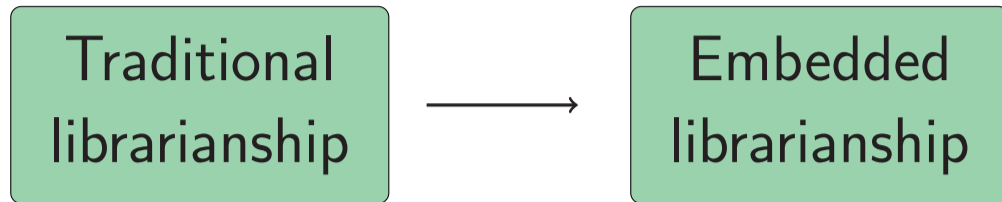




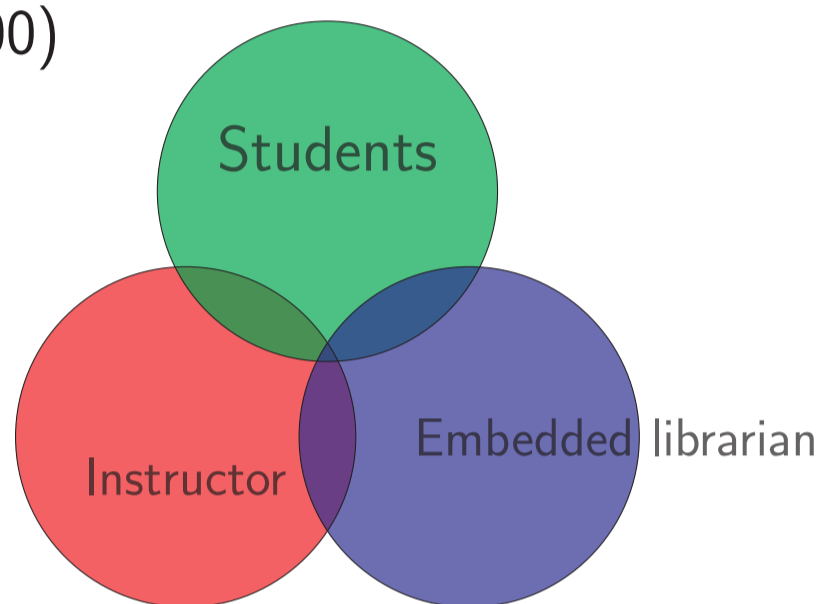
Background and Motivation

Kazakhstan 2050 Strategy: modernization of education
⇒ active learning and problem-based learning (PBL).

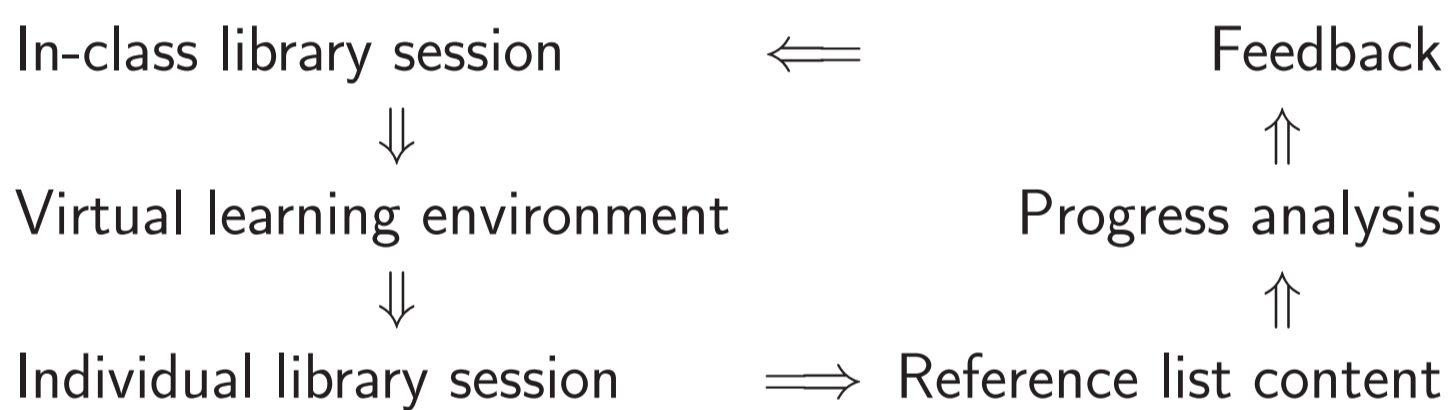


Embedded Librarian

Traditional librarian: professional workers in a library.
Modern librarian: information experts in information age.
(Crosby, 2000)



Embedded librarian (EL) in action



PBL in Mathematics Courses

PBL: students learn through problem-solving.
Origin: Medical school, McMaster University, Canada.
Pioneer: Howard Barrows *et al.* in the late 1960s.
Feature: active learning style
instructor as facilitator
small group collaborative learning
stimulate cognitive process.

PBL in Mathematics at Nazarbayev University

Semester	Courses	Students	Teams	EL
Autumn 2013	Discrete Math	18	6	★
Spring 2014	Calculus 2	30	11	*
Spring 2014	Linear Algebra	29	9	★
Spring 2014	Applied Statistics	31	9	*

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PBL Examples

Discrete Mathematics	
Topic	Examples
Graph theory	Minimize the cost for cleaning Astana from dust (in summer) and snow (in winter)
Complete graph	Construct high-speed rails in Kazakhstan connecting north-south corridors
Calculus	
Differential equations	Explore the relationship and model the interaction between ladybugs and aphids
Sequence and series	Investigate a particular aspect of fractals: historical, mathematical, beauty, application
Linear Algebra	
Linear system	Describe and predict Kazakhtan's economy using Leontief's input-output model
Matrix algebra	Investigate applications of Markov chains in social status among Kazakh people
Eigenvalue eigenvector	Application of eigenvalues and eigenvectors in discrete predator-prey system
Applied Statistics	
Data collection	Design an online questionnaire on students' attitude toward health, music, employment
Statistical inference	Perform statistical inference on the collected data (one-sample, two-sample, ANOVA)

Qualitative Comparison

Qualitative progress due to embedded librarianship

Course	Discrete Mathematics	Linear Algebra
Semester	Autumn 2013	Spring 2014
Enrollment	18	29
Team	6	9
Reference list contents	Average number of references = 5 Source: textbooks internet resources No library e-resources	Average number of references = 10 Library e-resources Government docs Reliable statistics
Citation style	No style No proper citation	APA style Few proper citation
Evaluation	Excellent or good:	Excellent or good:

References

Barrows, H.S. (1996) *New Directions Teaching Learning* **68**: 3–12.
Crosby, O. (2000) *Occupational Outlook Quarterly* **44**: 3–15.
Kvenild, C. and Calkins, K. (2011) *Embedded Librarians: Moving beyond one-shot instruction*. Chicago, IL.