The Gendered Hidden Curriculum in STEM subjects. Insights from a School for Gifted Students in Kazakhstan

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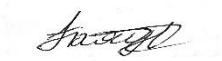
Signed: 

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ETHICAL APPROVAL

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Date: 10th of October 2022

Dear Ayaulym Bauyrzhanova

This letter confirms that your research project titled, 'The Gendered Hidden Curriculum of STEM Subjects. Insights from One STEM-Oriented School in Kazakhstan' has been approved by the Graduate School of Education Ethics Committee of Nazarbayev University.

You may proceed with contacting your preferred research site and commencing your participant recruitment strategy.

Yours sincerely,

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CITI Training Certificate

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ABSTRACT

The Gendered Hidden Curriculum in STEM subjects. Insights from a School for Gifted Students in Kazakhstan

STEM (science, technology, engineering, and mathematics) education is crucial for a country's prosperity, as it is the foundation for innovation, economic growth, and social development. However, there is a shortage of STEM workers, and the underrepresentation of women and girls in STEM fields is a significant issue. Schools have a crucial role to play in addressing this issue by providing students with the necessary information and nurturing the required abilities in academic subjects, particularly in STEM. Although the official curriculum is considered gender-neutral, schools also transmit explicit and implicit messages through the hidden curriculum on what constitutes appropriate gender-role behaviour and attitudes. This qualitative instrumental case study sought to answer the following questions to explore the way gendered hidden curriculum influences both male and female students' career choices: (1) What are grade 12 students' perspectives on the gendered hidden curriculum in STEM subjects? (2) What are teachers' perspectives on the gendered hidden curriculum in STEM subjects? (3) In what ways does the gendered hidden curriculum in STEM subjects influence male and female students' career pathways in STEM? The study employed multiple methods of data collection to ensure its rigour and validity. Semi-structured interviews with STEM teachers and focus group discussions (FGDs) were conducted, and the lessons of STEM teachers were observed to obtain a comprehensive understanding of gendered aspects of hidden curriculum manifestation in STEM subjects. The study indicated that both teachers and students hold gendered beliefs regarding students STEM abilities and outcomes, claiming that boys are better at logical thinking and quickly master complex concepts. In addition, it was found that teachers attribute qualities such as responsibility, diligence, and effort to girls and brilliance to male students. Furthermore, the

study revealed that male teachers' practises are gendered since they tend to use techniques that undermine girls' participation in STEM subjects. Lastly, both teachers and students exhibited gendered views regarding STEM occupations, attributing math-intensive fields of STEM as male domains and not aligning with girls' gender roles. The study presented recommendations for schools and curriculum developers.

Key words: STEM and gender, gendered hidden curriculum, gender roles, STEM careers.

Аңдатпа

STEM Пәндері Бойынша Гендерлік Жасырын Оқу Бағдарламасы. Қазақстандағы Дарынды Оқушыларға Арналған Мектептен Көзқарас

STEM білімі елдің өркендеуі үшін өте маңызды, өйткені ол инновацияның, экономикалық өсудің және әлеуметтік дамудың негізі болып табылады. Дегенмен, STEM жұмысшыларының тапшылығы бар және STEM салаларында әйелдер мен қыздардың өкілдігінің жеткіліксіздігі маңызды мәселе болып табылады. Мектептер бұл мәселені шешуде студенттерге қажетті ақпаратты беру және академиялық пәндер бойынша, әсіресе STEM бойынша қажетті қабілеттерді дамыту арқылы шешуші рөл атқарады. Ресми оқу бағдарламасы гендерлік бейтарап болып саналса да, мектептер гендерлік рөлдік мінез-құлық пен қарым-қатынастың не екенін жасырын оқу бағдарламасы арқылы анық және жасырын хабарламалар жібереді. Бұл сапалы аспаптық кейс-стади гендерлік жасырын оқу бағдарламасы студенттердің де, студенттердің де мансап таңдауына қалай әсер ететінін зерттеу үшін келесі сұрақтарға жауап беруге бағытталған: (1) STEM пәндері бойынша гендерлік жасырын оқу бағдарламасына оқушылардың көзқарасы қандай? (2) STEM пәндері бойынша жасырын гендерлік оқу бағдарламасына мұғалімдердің көзқарасы қандай? (3) STEM пәндері бойынша гендерлік жасырын оқу жоспары STEM-дегі ерлер мен әйелдердің мансаптық жолына қалай әсер етеді? Зерттеу оның қатаңдығы мен сенімділігін қамтамасыз ету үшін деректерді жинаудың бірнеше әдістерін қолданды. STEM мұғалімдерімен жартылай құрылымдалған сұхбаттар және фокус-топтық талқылаулар (FGD) жүргізілді, сонымен қатар STEM пәндері бойынша жасырын оқу бағдарламасының гендерлік аспектілері туралы жан-жақты түсінік алу үшін STEM мұғалімдерінің сабақтары байқалды. Зерттеу көрсеткендей, мұғалімдер де, студенттер де STEM-дегі оқушылардың қабілеттері мен нәтижелеріне қатысты гендерлік

сенімдерді ұстанады, бұл ұлдардың логикалық тұрғыдан жақсы ойлайтынын және күрделі ұғымдарды тезірек меңгеретінін дәлелдейді. Сонымен қатар, мұғалімдер қыздарға жауапкершілік, еңбекқорлық және еңбекқорлық сияқты қасиеттерді, ал жас оқушыларға ақылдылықты жатқызатыны анықталды. Сонымен қатар, зерттеу көрсеткендей, ер мұғалімдердің тәжірибесі гендерлік сипатқа ие, өйткені олар қыздардың STEM пәндеріне қатысуына нұқсан келтіретін әдістерді қолданады. Ақырында, мұғалімдер де, студенттер де STEM сабақтарына гендерлік көзқарастарын көрсетті, STEM математикалық бағыттарын ерлер салаларына жатқызып, қыздардың гендерлік рөлдеріне сәйкес келмеді. Зерттеу мектептер мен оқу бағдарламаларын әзірлеушілерге арналған ұсыныстарды ұсынады.

Түйін сөздер: STEM және гендер, жасырын оқу бағдарламасы, гендерлік рөлдер, STEM мансабы.

Аннотация

Гендерная скрытая учебная программа по предметам STEM. Взгляд из школы для одаренных учащихся в Казахстане

STEM-образование имеет решающее значение для процветания страны, поскольку оно является основой инноваций, экономического роста и социального развития. Однако существует нехватка работников STEM, и недостаточное представительство женщин и девочек в областях STEM является серьезной проблемой. Школы играют решающую роль в решении этой проблемы, предоставляя учащимся необходимую информацию и развивая необходимые способности по академическим предметам, особенно по STEM. Хотя официальная учебная программа считается гендерно-нейтральной, школы также передают явные и неявные сообщения через скрытую учебную программу о том, что представляет собой соответствующее гендерно-ролевое поведение и отношения. Это качественное инструментальное тематическое исследование было направлено на то, чтобы ответить на следующие вопросы, чтобы изучить, как гендерно-скрытая учебная программа влияет на выбор карьеры как учащимися, так и учащимися: (1) Каковы взгляды учащихся на гендерно-скрытую учебную программу по предметам STEM? (2) Каковы взгляды учителей на скрытую гендерную учебную программу по предметам STEM? (3) Каким образом гендерно-скрытый учебный план по предметам STEM влияет на карьерный путь учащихся мужского и женского пола в STEM? В исследовании использовались несколько методов сбора данных, чтобы обеспечить его строгость и достоверность. Были проведены полуструктурированные интервью с учителями STEM и обсуждения в фокус-группах (FGD), а также наблюдались уроки учителей STEM, чтобы получить всестороннее понимание гендерных аспектов скрытого проявления учебной программы по предметам STEM. Исследование показало, что и учителя, и учащиеся придерживаются гендерных убеждений

относительно способностей и результатов учащихся в области STEM, утверждая, что мальчики лучше мыслят логически и быстрее осваивают сложные понятия. Кроме того, было установлено, что учителя приписывают девочкам такие качества, как ответственность, трудолюбие и трудолюбие, а ученикам-юношам - сообразительность. Кроме того, исследование показало, что практика учителей-мужчин имеет гендерный характер, поскольку они, как правило, используют методы, которые подрывают участие девочек в предметах STEM. Наконец, как учителя, так и ученики продемонстрировали гендерные взгляды на занятия STEM, приписывая математические области STEM мужским областям и не согласуясь с гендерными ролями девочек. В исследовании представлены рекомендации для школ и разработчиков учебных программ.

Ключевые слова: STEM и гендер, скрытая учебная программа, гендерные роли, карьера в STEM.

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1. Introduction

1.1 Background Information

STEM (science, technology, engineering, and mathematics) advancements are widely recognised as major predictors of economic success in developed as well as developing countries, with consequently increased living standards and enhanced quality of life (Burke & Mattis, 2007). Likewise, international and local investments in STEM education and career are seen as significant to the formation of a country's economic security and the enhancement of scientific advancement and technological developments that make lives easier (Fisher &Margolis, 2002). Therefore, the contributions of STEM to the country's ongoing prosperity and security are considered crucial. Since both developed and developing countries strive to be fully industrialised and developed but experience qualified labour shortages in STEM fields, emphasis must be put on the importance of STEM subjects and effective teaching and learning of science in schools (Falloon et al., 2021). In this aspect, schools are central to enhancing learners' preferences for STEM careers and the place where students identify their fitness with the STEM field (Falloon et al., 2021). However, one of the challenges for STEM occupations in many countries is the shortage of skilled STEM workforce, especially the underrepresentation of women is a global challenge (Salmon, 2015). Furthermore, Salmon (2015) states that gender inequalities in STEM disciplines emerge in student performance as early as 15 years old, before the job market or even in higher education.

Schools are accountable for conveying information and nurturing required abilities in academic subjects, social and personal attitudes and values through the official curriculum. Indeed, the official curriculum is considered gender neutral because all required content is taught to all learners, including both girls and boys. Aside from the official curriculum, schools also impart explicit and implicit messages through the hidden curriculum on what constitutes appropriate gender role behaviour and attitudes. The term "hidden curriculum" describes the implicit messages conveyed through the socialization process in schools, which

may include norms, values, and expectations not explicitly stated in the formal curriculum (Anyon, 1980; Apple, 1971; Jackson, 1990). Gender-related hidden curriculum in general education can present itself in a variety of ways and acceptable gender role behaviours and attitudes may be transmitted in schools through a number of mechanisms (Dwyer, 1982). These mechanisms might include gendered teachers' expectations, gendered language, gendered classroom setup, and gendered curriculum content, significantly affecting the development and socialization of students.

Therefore, this study focuses on how the gendered hidden curriculum shapes gender stereotypes among teachers and students since the messages acquired through this peculiar mechanism affect not only students but also teachers (Hernández et al., 2013). That is why it is crucial to investigate how STEM subjects are gendered, and the role of the hidden curriculum in students' career pathway in STEM, as without this understanding the drop out and underrepresentation of young girls in STEM subjects is hard to address (Villanueva et al., 2018).

1.2 Problem Statement

Kazakhstan has pledged to achieve the 17 Sustainable Development Goals (SDGs) established by UNESCO and is working towards fulfilling its commitments. One of the goals, SDG 4.7, requires national governments to ensure that students learn to advance sustainable development, including promoting gender equality (Durrani et al., 2022). This involves integrating gender parity into domestic educational policies, curricula, teacher education, and student assessment, as well as monitoring teachers' and students' attitudes and interactions related to gender. Indicators are used to measure the degree to which these goals are being achieved (Shiel et al., 2016).

Worldwide, education options for women have grown dramatically at the postsecondary level. Between 1995 and 2018, global female tertiary enrolment quadrupled,

from 38 million to 116 million. As for Kazakhstan, there is a high enrolment of young girls and women in various tiers of education, including higher education. For example, women comprised 53.2 % of all undergraduate students, while 46.8 % of young people study in universities (“Information Analytic Centre” JSC, 2020).

It is noteworthy that women tend to be disproportionately represented in certain fields, such as education, health, humanities, and social sciences, on a global scale. Conversely, STEM fields exhibit a marked gender imbalance, with a strong male predominance (UNESCO, 2016). In a significant majority of countries, specifically close to 66%, the percentage of female students pursuing degrees in the fields of engineering, construction, manufacturing, or information and communication technology (ICT) is below 25%. According to the OECD (2019), the representation of women in postsecondary computer science programmes is typically less than 20%, while their participation in engineering programmes is approximately 18% across OECD countries. This assertion appears to hold validity in the context of Kazakhstan. Despite the increased enrolment of females in higher education, there remains a significant marginalization and underrepresentation of young girls and women in the STEM fields. Specifically, females comprise only 28.7% in engineering and construction industries, and 30% in ICT (“Information Analytic Centre” JSC, 2020).

Gender disparity in fields of study has an impact on career prospects and equality in the workplace. According to the results of the Program for International Student Assessment (PISA), on average across OECD countries, only 1 % of girls but 8 % of boys planned to pursue a career in ICT-related occupations, and only 14 % of girls but 26 % of boys who excelled in science and mathematics expressed intention to pursue jobs in science and engineering fields (OECD, 2019). Because the results demonstrate that girls and boys performed similarly in maths in over 50 % of the OECD countries (OECD, 2019), these expectations were unrelated to performance.

Moreover, women are mainly missing from technological innovation frontiers, where job pay is typically the highest. Women make up fewer than 1% of the candidate pool in Silicon Valley for positions related to artificial intelligence and data science. Female application and software developers comprise only 6 % of total developers. As big data and algorithms grow more influential in everyday life, a lack of gender diversity can have a severe amplifying impact (Rosenberg, 2017). Technology mirrors the values of its creators; therefore, it is critical to minimise gender bias in technology-related fields.

The underrepresentation of girls and women in STEM fields, especially in engineering and IT, is mainly explained by their abilities in maths emphasising that females can not succeed in maths related fields. However, according to the results of the international assessment PISA, Kazakhstani girls scored similarly to boys in mathematics and outperformed boys in science by seven points which breaks the stereotypes about girls' inability to perform well in STEM subjects (OECD, 2019). Despite the results showing no gender gap in mathematics and science, amongst high-performing students, only one in seven girls expects to work as an engineer or scientist by the age of 30, while this ratio for boys comprises 3 out of 10. This suggests that institutional barriers are impeding girls' and women's engagement in STEM education and careers, despite the fact that Kazakhstani girls do not exhibit a deficit in science and mathematics achievement compared to boys.

According to the Asian Development Bank's gender assessment in Kazakhstan 2018, the position of women in Kazakhstani society is stereotypical and mostly refers to housework and family (ADB, 2018), leading to the notion of a "gender paradox" in which girls and women are generally literate and represent a larger proportion of bachelor's and master's degree holders relative to men, but are nevertheless underrepresented in certain professions such as engineering and ICT (Durrani et al., 2022).

The analysis of textbooks revealing stereotypical views has shed light on the study and explanation of gender roles in Kazakhstan (Durrani et al., 2022). However, the influence of the hidden curriculum on shaping gender roles and its impact on girls remains a relatively unexplored area of research. Studying the hidden curriculum is crucial in comprehending the role of educational institutions in shaping gender attitudes and identities. According to Bejerano and Bartosh's (2015) research, the hidden curriculum within STEM education serves to perpetuate the notion that science is a masculine domain, leading to fewer girls pursuing science careers. Similarly, Jung et al. (2018) found that the hidden curriculum in physical education reinforces traditional gender roles and norms, leading to girls being discouraged from participating in sports.

1.3 Purpose of the Study

The purpose of the current study is to explore Year 12 students' and STEM teachers' perceptions about the gendered hidden curriculum in STEM subjects. Furthermore, the study aims to explore to what extent the gendered aspects of the hidden curriculum affect both male and female students' choices of their major subject.

1.4 Research Questions

This study seeks to answer the following research questions:

RQ1: What are students' perspectives on the gendered hidden curriculum in STEM subjects?

RQ2: What are teachers' perspectives on the gendered hidden curriculum in STEM subjects?

RQ 3: In what ways does the gendered hidden curriculum in STEM subjects influence male and female students' career pathways in STEM?

1.5 Significance of the Study

It is critical to inquire into perceptions of the gendered hidden curriculum in STEM subjects among teachers and students since this academic domain is strongly gender biased, which is characterised by a lower rate of female students' involvement. The study holds significance in identifying the underlying factors contributing to gender disparities in STEM fields among high school students, as this is a crucial stage when students are in the process of making or have already made definitive decisions regarding their career paths.

Furthermore, exploring and understanding the role of the hidden curriculum in shaping gender stereotypes regarding STEM subjects will provide teachers with new insights and support reflections on how teachers and the school might be unconsciously reproducing gender stereotypes, as well as what measures can be taken to advance gender parity within the realm of education. Through the facilitation of teachers' recognition of the implicit messages conveyed by the hidden curriculum, teachers can enhance their capacity to address gender-based stereotypes by improving their practices and mitigating the impact of gender-biased attitudes on girls' engagement with STEM subjects.

1.6 Definition of Central phenomenon

It is argued that forming gender notions and behaviour starts from children's early age through their dress, dramatic play, playground conversation, and schoolwork (Frawley, 2005). The biases of teachers, whether deliberate or unintentional, communicate explicit and unfavourable messages to students, ultimately influencing their self-perception of their aptitudes. The perceptions of gender roles among children are significantly influenced by both explicit forms of gender bias, such as gender-based restrictions on tasks, as well as the gendered hidden curriculum. This gendered hidden curriculum comprises various factors, including gendered language, classroom arrangements, teacher-student interactions, dress codes, gender-based disciplinary practises, and gendered expectations. (Frawley, 2005).

The term “gendered hidden curriculum” refers to the unintended gendered consequences of the formal curriculum that are nonetheless transmitted to learners and students at educational institutions (Print 1987). It includes unofficial and inadvertent components of learning in schools. The curriculum thus extends beyond the aims indicated in syllabuses or teachers’ manuals. As a result, students learn things other than the planned curriculum in school.

As a result, the hidden curriculum produces educational outcomes that educators did not anticipate. Teachers may not have intended these since they are not expressed in spoken or written forms of instructional objectives, nor documented in educational materials such as syllabi or school policy. The hidden curriculum taught to pupils is effectively “hidden” from them insofar as it is not explicitly articulated. It may be hidden not just from students but also from teachers, at least on a conscious level. It is suggested, however, that the hidden curriculum is potent and is presented in such pervasive and subtle ways that instructors and students may be unaware of its effects.

1.7 Summary

The current chapter elaborated on the justification for the research problem, the purpose and significance of the study were discussed. The chapter presented the research questions and determined the central phenomena of the study. The second chapter presents a review of the literature on the topic. The next chapter provides a comprehensive literature review pertaining to the research topic. Chapter three elucidates the methodology employed in the research, whereas chapter four presents the findings. Chapter five addresses the analysis of the findings in light of the body of prior research on the topic. The last chapter offers conclusion, recommendations, and implications for further research.

2. Literature Review

This study explores the gendered hidden curriculum of Science, Technology, Engineering, and Mathematics (STEM) subjects in Grade 12 and how the hidden curriculum in STEM subjects shapes students' aspirations for higher education and careers. In this chapter, I review and synthesise existing studies regarding the factors that affect the gendered nature of STEM subjects and hinder female students' engagement with STEM subjects.

The review is organised into five sections. The first section conceptualises gender, gender identity and gender roles. The second section then delves into research on gender and STEM, while the third section reviews scholarship on hidden curricula. Finally, attention is drawn to research about the hidden gendered curriculum in the fifth section.

2.1 Conceptualising Key Terms

2.1.1 Defining Gender

Gender-related research has gained in popularity in recent years. Gender conceptualizations differ between researchers, despite agreement on their significance. There is a consensus among social scientists regarding the notion of gender, which is widely defined as a social concept and social construction with less focus on the biological features distinguishing gender from the sex of the person (Brannon, 2002; Deaux, 1993; Lorber, 1994). In the same vein, research by Riegle-Crumb and Morton (2017) suggests that gender is a social construct that is generated and sustained across multiple levels, encompassing structures at the macro-level and the immediate local surroundings in which people live. Risman and Davis's (2013) definition of gender also acknowledges its social construction but also accounts for biological and reproductive aspects defining gender, as the organisation of social relationships centred on the reproductive sphere and the collection of behaviours that incorporate reproductive distinctions between bodies into social processes.

Bonvillain (2020) takes the definition a step further, incorporating both time and context, claiming that gender refers to acquired social differences that change over time and

vary greatly within and across cultures. While varying to some degree, the aforementioned definitions reflect the biological, social, cultural, and temporal milieu that generates expectations for gender-related behaviour.

In 1990, Butler published a paper in which she described gender as not something we are, but something we do and claimed that gender must constantly be socially reconstructed in light of the "normative conception" of being men and women because individuals act with the knowledge that they will be assessed based on what is considered suitable feminine or masculine behaviour.

Howes (2002) suggests that the concept of gender is typically linked to the qualities, actions, and social norms that are taught to boys and girls by their respective cultures and are expected of them to adhere to (p.25). This view is supported by Walkerdine (1989), who writes that gender is dynamic and what is considered gender appropriate behaviour changes over time, with the normative views of being men and women also dependent upon ethnicity, group and social position. Walkerdine also points to the ever-present potential to act as manly men or womanly women and concludes that gender is an evolving feature of social interaction (Walkerdine, 1989).

Walkerdine (1989) identifies femininity, i.e. culturally approved ways of acting like a woman, as a performance, noting a significant disparity between how gender-related performances are evaluated, leading to inequalities. These derogatory sentiments were frequently linked to the notion that women's success in STEM was based on hard work and rule-following rather than innate intelligence or exceptional aptitude.

According to Renold (2006), studies that examine gender performances and interactions within educational settings highlight the different approaches taken by boys and girls in positioning themselves as learners, and how they are positioned by others, as learners. Despite their high academic achievements, girls are often marginalised in the classroom.

To sum up, gender is not an essential and universal construct. Instead, gender can be considered as a social construct influenced by the local, institutional, and socio-cultural conditions in which people live. Gender is expressed behaviourally within the given framework of expectations, with evidence suggesting some level of bias of sentiment toward high female academic performances. With a definition of gender established, I turn my attention now to defining gender identity and gender role behaviours.

2.1.2 The Construction of Gender Identity and Gender Roles

Gender roles are societal constructions that are used to define and distinguish the roles of men and women in a given culture. These roles have been present since ancient times, with societies around the world having their own set of norms, values, and beliefs about the roles of men and women within a community. Despite the fact that gender roles have been present in all societies, they have been subject to change over time, especially in recent decades. This literature review discusses the way in which gender roles have been constructed, the factors that contribute to their construction, and how these roles have changed over time.

The concept of gender roles has been studied extensively in the social sciences, with many researchers attempting to understand the factors that contribute to the construction of gender roles. One of the most influential theories of gender role construction is the Social Role Theory, developed by Joan Acker. According to Acker (1975), gender roles are a product of the process of socialisation, whereby individuals learn to adopt certain values and behaviours that are deemed appropriate for their gender. This theory suggests that gender roles are the result of various societal influences, encompassing cultural norms, family structures, and religious beliefs.

Butler (1999) argues that knowledge about gender roles is constructed socially and culturally when a child understands whether someone is a man or woman from the attributes such as clothes, hairstyle, and behaviour. Maccoby and Jacklin (1974) claim that a child

forms a relevant role identity through imitating adults by receiving praise and encouragement for perceived feminine or masculine behaviours and trying out different roles with. In addition, Blaise (2009) claim that children acquire an understanding of gender roles by means of their conversations with peers and their interactions with individuals in their social environment. This implies that children themselves are active in the construction of their gender identity.

The notion of performativity, as discussed by Butler (1999), posits that gender is primarily performative and shaped by a series of actions. The argument made by Blaise and Taylor (2012) aligns with the statement that gender is not simply an inherent quality but rather a product of repeated verbal and physical actions and expressions that individuals use to identify as either male or female. Tylor asserts that this performance of gender is carried out through specific bodily movements and verbal language, as well as their continual repetition (p.92). The act of conforming to gender roles as per the prevalent gender norms implies that children are being taught that conventional gender role expressions and practices are standard and they are required to behave accordingly (Blaise & Taylor, 2012).

The construction of gender roles is also closely linked to power dynamics, especially between men and women. As noted by Ferree (1990), gender roles are defined by a set of power relations that are shaped by society's dominant ideologies. This means that gender roles are often shaped by the expectations of men and women within a given culture and can also be used to maintain male dominance. For example, in some cultures, women are expected to remain home and fulfil domestic roles, while men are expected to work and be the breadwinners. This type of gender role construction has been used to maintain male dominance and power in certain societies.

In addition to power dynamics, gender roles are also shaped by cultural beliefs and values. For example, in some cultures, masculinity is associated with strength and power,

while femininity is associated with beauty and passivity. These traditional gender roles are often reinforced through language, media, and other forms of communication. However, in recent years, there has been a shift in gender roles, with more people challenging traditional gender roles and advocating for greater gender equality.

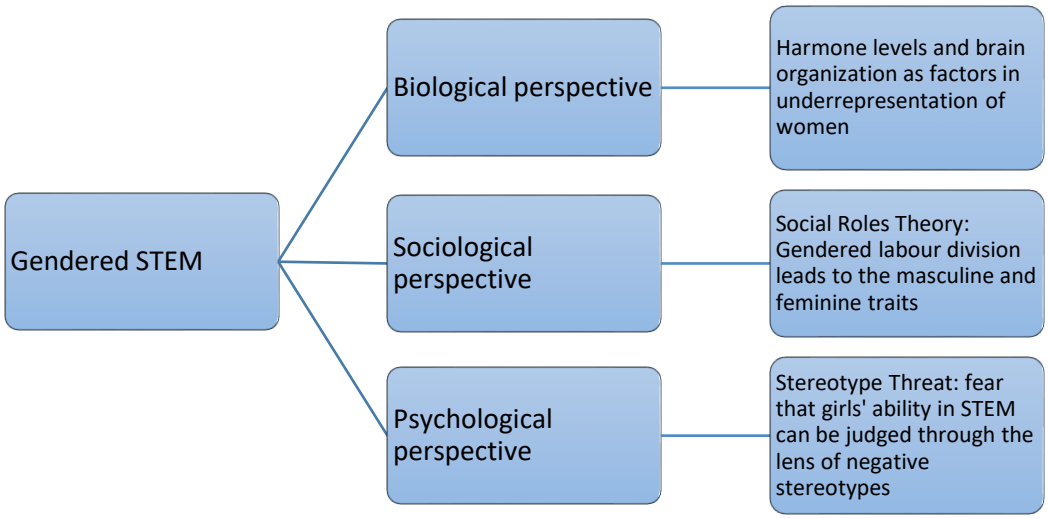
Overall, gender roles are cultural constructs that have existed in all societies throughout history but have experienced tremendous changes over time. These roles are shaped by a variety of factors, including socialisation power dynamics, cultural beliefs, and values. The Social Role Theory suggests that gender roles are the results of a combination of social forces, while performativity theory argues that gender is largely performative and constructed through a set of acts. Gender roles have traditionally been used to maintain male dominance and power, but in recent years, there has been a shift towards greater gender equality and the challenging of traditional gender roles.

2.2 Gender and STEM

In recent years, there has been a surge in the need for STEM qualified professionals on a global scale. However, gender-based stereotypes in these fields persist and have been extensively studied. The evidence suggests that these stereotypes and biases in STEM subjects start during primary and secondary education (Blackburn, 2017). The literature has identified a multitude of factors that impact the underrepresentation of girls and women in STEM fields. In an attempt to understand the role of such stereotypes in STEM settings, biological and social factors will be reviewed. The following figure describes the factors contributing to the gendered STEM education.

Figure 1

Framework on Factors Contributing to Gendered STEM



2.2.1 A Biological Perspective

The subject of women's underrepresentation in STEM fields is a major focus in literature, with many studies delving into biological theories. These theories argue that differences in academic achievement are rooted in differences in sex between males and females (Roberts, 2000). Traditionally it has been argued that hormone levels and brain organisation differences are factors in the under-representation of women in STEM (Collins & Kimura, 1997; Hines, 2006). Those supporting this biological reasoning argue that men have developed superior spatial skills because of testosterone levels, resulting in a lower women's performance in maths and science and less women involvement in STEM- related fields (Clint et al., 2012).

However, Hines (2006) investigated the relationship between prenatal testosterone level and gender-related behaviour and found that although there is a significant influence of testosterone level on sex-typed postnatal childhood play, mathematical abilities or visuospatial abilities do not appear to be influenced by the testosterone level. While Hyde et al. (1990) found statistically significant gender differences in visual-spatial skills, she asserted that these findings were insufficient to account for the extent of women's underrepresentation in the engineering field. While there exists evidence indicating that men

tend to outperform women on standardised maths tests like the SAT-M (Gallagher and Kaufman, 2005), some scholars have argued that this discrepancy is typically minor, and that there is often substantial overlap in the score distributions of men and women (Hyde, 2005).

Eliot (2011) argues that results from contradictory studies on sex differences in the brain are misinterpreted and exaggerated in public discourse, reinforcing stereotypes about the effect of hormones on gendered behaviours and maths results. In addition, Anglim (2019) suggests that teachers' beliefs regarding the effects of hormones may be significant, and cites Eliot (2011, 2013) to illustrate how our beliefs about hormones can have a greater influence on behaviour than the hormones themselves.

Many studies have attempted to explain men's superiority over women in quantitative reasoning skills by investigating brain differences between sexes using MRI results of adults (Frederikse, 1999; Merrill et al., 2016). The study by Reilly et al. (2015) explains that quantitative reasoning differences between sexes emerge as a result of differentiated roles of women and men, with men being heavily exposed to hunting and navigation activities that require visual-spatial skills. This view is supported by the majority of researchers in neurosciences who claim that the brain has neural plasticity and is susceptible to change and development according to social and physical environments (Greenough et al., 1987). As a result, the environment and treatment received by boys and girls will have an impact on how they develop. Boys' pattern of better performance may be due to their greater access to problem-solving opportunities outside of mathematics classrooms than girls' (Kimball, 1989).

Overall, biological theories have been employed to account for the underrepresentation of women in STEM fields. However, recent studies have challenged the notion that differences in hormone levels and brain structure are solely accountable for gender differences in educational performance. The evidence suggests that both societal and

environmental factors have a pivotal influence on individual development and behavioural patterns.

2.2.2 Socio-Psychological Perspectives

2.2.2.1 Social-Roles Theory

Besides biological factors, the roots of girls' underrepresentation in STEM fields lie in sociological factors that underpin the division of gender roles and labour**.** According to Eagly and Wood's (1999) social-roles theory, psychological differences between sexes are a result of the societal allocation of gender-specific roles to men and women. Reilly et al. (2015) claim that gender specific labour division leads to the development of masculine and feminine traits, attributing qualities such as strength, achievement-orientation, and competitiveness to men and communication-oriented traits to women.

Eagly and Wood (1999) in their study on the origins of sex differences in human behaviour refer to the social structuralist perspectives, pointing out that gendered labour division acts as an engine in sex-differentiated behaviour and enables men and women to build schemas about sex-typing activities and interests which in turn facilitates the development of particular cognitive skills.

2.2.2.2 Stereotypes about Gender and STEM

Research has shown that gender stereotypes in STEM exist and are prevalent in society. For example, women are often perceived to be less competent in math and science than men, even though this has been proven to be untrue (Eagly & Wood, 1999).

Stereotypes that depict STEM as a field dominated by men also discourage girls from pursuing careers in these fields (Almukhambetova & Kuzhabekova, 2021; Rogers et al., 2021). Dasgupta and Stout (2014) assert that cultural stereotypes persistently depict men as the ideal scientists, engineers, and technological innovators. The disparity between male

STEM norms and feminine gender role expectations creates obstacles to the involvement of girls and women in STEM field throughout their lifespan.

It is presumed that messages regarding STEM from socialisation forces, such as parents, communities, schools, and media, may communicate the notion that STEM fields are more suitable for males. According to the gender schema theory, the messages conveyed about STEM professions have established distinct gender-based roles for children, thereby influencing their perception of STEM careers. Specifically, boys are more likely to view STEM vocations as socially acceptable options that align with their gender identity, while girls may not share the same perspective. Frome and Eccles (1998) argue that parents may develop a schema that associates mathematics and science with male cultural tasks due to the underrepresentation of women in the science workforce. Van Der Vleuten et al. (2016) argue that gender ideology has a substantial impact on the academic decisions of both male and female students. Specifically, boys are more likely to select science-related courses that are traditionally associated with masculinity, while girls tend to opt for subjects such as art, language, and humanities, which are typically viewed as feminine (p. 184).

According to new research on female students' experiences in STEM majors in Kazakhstan, STEM careers are not acceptable for women because women are not expected to earn more money or put in more hours at work than their husbands, which highlights the idea of the hierarchy between the sexes in traditional Kazakh homes (Almukhambetova & Kuzhabekova, 2021).

2.2.2.3 Stereotype Threat

The literature on the effect and consequences of stereotype threat on women's performance and engagement in STEM fields has grown in recent years (Spencer et al., 1999). The stereotype threat is a socially shaped fear or anxiety that one's ability and performance can be judged through the lens of negative stereotypes (Steele, 1997). One of the

first studies investigating the effect of stereotype threat was conducted by Spencer et al. (1999), who found that female participants exhibited poor performance on maths test than their male counterparts when exposed to stereotype threat conditions. Similarly, Steele and Ambady (2006) conducted a study to investigate the impact of a self-relevant category prime on women's attitudes towards the gender-stereotyped domains, specifically arts (positively stereotyped) and mathematics (negatively stereotyped). The study revealed that women are more susceptible to experiencing anxiety in maths-related settings that involve high maths abilities due to their gender. Studies investigating the effect of stereotype threat in experimental conditions where women's gender is made salient found that it leads to lower maths test results.

Another study conducted by Ambady et al. (2004) found that when women in threatened condition were presented with gendered words as "doll", "dress", "earrings", "skirt", resulted in underperformance of women in challenging maths tests in comparison with women who were presented with neutral words. These studies illustrate that stereotype threat can be caused by various situational cues such as the description of the test, the gender composition of the room, and factors that make women's gender salient.

Overall, research on STEM education has entailed significant empirical endeavours aimed at comprehending the fundamental factors that influence student achievements throughout the STEM pipeline. The main findings suggest the effect of biological differences as the level of testosterone does affect the visual-spatial ability, but statistically significant differences between genders are accounted for by how boys and girls are differently socialised according to their gender, with boys being more involved in activities that enhance visual-spatial abilities. In addition, sociological factors such as gender roles and labour division lead to the development of specific traits and activities associated with each gender

and enables women and men to build gender specific schemas about sex-typing activities and interests.

2.3 The Hidden Curriculum

More than any other institution, schools are the means through which young people are socialised (Martin, 1976; Mutekwe & Modiba, 2012). Apart from imparting explicit education instruction in academic disciplines, schools also provide more covert training in social norms and behaviours. Students in schools not only learn what is explicitly taught in subjects, but they also accumulate additional "hidden" lessons throughout the process of learning.

According to the research, the human brain unconsciously processes around 80% of "hidden" signals, information, content, and messages known as the *hidden curriculum*. The notion of the *hidden curriculum* first emerged in the late 1960s in empirical studies by Jackson (1968) who explored the hidden messages that students learn in the process of schooling. Jackson (1968) in his book *Life of Classrooms,* claimed that there were expected values, dispositions, and social and behavioural norms that students were taught within unofficial and hidden messages (Kentli, 2009). Dreeben (1968) places particular emphasis on "what is learnt in school" as a result of the social dynamics in the classroom and the teacher's use of power (as cited in Apple, 1971). According to Kohlberg (1970), the hidden curriculum has an impact on both moral education and the teaches obligation to instil moral values in students.

The hidden curriculum operates at all levels of education. Henry (1955) addresses the connection between a student and a teacher, the norms that regulate it, and the function that these values serve in "educating for docility". Similarly, Margolis (2001) concurred that there are features of classroom life that enhance the socialisation process of students and students pick up messages through just being involved in it. Moreover, Winter and Cotton (2012) add

that in higher educational institutions, aspects of hidden curricula might be unknowingly transmitted to students through social, institutional, or lecturer's values, so hidden curricula are not bound to any level of education.

Most studies on hidden curricula are focused on their negative features, such as the predisposition to propagate inequalities within society. Hidden curricula studies include aspects of social conditioning through rigid timetables and structures and surveillance and regulation. For example, Willis's (1978) ethnographic study, "Learning to Labour" in addition to providing insight into working-class subcultures, revealed how the structure of secondary schools helped the training of working-class children for a lifetime of labour in factories (as cited in Cotton *et al,* 2013). Furthermore, Dunne et al. (2016), in the study of the implication of hidden curriculum in Post-Colonial Ghana, revealed that the regulation and surveillance of students' time was closely related to the regimentation of school life. The timetable itself was an essential disciplinary tool that not only structured and organised school time but also built school hierarchies that positioned pupils as subject to the established regimes policed and enforced by the headmaster. In addition, in the study on the marginalisation of indigenous students, Rakhman (2013) argues that most learning standards in schools mirror "white" dominant cultural values and practices, and those who do not possess the cultural competencies necessary for academic success, such as indigenous and minority children, are at a significant disadvantage in their educational pursuit.

2.4 Hidden Gendered Curriculum

A person's behaviour, beliefs, and values can be significantly affected by negative lessons learned through the hidden curriculum. Evidence suggests that it can reinforce outdated gender roles by prescribing which subjects are most appropriate for a person's gender, which is the manifestation of a gendered hidden curriculum, in addition to preparing

students for integration into society outside of school and stressing the importance of obedience and discipline.

The gendered hidden curriculum is an important educational concept that has been addressed by numerous leading scholars in the field. According to Blumberg (2008) the gendered hidden curriculum is defined as the ways in which gender is taught and learned in school through the formal and informal processes of socialisation. This concept has been studied extensively by researchers such as Bem (1981), who argued that traditional gender role socialisation in schools reinforces gender stereotypes, and Sadker and Sadker (1994), who discussed how gender bias in the classroom environment can lead to differential educational opportunities for boys and girls. Similarly, Pollack (1998) highlighted the need for schools to address the gender-based power dynamics in educational contexts. Collectively, these scholars have provided important insights into the complexity of the gendered hidden curriculum in school contexts.

The review of relevant literature supports the idea that schools, as contemporary social control mechanisms, define not only what is to be taught and what knowledge is, but also what a girl or boy pupil is and how teaching and learning are to be viewed for all students. It does so in relation to a variety of tools, including the classroom wall charts and individual work cards, teacher attitudes and expectations of gender roles, and the physical layout of the school.

The school serves as a significant entity in shaping the child's socialisation process, particularly in terms of acknowledging gender roles. According to scholarly literature, there exists a socialisation process that encourages female students to be expressive and male students to be instrumental. However, educational researchers have observed that schools not only fail to challenge these gender stereotypes prevalent in society, but also tend to amplify them (Delamont, 1983, p. 83).

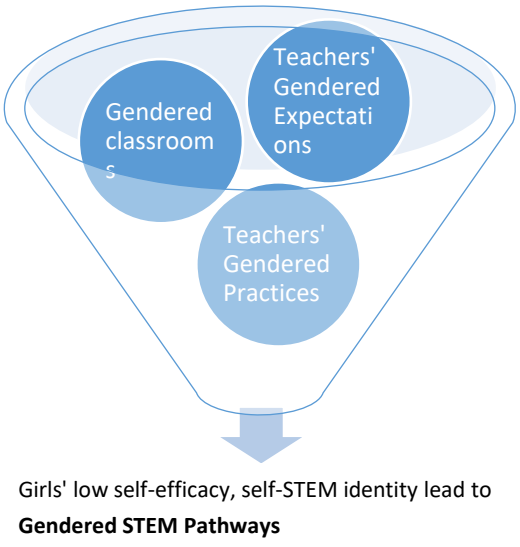
In the study by Knick and Jules (1997) on students' perception of a good teacher, it was found that there were some significant differences in perception of a good teacher in classroom management and teaching style: female teachers tend to prioritise building positive interpersonal relationships with their students and use classroom strategies to promote participation. In contrast, male teachers are often perceived as more assertive and effective in managing student behaviour.

2.5 The Gendered Hidden Curriculum in STEM Subjects

The discussion below depicts the gendered messages relayed to students in STEM classes via the hidden curriculum in classrooms, teachers' expectations and teachers' gendered classrooms. The following figure provides a visual illustration of the negative impact of gendered aspects of the hidden curriculum on girls' self-efficacy, self-STEM identity and the production of gendered STEM pathways.

Figure 2

Gendered Aspects of the Hidden Curriculum and its Influence on Students' Career Pathways.



2.5.1 Gendered STEM Classrooms

Students' perceptions of relatedness and belonging are significant predictors of girls' science motivations and engagement with STEM subjects. Cheryan et al. (2009) conducted a

study on gender participation in Computer Science and found that classroom environments in this field projected a masculine image, leading to a sense of exclusion among female students. Dasgupta and Stout (2014) claim that learning and professional environments that foster a sense of belonging within one's intellectual community are significantly more effective in attracting, retaining, and promoting girls and women in STEM. Research by Master et al (2016) found that women who were surrounded by stereotypical objects within a Computer Science classroom demonstrated a decreased level of interest in the subject when compared to their counterparts who were exposed to non- stereotypical objects in the same environment. In research by Martin (1998), it was found that classrooms are often organized in ways that reinforce gendered stereotypes, such as having separate areas for boys and girls to play or using gendered colours to decorate the classroom. She also observes that teachers often interact differently with boys and girls, encouraging boys to engage in rough and tumble play while praising girls for being quiet and well-behaved.

Steele et al. (2007) found that a robust gender stereotype was evident among boys and girls in the later stages of elementary school. The findings indicate that both groups of children exhibited a tendency to more rapidly link male images with mathematical concepts and female images with reading and writing, as opposed to the converse associations. As claimed by Bandura and Bussey (1999), men and women are directed towards different life choices as a result of students' presumptions about what is more acceptable for men and women to pursue as a career when they learn such repetition of depictions in occupation.

2.5.2 Teachers' Gendered Expectations

Research has indicated that biases and expectations of teachers are highly influenced by the gender of their students, and this can perpetuate and strengthen gender disparities in STEM (Jussim et al., 1996). According to Hand et al. (2017) both teachers and students have strong perceptions that boys perform better in STEM disciplines and attribute more masculine

characteristics to someone working in the field of science. Similarly, Perander et al. (2020) found that teachers and counsellors exhibited a tendency to perceive male students as intelligent and did not attribute their lack of mathematical abilities to their gender, unlike their female counterparts. To clarify, educators have a tendency to link mathematical proficiency with masculine traits and hold the belief that males possess an inherent talent for excelling in mathematics and scientific fields. Sansone (2017) claims that the beliefs held by teachers regarding female students' abilities in maths and science, along with any discriminatory actions taken by teachers, are important factors in predicting the level of interest and confidence that students exhibit in STEM subjects. In addition, it was reported that the self-efficacy of students is diminished in cases where female teachers hold the belief that male students possess superior abilities in mathematics or science compared to their female counterparts (Sansone, 2017). Previous studies have demonstrated that teachers tend to describe their female students as untalented, highly diligent, or motivated and dependant on help from adults (Avitzour et al., 2020). One well-known study into the effects of teachers' biases on students' academic outcomes revealed that male students were favoured by maths and science teachers, leading to teachers over-marking boys' maths tests in a non-blind classroom tests in Year 7.

2.5.3 Teachers' Gendered Practices

Studies have shown that teachers may exhibit gendered behaviours in their teaching practices, such as favouring male students over female students in their interactions and classroom activities (Cheryan et al., 2011). For example, male teachers may give male students more attention and opportunities for hands-on activities, while female teachers may provide more opportunities for verbal activities to female students. Becker (1981) argues that teachers approach girls and boys differently in areas such as (a) open questioning, (b) the cognitive level of questions, (c) providing positive and negative feedback, (d) the level of

encouragement given, (e) the extent of individualised assistance provided, and (f) the nature of conversation and humour exchanged. Male students were advantaged by observed disparities as they received greater levels of teacher attention, reinforcement, and emotional support. Females who have been traditionally considered as subordinate gender have been allocated comparatively fewer resources across the three domains (Becker, 1981, p.51).

According to Martin (1998), there is a greater likelihood for male students to engage in behaviours such as speaking without raising their hands, engaging in rough play, and talking more loudly in comparison to girls. In addition, Riley (2014) found that teachers praised female students for good behaviour and diligence, with some even attributing these qualities to their academic accomplishments. Gilliam et al. (2016) point out that teachers' need to manage a classroom and control children's behaviour may lead to the implementation of a gendered hidden curriculum to transmit explicit and implicit messages about gender, which are used to regulate the behaviour of both male and female students. Consequently, teachers communicate gender norms regarding suitable behaviour for boys and girls via disciplinary measures (Erden & Wolfgang, 2004; Martin, 1998).

Regarding gendered language use, research conducted by Saeed (2020) in Pakistan found that teachers use different linguistic strategies when communicating with male and female students. Male students were addressed using more assertive and commanding language, whereas female students were addressed using more polite and soft language. The study also found that this gendered language use had a significant impact on classroom communication. Female students were less likely to participate in class discussions and were less likely to ask questions, which affected their overall academic performance. On the other hand, male students were more likely to participate in class discussions and were more likely to ask questions.

2.6 Summary

This literature review provides an overview of various definitions of gender and its social construction. Researchers argue that gender is not an essential and universal construct, but rather a social construct influenced by local, institutional, and socio-cultural conditions. Gender roles are societal constructions used to define and distinguish the roles of men and women in a given culture and are subject to change over time due to various factors, including socialisation processes, cultural norms, family structures, and religious beliefs. The review also explores the concept of performativity, which argues that gender is predominantly performative and constructed through a set of acts, and the active role children play in constructing their gender identity.

Regarding gendered STEM fields, the literature discusses three perspectives that contributed to the underrepresentation of women in STEM. Biological theories have been used to explain women's underrepresentation in STEM fields, and recent studies have challenged the notion that differences in hormone levels and brain organization are solely responsible for gender differences in educational performance. The evidence suggests that social and environmental factors play a crucial role in shaping individual development and influencing behaviour. Overall, research on STEM education represents substantial empirical efforts to form a better understanding of the underlying factors that influence student success along the STEM pipeline. The main findings suggest the effect of biological differences as the level of testosterone does affect the visual-spatial ability, but statistically significant differences between genders are accounted for by how boys and girls are differently socialised according to their gender, with boys being more involved in activities that enhance visual-spatial abilities. In addition, sociological factors such as gender roles and labour division lead to the development of specific traits and activities associated with each gender

and enables women and men to build gender specific schemas about sex-typing activities and interests.

Moreover, this literature review explores the concept of the hidden curriculum, which refers to the implicit messages and values that students learn in the process of schooling. It also highlights the negative aspects of the hidden curriculum, including its potential to perpetuate inequalities in society. The review further expanded exploring the concept of the gendered hidden curriculum, which refers to the ways in which gender is taught and learned in schools through formal and informal processes of socialization. The review highlights that the gendered hidden curriculum can reinforce gender stereotypes and lead to differential educational opportunities for boys and girls. The review also discusses the negative impact of the gendered hidden curriculum on girls' self-efficacy and self-STEM identity in STEM classrooms. The study emphasizes the importance of creating inclusive and equitable classroom environments that foster belonging in one's intellectual community to recruit, retain, and advance girls and women in STEM fields. The review concludes that educators should be aware of their biases and expectations to avoid reinforcing gender stereotypes and strive to promote gender equity in education.

3. Methodology

The purpose of the current study is to explore STEM teachers' and grade 12 students' perspectives on the gendered hidden curriculum. Furthermore, the current study investigates to what extent the gendered hidden curriculum of STEM subjects affects boys and girls differently when choosing major subjects.

This chapter begins by discussing the rationale for employing a qualitative case study that aligns with the research questions to be explored. Next, the selection of the research site and sample is described, followed by explanation of the procedure employed in recruiting participants. Then, data collection method is outlined, which comprised semi-structured interviews with teachers, focus group discussions with Grade 12 students, and lesson observations. Additionally, I explain the way I analyzed the collected data. Following the discussion of the study's ethical considerations, a brief summary of the chapter is provided.

3.1 Research Design

The current study is phenomenological in orientation since it focuses on discovering and explaining the core essence of the participants' cognitive processes in relation to some common experience (Patton, 2002). In other words, understanding a particular phenomenon as seen through the eyes of those who have experienced it. Since the central phenomenon of the present study is the *gendered hidden curriculum*, phenomenological research will be applied to provide a description that presents the essence of this phenomenon by exploring both male and female students' experiences with gendered STEM subjects.

The present study adopts an instrumental case study design to investigate a single school for gifted students. This approach is in line with Creswell's (2014) conceptualisation of a class or school community as a bounded system. Yin (2002) claims that "case study approach is used to investigate a phenomenon in its natural environment, especially when the distinction between a phenomenon and its context is unclear, and the researcher has minimal control over both the phenomenon and context" (p.13). Furthermore, this definition of a case

study is considered as a more appropriate research design, given the nature and topic of the current study. Other research designs that employ quantitative methods, such as experimental and survey research, may not provide the researcher with the necessary level of data comprehensiveness (Yazan, 2015). Thus, Yin (2002) defines the case study as a "distinctive research approach" that provides a comprehensive exploration of real-life situations (p.14).

An instrumental case study is a research design that focuses on a specific case or phenomenon to gain insights into broader issues or theories (Stake, 1995). In this case, the phenomenon is the gendered hidden curriculum in STEM subjects. By examining specific cases in depth, the researcher can develop a better understanding of the underlying factors that contribute to gender disparities in STEM education and identify potential solutions.

One advantage of the instrumental case study approach is its flexibility, which allows the researcher to collect a wide range of data from multiple sources (Yin, 2009). In the case of the gendered hidden curriculum, it involved observing classroom interactions, conducting semi-structured interviews with teachers, and conducting focus group discussions with students.

Another advantage of the instrumental case study approach is its ability to generate rich, detailed data that can be used to develop nuanced explanations of complex phenomena (Merriam, 2009). This is particularly important for understanding the gendered hidden curriculum, which involves subtle and often unconscious messages and norms that are difficult to capture through quantitative data alone.

3.2 Research Site

The current study was conducted at one STEM-Oriented school for gifted students in Kazakhstan. Only high-achieving students study at this school as they are selected on the basis of their results on subject exams. The reason for choosing this school is that it is a STEM -oriented school and considered information-rich regarding this study. In addition, this

school was selected since it has grade 12, where there are students who are 18 years of age or older and can independently give consent.

3.3 Research Sample

Participants for this study included year 12 students and teachers teaching STEM subjects. In the present study, a purposeful sampling strategy was used to select STEM Teachers and 12 students in Year 12, all of whom are 18 years of age or older. The use of purposeful sampling facilitated the selection of cases that were deemed to be rich in information for the purpose of conducting an in-depth study. This sampling strategy allowed researcher to acquire a comprehensive understanding of the case, thereby enabling the researcher to gain valuable insights into issues that were central to the inquiry (Patton, 2002). The study was conducted with the aim of exploring the gendered aspects of the hidden curriculum in STEM subjects and the extent to which the gendered hidden curriculum influences students' career pathways in STEM, gender, students' major choice, and teachers subject specialism were the main criteria for the sample selection. The study's sample comprised of twelve students, specifically six male and six female students in Year 12, four teachers, each teaching one of the STEM subjects in a selective school located in southern Kazakhstan. The school is known to have a student body composed of predominantly high-achieving individuals. This particular grade level has been chosen due to the fact that students at this stage begin to actively make up their minds or are already certain about their future academic pursuits and professional aspirations. Approximately half of the student participants were studying biology, whereas the remaining half were studying physics. The choice of these subjects is indicative of distinct career paths, with biology being a compulsory subject for those pursuing a degree in medicine and physics a requisite for those interested in engineering. Kazakhstan exhibits gendered patterns in both of these fields, with a higher concentration of women in medicine and men in engineering (UNESCO Bangkok, 2016). I

sampled six male and six female students from Year 12 and four teachers, each teaching one of the STEM subjects to answer the underlying research questions.

3.4 Procedures for Recruiting Participants

Once ethical approval from the Research Ethics Committee obtained, the school principal was contacted via email and the aim and the importance of the study were explained to them. Ethical approval from NUGSE Ethics Committee and Information Letter was provided to the school principal. After obtaining agreement from the principal to conduct research, Year 12 classroom curators were asked to provide me access to the students and STEM teachers of grade 12 to introduce my research and provide details regarding the research process. Explanation of the research purpose and details were provided to students and teachers and both requested to volunteer to participate. Prior to taking part, information and informed consent documents were provided in Kazakh and Russian languages and participants chose the language that they were comfortable with and they had opportunity to ask questions regarding research and their participation. To provide different perspectives when exploring the gendered aspects of the hidden curriculum in STEM subjects, students were chosen based on their gender and age. As for semi-structured interviews

3.5 Data Collection Tools

Three methods of data collection were used in this study: semi-structured interviews with teachers of STEM subjects, discussions with Year 12 students, and observation of Year 12 STEM subjects' lessons (Table 1).

Table 1

Sample Size and Data Collection Methods

Participants	Method	Biology/chemistry	Physics/ICT	Total
Students of grade 12	FGD	6 students: 3 girls 3 boys	6 students: 3 girls 3 boys	12 students

Teachers	Interview	2 teachers: 1 teacher of Biology 1 teacher of Chemistry	2 teachers: 1 teacher of Physics 1 teacher of ICT	4 teachers	
Class Observations	Observation	The same two teachers	The same two teachers	*2*	Classrooms

3.5.1 Semi-structured Interviews

Semi-structured interviews are a commonly used method for collecting qualitative data in research studies. This type of interview allows for flexibility in the conversation while still ensuring that the researcher is gathering relevant and in-depth information regarding the participant's experience and perceptions (Cohen et al., 2011). When conducting semi-structured interviews with STEM teachers, this method provided rich data on their teaching practices, beliefs, and attitudes towards STEM and the gendered hidden curriculum. It was an efficient way to explore teachers' beliefs about students' abilities in STEM subjects and explore the extent of teachers' exposure to gendered stereotypes about STEM subjects and careers.

Semi-structured interviews are important in this study since they offer greater flexibility for the researcher to follow up on relevant points in depth (Wellington, 2015). Since the study is built around understanding the central phenomenon, the responses from teachers are likely to yield in-depth understanding of the way gendered aspects of hidden curriculum influence STEM teachers' experience and perceptions about differences in students' abilities, performance based on gender.

Table 2

Gender and Subject Specialism Characteristics of Participants

	Gender	Subject specialism
Teacher 1	male	Physics
Teacher 2	male	Biology
Teacher 3	female	ICT
Teacher 4	male	Chemistry

I interviewed four teachers (see Table 1). Each teacher taught biology or chemistry (medicine pathway) or physics or ICT (engineering pathway). One teacher was a woman, the remaining three were men. Three teachers were ethnic Kazakh, while one teacher was Filipino. Each interview lasted approximately 40 minutes. Teachers were asked to share their perceptions regarding students' abilities in their subject, experiences on addressing gender in the classroom, and to comment on the gendered nature of STEM careers (see Appendix C)

3.5.2 Focus Group Discussions

Focus group discussions (FGDs) were used to collect data from students (Table 1). FGDs with Year 12 students were conducted in a quiet room within school settings. FGDs are the most suitable data collection instrument for this study since they allow the researcher to gather detailed, in-depth qualitative data by asking open-ended, leading and probing questions. Two FGDs were conducted, with a total of 12 student participants, six in each group. Each FGD consisted of an equal number of male and female participants, with three boys and three girls in each group. This was done in order to investigate the gendered hidden curriculum in STEM subjects and to obtain perspectives from both genders on the work of hidden curriculum (see Table 3 for the gender and subject choice of students). The first FGD provided the views of students from the physics and ICT pathway, while the second one reflected the views of biology and chemistry students to see how the hidden curriculum

manifests differently in these two subjects. FGDs were conducted with students due to their inherent advantages. According to Creswell (2012), FGDs are particularly useful when the interaction among interviewees is expected to yield the most informative results, when the interviewees share similar characteristics and are cooperative with each other, or when individuals may be reluctant to provide information in other types of interviews.

Table 3

Gender and Subject Choice Characteristics of Participants

	Gender	**Subject choice**
Student 1	Male	Biology/Chemistry
Student 2	Male	Biology/Chemistry
Student 3	Male	Biology/Chemistry
Student 4	Female	Biology/Chemistry
Student 5	Female	Biology/Chemistry
Student 6	Female	Biology/Chemistry
Student 1	Male	Physics/Chemistry
Student 2	Male	Physics/Chemistry
Student 3	Male	Physics/Chemistry
Student 4	Female	Physics/Chemistry
Student 5	Female	Physics/Chemistry

Student 6	Female	Physics/Chemistry

Each FGD lasted for forty minutes and was conducted in Russian language as students were comfortable with this language. During the discussions, topics such as career choice, students' perceptions of their STEM abilities, and the gendered aspects of STEM subject were discussed (see Appendix D).

3.5.3 Observations

Lesson observations of STEM subjects were used to gain data (Table 1). Observation of lessons is a valuable data collection tool for exploring the gendered hidden curriculum in STEM subjects. This method allows the researcher to observe the ways in which gender norms and biases are reinforced through teaching practices and classroom interactions. As such, it can reveal how the gendered nature of STEM education may impact students' attitudes, beliefs, and experiences.

Research has shown that gendered stereotypes and biases are pervasive in STEM education, particularly in the fields of physics and engineering. For example, a study by Wright and King (1991) found that physics instructors were more likely to use masculine language and examples in their teaching, which may contribute to a "chilly" climate for women in these fields. Similarly, research by Moss-Racusin et al. (2012) showed that engineering professors were more likely to respond to male students with encouraging comments and to female students with critical feedback, which may contribute to gender disparities in these fields. Therefore, observation of lessons can help to uncover these kinds of gendered biases and stereotypes in STEM education. In addition, lesson observations allow the researcher to observe the ways in which gender norms and biases are reinforced through teaching practices and classroom interactions and can reveal how the gendered nature of STEM education may impact students' attitudes, beliefs, and experiences.

I recorded my observations using a structured observation guide (see Appendix E). The guide included categories of behaviour, teacher-student interactions, and the nature of classroom activities. The researcher also took notes on any instances of gender bias or stereotypes that were evident in the lessons. I observed the same teachers I interviewed. Lesson observations followed after conducting the semi-structured interviews with teachers. Conducting interviews with teachers before observing their lessons provided valuable context for interpreting what was observed during the lesson. The interviews provided insight into the teachers' perceptions of students' abilities. This information helped me understand what to look for during the lesson and also helped to interpret what I saw in a more meaningful way.

3.6 Data Analysis

The following section discusses the process of data analysis. After organizing data, which consisted of FGDs and interviews, into designated folders on a computer, I proceeded to transcribe and translate the data into the English language. The data obtained from the interviews, FGDs and observations were coded using Saldana's (2012) first and second cycle coding algorithms. During the initial stages of the coding process, the researcher engaged in a thorough review of the interview transcripts in order to gain a comprehensive understanding of the data (Creswell, 2012). This involved identifying significant comments, sentences or quotes and deconstructing the data to generate meaningful ideas or codes. The data obtained from various sources were analysed separately. Furthermore, the codes were analysed in conjunction with the dataset pertaining the particular group of participants, namely, teachers and students, whereby similarities and differences were identified with the aforementioned groups. As stated by researchers (Miles et al., 2014), codes were combined into larger themes, and participants' responses were examined for overlap and repetition, as well as their relevance to the research questions. Finally, utilizing the first and second cycle coding methods, as well as in vivo coding, I combined codes to construct broad themes that framed

the discussion for analysis and allowed common patterns emerge. One of the notable themes that emerged during the data analysis was teachers' and students' beliefs about students abilities with several codes, including boys and girls abilities, evidence of boys superiority, and girls diligence.

3.7 Ethical Issues

Considering the nature of this research, some ethical considerations must be made. First, all participants were treated with respect and politeness. The research was conducted using an "informed consent", with the purpose and methodology of the study made apparent to all participants **(**see Appendix A; Appendix B**).** Because of the nature of FGDs, students were asked to sign individual confidentiality forms in addition to a consent form where they agreed not to share any information collected during the FGDs. Participants were informed about the duration of the study, the nature of the research and what exactly was required from their participation. Since it is impossible to guarantee complete anonymity in a qualitative study, participants were ensured that I will use de-identifiers to give my participants partial anonymity and use strategies to maintain their confidentiality. Then participants' permissions were asked for the interviews to be audio-recorded. Participants had the right to withdraw from the study at any time and not answer the questions that made them feel uncomfortable as well. The participants were informed that data collected would be used in writing a research report and publishing a research paper in a journal that will be read by the individuals interested in the research topic. Though interview snippets would be published in the final study report, participants' names and other information related to their identity would be kept anonymous and confidential.

In addition, to ensure participants' anonymity, they are given pseudonyms. Participants were fully informed that information obtained in the study would be used in writing a research report and that findings might be presented at educational research

conferences or published in a journal. They were guaranteed that audio-recorded interviews would be confidential, and no one except the researcher and her supervisor will have access to the tapes. Participants were informed that their participation would contribute to a better understanding of what kind of hidden curriculum perspectives are communicated and how they affect boys and girls differently and research findings might serve as a basis for understanding gendered stereotypes in STEM subjects and how they are formed to reduce its effect on students' major subject choice.

When collecting research data, it is essential to ensure that the data is stored securely to protect the privacy and confidentiality of the participants involved. Regarding the current research, the data was stored in two different locations - on the researcher's personal computer and on a cloud storage platform provided by Nazarbayev University.

The researcher's personal computer was used as a local storage location for the research data. The researcher ensured that their personal computer was password protected to prevent unauthorized access to the data. This is an important security measure as it helps to prevent the data from falling into the wrong hands in case the computer is lost or stolen.

In addition to the local storage, the data was also stored on a Google Disk cloud storage platform provided by Nazarbayev University. This cloud storage platform was attached to the researcher's personal student account. The researcher chose to use cloud storage platform, in addition to the local computer because it offers several benefits, such as ease of access and backup.

3.8 Summary

This chapter presented the research methodology employed in the study to obtain teachers' and students' perceptions of the gendered hidden curriculum in STEM subjects. The rationale for employing instrumental case study and various data collection methods was grounded in relation to the need to explore the in-depth understanding of the

phenomenon. Additionally, the chapter provided an overview of the methods employed for participant recruitment and data collection procedures, as well as the ethical considerations involved in the study. The next chapter will present the findings of the research based on four semi-structured interviews with STEM teachers, four lesson observations and two FGDs.

4. Findings

This chapter presents the analysis of data collected from students, teachers and observations of lessons in a specialised school for high-ability students in south Kazakhstan. The data sets were collected through semi-structured interviews with four Grade 12 STEM teachers, each teaching either physics, ICT, biology, or chemistry, one classroom observation of each of the teachers interviewed and focus group discussions (FGDs) with 12 Grade 12 students, six studying the physics and ICT pathway and six concentrated in the biology and chemistry pathway. The study is aimed to explore students' and teachers' perceptions of the gendered hidden curriculum in STEM subjects and the extent to which the gendered aspects of the hidden curriculum influence male and female students' choice of career pathways in STEM.

The analysis of the data revealed five themes: (1) Gendered beliefs about students' abilities in STEM: teachers' vs students, (2) gendered beliefs about students' outcomes: teachers' vs students (3) STEM teachers' gendered practices, (4) Stem teachers' gender and the perception of a good STEM teacher, (5) and teachers' gendered views on STEM professions. The chapter concludes with a brief summary of the findings.

4.1 Gendered Beliefs about Students' Abilities in STEM: Teachers' vs Students'

The analysis of interview data indicates that three of four interviewees believe that boys and girls have different abilities in STEM. When asked how boys and girls differ in their subject specialisation, a common view amongst teachers was that boys are more logical and catch complex concepts much easier and faster than girls and are more prone to choose physics. For example, the Physics teacher explained: "Boys are more prone to calculation, that is, they do it better. Boys are more logical and better at maths and physics than girls, that's why mostly boys choose physics in grade 12." (Participant 1, male, physics).

Another teacher teaching Chemistry, when asked to give an example of gender differences in abilities, replied that boys may misbehave in the lesson, but nonetheless, they

can quickly comprehend complex concepts and be at the required level while girls need more time to be at the same level as boys.

> They easily grasp everything during the lesson, but sometimes they might skip ... they might behave inappropriately ... I mean skip doing some assignments, and home tasks while still being able to understand everything that I wanna deliver to them. While girls, need more time for understanding. (Participant 4, male, chemistry)

Most interviewed teachers seem to hold gendered beliefs about students' abilities in STEM subjects. The teachers stated that girls need more time to understand and engage with STEM subjects and often require more guidance and support than boys. For example, a Chemistry teacher stated that "in the case of girls, they need more examples, more time while boys, they master quickly and they need only a few tasks, just to stand at the required level. Girls need a lot of practice." (Participant 4, male, chemistry).

Furthermore, teachers noted that girls tend to prefer activities that involve presentations, decorating posters and group work, rather than tasks that involve deep analytical thinking favouring aesthetics over subject content. A Physics teacher said: "but girls don't like this, they prefer a simpler solution method. They like to focus on something more, for example, drawing and decorating posters. That is, they love visuals more than content." (Participant 1, male, physics). Additionally, the ICT teacher believed that female students are not interested in computing and are not as good at programming as male students.

> They are not good at computing or programming as boys. Yes, they are good at discussions but in theory and logic they are not good. Mainly girls aren't that much interested in technology. They are interested in those parts which demand creativity, discussions. (Participant 3, female, ICT)

Interestingly, all teachers attributed responsibility and diligence to the female students rather than male students, highlighting that girls tend to complete homework on time and fulfil all task requirements while boys usually omit some parts of the task. For example, a

Chemistry teacher noted that “girls are more diligent than boys; they do as much as they can when I give them a bunch of homework while boys can skip doing some tasks.” (Participant 4, male, chemistry). Likewise, an ICT teacher commented: “Girls are more responsible than boys and girls always try to do everything perfectly. They try to fulfil the descriptors they have been asked for, and they try to manage the deadlines.” (Participant 3, female, chemistry).

The interviews with the teachers also provided insightful information regarding female students' self-efficacy in STEM subjects. It was noted that female students tended to display less confidence in their abilities, as it was evidenced by their passive engagement in STEM subjects. It was also noted that girls are unlikely to take leadership roles voluntarily. For example, a Biology teacher replied, “yes, even though they are capable. You have to assign them. Females would not volunteer even though they are capable.” (Participant 2, male, biology). The participant attributed it to inequalities in Kazakhstani society, as in other countries where he had worked, such as the Philippines and Indonesia, female students were more competitive and active during lessons. It was further suggested that this could be due to the influence of the family, as many mothers of the female students in those countries were businesswomen, and they served as role models for their children.

> In the Philippines and Indonesia, females are equal, or they tend to become more competitive in terms of discussion and participation and leadership. I think this is due to the structure of society. In the Philippines most of the parents of females we had were businesswomen… most probably, this is part of the family. I am not sure, but this comes from there. (Participant 2, male, biology)

Moving the focus now to students’ beliefs about how girls and boys differ in their abilities, I found a substantial overlap between students’ and teachers’ views on students’ STEM abilities from the FGDs data. Generally, most boys tend to perceive their STEM abilities as sufficient or above average and have a positive attitude towards maths-intensive

STEM subjects; even though some of them did not practise a lot in programming, they tend to exhibit high self-efficacy in this subject, while girls perceive that they are weak in ICT since they lack computer-related experiences, and that they were forced to choose the combination of physics/ICT subjects since biology/chemistry combination is applicable only for students who are planning to enter medical school. One female student stated: “Although we have chosen computer science as one of the major subjects, I feel that I don’t know it in depth like the rest of the guys who purposefully chose computer science.” In addition, male students noted that girls in grade 12 usually memorise codes for Summative Assessment without understanding how these codes work and that they lack the understanding of the underlying principles of building codes.

> I have heard from them many times that girls studying computer science or programming just memorise everything. They can't understand, just cramming and getting grades. And I really agree with them, but I often come across this ... And it’s impossible to say that they are wrong, in most cases, yes, many girls from my environment, when they study programming, they don’t try to understand it, they just try to memorise it and pass the exam. (Student 1, male, Physics/ICT)

However, one of the male students revealed that boys also tend to memorise some topics without understanding when they prepare for the Summative Assessments. However, since male students tend to communicate primarily with other males, they do not discuss boys’ tendency to memorise topics, but usually discuss how girls do it. For example: “Yes, boys also memorise; they do it too to pass Summative Assessments. But because I interact a lot with boys, they don't talk about other boys or themselves that way, only about girls.” (Student 2, male, Biology/Chemistry).

Overall, my analysis suggests that teachers hold gendered beliefs about students’ abilities in STEM subjects. Boys are seen as more logical and able to learn complex concepts faster than girls, while girls are perceived as needing more time and guidance to comprehend and engage with STEM subjects. In other words, they associate inborn talent with boys and

hard work and mediocracy with girls. Teachers consider that girls prefer activities that involve presentations, decorating posters and group work, rather than tasks that require deep analytical thinking. In other words, girls' interests and abilities seem to be associated with aesthetics, collaboration and oral communication rather than the depth of analytical thinking needed to advance in STEM subjects. Additionally, interviews with the teachers revealed that female students had lower self-efficacy in STEM subjects than their male counterparts, likely due to an unequal social structure and the influence of their families. Moreover, a strong association was found between the views of teachers and those of students studying the ICT/Physics pathway regarding how girls and boys differ in their abilities in STEM subjects. Consistent with teachers' views, boys perceive their STEM abilities as strong and sufficient, while female students report their weaker abilities in subjects such as ICT and Physics are weaker compared to their male counterparts. In addition, male students seem to hold negative beliefs about female students' abilities, stating that girls need to memorise information in order to pass Summative Assessments as their understanding of concepts is weak.

4.2 Gendered Beliefs about Students' Outcomes: Teachers' versus Students'

Analysis of semi-structured interviews shows that some teachers also hold gendered perceptions about students' outcomes. Several participants indicated that boys generally get the highest results while girls tend to perform at an average level. For example, one interviewee said: "The highest results are shown by boys, the leading results are achieved by boys. Girls always have average results." (Participant 1, male, physics).

However, a teacher claimed that although boys achieve the highest results, some boys also get average and even the lowest scores, but girls always are at the average level.

Although teachers perceived boys as natural and active STEM learners, a Biology teacher noted that despite the fact that girls' participation is not as active as boys, they usually perform better and get the highest results during exams compared to boys because of their

diligence and persistence: “Well, males are more active when raising hands and asking questions, while females in my class tend to be more studious, and diligent. Well, later during the exam, most of the females would have higher marks compared to males.” (Participant 3, male, biology).

Teachers tried to provide explanations for the gendered students’ outcomes in STEM. A Physics teacher indicated that biological factors might explain girls’ average and poor performance and exam results. The teacher claimed that girls are more likely to be distracted by phones and dating than focusing on their studies as they grow up earlier and hormones start to affect them. Moreover, this participant stated that girls might also fail due to their menstrual cycle.

> Several times it is periodically repeated that they are at risk that is, during the year, girls can be in the Students C group, which is the lowest ability group, and these periods occur at different times of the year. While boys have consistently high results, I think this is due to their period. I know that girls develop earlier; right now they are at such an age that they have more to live. That is, they are distracted in every possible way by phones, dating, and this is what prevents them from concentrating on their studies, and as a result of this, their results are falling. (Participant1, male, Physics)

Moving the focus now to students, the analysis of the FGDs contradicts teachers’ gendered beliefs about students’ outcomes. Despite the fact that female students feel that they do not have a sufficient level of knowledge in ICT, they tend not to associate grades as the sole indicator of their abilities in STEM subjects. Instead, most female participants reported psychological factors, such as a lack of attention, nervousness, and an inability to manage time during the exams, along with the lack of experience in computer sciences, explain their lower academic performance than their lack of academic abilities in STEM subjects. They have added that their insufficient knowledge in ICT is caused by poor exposure to programming and computer-related experiences, but not the inborn inability to master programming.

Taken together, findings from the semi-structured interviews show that teachers hold gendered beliefs about students' outcomes in STEM, with boys generally seen to be getting the highest results and girls performing at an average level, although one teacher acknowledged that girls outperform boys in exams because their diligence and hard work compensate for their lower abilities. Teachers offer a biological explanation for the lower academic achievement of girls, linking it to puberty, interest in boys and menstruation. However, findings from the FGDs with students contradict this, suggesting psychological factors, such as lack of attention, nervousness, and an inability to manage time during exams, are more likely to be the reasons for their poor exam results than their lack of academic abilities in STEM subjects.

4.3 STEM Teachers' Gendered Practices

Despite having gendered beliefs regarding students' abilities and outcomes in STEM, in the interview conversation, two teachers claimed that teachers should remain neutral regarding students' gender and not favour one gender over another. For example, a Biology teacher said: "No, I don't think so. Regardless of gender, teachers should be neutral." (Participant 2, male, biology).

Although teachers reported that they should be neutral regarding students' gender, the analysis of the FGDs with students has revealed an interesting dichotomy in their perception of teachers' biases. On the one hand, the majority of students, mainly boys, believe that teachers are not biased by students' gender, and assess the students by their level of knowledge. One participant said: "Well, it seems to me that teachers are not biased by gender, but rather by the level of knowledge. And so I did not notice that our teachers divided or deprived students by gender." (Student 2, male, physics/ICT).

On the other hand, some students, particularly females, think that female teachers tend to have a different attitude towards students because of their gender. Female students in

particular, feel that they are not given the same respect and attention as their male classmates, and that their teachers believe that girls are not as capable in certain subjects. According to participating girls, this gendered attitude is made evident through teachers' practices when female teachers pay more attention to male students by asking boys more and complex questions.: "Some teachers believe that girls are dumber in this subject, and it is more difficult for them to understand this subject because they are dumber. Although, well, it happens that boys know certain material worse." (Student 3, female, Physics/ICT). Another student added: "And during the lessons, when she asks questions, she only asks the boys. Although, we have an equal number of boys and girls in the group. Well, so yes, we girls are a little offended." (Student 6, gender, Physics/ICT).

According to the participants, female teachers have a tendency to be stricter and more demanding when it comes to female students' inappropriate behaviour. Boys are more likely to be allowed to get away with bad behaviour and be taken as a joke, while girls seem to be told off and expected to be serious and diligent in class. This gender bias can have a negative impact on girls' self-esteem and academic performance. This raises the question as to whether female teachers are more likely to hold girls to higher standards than boys and whether this is a sign of gender bias.

> Boys are also distracted by something, but the teacher can ignore it. But if the girl is distracted in the lesson, the teacher immediately makes a remark. Even if this student did, let's just say, show his disrespectful attitude, the teachers will take it as a joke and say it's okay. And if a female student did this, the teacher would scold this student. (Student 3, female, Physics/ICT)

Despite teachers claiming being gender neutral in their practice, two teachers acknowledged that they had different approaches to teaching based on the gender of the student. For example, one teacher responded that girls might need more time to comprehend concepts and providing familiar examples for them might ease their understanding of chemistry, so the teacher stated that to explain difficult topics and engage female students

with chemistry, the teacher tries to provide examples from cooking and cosmetics chemistry. While this could potentially be viewed as gender-responsive approaches in their teaching, however, these strategies might enhance messages related to stereotypical gender roles, indicating that girls' role is making meals for the family and to look beautiful to satisfy man's desire.

> My attitude to girls is different because sometimes I need to be more patient, because some concepts are not easy to understand for girls. In this case I try to provide examples that are familiar to girls, for example, cooking chemistry, the chemistry of proteins, skin, and cosmetics. (Participant 4, male, chemistry)

> I have some female students who are not good at programming but they are good at organisations and planning, so they can be good at some ICT skills and specialities. I am trying to give individual feedback to each of them and that is why I think I treat them differently. (Participant 3, female, ICT)

Regarding students' performance in the class, teachers highlighted that in most cases, boys tend to be more active and be leaders both in the classroom and lab setting, taking the initiative in finding solutions to problems, and being in charge of group activities. For example, a Biology teacher stated, "it would be males who manipulate things and take the lead voluntarily. Unlike females, it would take you to appoint them as a leader in comparison to males. With regard to skills, girls tend to be hesitant to manipulate." (Participant 2, male, biology).

> That is, my last task was a description of geostationary orbits, and polar orbits. There were many words that needed to be divided into these groups, and the girls took sheets, cut out these answers, and grouped them in the right category according to what the boys said. It turns out that boys were the leaders of the group, they were the creators of the idea to do it, and the girls were the performers; they were engaged in design. (Participant 1, male, physics)

In addition, one interviewee stated that boys tend to show their dominance and superiority by leading the discussions and asking more questions during the lessons while girls need to be called by names. Also, the interviewee emphasised that boys often exhibit dominance in an activity even when they are the minority and ask questions not to clarify but rather to confirm that their understanding of some concepts is correct. For example, a Biology teacher stated, “Boys mostly ask questions to confirm what they already know, not to clarify. They want to ask questions not to understand but to confirm whether their understanding is correct or not.” (Participant 2, male, biology).

> Males feel they want to become dominant in classroom discussions and show their superiority… I think this is still due to males feeling dominant. For example, in grade 11, I have only one male in each class. In grade 12, I have two or three. Even if there is only one male, still the boys tend to be more active participants. (Participant 2, male, biology)

My analysis of lesson observations of STEM subjects confirms teachers’ beliefs that there is a gender difference in the ways the students were engaged, with boys being more likely to actively participate and ask questions than girls. On the other hand, girls tended to be more hesitant and unsure when it came to asking questions or completing tasks, making them less likely to engage with the lesson. During the ICT lessons, students were involved in group work and presented their posters. The boys tended to take a leadership role, and when presenting their work, they used more technical terms and omitted some details. On the other hand, the girls were more attentive to details and tried to explain the specific terms used. In addition, boys explain physical processes by using their hands and drawing schemas in the air.

However, rather than taking the gendered STEM engagement on the part of students as biological, innate and immutable, I observed teachers’ practice with boys and girls varied in ways associated with the gendered student engagement and performance. Observing a Physics lesson, I saw a male teacher mostly interacted with boys, and they understood each

other better because the teacher used specific masculine words when explaining how different parts of the aeroplane work, omitting details and steps to solve the exam questions using formulas and physics laws that led to the female students' disengagement with the lesson. In addition, it seemed that the strategy the teacher used to explain how the aeroplane works was gendered, as only boys could understand what the teacher was drawing in the air, repeating after the teacher. The teacher did not engage girls while explaining and eliciting some answers from the students and was primarily focused on boys rather than girls. However, boys in Physics and Chemistry lessons were more frequently asked to solve the questions and justify their answers by explaining the way they solved them. It was obvious to the observer that boys were asked to do so because the teachers were confident that male students could explain the solutions to the questions correctly.

When explaining the reasons for males' superiority in abilities, teachers referred to the social and cultural aspects as possible explanations. Teachers stated that boys are exposed to activities that demand calculation and logic since childhood and referred to the legacy of the Soviet Union. For example, a male Physics teacher reflected, "we have been taught to calculate correctly and think logically since childhood; this is probably more left over from the times of the Soviet Union, to draw up a problem." (Participant 1, male, physics). Moreover, one participant linked males' superior behaviour to the cultural aspects, noting that males mostly refuse to do some domestic chores because they do not correspond to their gender roles that were culturally shaped. For example, "I told boys like 'why don't you help girls clean after eating?' They told me it is not their role. Maybe not only roles but the culture too." (Participant 2, male, biology).

Overall, the main findings on gendered practices suggest that despite teachers' views on being neutral regarding students' gender, teachers' practices are negatively gendered. It was identified that only some teachers try to engage female students by applying strategies

that reinforce stereotypical gender roles, while others disengage female students through gendered practices. In addition, there is a discrepancy in the students' perceptions of teacher bias. While the majority of students, especially boys, believe that teachers are not biased by gender, some students, particularly females, believe that female teachers may have a different attitude towards students based on their gender. In other words, boys benefit from gendered teacher practices so they are blind to the ways teachers prioritise them, while girls are at the receiving end (negative effect) of biased teacher's practice.

4.4 STEM Teachers' Gender and Perception of a Good STEM Teacher

Some teachers indicated that gender does not play a major role in teaching STEM subjects. Regarding students' attitudes towards teachers' gender, one participant noted that students' gender-related attitudes could start to emerge in secondary school and become even more apparent in high school, when male teachers may be perceived as more authoritarian than their female counterparts. "When the teacher is male, they are taken more seriously, especially by boys." (Participant 1, male, physics). This indicates that although teachers should remain neutral about gender, there could be subtle differences in how they are perceived by their students. The participant referred to the national and cultural aspects of the country, noting that men are always more respected in the family and society.

> Well, again, this is related to a national or cultural feature of our country. Because in our country, for a long time, men are always more respected; this can be seen in the traditions, our traditions. That is, men should go first, men should sit at the head of the family, and men should always be in charge. (Participant 1, male, physics)

In addition, the male teacher suggested that female teachers may not be as competent as their male counterparts in providing instructions and maintaining discipline in the classroom. This could be a result of male students feeling more comfortable with male teachers when it comes to fields like physics and ICT, which have traditionally been dominated by males.

Moreover, according to a female teacher, the majority of the students initially had a negative perception of the female teacher's competences in teaching the ICT subject. This is likely due to the traditional male dominance of this field. However, as the students became more familiar with the teacher and her teaching methods, they began to recognise her expertise and capability in teaching this subject.

> I noticed after a few lessons that they thought I was not that smart in ICT and they tested me in different ways (emotionally and professionally) … I think this is due to the stereotype they have ... because there are males mostly in IT. (Participant 3, female, ICT)

Overall, the interview findings suggest that gender can have an impact on how teachers' competencies are perceived and treated by their students. While teachers should strive to remain impartial regardless of gender, it is important to recognise that students may have different perceptions of an ideal STEM teacher depending on a teacher's gender.

4.5 Gendered Views on STEM Occupations

The analysis of the interview reveals that two out of four teachers interviewed hold gendered beliefs about professions, particularly that engineering and working in manufacturing or production is not appropriate for women. This is evidenced by Participant 1's reference to his sister-in-law, who is a mechanic by profession but has not worked and is now a housewife. Participant 3 also supports this view, having studied engineering but feeling it was not for her and quitting the profession.

Another teacher (Participant 2, male) claimed that female students mainly choose biology to get enrolled in medicine, while male students tend to select physics as their major subject, which explains the way they easily comprehend complex concepts rather than girls. In the same vein, one teacher indicated that most female students seem to enrol in a medical degree while male students mainly choose physics to be enrolled in the field of engineering.

> So far I have been here for five years, and most females are in a medical degree. I have a few males, but they also enrol in medicine. As regards engineering, it attracts more males, mathematics as well, but in biology, they take the course that leads to medicine and this is more for females. (Participant 2, male, biology)

Furthermore, a Physics teacher believes that the specialties female students tend to choose are related to the service sectors where communication skills are required while fields that require knowledge of physics and ICT skills are related to production and that is why most males tend to choose physics and major in engineering fields.

> That is, there is no such thing as physics and mathematics being associated with service industries, for example. There they are all focused on production, and technology, so girls choose these professions … while girls more often work in service sectors where communication prevails. (Participant 1, male, physics)

Although some teachers hold gendered beliefs about professions, findings from FGDs with students show that almost all of the students are aware of the stereotypes regarding appropriate careers for female and male students. When talking about the stereotypes regarding career choice, one participant revealed that her relatives were against her choice to be a civil engineer as they perceive this field as masculine and not appropriate for female students. “I announced my major … the first reaction from the relatives was that they said that this is not a women's profession and that I need to choose medicine.” (Student 3, female, physics/ICT). When asked to share how she dealt with this reaction, she refused to answer as it seemed that this topic is not pleasant to her, but she commented that this kind of reaction would not force her to change her decision. “Well, I don’t like this topic very much and exactly such words will not change my decision and my opinion, so I simply answered that this is my choice, I decided so and I will go there.” (Student 3, female, physics/ICT). Another female student shared that she changed her mind about entering the energy sector after a conversation with her uncle: “ I am also applying for civil engineering, but before that I was

thinking about working in the energy sector because of a conversation with my uncle I decided to choose civil engineering." (Student 6, female, Physics/ICT).

Furthermore, students provided some explanations for the stereotypical division of professions. One of the male students related this division to social and cultural factors, relating the purchase of blue toys for boys and pink toys for girls as an illustration, as well as ICT for boys and biology for girls. Girls, on the other hand, referred to historical and cultural factors, emphasising that stereotypes about gendered careers exist because girls were only permitted to study comparatively recently to boys. Due to the fact that boys had access to study science much earlier than girls, they have made more scientific discoveries and there are significantly more male scientists than female scientists. Because of this, people tend to associate sciences with masculinity, and men continue to dominate in this field.

> It seems to me that this stereotype exists because, in ancient times, only men could study, and women stayed at home. Therefore, since ancient times, it seems that all scientists are almost men who made some kind of scientific discoveries. But not because women are stupid and do not understand, but because they were simply not allowed to learn. (Student 5, female, Physics/ICT)

In general, the main findings show that half of the participants hold gendered beliefs about professions, particularly that engineering and working in manufacturing or production is not appropriate for women.

4.6 Summary

The purpose of this chapter was to present the findings drawn from four semi-structured interviews with STEM teachers, observation of their lessons, and two focus group discussions with students. My analysis has shown that teachers hold gendered beliefs about students' abilities in STEM subjects and that these beliefs manifest in their practices hindering female students' active engagement with male-dominated subjects such as physics and ICT. Another notable finding was that one of the interviewed teachers linked girls' poor

exam results with biological reasons stating that hormones and periods prevent girls from reaching their high potential.

The next chapter discusses the research findings in connection with prior research on similar topics and articulates how these findings can enhance understanding of the research topic.

5. Discussion

In the previous chapter, I presented the analysis of the data collected from semi-structured interviews with four Grade 12 STEM teachers, each of whom teaches either physics, ICT, biology, or chemistry; classroom observations of each of the interviewed teachers; and focus group discussions (FGDs) with 12 Grade 12 students, six studying the physics and ICT pathway and six concentrated in the biology and chemistry pathway. In this chapter, I discuss the main findings in connection to the research questions and relevant literature. The chapter is organised into five sections. The first section delves into both teachers' and students' gendered beliefs about students' abilities in STEM. The second section discusses the teachers' and students' gendered beliefs about students' outcomes. The third section discusses teachers' gendered practices. The fourth section discusses STEM teachers' gender and the perception of a good STEM teacher. Finally, attention is drawn to the teachers' and students' views on gendered professions. The concluding section summarises the chapter.

5.1 Gendered Beliefs about Students' Abilities in STEM: Teachers' vs Students

In order to understand teachers' beliefs about students' abilities in STEM subjects, participants were asked in what ways their students' abilities in STEM differed based on their gender. Teachers in the current study indicated that boys are more capable in logical thinking and quantitative reasoning, and they learn complex concepts much easier and faster than girls. This shows that teachers hold gendered beliefs about students' abilities in STEM. Additionally, one teacher noted that male students tend to select physics as their major subject, which explains the way they comprehend complex concepts more easily than girls. Hand et al. (2017) reported that there exists a prevalent perception among both educators and students that males exhibit superior performance in STEM fields, and that individuals working in the scientific domain are more likely to possess masculine traits. In the same vein,

Jussim et al. (1996) argue that teachers' biases and expectations are significantly influenced by the gender of their students, which can potentially perpetuate gender disparities in STEM fields. Similarly, Perander et al. (2020) found that teachers and counsellors tended to perceive boys as smart and did not attribute the lack of mathematical abilities to boys as they did to girls. In other words, teachers tend to associate mathematical ability with masculine features and believe boys have innate abilities to perform better in maths and the sciences. However, the literature has revealed that quantitative reasoning differences between sexes arise due to the involvement of men in activities such as hunting and navigation which necessitate the use of visual-spatial skills (Reilly et al., 2015). Studies in neuroscience further explain that the brain exhibits neural plasticity and is capable of adapting and evolving in response to both social and physical surroundings (Greenough et al., 1987). Consequently, the environment and treatment received by boys and girls will influence their development. Boys may have greater access to problem-solving opportunities outside of mathematics classrooms compared to girls, which leads to the development of specific cognitive skills that are needed in maths and science (Kimball, 1989).

In addition, Eagly and Wood (1999), in their study on the origins of sex differences in human behaviour, refer to the social structuralists' perspective, which suggests that gendered labour division serves as a catalyst for sex-differentiated behaviour. This division allows men and women to form schemas about sex-typing activities and interests, which in turn facilitate the development of specific cognitive skills. However, the perception of maths ability as a masculine and innate trait presents challenges for girls in terms of self-identification and external recognition of their proficiency in mathematics, and this can be used to link the outflow of girls and women from mathematical academia and professional domains on a global scale (Mendick, 2005). Therefore, it could be argued that there are no inborn maths abilities that favour one gender over another; instead, the way boys and girls socialise

according to their gender consolidates specific skills and abilities that are needed to master STEM subjects.

Additionally, participants in the study tend to associate female students with such characteristics as responsibility, diligence, and hard work rather than the ability to think critically and deeply analytically that is required in STEM subjects, stating that girls always make sure to complete assigned tasks on time and are attentive to details, writing down everything in their notebooks. In accordance with the present findings, previous studies have demonstrated that teachers tend to describe their female students as untalented, highly diligent, or motivated and relying on help from adults (Avitzour et al., 2020). Riley (2014) found that female students were often praised by their teachers for good behaviour and effort, with some teachers attributing these factors to the academic success of female students. As a result, the teachers tend to recall their male students as messy geniuses who occasionally fail despite intrinsic brilliance and their female students as average students who occasionally succeed by working hard and getting help. In other words, boys are implicitly associated with intelligence, whereas girls are associated with hard work. Reyna (2000) highlights that when success is consistently attributed to traits such as effort and behaviour rather than innate ability, students may begin to doubt their academic capabilities, ultimately destroying their confidence. Spencer et al. (1999) write that such perceptions negatively affect the long-term personal development of female students' self-esteem and career aspirations, preventing them from enrolling in STEM degrees. Walkerdine (1989) views femininity as a performance, i.e. culturally accepted ways of acting like a woman, highlighting a large gap in how gender-related performances are evaluated, which leads to inequities. In addition, Walkerdine (2012) observed that there existed a correlation between derogatory attitudes and the notion that women's success in STEM fields was attributed to diligence and adherence to rules rather than innate intelligence or exceptional aptitude.

Furthermore, most of the teacher participants believed that female students needed more time to comprehend complex concepts, needed additional guidance, and preferred tasks that required creativity, such as decorating posters, giving presentations, and doing group work. These gendered beliefs might lead to practices that hinder female students' engagement with STEM subjects. If female students are consistently directed to activities that are more creative and require less analytical thinking, they may be less likely to engage with STEM subjects, as they are unlikely to be exposed to the analytical skill sets required to succeed in these disciplines, leading them to choose mainly humanitarian subjects as their majors.

Findings from FGDs indicated that male students have strong self-efficacy and confidence in relation to STEM abilities but tend to hold gendered beliefs about female students' abilities in ICT, stating that girls usually memorise the codes to pass exams successfully rather than understand how codes in programming languages work. In addition, my study indicated that girls and boys tend to exhibit different levels of self-efficacy in terms of programming. Even though both girls and some boys (two out of six) revealed that they did not code before high school, boys noted that they are confident in their skills and are able to pass the exams, while girls perceive that they are weak in this subject. Previous studies have demonstrated that young children exhibit in-group bias, believing that their own gender is superior in maths ability, but when children grow older, they become more aware of social messages around them, and this bias tends to fade away (Bian et al., 2017). However, the recent research by Starr and Simpkins (2021) on high school students' maths and science gender stereotypes reported that there was a significant shift towards the traditional gender stereotype about students' maths abilities by the 11th grade, with the belief that male students are better at maths and science. This suggests that the latter stage of high school could potentially serve as a crucial phase in an individual's development, as it marks the initiation of the adoption of conventional stereotypes that could endure throughout their adult life. In

addition, Robnett (2013) claims that peer climate and support in STEM might have implications for the extent to which girls and women identify with STEM and their intent to remain in STEM. As a result, male high school students' endorsement of the traditional gender stereotypes and exhibiting group biases stereotyping males as better at maths and sciences may undermine girls' self-efficacy and self-identity with STEM, contributing to the gender gap in STEM fields that have long been dominated by men.

Overall, the study found that despite the fact that teachers hold gendered beliefs about their students' abilities in STEM subjects, considering boys have inborn abilities for logical thinking, quantitative reasoning, and learning complex concepts easier and faster than girls, literature revealed that quantitative reasoning differences between sexes emerge as a result of differentiated roles of women and men, with men being heavily exposed to hunting and navigation activities that require visual-spatial skills. Additionally, teachers' tendency to implicitly attribute qualities such as responsibility, diligence, and hard work to female students rather than critical thinking and analytical skills, negatively influences female students' self-efficacy and undermines their confidence which might have long-term consequences in terms of career aspirations, preventing them from enrolling in STEM fields.

5.2 Gendered Beliefs about Students' Outcomes: Teachers' vs Students' Beliefs

Analysis of the findings shows that some teachers hold gendered perceptions about students' outcomes, arguing that boys typically get the highest results while girls typically perform at an average level. In contrast to these findings, PISA results for Kazakhstan 2018 showed that girls outperformed boys with a statistically significant difference of seven points in science, while in mathematics, boys performed better than girls with a non-statistical difference of one point (OECD, 2019). Consistent with PISA results, only one teacher pointed out that girls, although not as active as boys, often perform better and obtain the

highest marks in exams. However, this teacher claimed that girls get better grades in exams due to their diligence and persistence rather than their inner abilities.

Biological causes were cited as an explanation for girls' low performance, with one physics teacher stating that hormones influence girls' behaviour, causing them to get easily distracted by phones or other people. In addition, the teacher mentioned that girls might fail due to their menstrual cycle. However, these findings are not in agreement with the results from studies on biological differences that are often misinterpreted and exaggerated in public discourse, reinforcing stereotypes about the effect of hormones on gendered behaviours and maths results (Eliot, 2011). According to Anglim (2019), teachers' perceptions about the effects of hormones may well come into play and refers to Eliot (2011, 2013), who explains how our beliefs regarding hormones can potentially exert a greater influence on behaviour than the hormones themselves. The finding about the menstrual cycle being the cause of female students' poor abilities was unexpected. I did not discover any similar findings in previous research on this topic.

Although teachers claimed that female students perform worse than male students, this was not supported by findings from the FGDs with students. Female students indicated that they do not associate grades as the sole indicator of their abilities in ICT and physics. Instead, the girls argued that a lack of exposure to programming and computer-related experiences since childhood, along with psychological factors such as lack of attention, nervousness, and an inability to manage time during the exams, might be the reasons for their poor performance. Cheryan et al. (2009) indicated that girls perceive ICT subjects as male-gendered, and since computer science classroom environments broadcast masculinity, girls and women feel like they do not belong in the field). Moreover, male-biased software that enhances male students' confidence and makes them feel superior often comes from gaming

since commercial games are mostly oriented toward the male market (Margolis & Fisher, 2003).

Overall, this study revealed that although teachers hold gendered beliefs about students' outcomes in STEM, PISA results show that girls surpassed boys in science by seven points and boys outperformed girls only by one point in maths. It was indicated that the way boys and girls socialise and are exposed to different activities and experiences based on their gender influences the development of particular cognitive skills that are required in STEM subjects rather than inborn abilities that determine biologically favouring boys over girls in maths-related abilities.

5.3 STEM Teachers' Gendered Practices

Even though two teachers claim that they should be neutral regarding students' gender, findings from the FGDs with students revealed that teachers' attitudes towards students and practices are gendered. While male students stated that teachers are not biased towards students based on their gender and judge students according to their level of knowledge, female students indicated that they are not treated with the same respect and attention as their male peers. Furthermore, girls added that their teachers assume female students are less capable in certain subjects that require maths abilities.

According to the female students, this gendered belief manifests in teachers' behaviours and attitudes when female teachers give more attention to male students by asking more sophisticated follow-up questions and providing more detailed feedback. This finding is in agreement with Becker's (1981b) findings, which showed that teachers tend to treat girls and boys differently in various aspects of practices such as (a) open questioning, (b) the cognitive level of questions, (c) providing positive and negative feedback, (d) the level of encouragement given, (e) the extent of individualised assistance provided, and (f) the nature of conversation and humour exchanged. Male students were advantaged by observed

disparities as they received greater levels of teacher attention, reinforcement, and emotional support. Females who have been traditionally considered as subordinate gender have been allocated comparatively fewer resources across the three domains (Becker, 1981, p.51). Similarly, Sadker and Sadker (2010) found that teachers provide more resources to boys than girls, such as time and challenging developmental feedback. Therefore, it might be concluded that boys perceive teachers' attitudes and practices as gender neutral since they benefit from gendered teacher practices, so they are blind to the ways teachers prioritise them while girls are at the receiving end (negative effect) of biased teachers' practices. This gendered favouritism towards boys has a negative effect on girls since teachers' beliefs about female abilities in maths and science, together with their discriminatory behaviour, are significant predictors of students' interest and confidence in STEM subjects (Sansone, 2017). In addition, it is possible that female students' self-efficacy may decrease if their female teachers hold the belief that male students have superior abilities in maths and science; as a result, they may disengage from class and be less likely to pursue academic subjects.

Past research on teachers' gendered practices found that teachers discipline boys and girls differently (Eccles & Blumenfeld, 1985; Martin, 1998). Consistent with these studies, my study found that teachers tend to overreact to female students' misbehaviour, expecting them to be diligent and focused, while male students' inappropriate behaviour is usually ignored or taken as a joke. Likewise, Martin (1998) found that there is a gender-based disparity in the classroom, where male students are more likely to be allowed to speak without raising their hands, participate in rough play, and talk more loudly than girls. Gilliam et al. (2016) highlight that teachers' need to manage a classroom and control children's behaviour may lead to the implementation of a gendered hidden curriculum to transmit explicit and implicit messages about gender, which are used to regulate the behaviour of both male and female students. Therefore, teachers communicate gendered expectations for

suitable classroom behaviours for boys and girls through discipline (Erden & Wolfgang 2004; Martin 1998). As a result, teachers influence gender construction in schools through the implementation of hidden curricula.

When it comes to students' performances in class, teachers claim that boys tend to be more active in terms of asking questions, mostly taking the role of a leader both in the classroom and in lab settings. In addition, it was added that boys seem to show dominance even when they are in the minority and ask questions to confirm their correct understanding rather than to clarify. On the other hand, girls seem to be quiet and less active in class. Consistently, observations of lessons revealed that boys were more involved in all four STEM disciplines than girls. These findings are congruent with studies by Martinez and Guzman (2013), who found a reduction in girls' STEM involvement despite active participation in other areas such as languages and art. My data also indicated that the physics teacher exhibited a higher degree of interaction with male students. Specifically, male students were more frequently called upon to explain physics rules and engage in problem-solving activities on the board, thereby suggesting that the teacher held distinct expectations for students in STEM subjects and gave greater opportunities to male students. Stated differently, this suggests that male students are more prone to receiving support and motivation from teachers to excel in physics, thereby indicating the prevalence of gender-based stereotypes among teachers. Similarly, Brophy (1985) has observed that there are differences in the educational styles of male and female teachers, which conform to normative gender roles.

5.4 STEM Teachers' Gender and the Perception of a Good STEM Teacher

Surprisingly, the current study found that two out of three interviewed male teachers tend to believe that they are perceived as more authoritarian and more respected by students, especially by boys, than female teachers, connecting this tendency with the culturally

accepted picture and role of men in Kazakhstani society, where men are seen as respected given the priority in the family and society. In addition, male teachers assume that STEM female teachers might not be as competent as male teachers in terms of delivering effective instructions and maintaining discipline in the class Kutnick and Jules (1993)found that there were significant differences in perceptions of a good teacher in classroom management and teaching style: female teachers are seen to build good interpersonal relationships with their students and employ various classroom techniques to sustain engagement. Conversely, male teachers are perceived as more assertive and in control of students' behaviour. In Kazakhstan, men are usually associated with possessing authority and power as defining traits.

Additionally, a female teacher revealed that at first, she was negatively perceived by the majority of students as lacking ability in computer sciences and incompetent in teaching ICT. Dasgupta and Stout (2014) found that stereotypes that are pervasive in culture consistently portray ideal scientists, engineers, and technological innovators as men.

Furthermore, my study indicated that students' perceptions of teachers' gender might have an impact on their engagement and participation in lessons. Specifically, female students were more likely to be actively engaged in the ICT lesson delivered by the female teacher, while boys exhibited more active participation in physics, chemistry and biology classes led by male teachers. One possible explanation for these differences is that the teaching practices of male and female teachers differed in ways that appeal more to students of a particular gender. For example, the female ICT teacher used a student-centred approach that encouraged group work and presentations, which may have resonated more with female students. However, this finding should be taken with caution since there was only one female teacher's lesson observed and this finding can not serve as a reliable source to attribute it to the whole STEM female teachers and female students.

On the other hand, male students actively participated in the physics and chemistry lessons, where the teachers mostly used a teacher-centred approach relying on verbal explanations and schemas without providing any visual aids. This may have been less engaging for female students, who might have preferred a more interactive and visually stimulating approach.

5.5 Gendered Views on STEM Occupations

The study indicates that teachers hold the perception that working as an engineer is more appropriate for men and is not aligned with female gender roles. The belief that working as an engineer is more suitable for men and not aligned with female gender roles can have negative implications since this belief may lead to unconscious biases in the classroom that can impact girls' education negatively. For instance, teachers might give less attention to girls' performance in STEM subjects, offer less challenging coursework or overlook them for opportunities, such as extracurricular activities, internships, or research experiences. These experiences can impact girls' confidence and interest in STEM fields and may deter them from pursuing careers in engineering. This finding corroborates the idea of Mendick (2005),

who argues that " gendered discourses inscribe mathematics as a masculine domain, thereby making it challenging for girls and women to perceive themselves as talented and comfortable with mathematics. Consequently, this perception affects their choice of pursuing mathematics and their performance in the subject" (p. 217). Likewise, Scholars contend that implicit gender norms play a role in dictating the acceptable choices for boys and girls, with science frequently being viewed as a superior subject that is deemed unsuitable for girls by many societies (Blickenstaff, 2005).

According to Van Der Vleuten et al. (2016), gender ideology exerts a significant influence on academic choices made by students of both genders. Specifically, boys are more likely to select science-related courses that are traditionally associated with masculinity,

while girls tend to opt for subjects such as art, language, and humanities, which are typically viewed as feminine (p. 184).

Additionally, it was found that teachers believe that female students tend to choose the specialities related to the service sectors where communication skills are prevalent. This is consistent with Reilly et al. (2015), who claim that gender specific labour division leads to the development of masculine and feminine traits, attributing qualities such as strength, achievement-orientation, and competitiveness to men and communication-oriented traits to women.

Findings from FGDs with students show that almost all students are aware of the stereotypes regarding appropriate careers for female and male students. When discussing career choice stereotypes, the family was found to reinforce stereotypes about STEM careers by emphasising suitable careers matching gender roles. Similarly, Frome and Eccles (1998) argue that parents may develop a schema that associates mathematics and science with male cultural tasks due to the underrepresentation of women in the science workforce. According to the gender schema theory, the messages conveyed about STEM professions have established distinct gender-based roles for children, thereby influencing their perception of STEM careers. Specifically, boys are more likely to view STEM vocations as socially acceptable options that align with their gender identity, while girls may not share the same perspective. According to Almukhambetova and Kuzhabekova (2020), STEM is perceived as masculine in the Kazakhstani context. They argue that there exist distinct "societal culture and gender role expectations" for boys and girls in Kazakhstan, where "men are regarded as the main breadwinners, women are caretakers", adding that STEM careers are not acceptable for women because women are not expected to earn more money or put in more hours at work than their husbands, which may potentially undermine the idea of the hierarchy between the sexes in traditional Kazakh homes (p. 13). This might suggest that the gender gap

observed in STEM filed selection is not necessarily attributed to inherent biological differences between men and women but depends on how the social environment (e.g. peers, family, and teachers) conceptualises gender norms, framing the profession as masculine or feminine.

5.6 Conclusion

The purpose of this chapter was to discuss the findings of the current study in relation to the existing studies on the topic. The study found that both teachers and students exhibit gendered views about students' STEM abilities. Although these stereotypical beliefs are based on biological reasons, the study found that these gender differences in abilities are mainly caused by the ways boys and girls socialise according to their gender roles and get exposure to particular experiences and activities. It was also found that teachers attribute characteristics such as responsibility, diligence and hard work to female students, while describing boys as critical and analytical thinkers. This persistent association of female students with effort and behaviour rather than ability may cause girls to doubt their academic ability, which can undermine their confidence, negatively affect their career aspirations, and discourage them from enrolling in STEM degrees. The chapter also discussed teachers' gendered beliefs about students' outcomes, noting that girls usually achieve at average level, while the highest results always are among boys. However, this finding contradicts the PISA results for 2018, where girls outperformed boys in science and boys performed better only for one point in mathematics. Even though teachers assured to be neutral regarding students' gender, it seemed that their gendered beliefs manifest in their practices since female students indicated that they are treated differently because of their gender, highlighting that some teachers perceive them as incompetent in maths and they are always expected to be diligent. Moreover, male teachers tended to believe that they were viewed as more authoritative and respected than female teachers. This notion is tied to societal and cultural practices that

emphasise men. Female teachers may encounter unfavourable perceptions about their competency in STEM disciplines, which can have an impact on how students view them. The study also reveals that the gender of teachers and the teaching strategies utilised may impact students' involvement and participation in lessons. Female students are more engaged in lessons given by female teachers than male students are in classes taught by male professors. These disparities might be attributed to variances in teaching strategies that favour pupils of a specific gender. Finally, engineering careers are perceived as male-dominated professions that do not correspond with female gender roles. In Kazakhstan, because men are believed to be the primary breadwinners and women are caretakers, STEM professions are viewed as masculine, making engineering unsuitable for women. This might imply that gender disparities in STEM choices are not due to biological differences between men and women but rather to how the social environment (e.g. peers, family, and teachers) conceptualises gender norms, defining professions as masculine or feminine.

As noted by Ferree (1990), gender roles are defined by a set of power relations that are shaped by society’s dominant ideologies. This means that gender roles are often shaped by the expectations of men and women within a given culture, and can also be used to maintain male dominance. For example, in some cultures, women are expected to remain in the home and fulfil domestic roles, while men are expected to work and be the breadwinners. This type of gender role construction has been used to maintain male dominance and power in certain societies.

6. Conclusions

This chapter summarises the findings of my study which sought to explore Year 12 students' and teachers' perceptions about gendered hidden curriculum in STEM subjects and the extent to which the gendered aspects of the hidden curriculum influence male and female students' career pathways in STEM. The chapter is organised into five sections. The first section provides a comprehensive summary of the study, including a review of the research questions. The second section discusses the limitations of the present study, while the third section offers recommendations to schools and curriculum developers. The fourth section presents potential implications for further research based on the findings of the study. Finally, the last section provides personal reflection regarding this study.

6.1 Revisiting Research Questions

6.1.1 What are students' perspectives on the gendered hidden curriculum in STEM subjects?

The study revealed that most male students tend to be exposed to gendered beliefs about girls' abilities in ICT, noting that girls usually memorise codes to pass exams rather than understand how programming languages work. Male high school students' endorsement of traditional gender stereotypes and exhibiting group biases stereotyping males as better at maths and science may undermine girls' self-identity with STEM, preventing them from enrolling on STEM programmes. Additionally, girls and boys tend to exhibit different levels of self-efficacy in terms of programming, with boys being more confident in their skills than girls.

Moreover, female students revealed that they are treated differently by their STEM teachers based on their gender, while boys indicated that teachers' attitudes might differ because of students' knowledge rather than gender. It was found that teachers discipline boys and girls differently, conveying gendered expectations for appropriate classroom behaviours.

It was revealed that teachers tend to overreact to girls' misbehaviour while boys' inappropriate behaviour is usually ignored or taken non-seriously. Thus, teachers' need to manage a classroom and control children's behaviour can result in teachers using a gendered hidden curriculum to transmit explicit and implicit messages about gender to regulate boys' and girls' behaviours.

Finally, observations of lessons showed that male students were more involved in all four STEM subjects compared to female students, with the physics teacher mostly interacting with male students. This implies teachers' different expectations of students in STEM and giving boys more opportunities, signalling binary gender-based stereotypes among teachers. Similarly, male and female teachers' educational styles have differed, demonstrating conformity to normative gender roles.

Overall, the study highlights the presence of gendered beliefs and biases in STEM education, with male students being exposed to stereotypes about girls' abilities in ICT and exhibiting group biases in maths and science. This may lead to a lack of self-identity with STEM among girls, preventing them from enrolling in these fields. Moreover, female students reported being treated differently by STEM teachers based on their gender, and teachers' discipline of boys and girls differed, conveying gendered expectations for appropriate classroom behaviours. Finally, observations of lessons indicated a higher level of involvement of boys compared to girls in all four STEM subjects, with male teachers conforming to normative gender roles. The findings suggest the need for addressing gender stereotypes and biases in STEM education to provide equal opportunities for all students.

6.1.2 What are teachers' perspectives on the gendered hidden curriculum in STEM subjects?

Findings provide insights into this research question, revealing the ways teachers' beliefs manifest in their practices undermining girls' engagement with STEM subjects. The

study found that teachers' gendered beliefs about students' abilities in STEM manifested through boys being perceived as better at logical thinking and quantitative reasoning, and learning complex concepts more easily and quickly than girls. Demonstration of these beliefs led to the gendered expectations and norms in teaching practices, which may reinforce and reproduce gender inequalities in STEM.

Additionally, it was found that teachers tend to associate mathematical ability with masculine features and believe that boys have innate abilities to perform better in maths and the sciences. The literature revealed that quantitative reasoning differences between sexes emerge as a result of differentiated roles of women and men, with men being heavily exposed to hunting and navigation activities that require visual-spatial skills.

Moreover, teachers also associate being a male student with being a successful learner in subjects such as physics. In contrast, female students are seen as better at completing assigned tasks on time, being attentive to details and working hard. Additionally, female students are often associated with creativity and communication such as decorating posters, working in groups, and doing presentations which can hinder their engagement with analytical STEM subjects. The literature highlights that consistent association of success with traits like effort and behaviour rather than ability may lead to the students questioning their academic ability and thus undermining their confidence.

The findings suggest that gendered beliefs might lead to practices that hinder female students' engagement with STEM subjects. If female students are consistently directed to activities that require less analytical thinking, they may be less likely to engage with STEM subjects, leading them to choose mainly humanitarian subjects as their majors.

Finally, it was highlighted that some teachers hold gendered perceptions about students' outcomes, arguing that boys typically get the highest results while girls typically perform at

an average level. However, PISA results for Kazakhstan 2018 showed that girls outperformed boys in science, while in mathematics, boys performed better than girls.

6.1.3 In what ways does the gendered hidden curriculum in STEM subjects influence male and female students' career pathways in STEM?

The gendered hidden curriculum in STEM subjects can have significant implications on male and female students' career pathways in STEM. Teachers hold the perception that engineering is more appropriate for men and not aligned with female gender roles, which can lead to unconscious biases in the classroom that negatively impact girls' education. This can result in teachers giving less attention to girls' performance in STEM subjects, offering less challenging tasks, or overlooking them for opportunities, such as extracurricular activities, subject olympiads, or research experiences. These experiences can affect girls' confidence and interest in STEM fields and may deter them from pursuing careers in engineering.

The study found that one male teacher believes that female students tend to choose specialties related to the service sectors where communication skills are prevalent, while engineering careers are considered suitable for males. Adherence to the traditional gender beliefs that science is a masculine subject and not suitable for girls can discourage girls and women from pursuing STEM careers.

Additionally, the family was found to reinforce stereotypes about appropriate careers for female and male students, conveying STEM as appropriate for males. It was indicated that girls tend to change their minds about their future careers after having discussions with their families. Since the social environment conceptualises gender norms, framing the profession as masculine or feminine, STEM is viewed as a masculine area in Kazakhstani society, and gender role expectations discourage girls from pursuing STEM careers. Therefore, gender disparities in choosing STEM careers are not related to the biological construct of men and women but depend on how the social environment conceptualises gender norms.

Since the family tends to reinforce gender stereotypes and discourage girls from pursuing STEM careers, it is important for schools and teachers to create an inclusive and gender-neutral learning environment that encourages girls to pursue their interest in STEM. Teachers can play an active role in challenging gender stereotypes and promoting a more diverse and inclusive view of gender roles in the classroom. Additionally, schools can introduce initiatives that encourage girls to pursue STEM, such as mentorship programs and scholarships for female students in STEM fields.

6.2 Limitations

The study explored the presence of the gendered hidden curriculum within the context of STEM subjects in one school for gifted students. It is important to note that the findings of the research may not fully capture the experiences and perspectives of students in mainstream schools, given that the research was conducted at a selective school for students with high abilities. Thus, the findings of the research are limited to students with high abilities. Furthermore, the school is rich in resources, especially for STEM subjects. Hence, it is plausible that data from an alternative context may have been gathered to scrutinise potential variations in findings among different school types. Due to the classification of research involving participants under the age of 18 as “high risk”, the process of obtaining ethics approval for such studies is lengthier. As a result, my research is restricted to high school students does not consider the perspectives and experiences of secondary or primary school students. In addition, there are no students aged 18 years or older in mainstream schools, so given the duration of a masters’ thesis, it was not feasible to study the hidden curriculum perspectives at mainstream schools.

Furthermore, it is important to study other factors such as geographical location or the influence of socio-economic background to determine their role in shaping gender related stereotypes and the underrepresentation of girls and women in STEM.

Acknowledging the small scale of the research is an important step in being transparent about the limitations of the research. However, it is also important to highlight the steps taken to enhance the rigor and validity of the study despite its small scale.

In this case, while the study may have been small in terms of the number of participants, data were collected from multiple stakeholders, including both teachers and students. Additionally, a variety of data collection methods were employed, including semi-structured interviews, FGDs, and lesson observations.

By utilizing multiple methods and perspectives, the study was able to gather a more comprehensive understanding of the topic at hand. This approach also helped to mitigate the potential biases that may have arisen from relying on only one source of data or one method of data collection.

6.3 Recommendations

The research findings have contributed to a better understanding of teachers' and students' perceptions of the gendered hidden curriculum and the ways gendered aspects of the hidden curriculum influence male and female students' career aspirations. The research provides several recommendations for engaging students in STEM, in particular girls. First, schools should actively encourage girls' participation in STEM subjects by providing opportunities for girls to explore their interests and abilities in these fields. This could involve offering extracurricular activities or clubs that focus on STEM subjects or providing access to female role models in this field. In addition, providing training for teachers on gender equity is one of the ways to address teachers' own biases. This training should cover the strategies for promoting gender equity in the classroom and ways to avoid language and practices that reinforce gender stereotypes. To ensure that all students are able to reach their full potential, it will be necessary, to train both pre-service and in-service teachers to implement gender-sensitive teaching strategies (UNESCO Bangkok, 2016). It is also important to guarantee that

there is no promotion of gender stereotypes in educational materials by conducting a revision of textbooks and curricular materials (p. 4).

Since gendered cultural and classroom norms are still prevalent, it is necessary to have an understanding of the elements that impact students' choice of major (Hunt & Michael, 1983). This will allow for the organisation and delivery of more informed career counselling to students. In addition, gender-sensitive career counselling programmes should be developed for secondary school students in order to assist such students in making an educated decision on their future careers prior to entering high school. It is essential that schools and instructors collaborate with parents and families to combat the gendered stereotypes they uphold, as this is another factor that determines the level of interest and ambitions that girls have in STEM fields.

6.4 Directions for Future Research

The present study aimed to explore teachers' and students' perspectives and experiences on the gendered hidden curriculum in STEM subjects using a qualitative case study design. The study could be expanded by exploring the perspectives of parents. This would enable a comprehensive understanding of the impact of the gendered hidden curriculum on students' career pathways.

Given that the current study was conducted only in one school with predominantly high-achieving students, a similar study in a mainstream school would yield valuable perspectives. An additional avenue for future research may involve the perspectives of students attending mainstream schools in urban and rural areas using a multiple case study approach to analyse the influence of socio-economic factors on students' engagement and choice of STEM fields, as school and geographical contexts may vary. In addition to a case study method, it would be beneficial to analyse STEM course books to identify potential gendered patterns that may impede the participation of both male and female students.

6.5 Personal Reflection

Conducting this research allowed me to develop a deeper understanding of a gendered STEM and gendered hidden curriculum in STEM subjects in the context of Kazakhstani schools. Through the process of conducting research, I uncovered new insights and perspectives that I was not previously aware of. Additionally, thesis research helped me to develop critical thinking, research skills, and analytical skills that will be valuable in many different areas of life.

However, conducting thesis research was quite challenging. It required a significant amount of time, effort, and dedication, as well as the ability to manage and organise complex data and information. Additionally, prior to the beginning of the data collection procedure, I faced obstacles with getting permission from school principals to conduct research. Unfortunately, I realised that some schools and principals are not aware of the benefits of conducting research in their schools and still hold perceptions that researcher conducts research only to check or reveal problems that schools do not want to uncover.

Overall, while conducting thesis research can be challenging, the benefits of the experience are well worth the effort. By pushing myself to explore new ideas and perspectives, I found that I am able to achieve a deeper understanding of my chosen field and develop skills that will be valuable throughout my academic and professional career.

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Appendices

Appendix A

TEACHER INFORMED CONSENT FORM

Title: "The Gendered Hidden Curriculum of STEM Subjects. Insights from One STEM Oriented School in Kazakhstan".

Dear Participant,

I am Ayaulym Bauyrzhanova, a Masters' degree student at Nazarbayev University, Graduate School of Education. I am going to conduct research about the gendered hidden curriculum of STEM (Science, Technology, Engineering, and Mathematics) subjects in Grade 12. The hidden curriculum refers to the unwritten, unofficial, and often unintended lessons and perspectives that students learn in school. The gendered hidden curriculum manifestation can be apparent in stereotypical ideas about how girls and boys are expected to study different subjects because of their academic abilities. Therefore, I invite you to participate in the study because your experience and views on the issue will be very valuable to explore the issue in-depth. In this letter, you are provided with the information related to my research project.

The purpose of this qualitative study is to explore Year 12 students' and teachers' perceptions about the gendered hidden curriculum in STEM subjects and to find out the extent to which the gendered aspects of the hidden curriculum influence male and female students' career pathways in STEM.

You will be asked to participate in a one-on-one interview that will take about 40-60 minutes, at a place and time convenient for you. You will be asked several questions about your perceptions of the gendered hidden curriculum in STEM subjects such as how STEM learners' engagement and performance in your subject might differ according to student gender and how appropriate a STEM career is for boys and girls.

If you find some questions challenging, you are not required to answer them. If you permit, the interview will be recorded for collecting and analysing the data.

Furthermore, to better understand the gendered hidden curriculum perspectives on STEM subjects, I will observe one of your lessons and take notes with your permission.

The information from the interview and lesson observation be published as a Master's Degree Thesis work. The results of this research also may be presented at scientific or professional meetings or published in scientific journals, but your name and the name of your school will not be associated with the research findings in any way.

There are minimal anticipated risks for you in the study such as embarrassment to share your own opinion or experience. Please, feel assured that your answers will be kept confidential and I will use pseudonyms instead of your name and the name of your school will not be used in any written reports. You can also skip any questions that you do not want to answer. Your data along with other participants' will be stored on NU Google Drive, accessible only to my supervisor and me. I will transcribe the interview myself.

The benefit of participation is for you to reflect on your practices and expand your understanding of the gendered hidden curriculum in STEM subjects. In addition, your participation will enable me to produce findings, insights and support reflections on how teachers and the school might be unconsciously reproducing gender stereotypes, as well as what they can do to promote gender equality in and through education.

Participation in this study is strictly voluntary, and you can withdraw participation at any time without prejudice.

Should any questions, concerns or comments arise regarding this project, please contact my supervisor, Professor Naureen Durrani from Nazarbayev University Graduate School of Education (naureen.durrani@nu.edu.kz).

If you agree to participate in the study *"The Gendered Hidden Curriculum of STEM Subjects. Insights from One STEM Oriented School in Kazakhstan"*, sign this consent form, please.

- I have carefully read the information provided;
- I have been given full information regarding the purpose and procedures of the study;
- I consent to take part in the interview
- I give permission for my interview to be recorded
- I allow my lesson to be observed by the researches;
- I understand how the data collected will be used;
- I understand that I am free to withdraw from the study at any time without giving a reason;
- With full knowledge of all foregoing, I agree, of my own free will, to participate in this study

Signature: _____ Date: _____

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МҰҒАЛІМНІҢ АҚПАРАТТЫҚ КЕЛІСІМ ФОРМАСЫ

Зерттеу тақырыбы: STEM пәндеріндегі гендерлік жасырын оқу бағдарламасы. Қазақстандағы бір мамандандырылған мектептегі зерттеу.

Құрметті Қатысушы!

Мен, *Бауыржанова Аяулым*, Назарбаев Университетінің магистранты, 12-сыныпта STEM (жаратылыстану, технология, инженерия және математика) пәндерінен гендерлік жасырын оқу бағдарламасы бойынша зерттеу жүргізгелі жатырмын.. Жасырын оқу жоспары оқушылардың мектепте меңгеретін жазылмаған, бейресми және көбінесе күтпеген сабақтары мен көзқарастарын білдіреді. Гендерлік жасырын оқу жоспарының көрінісі қыздар мен ұлдардың академиялық қабілеттеріне байланысты әртүрлі пәндерді оқуы керек деген стереотиптік нанымдарда көрінуі мүмкін. Сондықтан, мен сізді осы зерттеуге қатысуға шақырамын, өйткені бұл мәселе бойынша сіздің тәжірибеңіз бен пікіріңіз тақырыпты тереңірек зерттеу үшін өте пайдалы болады.

Бұл зерттеудің мақсаты 12-сынып оқушылары мен мұғалімдерінің STEM пәндері бойынша гендерлік жауап беретін жасырын оқу жоспарын қабылдауын түсіну және жасырын оқу бағдарламасының гендерлік аспектілерінің жас қыздар мен ұлдардың STEM мансап жолына қаншалықты әсер ететінін зерттеу.

Шамамен 40-60 минутқа созылатын сұхбатқа қатысуыңызды сұраймын.Сұхбат өзіңізге ыңғайлы жерде және уақытта өтеді. Сізге STEM пәндеріндегі гендерлік жасырын оқу жоспарына байланысты бірнеше сұрақтар қойылады, мысалы, оқушылардың сіздің STEM пәніңізде қатысуы және үлгерімі студенттің жынысына байланысты қалай ерекшеленуі мүмкін және STEM жұмыстары ұлдар мен қыздарға қаншалықты сәйкес келеді.

Кейбір сұрақтар сізге қиын болса, оларға жауап бермеуіңізге болады. Рұқсат етсеңіз, сұхбат деректерді аудио жазбаға жазылады.

Сондай-ақ, STEM оқу бағдарламасының гендерлік жасырын перспективаларын жақсырақ түсіну мақсатында мен сіздің сабақтарыңыздың біріне бақылау мақсатында қатысамын.

Сұхбат және сабақты бақылау деректері зерттеу есебін жазу үшін пайдаланылады. Сондай-ақ зерттеу нәтижелері ғылыми конференцияларда немесе ғылыми журналда жариялануы мүмкін.

Зерттеу жазбаларында сіздің жеке ақпаратыңыздың құпиялығын сақтау үшін барлық шаралар жасалады. Жазбалар мен жиналған мәліметтер тек зерттеушіге ғана қолжетімді болады. Атыңыздың орнына лақап аттар пайдаланылады және басқа идентификациялық ақпарат NU Google Drive жүйесіндегі құпия сөзбен қорғалған қалталарда құпия сақталады. Сондай-ақ зерттеу нәтижелері ғылыми конференцияларда немесе ғылыми журналда жариялануы мүмкін.

Бұл зерттеуге қатысудың сізге пайдасы - сіз STEM пәндеріндегі гендерлік жасырын оқу жоспары туралы түсінігіңізді кеңейтесіз. Сонымен қатар, сіздің қатысуыңыз маған қорытынды жасауға және мұғалімдер мен мектептердің гендерлік стереотиптерді қалай бейсаналық түрде жаңғырта алатыны, сондай-ақ білім берудегі гендерлік теңдікті ілгерілету үшін не істей алатыны туралы ойлануға мүмкіндік береді.

Сіздің осы зерттеуге қатысуыңыз қатаң түрде ерікті және келісім берілсе, ол кез келген уақытта зиянсыз кері қайтарып алынуы мүмкін. Сіз нақты сұрақтарға жауап беруден бас тартуға құқылысыз.

Осы зерттеуге қатысты сұрақтарыңыз болса немесе қосымша ақпарат алғыңыз келсе, маған хабарласуыңызды сұраймын

Осы жобаға қатысты сұрақтарыңыз немесе пікірлеріңіз болса, менің ғылыми жетекшім, Назарбаев Университеті Жоғары білім мектебінің профессоры Наурин Дурраниге хабарласыңыз (naureen.durrani@nu.edu.kz).

Егер сіз “STEM пәндері бойынша жасырын гендерлік оқу бағдарламасына қатысуға келісім берсеңіз, Қазақстандағы STEM-бағдарланған бір мектептен көрініс”, осы келісім формасына қол қоюыңызды өтінемін.

- Мен берілген ақпаратты мұқият оқып шықтым;
- Маған зерттеудің мақсаттары мен процедуралары туралы толық ақпарат берілді;
- Мен сұхбатқа қатысуға келісемін;
- Мен сұхбатты жазуға рұқсат беремін;
- Зерттеушіге сабағымды бақылауға рұқсат етемін;
- Жиналған деректер қалай пайдаланылатынын

түсінемін;

- Мен кез келген уақытта себепсіз зерттеуден бас тарта алатынымды түсінемін;
- Жоғарыда айтылғандарды ескере отырып, мен осы зерттеуге қатысуға өз еркіммен келісемін.

Қолы: _____ Күні: _____

Білім беру көшбасшылығы магистрі,

Назарбаев Университеті Жоғары білім беру мектебінің,

Нұр-Сұлтан қаласы, Қабанбай батыр даңғылы, 53

Электрондық пошта: ayaulym.bauyrzhanova@nu.edu.kz

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ФОРМА ИНФОРМАЦИОННОГО СОГЛАСИЯ УЧИТЕЛЯ

Тема исследования: Гендерно-скрытая учебная программа по предметам STEM. Пример одной специализированной школы в Казахстане.

Уважаемый Участник!

Я, Бауыржанова Аяулым, студент магистратуры в Назарбаев Университете, собираюсь провести исследование о гендерно-скрытой учебной программе по предметам STEM (наука, технология, инженерия и математика) в 12 классе. Скрытая учебная программа относится к неписаным, неофициальным и часто непреднамеренным урокам и перспективам, которые учащиеся изучают в школе. Гендерное скрытое проявление учебной программы может проявляться в стереотипных представлениях о том, что девочки и мальчики должны изучать разные предметы из-за их академических способностей. Поэтому, Я приглашаю Вас принять участие в данном исследовании, потому что ваш опыт и мнение по этому вопросу будут очень полезны для углубленного изучения темы.

Цель данного исследования — изучить восприятие учащимися 12-х классов и учителями скрытой учебной программы по предметам STEM, учитывающей гендерные факторы, и выяснить, в какой степени гендерные аспекты скрытой учебной программы влияют на карьерные пути молодых девушек и мальчиков в STEM.

Прошу вас пройти интервью, которое займет около 40-60 минут, в удобное для вас место и время. Вам будет задано несколько вопросов о вашем восприятии гендерно-ориентированной скрытой учебной программы по предметам STEM, например, как вовлеченность и успеваемость учащихся STEM по вашему предмету могут различаться в зависимости от пола учащегося и насколько подходит карьера STEM для мальчиков и девочек.

Если некоторые вопросы вызывают у вас затруднения, вы не обязаны на них отвечать. Если вы позволите, интервью будет записано для сбора и анализа данных.

Кроме того, чтобы лучше понять гендерные скрытые перспективы учебной программы по предметам STEM, я буду наблюдать за одним из ваших уроков и делать заметки с вашего разрешения.

Информация из интервью и наблюдения за уроком будет использована при написании исследовательского отчета. Я также могу представить результаты на конференции или опубликовать исследование в научном журнале.

В исследовании для вас предусмотрены минимальные ожидаемые риски, такие как смущение, когда вы делитесь своим мнением или опытом. Пожалуйста, будьте уверены, что ваши ответы будут храниться в тайне, и я буду использовать псевдонимы вместо вашего имени, а название вашей школы не будет использоваться ни в каких письменных отчетах. Вы также можете пропустить вопросы, на которые не хотите отвечать. Ваши данные вместе с данными других участников будут храниться на Google Диске НУ, доступном только моему руководителю и мне. Я сама расшифрую интервью.

Преимущество в участии в данном исследовании для вас заключается в том, что вы расширите свое понимание гендерной скрытой учебной программы по предметам STEM. Кроме того, ваше участие позволит мне сделать выводы, и поддержать размышления о том, как учителя и школа могут бессознательно воспроизводить гендерные стереотипы, а также о том, что они могут сделать для продвижения гендерного равенства в образовании.

Ваше участие в этом исследовании является строго добровольным, и если дано согласие на участие, оно может быть отозвано в любое время без ущерба. Вы имеете право отказаться отвечать на конкретные вопросы.

Если у вас есть какие-либо вопросы касательно данного исследования или вам нужна дополнительная информация, пожалуйста, не стесняйтесь обращаться ко мне.

Если возникнут какие-либо вопросы, опасения или комментарии относительно этого проекта, пожалуйста, свяжитесь с моим руководителем, профессором Наурин Дуррани из Высшей школы образования Назарбаев Университета (naureen.durrani@nu.edu.kz).

Если вы согласны принять участие в исследовании *«Скрытая гендерная учебная программа по предметам STEM. Взгляд из одной STEM-ориентированной школы в Казахстане. »*, подпишите эту форму согласия, пожалуйста.

- Я внимательно прочитал предоставленную информацию;
- Мне предоставлена полная информация о целях и процедурах исследования;
- Даю согласие на участие в интервью;
- Я даю разрешение на запись моего интервью;
- Я позволяю исследователю наблюдать за моим уроком;
- Я понимаю, как будут использоваться собранные данные;
- Я понимаю, что могу отказаться от участия в исследовании в любое время без объяснения причин;
- Сознавая все вышеизложенное, я добровольно соглашаюсь участвовать в этом исследовании.

Подпись: _____ Дата:

_____

Аяулым Бауыржанова, магистр в лидерстве в образовании

Высшая школа образования, Назарбаев Университет

г. Нур-Султан, проспект Кабанбай батыра 53

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Мобильный: +7 7028409303

Appendix B

STUDENT INFORMED CONSENT FORM

Title: "The Gendered Hidden Curriculum of STEM Subjects. Insights from One STEM Oriented School in Kazakhstan.

Dear Participant!

I am Ayaulym Bauyrzhanova, a Master's degree student at Nazarbayev University, Graduate School of Education. I am going to conduct research about the gendered hidden curriculum of STEM (Science, Technology, Engineering, and Mathematics) subjects in Grade 12. The hidden curriculum refers to the unwritten, unofficial, and often unintended lessons and perspectives that students learn in school. The gendered hidden curriculum manifestation can be apparent in stereotypical ideas about how girls and boys are expected to study different subjects because of their academic abilities. Therefore, I invite you to participate in the study because your experience and views on the issue will be very valuable to explore the issue in-depth. In this letter, you are provided with the information related to my research project.

The purpose of this qualitative study is to explore Year 12 students' and teachers' perceptions about the gendered hidden curriculum in STEM subjects and to find out the extent to which the gendered aspects of the hidden curriculum influence male and female students' career pathways in STEM.

You will participate in a focus group discussion which will take approximately *40* minutes. You will be asked to reflect on the questions regarding your major subject choice and factors affecting your career pathway choice. Only your gender and the subject of choice will be revealed during the analysis of the collected data. All the participants will be asked not to identify themselves and others, but there is a risk of breach of confidentiality in a group

setting. If you find some questions challenging, you are not required to answer them. If you permit, the interview will be recorded for collecting and analysing the data.

Any information that is obtained during this study will be used in writing a research report. Data collected from the focus group discussions will be kept confidential to the full extent possible. All efforts, within reason, will be made to keep your personal information in my research record confidential. Pseudonyms will be used instead of your names and other identifying information will be kept confidential in password protected folders on NU Google Drive. I may also present the findings at a conference or publish the study in a journal.

Your participation in this study is strictly voluntary, and if agreement to participation is given, it can be withdrawn at any time without prejudice. You have the right to refuse to answer particular questions.

Should any questions, concerns or comments arise regarding this project, please contact my supervisor, Professor Naureen Durrani from Nazarbayev University Graduate School of Education (naureen.durrani@nu.edu.kz).

If you agree to participate in the study *"The Gendered Hidden Curriculum of STEM Subjects. Insights from One STEM Oriented School in Kazakhstan. "*, sign this consent form, please

- I have carefully read the information provided;
- I have been given full information regarding the purpose and procedures of the study;
- I consent to take part in focus group discussions
- I give permission for my interview to be recorded
- I understand how the data collected will be used;
- I understand that I am free to withdraw from the study at any time without giving a reason;
- With full knowledge of all foregoing, I agree, of my own free will, to participate in this study

Signature: _____ Date: _____

Ayaulym Bauyrzhanova, M.Sc. in Educational Leadership
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СТУДЕНТТІҢ АҚПАРАТТЫҚ КЕЛІСІМ ФОРМАСЫ

Зерттеу тақырыбы: STEM пәндеріндегі гендерлік жасырын оқу бағдарламасы. Қазақстандағы бір мамандандырылған мектептегі зерттеу.

Құрметті Қатысушы!

Мен, *Бауыржанова Аяулым*, Назарбаев Университетінің магистранты, 12-сыныпта STEM (жаратылыстану, технология, инженерия және математика) пәндерінен гендерлік жасырын оқу бағдарламасы бойынша зерттеу жүргізгелі жатырмын. Жасырын оқу жоспары оқушылардың мектепте меңгеретін жазылмаған, бейресми және көбінесе күтпеген сабақтары мен көзқарастарын білдіреді. Гендерлік жасырын оқу жоспарының көрінісі қыздар мен ұлдардың академиялық қабілеттеріне байланысты әртүрлі пәндерді оқуы керек деген стереотиптік нанымдарда көрінуі мүмкін. Сондықтан, мен сізді осы зерттеуге қатысуға шақырамын, өйткені бұл мәселе бойынша сіздің тәжірибеңіз бен пікіріңіз тақырыпты тереңірек зерттеу үшін өте пайдалы болады.

Бұл зерттеудің мақсаты 12-сынып оқушылары мен мұғалімдерінің STEM пәндері бойынша гендерлік жауап беретін жасырын оқу жоспарын қабылдауын түсіну және жасырын оқу бағдарламасының гендерлік аспектілерінің жас қыздар мен ұлдардың STEM мансап жолына қаншалықты әсер ететінін зерттеу.

Сізді шамамен 40 минутты алатын фокус-топтық талқылауға қатысуыңызды сұраймын.. Сізден негізгі пән таңдауыңызға және мамандық таңдауыңызға әсер ететін факторларға қатысты сұрақтарға жауап беру сұралады.

Жиналған деректерді талдау кезінде тек сіздің жынысыңыз бен таңдау пәніңіз ашылады. Барлық қатысушылардан өздерінің және басқа қатысушылардың аты-жөнін

ешкімге жарияламау сұралады, алайда топтық жағдайда құпиялылықтың сақталмау қаупі бар. Кейбір сұрақтар сізге қиын болса, оларға жауап берудің қажеті жоқ. Рұқсат етсеңіз, сұхбат деректерін жинау және талдау мақсатында аудиожазба жазылады.

Осы зерттеу барысында алынған ақпарат зерттеу есебін жазуда пайдаланылады. Осы зерттеу барысында алынған ақпарат барынша құпия сақталады. Осы зерттеу барысында алынған барлық ақпарат мүмкіндігінше құпия болып қалады. Зерттеу жазбаларында сіздің жеке ақпаратыңыздың құпиялығын сақтау үшін барлық шаралар жасалады, бірақ топтық жағдайда толық құпиялылыққа кепілдік берілмейді. Жазбалар мен жиналған мәліметтер тек зерттеушіге ғана қолжетімді болады. Атыңыздың орнына лақап аттар пайдаланылады және басқа идентификациялық ақпарат NU Google Drive жүйесіндегі құпия сөзбен қорғалған қалталарда құпия сақталады. Сондай-ақ зерттеу нәтижелері ғылыми конференцияларда немесе ғылыми журналда жариялануы мүмкін.

Сіздің осы зерттеуге қатысуыңыз қатаң түрде ерікті және келісім берілсе, ол кез келген уақытта зиянсыз кері қайтарып алынуы мүмкін. Сіз нақты сұрақтарға жауап беруден бас тартуға құқылысыз.

Осы жобаға қатысты сұрақтарыңыз немесе пікірлеріңіз болса, менің жетекшім, Назарбаев Университеті Жоғары білім беру мектебінің профессоры Наурин Дурраниге хабарласуыңызды сұраймын (naureen.durrani@nu.edu.kz).

Егер сіз “STEM пәндері бойынша жасырын гендерлік оқу бағдарламасына қатысуға келісім берсеңіз, Қазақстандағы STEM-бағдарланған бір мектептен көрініс”, осы келісім формасына қол қоюыңызды өтінемін.

- Мен берілген ақпаратты мұқият оқып шықтым;
- Маған зерттеудің мақсаттары мен процедуралары туралы толық ақпарат берілді;
- Мен сұхбатқа қатысуға келісемін;

- Мен сұхбатты жазуға рұқсат беремін;
- Жиналған деректер қалай пайдаланылатынын түсінемін;
- Мен кез келген уақытта себепсіз зерттеуден бас тарта алатынымды түсінемін;
- Жоғарыда айтылғандарды ескере отырып, мен осы зерттеуге қатысуға өз еркіммен келісемін.

Қолы: _____ Күні: _____

Білім беру көшбасшылығы магистрі,

Назарбаев Университеті Жоғары білім беру мектебінің,

Нұр-Сұлтан қаласы, Қабанбай батыр даңғылы, 53

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ФОРМА ИНФОРМАЦИОННОГО СОГЛАСИЯ СТУДЕНТА

Тема исследования: Гендерно-скрытая учебная программа по предметам STEM. Пример одной специализированной школы в Казахстане.

Уважаемый Участник!

Я, Бауыржанова Аяулым, студент магистратуры в Назарбаев Университете, собираюсь провести исследование о гендерно-скрытой учебной программе по предметам STEM (наука, технология, инженерия и математика) в 12 классе. Скрытая учебная программа относится к неписаным, неофициальным и часто непреднамеренным урокам и перспективам, которые учащиеся изучают в школе. Гендерное скрытое проявление учебной программы может проявляться в стереотипных представлениях о том, что девочки и мальчики должны изучать разные предметы из-за их академических способностей. Поэтому, Я приглашаю Вас принять участие в данном исследовании, потому что ваш опыт и мнение по этому вопросу будут очень полезны для углубленного изучения темы.

Цель данного исследования — изучить восприятие учащимися 12-х классов и учителями скрытой учебной программы по предметам STEM, учитывающей гендерные факторы, и выяснить, в какой степени гендерные аспекты скрытой учебной программы влияют на карьерные пути молодых девушек и мальчиков в STEM.

Вы будете участвовать в обсуждении в фокус-группе, которое займет около *40* минут. Вас попросят ответить на вопросы, касающимися вашего основного выбора предмета и факторов, влияющих на выбор вашей карьеры.

Только ваш пол и предмет выбора будут раскрыты в ходе анализа собранных данных. Всех участников попросят не идентифицировать себя и других, но есть риск

нарушения конфиденциальности в групповой обстановке. Если некоторые вопросы вызывают у вас затруднения, вы не обязаны на них отвечать. Если вы позволите, интервью будет записано для сбора и анализа данных.

Информация, полученная в ходе этого исследования, будет использована при написании исследовательского отчета. Информация, полученная в ходе этого исследования, будет оставаться конфиденциальной в максимально возможной степени. Будут предприняты все разумные усилия для сохранения конфиденциальности вашей личной информации в записях исследования, но полная конфиденциальность в групповой обстановке не может быть гарантирована. Вместо вашего имени будут использоваться псевдонимы, а другая идентифицирующая информация будет храниться конфиденциально в защищенных паролем папках на NU Google Drive. Я также могу представить результаты на конференции или опубликовать исследование в журнале.

Ваше участие в этом исследовании является строго добровольным, и если дано согласие на участие, оно может быть отозвано в любое время без ущерба. Вы имеете право отказаться отвечать на конкретные вопросы.

Если возникнут какие-либо вопросы, опасения или комментарии относительно этого проекта, пожалуйста, свяжитесь с моим руководителем, профессором Наурин Дуррани из Высшей школы образования Назарбаев Университета (naureen.durrani@nu.edu.kz).

Если вы согласны принять участие в исследовании «Скрытая гендерная учебная программа по предметам STEM. Взгляд из одной STEM-ориентированной школы в Казахстане.», подпишите эту форму согласия, пожалуйста.

- Я внимательно прочитал предоставленную информацию;
- Мне предоставлена полная информация о целях и процедурах исследования;

- Даю согласие на участие в интервью;
- Я даю разрешение на запись моего интервью;
- Я понимаю, как будут использоваться собранные данные;
- Я понимаю, что могу отказаться от участия в исследовании в любое время без объяснения причин;
- Сознавая все вышеизложенное, я добровольно соглашаюсь участвовать в этом исследовании.

Подпись: _____ Дата:

_____

Аяулым Бауыржанова, магистр в лидерстве в образовании

Высшая школа образования, Назарбаев Университет

г. Нур-Султан, проспект Кабанбай батыра 53

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Мобильный: +7 7028409303

Appendix C

Interview Protocol

Title: **The Gendered Hidden Curriculum of STEM Education. Insights from One STEM Oriented School in Kazakhstan.**

Date: _____

Time: _____

Participants' gender &subject specialism: _____

Participant code/ pseudonym:_____

[After introducing myself, I will thank the participants for their agreement to participate in the interview. I will remind them of the purpose, significance, measures taken to ensure their confidentiality and the approximate duration of the talk.]

[I will ask the participants to read the informed consent form and sign it if they agree to participate in the interview. I will ask their permission to audio record the discussion. With the participants' permission, I will start recording the discussion.]

Interview questions:

1. Can you please tell me a little more about your work as a teacher and how many years you have been teaching for?
2. Based on your teaching experiences, please tell me how boys and girls differ in your subject specialism?
    - Sense of responsibility as a learner;

- Independence as a
  learner;

- Interest in the subject;
- Ability or competence in the subject;
- Academic performance;
- Preferences for specific teaching method;
- Response to specific disciplinary measures.

3. In what ways do you respond to the gender differences in your teaching and interaction with students?
4. Do you think that a 'teachers' gender plays a role in the way they communicate with students or their expectations of students? If yes, how? If no, why?
5. Now let's talk about gender and specific careers. How appropriate are STEM careers for girls/ boys in Kazakhstan? Why?
6. There is a stereotype that girls are not as good at STEM as boys, do you agree or disagree with this point?
7. Have you faced any particular challenges in your teaching career related to your gender?
8. What's one message will you give girls interested in STEM education and careers? What about boys?

[I will thank the participants for participating in the interview.]

Сұхбат

Тақырыбы: **STEM пәндеріндегі гендерлік жасырын оқу бағдарламасы. Қазақстандағы бір мамандандырылған мектептегі зерттеу.**

Күні: _____

Уақыты: _____

Қатысушылардың жынысы мен пәні: _____

Қатысушының коды/лақап аты:

_____

[Өзімді таныстырып болғаннан кейін, қатысушыларғасұхбатқа қатысуға келіскендері үшін алғыс айтамын. Қатысушыларға зерттеудің мақсатын, маңыздылығын, олардың құпиялығын қамтамасыз ету үшін қабылданған шараларды және талқылаудың шамамен ұзақтығын еске саламын.]

[Қатысушылар талқылауға қатысуға келіссе, ақпараттандырылған келісім парағын оқып, қол қоюын сұраймын. Мен олардан талқылауды аудиожазбаға жазуға рұқсат сұраймын. Қатысушылардың рұқсатымен мен талқылауды жазуды бастаймын.

Сұхбат сұрақтары:

1. Ұстаздық қызметіңіз туралы және қанша жыл ұстаздық еткеніңіз туралы аздап айтып бере аласыз ба?

2. Педагогикалық тәжірибеңізге сүйене отырып, сіздің пәніңіз бойынша ұлдар мен қыздардың айырмашылығы неде екенін айтыңызшы?

    - Оқушының жауапкершілік сезімі
    - Оқушының дербестігі

    - қызығушылық
    - Пәндегі қабілеттілік немесе құзыреттілік
    - Академиялық үлгерім
    - Оқытудың белгілі бір әдісіне басымдық
    - Нақты тәртіптік әрекеттерге реакция

3. Сіз оқытудағы және студенттермен қарым-қатынасыңыздағы гендерлік айырмашылықтарға қалай қарайсыз?

4. Сіздің ойыңызша, «мұғалімдердің» жынысы олардың студенттермен қарым-қатынасына немесе студенттерден қандай нәтиже күтетілетініне әсер ете ме? Егер солай болса, қалай? Егер жоқ болса, неге жоқ?

5. Енді гендерлік және нақты мамандықтар туралы сөйлесейік. Қазақстандағы қыздар/ұлдар үшін STEM мамандықтары қаншалықты қолайлы? Неліктен?

6. Ұлдарға қарағанда қыздар STEM бойынша нашар деген стереотип бар. Сіз мұнымен келісесіз бе немесе келіспейсіз бе?

7. Сіз мұғалімдік мансабыңызда жынысыңызға байланысты қандай да бір қиындықтарға тап болдыңыз ба?

8. STEM білімі мен мансапқа қызығушылық танытқан қыздарға қандай кеңес айтар едіңіз? Ал ұлдарға ше?

[Мен қатысушыларға пікірталасқа қатысқандары үшін алғыс айтамын.]

Протокол Интервью

Название: **Гендерно-скрытая учебная программа по предметам STEM. Пример одной специализированной школы в Казахстане.**

Дата: _____

Время: _____

Пол и предметная специализация участников: _____

Код/псевдоним участника:_____

[Представившись, я поблагодарю участников за их согласие на участие в интервью. Я напомню им о цели, значении, принятых мерах по обеспечению их конфиденциальности и примерной продолжительности беседы.]

[Я попрошу участников прочитать форму информированного согласия и подписать его, если они согласятся участвовать в обсуждении. Я спрошу у них разрешения на аудиозапись обсуждения. С разрешения участников я начну запись обсуждени.]

Вопросы для интервью:

1. Не могли бы вы рассказать мне немного больше о вашей работе в качестве учителя и сколько лет вы преподаете?
2. Опираясь на свой педагогический опыт, скажите, пожалуйста, чем мальчики и девочки отличаются по вашей предметной специализации? А как вы с чем это связано?

- Чувство ответственности учащегося
- Независимость учащегося

- Интерес к предмету
- Способность или компетентность в предмете
- Успеваемость в учебе
- Предпочтения в отношении конкретного метода обучения
- Реакция на конкретные дисциплинарные меры

3. Как вы реагируете на гендерные различия в вашем преподавании и взаимодействии со студентами?

4. Считаете ли вы, что пол «учителей» влияет на то, как они общаются со студентами, или на их ожидания от студентов? Если да, то как? Если нет, то почему?

5. Теперь поговорим о гендере и конкретных профессиях. Насколько подходит карьера STEM для девочек/мальчиков в Казахстане? Почему?

6. Существует стереотип, что девочки хуже разбираются в STEM предметах, чем мальчики. Вы согласны или не согласны с этим?

7. Сталкивались ли вы с какими-либо особыми трудностями в своей преподавательской карьере, связанными с вашим полом?

8. Какое одно сообщение вы дадите девушкам, заинтересованным в STEM-образовании и карьере? Как насчет мальчиков?

[Выражаю благодарность участникам за участие в интервью.]

Appendix D

Focus Group Discussion Guide

Title: **The Gendered Hidden Curriculum of STEM Subjects. Insights from One STEM Oriented School in Kazakhstan.**

Date: _____

Time: _____

Subject specialism: _____

Number of girls & their pseudonyms/codes:

Number of girls & their pseudonyms/codes:

[After introducing myself, I will thank the participants for their agreement to participate in the focus group discussion. I will remind them of the purpose, significance, measures taken to ensure their confidentiality and the approximate duration of the talk. I will remind them that complete confidentiality cannot be guaranteed and that the content of the discussion and participants' identities should not be disclosed to anyone.]

[I will ask the participants to read the informed consent form and sign it if they agree to participate in the discussion. I will ask for their permission to audio record the discussion. With the participants' permission, I will start recording the discussion.]

Focus group discussion questions:

1. What are your major subjects?

2. What is your reason for choosing biology, chemistry/ physics, ICT? Who helped you in choosing them?

2. What career do you want to pursue? Why do you wish to follow that career?

3. Are there any factors(for example, family/ interest/ ability/competence /good salary) that influenced your choice of major in STEM subjects?

4. How confident are you of your knowledge and skills in biology and chemistry/ physics and ICT? What evidence are you drawing on (e.g. grades, teacher appreciation)?

4. How would you describe your engagement in / with biology, chemistry/ physics and ICT inside the classroom? And outside the classroom? (cues, private study time, participation in classroom activities or experiments; volunteering to answer or lead on projects?

5. Should boys and girls study the same subjects?

5. Do you think girls/boys are treated differently or they behave differently in biology and chemistry/ physics and ICT classrooms? (e.g. teacher questions, assignment of leadership roles in classroom activities, teacher praise and feedback; student volunteering to respond/ take a leadership role or initiate a question/ discussion)

6. What do you not like about studying biology and chemistry/ physics and ICT?

7. What would make studying biology and chemistry/ physics and ICT more enjoyable for you?

8. What would make studying biology and chemistry/ physics and ICT more meaningful for you?

9. Are you facing barriers in pursuing a career pathway in STEM?

10. What are some biases you've encountered or seen others deal with in relation to who is best suited to study in one field or another? Are there any subjects you consider best suited for boys and for girls?

11. Is there any encouragement from parents/teachers to get into STEM?

12. Are there any science or math clubs or *after-school activities at your school ? What do you think of them? Do you join them?

13. Is the educational material you use in studies gender neutral?

[I will thank the participants for participating in the discussion. I again ask them not to disclose the content of the discussion and participants to others.]

Фокус-топтық талқылау хаттамалары

Зерттеу тақырыбы: STEM пәндеріндегі гендерлік жасырын оқу бағдарламасы. Қазақстандағы бір мамандандырылған мектептегі зерттеу.

Күні: _____

Уақыты:

_____

Қатысушылардың аты-жөні: _____

Қыздар саны және олардың лақап аттары/кодтары:

Ұлдар саны және олардың лақап аттары/кодтары:

[Өзімді таныстырып болғаннан кейін, қатысушыларға фокус-топтың талқылауына қатысуға келіскендері үшін алғыс айтамын. Қатысушыларға зерттеудің мақсатын, маңыздылығын, олардың құпиялығын қамтамасыз ету үшін қабылданған шараларды және талқылаудың шамамен ұзақтығын еске саламын.]

[Қатысушылардан зерттеуге қатысуға келісім формасын оқып, талқылауға қатысуға келіскен жағдайда қол қоюын сұраймын. Мен олардан талқылауды аудиоға жазуға рұқсат сұраймын. Қатысушылардың рұқсатымен мен талқылауды жазуды бастаймын.]

Фокус-топтық талқылауға арналған сұрақтар:

1. Биология, химия/физика, Информатика пәнін таңдауыңыздың себебі неде?

2. Қандай мансаппен айналысқыңыз келеді? Неліктен?

3. STEM пәндері бойынша мамандық таңдауыңызға әсер еткен факторлар (мысалы, отбасы/қызығулар/қабілеттер/құзыреттілік/жақсы жалақы) бар ма?

4. Биология, химия/физика және Информатика пәндері бойынша біліміңіз бен дағдыларыңызға қаншалықты сенімдісіз? Сіз қандай дәлелдерге сүйенесіз (мысалы, бағалар, мұғалімнің мақтауы)?

4. Сабақта биология, химия/физика және Информатика пәндеріне қатысуыңызды қалай сипаттар едіңіз? Сыныптан тыс уақытта ше? (сұрақтар, өз бетімен оқуға уақыт, сыныптағы іс-шараларға немесе эксперименттерге қатысу; жобаларға өз еркімен қатысу немесе оларға жауап беру?

5.Сіздің ойыңызша, қыздарға / ұлдарға басқаша қарым-қатынас жасалады ма немесе ұлдар/ қыздар биология, химия/физика және инфориатика сабақтарында өздерін өзгеше ұстайды ма? (мысалы, мұғалімнің сұрақтары, сыныптағы көшбасшылық рөлдерді бөлу, мұғалімнің мадақтауы және кері байланыс; оқушылардың көшбасшылық рөлі атқаруға дайын болуы, немесе сұрақтар қойып, пікірталас бастауы және т.б.)

6. Биология, химия/физика және Информатика пәндерін оқығанда сізге не ұнамайды? ?

7. Биология мен химия/физика және АКТоқып үйренуді не жағымды етер еді ?

8. Сіз белгілі бір салада оқуға кім қолайлы екеніне қатысты басқаларды кездестірдіңіз бе немесе көрдіңіз бе ?

11. Сіздің мектебіңізде жаратылыстану және математикалық үйірмелер бар ма? немесе сыныптан тыс іс-шаралар? Олар туралы не ойлайсыз? Сіз оларға қатысасыз ба?

[Мен қатысушыларға пікірталасқа қатысқандары үшін алғыс айтамын. Мен тағы да олардан талқылаудың мазмұнын және қатысушыларды басқаларға жарияламауын сұраймын.]

Протокол обсуждения в фокус группе

Название: **Гендерно-скрытая учебная программа по предметам STEM. Пример одной специализированной школы в Казахстане.**

Количество девушек и их псевдонимы/коды:

Количество мальчиков и их псевдонимы/коды:

[Представившись, я поблагодарю участников за их согласие участвовать в обсуждении в фокус-группе. Я напомню им о цели, значимости, мерах, принятых для обеспечения их конфиденциальности, и о приблизительной продолжительности беседы. Я напомню им, что полная конфиденциальность не может быть гарантирована и что содержание обсуждения и личности участников не должны раскрываться никому.]

[Я попрошу участников прочитать форму информированного согласия и подписать его, если они согласятся участвовать в обсуждении. Я спрошу у них разрешения на аудиозапись обсуждения. С разрешения участников я начну запись обсуждения.]

Вопросы для обсуждения в фокус-группе:

1. Какие ваши основные предметы?
2. Почему вы выбрали биологию, химию/физику, ИКТ? Кто помогал вам в их выборе?
3. Какой карьерой вы хотите заниматься? Почему?
4. Есть ли какие-либо факторы (например, семья/интересы/способности/компетентность/хорошая заработная плата), которые повлияли на ваш выбор специальности по предметам STEM?
5. Насколько вы уверены в своих знаниях и навыках в области биологии, химии/физики и ИКТ? На какие доказательства вы опираетесь (например, оценки, похвала учителя)?

6. Как бы вы описали свое участие в биологии, химии/физике и ИКТ в классе? А вне класса? (подсказки, время на самостоятельные занятия, участие в классных занятиях или экспериментах; добровольное участие в проектах или ответы на них?
7. Должны ли мальчики и девочки изучать одни и те же предметы?
8. Считаете ли вы, что к девочкам/мальчикам относятся по-разному или они ведут себя по-разному на уроках биологии, химии/физики и ИКТ? (например, вопросы учителей, распределение ролей лидера в занятиях в классе, похвала и обратная связь учителя; учащиеся добровольно отвечают/берут на себя роль лидера или инициируют вопрос/обсуждение)
9. Что вам не нравится в изучении биологии и химии/физики и ИКТ?
10. Что может сделать изучение биологии и химии/физики и ИКТ более приятным для вас?
11. Что может сделать изучение биологии и химии/физики и ИКТ более значимым для вас?
12. Сталкиваетесь ли вы с препятствиями на пути к карьере в STEM ?
13. С какими предубеждениями вы сталкивались или видели, как другие сталкиваются в отношении того, кто лучше всего подходит для обучения в той или иной области ? Есть ли предметы, которые, по вашему мнению, лучше всего подходят для мальчиков и для девочек?
14. Есть ли в вашей школе кружки по естествознанию и математике или внеклассные мероприятия? Что вы о них думаете? Вы присоединяетесь к ним?

[Я поблагодарю участников за участие в обсуждении. Я еще раз попрошу их не раскрывать содержание обсуждения и участников другим лицам.]

Appendix E

Observation Protocol

General Information:

Teacher pseudonym: Grade:

Observation date:

Time Start: End:_____

Subject: Chemistry

Student number:

No. of girls:

No. of boys:

Lesson topic:

Lesson objectives:

Student Seating:

Resources:

1. Wall charts: What does the classroom look like? Are there any hidden messages transferred in the form of dominantly male scientists being portrayed?
2. Proportion of girls to boys in subjects studied (To establish the ratio of boys to girls in STEM subjects):

3. Boys' and girls' involvement in cocurricular activities: How does student settings affect their engagement with the subject?
4. How is the lesson started? What is the tone of the teacher?
5. Does the teacher pay attention to students' interests, talents, preferences? How?
6. Forms of discourses used. Is there any gender bias in teachers' talk or interactions with students?
7. How roles are allocated to boys and girls. Is there any gender bias in task distribution, *e.g.* girls getting relatively easier tasks and boys expecting to complete more comprehensive tasks? How are girls praised and for what?
8. How are boys praised and for what?
9. How does the teacher assess student learning?

Бақылау хаттамасы

Жалпы мәліметтер:

Мұғалімнің лақап аты: _____ Сынып: _____

Бақылау күні: _____

Басталу уақыты : _____ Аяқталуы: _____

Тақырыбы: _____

Оқушылар саны: _____

Қыздар саны :

Ұлдар саны:

Сабақтың тақырыбы :

Сабақтың мақсаттары

Ресурстар:

1. Сынытың ішкі келбеті қандай? Негізінен ер ғалымдардың портреттері жасырын хабарлар түрінде тасымалданады ма?
2. Оқушылардың отыру тәртібі олардың пәнге қатысуына қалай әсер етеді?
3. Сабақ қалай басталады? Мұғалімнің үні қандай?

4. Мұғалім оқушылардың қызығушылығына, дарындылығына, қалауына мән бере ме? Қалай?
5. Мұғалімдердің әңгімелесуінде немесе оқушылармен қарым-қатынасында гендерлік көзқарастар бар ма?
6. Тапсырмаларды бөлуде гендерлік бейімділік бар ма, *мысалы,* қыздарға салыстырмалы түрде жеңілірек тапсырмалар беріледі, ал ұлдар қиынырақ тапсырмаларды орындайды деп күтілуде?
7. Қыздарды қалай мақтайды және не үшін ?
8. Ұлдарды қалай мақтайды және не үшін?
9. Мұғалім оқушылардың оқуын қалай бағалайды?

Протокол наблюдения

Общая информация:

Псевдоним учителя: _____ Класс: _____

Дата наблюдения: _____

Время Начало: _____ Окончание: _____

Тема: _____

Количество учеников: _____

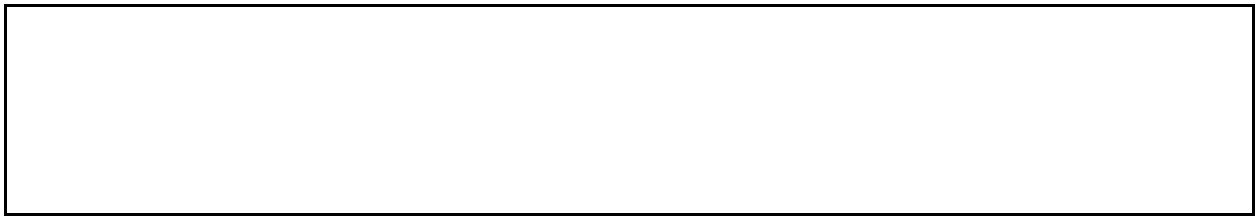
Кол-во девушек:

Количество мальчиков:

Тема урока:

Цели урока

Ресурсы:



1. Как выглядит классный кабинет? Имеются ли какие-либо скрытые сообщения, передаваемые в виде изображения преимущественно мужчин- ученых?
2. Как рассадка учащихся влияют на их вовлеченность в предмет?
3. Как начинается урок? Каков тон учителя?
4. Обращает ли внимание учитель на интересы, таланты, предпочтения учащихся? Как?
5. Есть ли какие-либо гендерные предубеждения в разговорах учителей или взаимодействии со студентами?
6. Есть ли какая-либо гендерная предвзятость в распределении задач, *например* девочки получают относительно более легкие задачи, а от мальчиков ожидают выполнения более сложных задач?
7. Как хвалят девушек и за что?
8. Как хвалят мальчиков и за что?
9. Как учитель оценивает обучение учащихся?