of the academic understanding of a phenomenon, it is important to delve more deeply with people who work with the topic in interconnected ways (e.g., teachers, game designers, students) as the findings of this research show many facets of the phenomenon that are yet to be explored by research.

Finally, for the past 2 years I have been working as a game designer and had the opportunity to be involved in the creation of more that 13 “serious games” focused on topics of media and information literacy, hate speech, fake news, gender equality, and critical thinking. This experience was enlightening in may ways. I could use my theoretical understanding of critical thinking and digital games when dealing with the concrete problems of game design: creating engaging storyline, focusing on learning goals of a game, thinking about various design elements such as feedback, level length, game economy, and in-game progress and balance. While initially my theoretical background helped me to bring educational components into the games, later, I saw my game design practice enhance my theoretical knowledge. Here are some lessons that I have reflected on when designing games and using my Three-Phase model for critical thinking and digital games:

- It is important to define a learning objective of a game as clearly as possible. It is important to be focused and not to try to develop everything at once. Considerations of your time and other resources will help in defining the scope of your work.

- The learning cycle of briefing, action, and debriefing is very useful in explaining complex concepts to learners. When providing feedback, a game designer should make sure that one addresses players in a language they understand (by this I mean the style used, rather than the use of English, Russian, or another language).
- Designing a game for critical thinking is primarily about designing a game! Having knowledge in critical thinking but lacking understanding of how games operate may result in people not playing your game. We should not forget that one fundamental trait of play is the voluntary nature of participation.
- Teaching complex concepts may create an impression that a game should include a lot of text in the same way as a textbook. In my experience, an engaging game explains the concept experientially and contextually, and does this with as little text as possible. Thus, a key component of engagement in a game is fun. Note, that this does not mean that a game should not have an explicit learning orientation, it rather means that a game can be fun even if it is a serious game.

This research and my game design experience have left me even more motivated to investigate digital games and their learning potential. I am excited to continue my research and practice to uncover what games may have to offer the players of the future.

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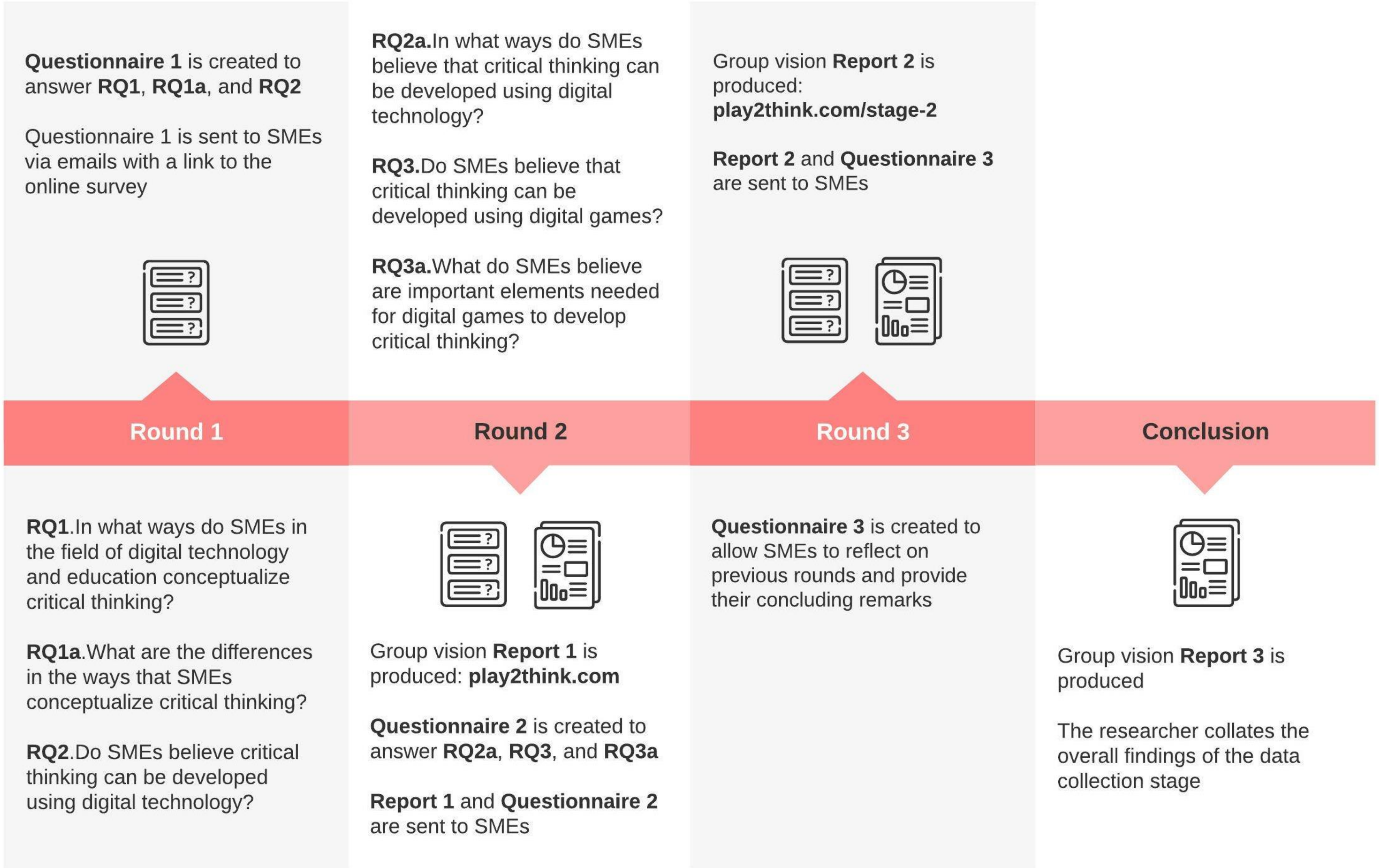
Appendix A

The Sequence of Procedures in my Delphi Study



Appendix B

Informed Consent Form

Playing to Think Critically: A Delphi Study on Digital Games for Critical Thinking

This investigation is being conducted to generate a collective expert vision of whether digital games can be used to promote critical thinking. Please, read the following consent form carefully.

As advocated by many researchers, practitioners and education experts, critical thinking is a key to sustainable development, life, and career readiness, and therefore an essential component to be embraced by educational systems. When it is possible to promote critical thinking in various ways and through different learning environments, this study is interested in how we can do it through digital games, known for their unique learning qualities.

This study uses Delphi method: an approach to generate knowledge about a topic which wasn't researched enough and achieve an experts' consensus [multiplicity of views] regarding the problem. The core of this exercise is to gather your opinions, then summarize and analyze them and share in a form of a report with other members of the group. After receiving a group vision report, you can change your mind, agree or disagree with other experts or stick to your initial position. Each stage informs the next stage, that is why it is important to thoroughly consider input from your colleagues. You may think about the whole process as a teamwork, which uses the wisdom distributed across many experts to determine a collective result.

Your input into this study is very important and will serve as a departing point for researchers, teachers, game designers, and methodologists who will use this data in their practices, thereby greatly contributing to the educational technology field.

As a participant, you will be asked to complete three surveys over the duration of three months. Each survey may take approximately from 30 to 60 minutes of your time.

- The first survey is about your perception of critical thinking.

In subsequent surveys you will be provided with the data generated by professionals such as yourself from across the globe:

- The second survey will investigate in what ways you believe critical thinking can be taught or promoted using digital technology;
- The final survey gathers your insights about how critical thinking can be taught and promoted using digital games.

Throughout the process, as well as at the end of the study, you will be provided with all data generated from the group of experts, as well as the report of the collective group vision.

At least five participants of this study will be also asked to join an individual Skype/telephone interview. After the final survey, you will receive an email where selected IDs will be called to participate. It is absolutely voluntary whether you respond to this general email and take part in the interview.

The possible risks associated with this study are determined to be no more than would be part of your typical working life. All responses collected will remain confidential (in case of interviews) and totally anonymous (in case of questionnaires). The information gathered through surveys will be directly transmitted to the principal investigator. Your survey responses cannot be traced back to you. Names or other identifying information gathered during the course of interviews will be kept anonymous by using pseudonyms in any publication or materials associated with this study. The information gathered through this study will be kept safely in password protected archives. You will not be asked to provide any personal information in your responses. Your participation is voluntary, and you have the right to withdraw your consent or discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. If you choose to participate, be aware that you are expected to go through all Delphi rounds.

Questions: If you have any questions, concerns or complaints about this research, its procedures, risks, and benefits, contact my thesis supervisor, namely, Dr. Michelle Irene Somerton: michelle.somerton@nu.edu.kz

Independent Contact: If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the NUGSE Research Committee: +7 7172 709359. You can also write an email to the NUGSE Research Committee at gse_researchcommittee@nu.edu.kz

By giving consent, you confirm that you possess experience both in critical thinking and digital technology for education fields, therefore, able to meaningfully contribute to this study.

If you wish to participate in this study, your consent will be made by clicking on the first button, "I Consent" below and then the "Next" button at the bottom of the page; this will continue the survey.

If you do not wish to participate, click on the second button, “I DO NOT consent" then the next button and the survey will be terminated. Please respond below:

Do you wish to participate in this investigation?

- I have carefully read the information provided;
- I have been given full information regarding the purpose and procedures of the study;
- I understand how the data collected will be used, and that any confidential information will be seen only by the researchers and will not be revealed to anyone else;

- I understand that I am free to withdraw from the study at any time without giving a reason.

- ○ I Consent: I understand the information presented above. I consent to participate in this investigation
- ○ I DO NOT Consent: I understand the information presented above. I do not consent to participate in this investigation

Appendix C

SMEs' Attraction Materials

Letter to a Potential SME who has Expertise Both in Digital Games and Critical Thinking

Dear _____,

Good day.

My name is Stanislav and I do PhD in Education at Nazarbayev University, Kazakhstan. I've found your profile when searching for experts in games / games for learning.

The reason I am writing is to ask for your support and involvement in my doctoral research project. I invite you to join an interesting learning opportunity: Delphi study on digital games and critical thinking. Your valuable expertise in __________ is of a perfect fit for the purpose of this research. I also believe that you have ideas to share in relation to critical thinking building on your works and background. If you do, please, take some time to go through the study details and/or promo video below. And I would really appreciate if you could spread the word about the study or recommend me your colleagues who may join too (you can also Retweet / FbRepost / LinkedinRepost my post about the study).

There are a number of studies suggesting that games are a great learning environment. Much of the research concerning digital games is mainly concerned with engagement, motivation, collaboration and problem-solving which are of course important for learning. However, a search in the research literature confirms there is not a lot of empirical data on digital games and critical thinking. This is really frustrating as the field of games for education grows every day and it is critical that the educational components are also in step. Those who create games know what it takes to design an engaging and challenging game. But if we want to move beyond that, we should bring educators, players, and researchers on board. Thus, what is really needed is research that brings these diverse people together to share and build knowledge. As critical thinking is a key component for better learning and living, I believe that it is important to understand how it is actually conceptualized among subject-matter experts (SME's) and in what ways it can be embedded into digital games for learning.

My research is a Delphi method study that is bringing together global SMEs in educational and technology spheres to generate knowledge and form a consensus [multiplicity of views]. This research design gathers survey data then analyses and summarizes these data to share back to participants in the research study. From each of the three stages of the data collection, you will receive a summary of the consensus [multiplicity of views] on thinking about critical thinking and digital games.

This is an excellent opportunity to interact with other experts working in the education and technology fields. Already I have participants that have registered from ________________. I believe that the results of this research will assist game developers to better support the educational sphere by understanding how to embed the processes for developing critical thinking into digital games. At the same time, educators will have more information and understanding around how to better evaluate and use digital games that support the development of critical thinking. I also feel that it is important for other researchers to consider how the development of certain skills and thinking can be supported through pedagogical and game design solutions.

The first stage of my research will begin __________ and each of the three stages will require online participation only. There is further opportunity to volunteer for a final interview to contribute any particular ideas that arise from the research process or that you believe are really important. The research design and process have been peer reviewed and I want to assure you that your participation would be very meaningful and beneficial for all of us.

If you are interested, you can proceed by clicking this link (or copy it below), where you will find detailed information and consent form.

https://nukz.qualtrics.com/jfe/form/SV_3wymVkzClFezluR

Please, also check the promo video for my study.

Yours sincerely,

Stanislav Khanin

Doctoral candidate

Graduate School of Education

Nazarbayev University

Astana, Kazakhstan

Headers Used to Tailor Messages or Emails for Participants With Different Expertise or Background

Minecraft Community

Dear ____,

As you are, I am a part of Minecraft Education community and a big fan of playing. Just recently I've had the luck to meet Santeri Koivisto, the creator of MinecraftEdu, which made me think about reaching to our community.

The reason I am writing is to ask for your support and involvement in my doctoral research project. I invite you to join an interesting learning opportunity: Delphi study on digital games and critical thinking. The fact that you are using Minecraft Education means that you know what it takes to promote learning through games. But if you also have experience of teaching, researching or applying critical thinking in your practice, then you are an ideal expert to join this study!

Educators in Skype Communities and Potential Participants Whose Experience Record is not Accessible

Hello, dear educators. My name is Stanislav Khanin and I do research on digital games and critical thinking at Nazarbayev University, Kazakhstan.

The reason I am writing is to ask for your support and involvement in my doctoral research project. I invite you to join an interesting learning opportunity: Delphi study on digital games and critical thinking. I am looking for professionals who use digital games to promote learning and have experience of teaching, researching or applying critical thinking in your practice. If you can say that you do both, then you are an ideal expert to join this study!

Participants who Have a Record of Experience in Critical Thinking or Digital Games Alone

The reason I am writing is to ask for your support and involvement in my doctoral research project. I invite you to join an interesting learning opportunity: Delphi study on digital games and critical thinking. Your valuable critical thinking related experience is of perfect fit for the purpose of this research. But if you also have experience with teaching, researching or applying edu. games in your practice, then you are an ideal expert to join this study. If you do, please, take some time to go through the study details and/or promo video below.

The reason I am writing is to ask for your support and involvement in my doctoral research project. I invite you to join an interesting learning opportunity: Delphi study on digital games and critical thinking. Your valuable expertise in games for learning is of a perfect fit for the purpose of this research. But if you also have experience of teaching, researching or applying critical thinking in your practice, then you are an ideal expert to join this study. If you do, please, take some time to go through the study details and/or promo video below.

Appendix D

Promotional Posts Placed in my Social Networks' Profiles

Figure D1

Screenshots of the Promotional Posts on Facebook and LinkedIn

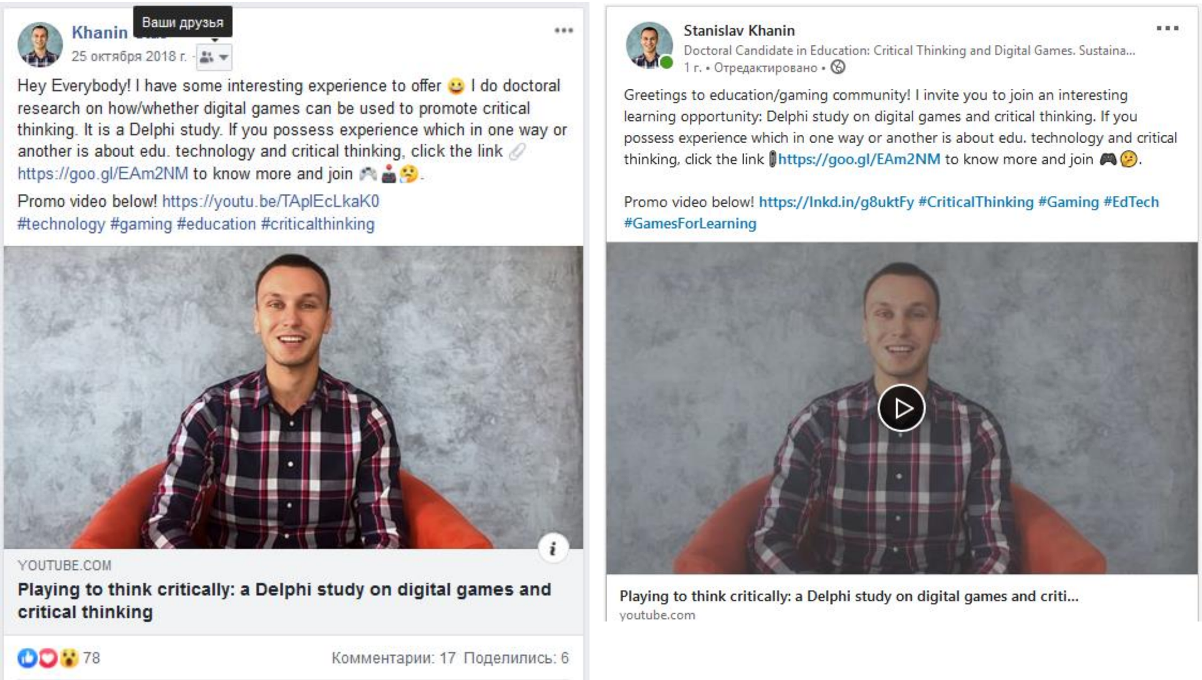


Figure D2

Screenshot of the Promotional Post on Twitter

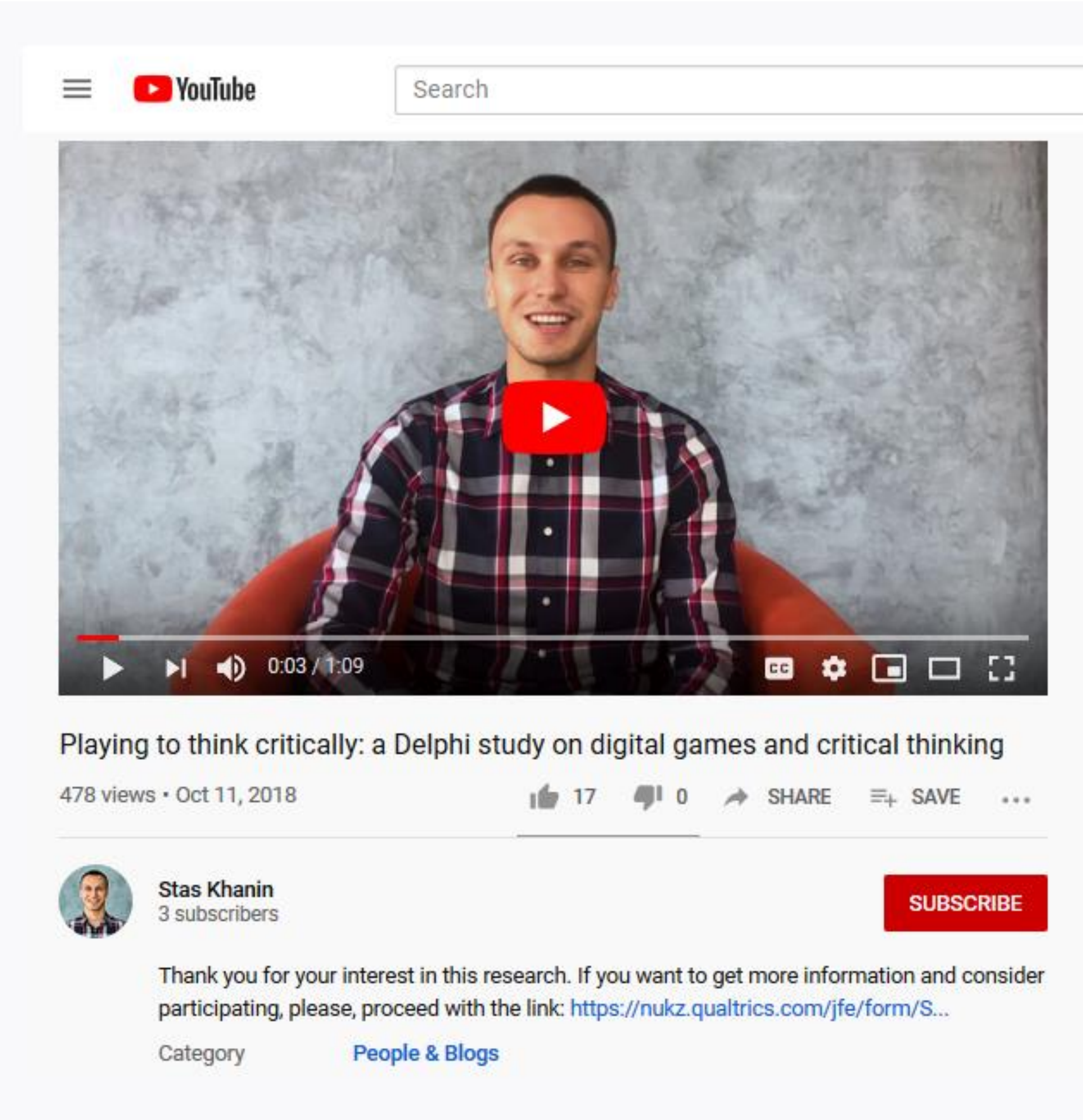
Appendix E

A Promotional Video Posted on YouTube

The video can be found by this link: https://youtu.be/TApIEcLkaK0

Figure E1

Screenshot of the Promotional Video for Potential Participants Attraction



Appendix F

Questionnaire 1

Start of Block: Introduction block

Info 1

Playing to think critically: a Delphi study on digital games for critical thinking

This investigation is being conducted to generate a collective expert vision of whether digital games can be used to promote critical thinking. Most probably, you had already read the information presented below. If it is so, you may scroll down and save your time not reading it again. It is displayed for reference purposes.

As advocated by many researchers, practitioners and education experts, critical thinking is a key to sustainable development, life, and career readiness, and therefore an essential component to be embraced by educational systems. While it may be possible to promote critical thinking in various ways and through different learning environments, this study is interested in if and how we can foster critical thinking through digital games, known for their unique learning qualities.

This study uses the Delphi method: a cyclical approach to generate knowledge about an underresearched area by asking informed individuals about the topic to then achieve a consensus [multiplicity of views] of experts' opinions. Therefore, the core of this exercise is to gather your opinions, to summarize and analyze them across the wider group, then to synthesize them in order to share in the form of an anonymized report with other members of the group. After receiving a group vision report, you can change your mind, agree or disagree with other experts or stick to your initial position. Each stage informs the next stage, that is why it is important to thoroughly consider input from your colleagues so the spiral of reaching a group-agreed consensus [multiplicity of views] is met. You may think about the whole process as teamwork, which uses the wisdom distributed across many experts to determine a collective result.

Your input into this study is very important and will serve as a departing point for researchers, teachers, game designers, and methodologists who will use this data in their practices, thereby greatly contributing to the educational technology field.

As a participant, you will be asked to complete three surveys over the three months' period. Each survey may take approximately 30–60 minutes to complete. The first survey is about your understanding of critical thinking. In subsequent surveys, you will be provided with the data generated by professionals such as yourself from across the globe. The second survey will investigate in what ways you believe critical thinking can be taught or promoted using digital technology, and, in particular, digital games. The final survey will present you with a report to reflect on, to consider and clarify certain points, and answer new questions in relation to digital games and critical thinking. Throughout the process, as well as at the end of the study, you will be provided with all data generated from the group of experts, as well as the report of the collective group vision.

At least five participants of this study will also be asked to join an individual Skype/telephone interview. After the final survey, you will receive an email where selected IDs will be called to participate. It is absolutely voluntary whether you respond to this general email and take part in the interview.

The possible risks associated with this study are determined to be no more than would be part of your typical working life. All responses collected will remain confidential (in the case of interviews) and totally anonymous (in the case of questionnaires). The information gathered through surveys will be directly transmitted to the principal investigator. Your survey responses cannot be traced back to identify you personally. The only identifier present in this survey is your random study ID, which is automatically assigned by Qualtrics. You will be asked to provide your ID below, and as this survey is set up to be anonymous, I will not know which email address corresponds to any of random IDs. The information gathered through this study will be kept safely in password protected archives. You will not be asked to provide any personal information in your responses.

Your participation is voluntary, and you have the right to withdraw your consent or discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. If you choose to participate, be aware that you are advised to go through all three Delphi rounds. Not having you as a contributor and evaluator of the information presented on each stage of the study, will leave us without a better and more comprehensive result, which we could achieve otherwise.

Questions and concerns: If, at any stage, you have any questions or concerns regarding this research, its procedures, risks, and benefits, please, feel free to contact my Ph.D. thesis supervisor, namely, Dr. Michelle Irene Somerton: michelle.somerton@nu.edu.kz. If you would prefer to make more independent contact, and you have concerns or any questions about the research or your rights as a participant, please contact the NUGSE Research Committee: +7 7172 709359, gse_researchcommittee@nu.edu.kz.

Page Break

Info 2 Please note that this survey allows navigation: you can always press the arrow "back" and change any data you have inputted before.

Page Break

Info 3

Dear colleague, the following questions are dedicated to your rights as the participant of the study. They will also ensure that we can proceed through one stage of the study to another.

Have you already provided your email address?

Note. Most probably, you have received the link to this survey from my email, which means that I have your email address. However, it may happen that you have got the link to this survey from your colleague, and didn't have a chance to complete the informed consent form and provide your email address. I need your email address to send you reports produced on each stage of the study, and links to the following surveys.

- Yes
- No, I have not seen the informed consent form yet, and I want to subscribe for the study

Display This Question:

If Dear colleague, the following questions are dedicated to your rights as the participant of the st... = No, I have not seen the informed consent form yet, and I want to subscribe for the study

Info 3.1

It should take approximately 2–3 minutes to complete the informed consent form and provide your email address by following this link:

https://bit.ly/2TT63an

Please, do not close this window/tab as you can proceed filling this survey after completing the informed consent form. That's why, please, open the link given above in a separate window/tab of your browser.

Note. After reading the informed consent form you may agree/disagree to participate in the study. If you agree to participate, you will be asked to provide your email address which will be used to send you the link to the second stage of the study.

Please, make sure that you do so, as I will not be able to contact you in any way if I do not have your email address.

Page Break

Info 4

The email which included the link and instructions to this survey also contains an automatically generated ID. Effectively, it is a password which will allow me to securely track your data from one participation to another. The ID will also help me to invite some of you for interview participation. Please, do not delete this email as it safely keeps your ID.

Note. The ID is automatically generated by Qualtrics. I cannot link your identity to your ID, as you are the only person who knows that this ID is yours. In the next question, you will be asked to provide it in the body of the survey, which is set to be anonymous and will not expose your identity to me or anyone.

Do you have access to your ID?

- Yes, I have my ID (1)
- No, by some reason I need a new ID (2)

Display This Question:

If The email which included the link and instructions to this survey also contains an automatically... = No, by some reason I need a new ID

Info 4.1

This is your automatically generated ID:

${rand://int/100000000:999999999}

To keep yourself anonymous do not mention it to anyone. Unless, you are asked to do so in the body of the survey, which is set to be anonymous and will not expose your identity.

The system of IDs keeps this study functioning right, and it is very important that you have access to your ID throughout the study. That's why I suggest you proceeding through one of these steps to keep your ID safe:

- Send an email from your email address to exactly the same email address including ID number in the body or theme of the email. E.g., send an email from "myemail@example.com" to identical "myemail@example.com". This is the most recommended option;
- Save your ID in a note-taking app (e.g., Google Keep, Notes for iOS, "Note to Self" in Outlook, etc.);
- Copy your ID into doc/txt file on your computer and give an identifiable name to the file, e.g., "ID Critical thinking and digital games";
- Write it down in your notebook and effectively highlight somehow, do not forget to leave a comment about this entry;
- Or use your own solution to keep it safe.

Display This Question:

If The email which included the link and instructions to this survey also contains an automatically... = Yes, I have my ID

Info 4.1

Now, please, input the ID number which you have received in the email with the link to this survey.

My ID is: ____

Page Break

End of Block: Introduction block

Start of Block: The main block

The technical part is over and we are ready to move on. Please, answer a couple of questions relating to you individually, and then we will focus on critical thinking.

Q1. How do you describe your current job?

Please, shortly explain what you do.

____

Q2. Where are you a local (e.g., country, region, village, etc.)?

Note. by place(-s) where you are "local" I mean the place(-s) where your living experiences happened and considerably shaped you as an individual. Please, write your answer below.

____

Page Break

Q3. Could you tell how you understand critical thinking? Perhaps you could begin by completing the following sentence: ‘To me, critical thinking is ___________________”.

In your definition, you can mention:

- An example of your use of Critical Thinking in your setting that illustrates your concept of it;
- Elements which are central to Critical Thinking and relation between these elements.

This is an essay box. Please, explain your position thoroughly.

____

Q4. My concept of critical thinking is largely:

Please, choose one option below.

- A product of my own thinking
- A product of one or more particular theories of critical thinking
- Both options
- Not sure

Display This Question:

If Q4. My concept of critical thinking is largely: Please, choose one option below. = A product of one or more particular theories of critical thinking

Or Q4. My concept of critical thinking is largely: Please, choose one option below. = Both options

Q4.1 Could you please tell me which theories or conceptual models shape your understanding of critical thinking (e.g., Bloom's taxonomy, Robert Ennis's dispositions and abilities of the ideal critical thinker, etc.).

Please, write your answer below.

____

Page Break

Q5. Why does an individual need critical thinking?

This is an essay box. Please, explain your position thoroughly.

____

Page Break

Q6. Based on your definition of critical thinking, please, come up with items (i.e., operations, behaviors, performances, processes, outcomes, abilities, skills, traits or dispositions) which you consider to be at the core of the Critical Thinking concept?

Write elements into corresponding fields. You can provide fewer elements than the number of fields provided. This is not a ranked list.

- Element A ____
- Element B ____
- Element C ____
- Element D ____
- Element E ____
- Element F ____
- Element G ____
- Element H ____
- Element I ____
- Element J ____

Page Break

Q7. These words have been used before to describe critical thinking. Choose 10 words that you think are the most relevant to the concept of critical thinking.

This is a multiple choice list. Please, tick 10 relevant boxes.

- ○ Accuracy
- ○ Active participation
- ○ Adequacy
- ○ Analysis
- ○ Analytical skills
- ○ Clarifying ideas
- ○ Clarity
- ○ Completeness
- ○ Consistency
- ○ Constructive skepticism
- ○ Convergent thinking
- ○ Cooperative learning
- ○ Creative thinking
- ○ Decision-making
- ○ Deductive reasoning
- ○ Depth
- ○ Disciplined
- ○ Discovery learning
- ○ Divergent thinking
- ○ Drawing conclusions
- ○ Drawing inferences
- ○ Epistemological understanding
- ○ Evaluating assumptions
- ○ Evaluation

- ◯ Fairness
- ◯ Higher order thinking
- ◯ Hypothesize
- ◯ Identifying/removing bias
- ◯ Independent thinking
- ◯ Inductive reasoning
- ◯ Intellectual challenges
- ◯ Investigate
- ◯ Logical
- ◯ Metacognitive skills
- ◯ Objective
- ◯ Open-minded
- ◯ Precision
- ◯ Problem-solving
- ◯ Rational thinking
- ◯ Reasoning
- ◯ Relevance
- ◯ Responsible
- ◯ Self-directed
- ◯ Significance
- ◯ Socratic questioning
- ◯ Specificity
- ◯ Student-centered
- ◯ Subjective
- ◯ Synthesis
- ◯ Taking ownership
- ◯ Thoughtful judgments

Page Break

Q8. Do you think there is a difference between "good or effective thinking" and "critical thinking"?

This is an essay box. Please, explain your position thoroughly.

____

Q9. Do you think there is a relationship between culture and critical thinking?

- Yes
- No
- Do not know

Q10. Most likely, critical thinking is ...

- General skills and abilities, which can be taught/used across many disciplinary domains (e.g., reasoning ability mastered through the critical thinking course can be used when writing a literature essay and when doing a chemistry lab experiment)
- Domain and problem area specific (e.g., skills needed for critical thinking in natural sciences are different from skills needed for critical thinking in the humanities)
- Another position: ____
- I do not know

Q11. Is it possible to measure critical thinking?

- Yes
- No
- I do not know

Page Break

Q12. Can critical thinking be taught?

Please, choose one option below. If you choose no, please, explain why.

- Yes
- No. The reason for that is ... ____
- I do not know

Q13. Critical thinking can be developed using digital technologies.

Please, rate the statement given above.

Note. Digital technology for this question refers to a range of devices, systems, programs (software) and methods used to achieve certain practical purposes; in the context of this study, educational outcomes.

- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- I do not know

Q14. What kind of digital technologies do you believe support the development of critical thinking (e.g., MOOCs, digital games, blogs, WIKIs, etc.)?

Please, propose some below.

____

Page Break

Q15. Returning to your current job, please, identify how best you see your background may fit the purposes of the research. Choose one option which describes your professional background or experience in relation to this study. You can use the field "Other" if your case doesn't fall into provided categories. I possess background/experience in:

- Education
- Technology
- Education and Technology
- Other: ____

Q16. How many years of experience do you have in this profession or activities (see previous question)?

Please, choose one option below.

- Less than 1 year
- One year
- Two years
- Three years
- Four years and more

Q17. How many years of experience do you have in your profession engaging with concepts of critical thinking? Please, choose one option below.

- Less than 1 year
- One year
- Two years

- Three years
- Four years and more

Q18. What is your highest level of education?

Please, choose one option below or type your case in the entry "Other".

- PhD or above (e.g., Candidate of Sciences, Doctor)
- Master’s degree (e.g., Specialist degree)
- Bachelor’s degree (e.g., Diploma)
- Postsecondary vocational (e.g., Technical college diploma)
- Secondary education
- Primary education (1–4th grades)
- Not applicable
- Other: ____

Display This Question:

If Now, please, input the ID number which you have received in the email with the link to this survey. My ID is: Text Response Is Equal to 19081992

QID ${rand://int/100000000:999999999}

End of Block: The main block

Appendix G

Questionnaire 2

Start of Block: Introduction block

Info 1

Playing to think critically: a Delphi study on digital games for critical thinking

Stage 2

Previously you shared with us your conceptualization and ideas around critical thinking and the reasons you believe why a person may need to think critically.

As this research design is a Delphi method study, you are now invited to participate in the second stage. There are only six questions in this stage of the research which should take you approximately 10 minutes to complete.

However, prior to doing this, I suggest visiting the website where you can view the results of the first stage about the way critical thinking is conceptualized. There is a lot of interesting data there and you have the opportunity to comment, suggest, question, agree or disagree with anything presented from the previous stage.

To do so, please, highlight a block of text you are referring to and press “CTRL Enter” to leave your comment on the website (this feature works only if you have a keyboard), otherwise, you may leave your comments in the last section of this survey.

Stage 1 indicated that there was a general consensus (27 SMEs “Yes”, 0 SMEs “No”) that critical thinking can be taught.

This stage of our Delphi research concerns the ways in which critical thinking can be taught with the use of digital technology and more specifically, through the use of digital games.

Page Break

Info 2 Please note that this survey allows navigation: you can always press the arrow "back" and change any data you have inputted before.

Page Break

Info 3

Now, please, input the ID number which you have received in the email with the link to the first survey (email subject: Stage 1 Begins, received on 6th of June 2019, or for some of you it is 14th or 15th of June). It is a nine-digit code.

My ID number is:

____

Info 3.1 It is also possible that you requested a new ID number when filling the first survey. In this case, your ID may be:

- In an email from your email address to exactly the same email address including ID number in the body or theme of the email;
- Saved in a note-taking app (e.g., Google Keep, Notes for iOS, "Note to Self" in Outlook, etc.);
- Saved in a doc/txt file on your computer with an identifiable name, e.g., "ID Critical thinking and digital games";
- Written in your notebook and somehow highlighted. There may be a comment about this entry;
- Or you saved it in a place where you usually keep this kind of information.

○ I've looked everywhere and I can't find my ID number

Page Break

Display This Question:

If It is also possible that you requested a new ID number when filling the first survey. In this cas... = I've looked everywhere and I can't find my ID number

Info 4

This is your automatically generated ID:

${rand://int/100000000:999999999}

To keep yourself anonymous do not mention it to anyone. Unless, you are asked to do so in the body of the survey, which is set to be anonymous and will not expose your identity.

The system of IDs keeps this study functioning right, and it is very important that you have access to your ID throughout the study. That's why I suggest you proceeding through one of these steps to keep your ID safe:

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- Save your ID in a note-taking app (e.g., Google Keep, Notes for iOS, "Note to Self" in Outlook, etc.);
- Copy your ID into doc/txt file on your computer and give an identifiable name to the file, e.g., "ID Critical thinking and digital games";
- Write it down in your notebook and effectively highlight somehow, do not forget to leave a comment about this entry;
- Or use your own solution to keep it safe.

Please, copy ID generated above here:

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End of Block: Introduction block

Start of Block: The main block

Page Break

Section 1

Digital Technologies

In Stage 1 most of you agreed that critical thinking can be developed using digital technologies ("agree" and "somewhat agree"—25 SMEs, "neither agree nor disagree"—two SMEs, "somewhat disagree"—one SME).

You also provided a list of digital technologies which you believe support the development of critical thinking: digital games, WIKIs, blogs, discussion boards and forums, MOOCs. Besides, some of you suggested that any tech solution may support the development of critical thinking when a proper pedagogy, design, or strategy are applied. Therefore,

Q1. What features/elements of digital technologies do you think can promote/teach critical thinking (e.g., their design, capacity for collaboration, etc.)? This is an essay box. You may explain.

____

Page Break

Digital Games

The previous question asked about digital technologies, now this section is asking about digital games

Q2. Most of you suggested that digital games can support the development of critical thinking (24 SMEs).

Could you explain what you think are the features/elements of <u>digital games</u> that make them well suited for this task (e.g., feedback, problem-solving, etc.)?

____

Q3. Is there an underlying philosophy/theory which you think makes <u>digital games</u> suitable for teaching/promotion of critical thinking?

- Yes
- No
- I do not know

Display This Question:

If Q3. Is there an underlying philosophy/theory which you think makes digital games suitable for tea... = Yes

Q3.1 Please name that theory or philosophy and explain why it makes <u>digital games</u> suitable for teaching/promotion of critical thinking:

____

Q4. What genre(-s)/type(-s) of <u>digital games</u> or particular game(-s) are the most suited for teaching/promotion of critical thinking? This is an essay box. You may explain.

____

Q5. What setting(-s) may be the most effective for the promotion of critical thinking through <u>digital games</u>?

You can choose more than one option or provide your response in the "Other" field.

- Formal learning settings (use of games as a part of formal learning curriculum at schools, colleges, universities or workplace training);
- Informal learning settings (e.g., casual playing: just for fun; learning is not intentional from the learner's standpoint);
- Nonformal learning settings (use of games in professional development courses, workshops, seminars or other nonformal learning settings. These courses do not constitute a formal learning program);
- Other: ____
- I do not know

Q6. What mode(-s) may be the most effective for teaching/promotion of critical thinking through <u>digital games</u>?

By “mode” I mean how these games are played. For example: with teacher or without teacher’s guidance, when teacher and students are playing a game on one/separate consoles or in a multiplayer/single-player modes, when the whole class plays a single-player game taking turns, any other mode(-s), or combination(-s) of presented options.

This is an essay box. You may explain.

____

Page Break

Section 2

Comments

Comments If you couldn’t do it on the website, you are invited to share your position here. Please, propose your comments, suggestions, raise a question, or agree/disagree with anything presented by you or your colleagues during the previous stage.

____

End of Block: The main block

Appendix H

Questionnaire 3

Start of Block: Introduction block

Info 1

Playing to think critically: a Delphi study on digital games for critical thinking

Stage 3

In Stage 1 you shared with us your conceptualization and ideas around critical thinking and the reasons you believe why a person may need to think critically. Also, most of you suggested that digital games can support the development of critical thinking (24 experts).

In Stage 2 you shared your ideas about how critical thinking can be developed with the use of digital technology and digital games. You reported on the features of games, their types, underlying philosophy, and gaming modes which may support the development of critical thinking.

As this research design is a Delphi method study, you are now invited to participate in the third stage. There is only one question in this stage of the research which should take you no more than 10 minutes to complete.

However, before answering this question, I ask you to visit the website where you can view the results of Stage 1 and Stage 2. There is a lot of interesting data there and you have the opportunity to comment, suggest, question, agree, or disagree with anything presented from the previous stages. To do so, please, highlight a block of text you are referring to and press “CTRL + ENTER” to leave your comment on the website (this feature works only if you have a keyboard), otherwise, you may leave your comments in Question 1 of this survey.

This final stage of our Delphi research is a reflective one. It consolidates the data you shared before and asks you to reflect upon the knowledge we generated so far. It gives you an opportunity to add your final thoughts.

Page Break

Info 2 Please note that this survey allows navigation: you can always press the arrow "back" and change any data you have inputted before.

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Info 3

Now, please, input the ID number which you have received in the email with the link to the first survey (email subject: Stage 1 Begins, received on 6th of June 2019, or for some of you it is 14th or 15th of June). It is a nine-digit code.

My ID number is:

____

Info 3.1 It is also possible that you requested a new ID number when filling the first survey. In this case, your ID may be:

- In an email from your email address to exactly the same email address including ID number in the body or theme of the email;
- Saved in a note-taking app (e.g., Google Keep, Notes for iOS, "Note to Self" in Outlook, etc.);
- Saved in a doc/txt file on your computer with an identifiable name, e.g., "ID Critical thinking and digital games";
- Written in your notebook and somehow highlighted. There may be a comment about this entry;
- Or you saved it in a place where you usually keep this kind of information.

○ I've looked everywhere and I can't find my ID number

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Display This Question:

If It is also possible that you requested a new ID number when filling the first survey. In this cas... = I've looked everywhere and I can't find my ID number

Info 4

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${rand://int/100000000:999999999}

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- Save your ID in a note-taking app (e.g., Google Keep, Notes for iOS, "Note to Self" in Outlook, etc.);
- Copy your ID into doc/txt file on your computer and give an identifiable name to the file, e.g., "ID Critical thinking and digital games";
- Write it down in your notebook and effectively highlight somehow, do not forget to leave a comment about this entry;
- Or use your own solution to keep it safe.

Please, copy ID generated above here:

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Page Break

Q1

Your Final Comments and Thoughts

By now you have seen the results of Stage 2 and looked again at Stage 1 data.

I ask you to provide your final thoughts and comments about everything you have read and done in this study so far. You may use these criteria to guide your answer:

- Reflect on how the results of Stage 2 may have built on your conception of critical thinking from Stage 1
- Are there any ideas you disagree with? Why perhaps?
- What are your final thoughts about technology and digital games for teaching/promotion of critical thinking?
- Leave any other comments about this study

____

End of Block: The main block

Appendix I

Theories and Conceptual Models Which Shaped SMEs' Understanding of Critical Thinking

- Bloom's taxonomy (mentioned by seven SMEs)
- Critical Race Theory
- Design thinking
- Performance improvement models
- Problem-solving
- Program evaluation
- Six Thinking Hats
- Daniel Kahneman's "Thinking, Fast and Slow"
- David Nicol's "The foundation for graduate attributes"—CT in a higher edu. context
- Diane Halpern's concept of CT
- Dewey's Reflective thinking
- G.W.F Hegel's Dialectical Philosophy
- Michel Foucault's discussion of 'problematisation'
- Stephen Toulmin's Argumentation Model
- Theories from the discipline of logic, philosophy of language, philosophy of mind, and other philosophical disciplines
- People: Aristotle, Immanuel Kant, David Hume, Bertrand Russell, Martin Heidegger, Ludwig Wittgenstein, Engeström, Paulo Freire, E. Wenger, Senge, Robert H. Ennis, Jiddu Krishnamurti, Edward Glaser
- also British Columbia curriculum presents CT concept

Appendix J

Core Critical Thinking Elements

Table J1

Items Which SMEs Consider to be at the Core of the Critical Thinking Concept

Element	Count participants	Element includes
Questioning	10	Question any information; why question; question; questions; questioning/inquiry; ask continuously why; ask "what if?"
Logic	7	Logical approach; logical thinking; Identify logical fallacies
Not taking things for granted	7	Challenging orthodoxies that do not adequately explain complex phenomenon; not taking all the things at face value; interrogating methodological assumptions; interrogating philosophical assumptions; give nothing for granted; willingness to let go of established beliefs; always revert the status quo
Concepts	6	Conceptualizing; operationalising concepts; sharing concepts with others; playing with ideas at conceptual boundaries; understanding concepts; wide knowledge of concepts
Open-mindedness	6	Openness to many viewpoints; openness
Reasoning	6	Abstract inductive reasoning; deductive reasoning (both Holmesian and Occam's)
Analysis	5	Analyzing
Reflection	5	
Research	5	Able to research an issue; investigate different perspectives and opinions on one topic; questioning/inquiry; inquiring mind
Self-regulation	5	Self-awareness (in terms of personal bias); self-awareness; self-regulating; mindfulness; metacognition
Understanding	5	Understanding interlinks; constructing understanding visually; understanding concepts
Able to identify bias	4	Self-awareness (in terms of personal bias); identify bias; unbiased; unbiased applications
Communication	4	Sharing concepts with others
Evaluating	4	Evaluative judgement; evaluation
Facts	4	Critique opinions and facts; ability to decide based on facts
Knowledge	4	Background knowledge; wide knowledge of concepts
Applying	3	Unbiased applications
Critique	3	Critique opinions and facts; criticizing

Element	Count participants	Element includes
Decision making	3	Informed decision-making; ability to decide based on facts;
Objectivity	3	Objective
Perspective taking	3	Investigate different perspectives and opinions on one topic; openness to many viewpoints
Synthesis	3	Able to synthesize the available information; synthesize
Abstraction	2	Abstract inductive reasoning
Concluding	2	Conclusion
Curiosity	2	
Debate	2	Argument your position
Development	2	Developmental
Experience	2	
Flexibility	2	Cognitive flexibility
Interpretation	2	
Observation	2	Observation skills
Problem-solving	2	
Rational	2	Rationality
Scepticism	2	Certain degree of scepticism
Skills	2	
System	2	Systems thinking
Understanding interlinks	2	Create connections between ideas
Abilities	1	
Ability to concentrate	1	
Ability to delve deep	1	
Ability to prioritize	1	
Able to identify and control own emotions	1	
Adaptability	1	
Analyze experiments	1	
Assessment	1	
Attention to detail	1	
Behaviors	1	
Building models	1	
Certain degree of cynicism	1	
Claim	1	
Comparing	1	
Conceding	1	
Confidence	1	
Courage	1	
Creating	1	

Element	Count participants	Element includes
Creative freedom	1	
Criteria	1	
Design skills	1	
Dispositions	1	
Drive/persistence	1	
Enhanced planning	1	
Environment	1	
Evidence	1	
Explanations of Processes and Procedures	1	
Fantasy	1	
Finding the root cause	1	
Focus	1	
Foresight	1	
Game process	1	
Gather	1	
Grouping	1	
Hypothesizing	1	
Immunity of social pressure and norms	1	
Implementing Innovative Approaches to Answer Question	1	
Independent thought	1	
Inference	1	
Information	1	
Intellectual rigor	1	
Interest	1	
Involvement	1	
Lateral thinking	1	
Long answer responses	1	
Manipulation	1	
Maturity	1	
Media	1	
Method	1	
Monetary considerations/access	1	
Outcomes	1	
Perception	1	

Element	Count participants	Element includes
Performance	1	
Persuade	1	
Phenomena	1	
Philosophy	1	
Practice	1	
Premise	1	
Principals	1	
Processes	1	
Project activity	1	
Refuting	1	
Responsibility	1	
Say you don't agree	1	
Strategic thinking	1	
Testing hypotheses	1	
Theorizing	1	
Think	1	
Thinking, weighing and pondering	1	
Transference	1	
Try to improve other's ideas	1	
Try to prove others false	1	
Wanting to learn	1	
Who does it benefit	1	
Zeal	1	

Table J2

Items Which SMEs Consider to be at the Core of the Critical Thinking Concept

№	Item	Count SMEs [a]	% of responded SMEs [b]
1.	Identifying/removing bias	16	55
2.	Open-minded	15	52
3.	Problem-solving	15	52
4.	Independent thinking	14	48
5.	Analysis	13	45
6.	Evaluating assumptions	11	38
7.	Logical	11	38
8.	Reasoning	11	38
9.	Analytical skills	10	34
10.	Decision-making	10	34
11.	Evaluation	10	34
12.	Higher order thinking	10	34
13.	Constructive scepticism	9	31

№	Item	Count SMEs [a]	% of responded SMEs [b]
14.	Creative thinking	9	31
15.	Hypothesize	9	31
16.	Inductive reasoning	7	24
17.	Investigate	7	24
18.	Divergent thinking	6	21
19.	Drawing inferences	6	21
20.	Intellectual challenges	6	21
21.	Metacognitive skills	6	21
22.	Objective	6	21
23.	Thoughtful judgments	6	21
24.	Convergent thinking	5	17
25.	Drawing conclusions	5	17
26.	Rational thinking	5	17
27.	Active participation	4	14
28.	Clarifying ideas	4	14
29.	Clarity	4	14
30.	Synthesis	4	14
31.	Consistency	3	10
32.	Deductive reasoning	3	10
33.	Responsible	3	10
34.	Self-directed	3	10
35.	Socratic questioning	3	10
36.	Taking ownership	3	10
37.	Adequacy	2	7
38.	Completeness	2	7
39.	Cooperative learning	2	7
40.	Depth	2	7
41.	Epistemological understanding	2	7
42.	Precision	2	7
43.	Relevance	2	7
44.	Accuracy	1	3
45.	Disciplined	1	3
46.	Discovery learning	1	3
47.	Fairness	1	3

[a] Number of SMEs who chose a particular item. [b] Twenty-nine SMEs responded to this question.

Appendix K

Kinds of Digital Technologies That SMEs Believe Support the Development of Critical Thinking

Digital Games

Mentioned by 24 SMEs, including: coding games: Like code Monkey, Frozen in Code.org and Minecraft Education Edition (x1); they [games] would be most effective in cooperative environments (x1); if they can provide access to multiple ways of viewing issues, and show systemic consequences of decisions (x1); in the right game, critical thinking is required to advance – the learning activity is built into the game (x1); I think that digital games can refine critical decision making for specific outcomes (x1); digital games through their experiential interactive nature (x1); Minecraft Creative and Playful Learning – Escape Rooms (x1); To be noted they [games] can also be used negatively (a blog can spread disinformation) (x1); Minecraft (x1); MMOs, match three games/apps, really any digital game with levels/consequences/scenarios (x1); Digital games are promising tools to teach critical thinking as they inherently promote systems thinking, decision making and interactivity. But again design is important, some digital games can be poor tools for teaching critical thinking as well (x1).

All Kind of Digital Technologies, Other Means, Pretty Anything, Everything

Mentioned by nine SMEs. The dominant idea here is that any tech solution may support the development of critical thinking when a proper pedagogy, design, or strategy is applied.

The responses included: The tech itself has to be designed to give the user the ability/space/narrative moments to question ideas. Otherwise, tech itself won’t drive critical thinking. For example, a person who has mastered Excel Spreadsheet might not question the credibility of political information on the web any more efficiently than another web user (x1); Other [tech] means that foster collaboration and communication, and providing some guidance and feedback (x1); all types of software, applications and technologies. It depends on how the teacher uses these tools (x1); anything that engages people in a debate – but these need strong structuring and facilitation to draw out the areas of criticality. I think initially, interaction is important in developing this skill. Later on, there is definitely opportunity to develop this through writing but needs feedback and support (x1); Any digital technology that encourages problem solving will encourage users to engage in the process of critical thinking. Though one needs to be careful not to overstate the capacity of these systems to produce critical agents (x1); Pretty much everything can support it if it's created in a proficient manner (x1); Anything that leads to computational thinking: robotics, programming (Scratch), etc. as well as technologies that force us to think logically and critically (mainly games and puzzles) (x1); Combining a variety of areas, for example, I link Minecraft with web 2.0 technologies, google tags, 3D paint, qr-code, working with reduced links, preparing for programming in professional languages and much more (x1); I believe all digital technologies can be designed to deliver pedagogy which promotes critical thinking. All but at the same time none of the digital technologies can be used to teach critical thinking, its all on the design and strategy (x1).

WIKIs

Mentioned by nine SMEs, including: they [WIKIs] would be most effective in cooperative environments (x1); can be used but would require more scaffolding i.e. the development and administration of learning tasks based on the blogs/wikis (x1); to be noted they [WIKIs] can also be used negatively (a blog can spread disinformation) (x1).

Blogs

Mentioned by seven SMEs, including: can be used but would require more scaffolding i.e. the development and administration of learning tasks based on the blogs/wikis (x1); to be noted they can also be used negatively (a blog can spread disinformation) (x1).

Discussion boards and forums

Mentioned by four SMEs, including: discussion boards that support images can develop the critical eye through human interaction (x1); open feedbacks (x1); Board Games Forums (x1); group discussions (x1).

MOOCs

Mentioned by three SMEs, including: MOOCs are effective for this [supporting the development of CT], if they can provide access to multiple ways of viewing issues, and show systemic consequences of decisions (x1); To be noted they [MOOCs] can also be used negatively (a blog can spread disinformation) (x1).

Things Mentioned Once

Digital technologies mentioned in SMEs' responses once: AI, apps (Research and Writing), articles, chat-bots, concept maps, eBooks, Interactive course (they would be most effective in cooperative environments), live-streams, MS Word (even MS Word develops critical thinking as one must consider things, such as font, font size, color, layout, etc. to effectively reach an intended purpose), news websites, online learning platforms, simulations, TED talks, video footage, VR and AR tools.

Appendix L

Table L1

Elements and Features of Digital Games and Digital Technologies That May Support the Development of Critical Thinking (SMEs' Responses)

Features and elements of digital technology	Features and elements of digital games
Elements relating to digital games (10):	Feedback (9) and result-seeing (1)
• Making decisions based on several choices (2) or sources (x1), solving problems in multiplayer games taking into account different perspectives (x1);	Problem-solving (9) and decision-making (1)
• Feedback (2) and resource management (2);	Collaboration (6)
• Collaboration (2);	Perspective-taking (4)
• In-game "messy problems" with no fixed answer (x1);	Game mechanics (2) and underlying design (1)
• Experiential knowledge through game mechanics, exploration, riddles (x1);	Resource management (2)
• Create moments of productive struggle (i.e.: defeating a Boss on a video game) (x1);	Math skills (2)
• Looking for a logical outcome (1);	Experiential knowledge (2)
• The connection of learning through the game with the real world, getting acquainted with modern tools, linking them with playing activities (x1);	Opportunity to repeat a task (2)
• The intention behind the design choices of the game. The underlying story and premise of the game (x1). Gameplay (x1).	Engagement (1)
The capacity of digital technologies for collaboration (7)	Genre (1)
The underlying design of digital technology (6)	Narrative-based games (1)
Feedback (4)	The ease of use and intuitiveness (1)
Discussion (2) and narrative-/storytelling based learning (3)	Project-based learning (1)
Autonomous inquiry, an agency on the part of the learner (3)	"Digital games allow students to take an active role in their learning" (1)
Perspective-taking (3)	"The use of digital games (say Minecraft Education Edition) might allow the learning of 21st century skills …" (1)
Display of systemic consequences (2) and engagement (2)	Sensory stimulation that promotes insight through mindfulness (see Sliwinski et al.) (1)
Project-based learning (1)	"… short-term vs long-term goals" (1)
Competition (1)	"Digital games that don't give the student

	all the answers, but give them all the tools needed to get to the answers … ” (1)
Scaffolding (1)	Deep thinking (1)
Evidence-based information (1)	“[games] are not yet at a point where they can replicate the kind of ‘open-ended games’ that reproduce the kind of complex adaptive systems known as complex/wicked environments” (1)
Usability (1)	
“… anything that involves, and/or requires, the person to “stop and think” even for a while” (1)	

Note. Numbers in brackets denote the frequency of specific entry occurrences in the data. Elements and features in bold repeat in both columns of the table.

Appendix M

SMEs' Responses Collected at Round 3

Response 1

I have found that way more of the proponents of this approach are nevertheless as critical as I am, and the field seems to be in good hands. While I may disagree with some theoretical frameworks, good science is based on disagreements and finding out more.

As a result of this, I am very happy that I decided to take part in this, even though it at certain moments took a lotofmy [sic] time. This is good, important work.

Response 2

I think the results are in line what I expected them to be after Stage 1. There are [is] nothing I disagree with, even if I would choose a different approach to utilizing or applying critical thinking through digital or video games.

In some of the responses and insights found on the website, it is clear that the background comes forward quite fast. Some responses are more practical, especially from teachers/lecturers, whereas others are more in line of trying to formulate what is critical thinking in and of itself, and how games could be used to foster, teach, and utilize it.

Of course, much like with gamification, there are many pitfalls that must be avoided. Firstly, it must be fully understood what is "critical thinking" and what value does teaching it through technology or digital games bring to it. Forcing it because it is trendy is more harmful for both pre-existing projects or environments, and new alike. Secondly, when the aim of digital games is not purely to entertain consumers, critical thinking must be part of the design and applying phases from the very beginning. It is not enough to just slap something that resembles Wikipedia's definition of "critical thinking" loosely on top of something pre-existing.

All in all, this study has been from my point of view rather fruitful and I feel honored to have been part of it. I shall await for any future updates about this, be it a presentation, lecture, academic publication, or the like.

P.S. Incidentally I was just thinking about this study the other day and five minutes later I got an e-mail from you.

Response 3

Critical thinking refers to the abilities to think in several patterns about a specific issue, and to suspend judgment about an issue in order to carefully consider and reflect on the validity of any belief or supposed knowledge prior to reaching a conclusion. For example, thinking patterns include the abilities to inquire, infer, analyze, synthesize, evaluate, judge, concede, refute, conclude, identify fallacies, etc. (see Bloom's Taxonomy, Toulmin's Rhetoric, sentential logic, predicate logic, general logic, informal logic, formal logic). Critical thinking is usually associated with informal logic.

To truly master critical thinking requires an awareness of the patterns of critical thinking and how to apply them to evaluate any belief of knowledge. A common method for evaluating a person's critical thinking skills is to ask that person to create an argument map (aka argument mapping). An argument is a conclusion reached about an issue, and a person's ability to construct an argument map would reveal if that person can identify the different thinking patterns present in an argument.

A game player does not necessary develop critical thinking by simply playing a game. They would need to be aware of the critical thinking patterns, suspend judgment on any belief or supposed knowledge, in order to apply those critical thinking patterns to understand issues, hypothetical or real.

It would be a mistake to suggest that gameplaying alone makes a player a critical thinker. But, with additional pedagogical guidance or coaching, the player can learn to develop an awareness of their own thought processes and better utilize those thought processes for the purpose of understanding the world.

Response 4

The results are indicating the need - and value - of games designers and their cohort to learn more about and understand the implications of educational theory/theories.

There is quite a lot of agreement about the need to design education contexts that make more use of games and simulations - indicating broader agreement about the problems with existing curricula.

Response 5

Digital games for education need to incorporate the elements like multiplayer, grouping of friends, live voice conversation kind of facilities to compete with current set of MOBA games and make an entry into the user's prime time of playing games.

Response 6

Critical thinking is a foundational basis for innovation. As the saying goes, 'necessity is the mother of invention'. It takes a critical viewpoint to move a thinking from the status quo to a need for change. Digital Games comes [sic] handy in making that skill developed in a learner in that there is a need to continually move and a reason to aim at a different level from the initial starting point. As the Stage 2 of this research detailed, the various viewpoints are in fact, different dimensions that digital games can be employed for critical thinking for the learner. And it is obvious that it is not an exhaustive list and just limited by the respondents' own knowledge and experience.

Looking forward to the product of this research. Thanks.

Response 7

Gaming for teaching is a new approach. It's interesting to know what people think, but would be more interesting to know what they do and how it works. Anything new, used right, can be good for CT development. I heard of an instance when maincraft [sic] was used to teach history and that was fascinating. I wish this study will have very useful findings.

Response 8

Being both an educator and also an avid gamer, I would say that the elements presented on digital learning from Stage 2's collation really do match my expectation of elements in digital games. There are omissions in terms of 'leaderboard/high score board' (for public show of competency or rank) and the 'save and load' (continue anytime) element. Otherwise, the results from Stage 2 is expected as of the answers collated in Stage 1.

From stage 2, the capacity of digital technologies for collaboration seemed to focus on board, near pods, wiki pages and documents. This is to disregard the most common gaming methods such as:

- Twitch/Twitter plays (or all variations of let's play together, where group of people jointly vote to choose the next move in a game)
- Discord - for sharing tips and discuss strategies during collaborative moments
- In-game collaboration - shown in Minecraft, Roblox and the likes commonly found in MMORPGs.

I personally still believe that digital games can be used as a technology to promote critical thinking. Although it must be used expertly to be an effective tool rather than as a distraction for learning.

Comments about this study:

The dropout in participants from Stage 1 to Stage 2 seemed to be high, although I am unsure on what is the common number for such a Delphi study on digital education."

Response 9

Because of the pandemic, I have had more opportunity than at any other time in my career to use games to increase critical thinking skills. Students have “gaming brains” and as an educator, I’ve had the opportunity to build gamification into the curriculum in a way I had not been able to do prior to the pandemic because I had more freedom than previously.

Gamification taps into the mind of students in this era. Students now think in a Tik-Tok, Social Media influencer manner. It is incumbent upon educators to meet students where they are.