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HIGHER EDUCATION DEVELOPMENT NATIONAL CENTER

№1 (49) 2025

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ВЫСШАЯ ШКОЛА КАЗАХСТАНА

HIGHER EDUCATION IN KAZAKHSTAN

ЖЫЛЫНА 4 РЕТ ШЫҒАРЫЛАДЫ
ВЫПУСКАЕТСЯ 4 РАЗА В ГОД
PUBLISHED 4 TIMES A YEAR

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CONTENTS

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DEVELOPMENT OF MAP READING SKILLS OF FUTURE GEOGRAPHY TEACHERS

Abstract: Map reading skills are considered one of the subject competencies of future geography teachers. Scientific sources and works of foreign scientists related to the concept of map reading skills were analyzed. The purpose of the study is to develop map reading skills of future geography teachers through PDCA stages “plan-do-check-action". The PDCA stages method was used in the research to develop map reading skills. Each stage should be started with proper planning of the works to be done with the geographical map. The tasks associated with the map are constantly executed and the actions during execution are checked for correctness or incorrectness. Actions associated with the map should be repeated to improve. It was found that map reading skills can be developed if future geography teachers repeat these stages. As a result of the research, it is possible to develop the map reading skills of future geography teachers by reading the symbols of the geographic map, understanding conventional signs, and performing practical work related to the map. Types of geography tasks for development of map reading skills were offered.

Keywords: map reading skills, map use, geography teacher, geographic map, map analysis.

Introduction

People use map widely and frequently in their daily life. That's why today the map is a communication tool that shows where and how to look for information and is modern in terms of application. A map is a miniature representation of reality and consists of a representation of space (Bjerva&Sigurjonsson, 2016). A map as a graphical representation of the environment that shows the relationship between geographic objects (Kimerling et al., 2016). A map is the language of geography. It is the main tool for displaying statistical data in the field of geography. The use of maps facilitates the identification and interpretation of geographic patterns (Daniel Adrian et al., 2020). ArcGIS StoryMaps geospatial technologies are widely used for mapping in geographic education and research (Caquard et al., 2017; Lee, 2020). StoryMaps, a multimedia platform for online maps with interactive functions based on the theories of geographic visualization, is often used in the educational process (Jakob et al., 2022).

Maps and digital atlases necessary for the process of geographic education are created using ArcGIS Online. This can be a prerequisite for the formation of spatial thinking and geographical knowledge of students, as well as the development of map reading skills. The use of geospatial technologies in the educational process increases the effectiveness of the geography curriculum (Rafael et al., 2020). Research shows that Web cartography is the most effective in developing spatial thinking. The value of Web cartography is important in geographic education.

This, in turn, can be the basis for the development of map reading skills of future geography teachers through a spatial thinking approach (Steven et al., 2014). Reading skills are important in solving current geographic problems. They are widely formed and developed in geographic education. Scientists have conducted scientific research on the development of map reading skills of teachers in solving geographic problems in geography lessons. The results of the study

showed that the map reading skills of school teachers were weakly developed before they were employed, and teacher-oriented teaching type prevailed (Tomas et al., 2023).

It helps to review information in a highly effective way with the help of skills in making the right decisions on the questions necessary for human life. In the social studies curriculum in Turkey, mapping skills are called «spatial skills» and are among the basic geographical skills. The results of Nazlı Gökçe's research showed that students' skills in working with maps are weak. She proposed the need to constantly repeat and improve working with the map in a practical sense (Nazlı, 2015).

To determine the literacy skills of social studies teachers, researcher İneç Zekeriya Fatih used a virtual map application integrated into a geographic information system. Qualitative research method was used in the research work, future teachers' attitude to skills was evaluated by content analysis, reflection skills were evaluated by descriptive analysis. The results of the study showed that the cartographic literacy of teachers was mainly in the direction of understanding the interpretation of symbols, finding coordinates, measuring distance, determining the direction, reading the map (İneç, 2021).

Scientists found that using Google Maps, students can take a two-dimensional (2D) image of the terrain and convert it into a 3D image. If the geography teacher uses them in the lesson, it is noticed that the participation of the students in the lesson will improve. By creating 3D models, students can learn the concepts of horizontal topography. Three-dimensional visualization of the local area can be explored through virtual reality and its possibilities to promote the development of spatial skills have been identified. This will improve map reading skills of future geography teachers. (Carlos, 2017). The flipped classroom method is used to teach GIS technologies in the development of students' geospatial competencies in higher educational institutions. The results of the study showed that this experience allows students to develop and implement their ability to work with maps. (Tian et al., 2022). Reading and using a map to improve students' analysis of specific examples, development of reflective thinking, and research skills in the process of geographic education widely used (Daley, 2010).

Geography textbooks play an important role in the formation of map reading skills. Textbooks are the most important reference tool for developing map reading skills. It can be seen from Gürgil's research that the skills characteristic of geography teachers include the interpretation of tables, graphs and diagrams. (Gürgil, 2018). ICT has entered all spheres of humanity. The use of information and communication technologies in geographical education is effective. The introduction of ICT into the educational process helps to better understand and master the subjects. ICT is a new subject, new skills necessary for students.

Today, it is impossible to imagine life without the use of ICT and it is a widely used tool in teaching and learning. Using ICT in the classroom and performing activities often forms and develops the student's map reading skills (Froilan et al., 2019). Teachers should be able to compose teaching materials in geography using various online programs. Working with digital resources contributes to the effectiveness of learning outcomes. Other scientists have shown in their research that working with online programs can be a starting point for the development of study skills (Fitra et al., 2022).

Researcher showed that the frequency of map use during geography lessons contributes to the development of map skills and the level of students' interest in geography will increase (Aksoy, 2019).

Map reading skills are very important for future geography teachers. It consists of activity components such as map reading, map application, map analysis and map interpretation. Map reading skills are implemented through the activities of working with types of geographic maps in basic and visual subjects in the structure of the educational program for the training of geography teachers. Even after the map reading skills have been developed as a professional, the school continues to teach the geography course. The purpose of the study is to develop map

reading skills of future geography teachers through PDCA stages «plan-do-check-improve» activities.

The problem of the research is that future geography teachers do not fully master map reading skills in working with types of maps, being able to read the map correctly, getting and processing information from the map.

Literature review

A sufficient level of knowledge and skills of map users to process the content of the cartographic product begins with the formation of cartographic skills at school. The acquired knowledge and skills are combined with professional training and improved (Kristien, 2016). Map reading skills are important not only in professional training, maps are used in everyday life for various purposes, from teenagers to adults. Such research may include a comprehensive review of the literature on how people develop map reading skills from adolescence to adulthood.

Based on Fisher's theory of skills, the interests of three map-related research communities, i.e., cartographers, cognitive psychologists, and educational researchers, were analyzed according to the research task. It can be seen that many scientific studies have focused on map usage rather than map reading skills development. The effectiveness of map usage skills is directly related to map reading skills. This can be seen from research findings that map reading skills can be developed by combining different skills (Leilani, 2023). There are research works on developing map reading skills through practice-oriented tasks in the learning process. By using sports orientation based on active practical activities, you can develop map reading skills. This study used an analytical rubric consisting of four criteria: direction/location, sign/symbol recognition, use of landforms, and time management. As a result of the study, it was found that the most complex map reading skill is determining the direction/location, and the simplest skill is determining the landforms (Uyar et al.,2022).

In education, it is important to work with concepts, explanations, definitions related to map reading skills. It has been determined that terminology is often the influencing factor in the construction of the map (Havelkova et al., 2019).

The ability to correctly obtain information from the map, find it and correctly recognize conventional signs has a positive effect on the development of map reading skills. Failure to correctly interpret a map can have major consequences in making quick decisions. The experience of map readers is an important and decisive factor in understanding the map. Factors such as their age, education, and gender have been shown in studies to contribute to interpretation. Experienced readers have been known to make frequent mistakes in geographical names when reading a map. In the results of the research, it was determined that special attention should be paid to symbols and placement on large-scale maps. This showed that future errors in map reading can be prevented (Szigeti-Pap et al., 2023).

Maps are the main source of information, so it is very important to develop the skills of students to work with maps. In this study, it was determined that the teacher and his/her actions of working with the map are the most important factor in the selection and development of map reading skills. As a result of the study, three types of teachers were identified: «Navigators», «Problem-oriented», and «Resource-oriented» based on a survey and interviews among Czech teachers. This will help future geography teachers to develop their map reading skills and help them become professionals. Map reading skills are required when using maps, plans, and geospatial information. Terrain is represented on a map using two-dimensional (2D) and three-dimensional (3D) cartographic methods (Havelková & Hanus, 2019).

In order to solve the difficulties in the interpretation of this information, «6B01515-Geography teacher training educational program» is provided in specific subjects (toponymy, etc.). Researchers found out that electronic maps are an active teaching tool, and showed that

students' map reading skills have expanded in class. It helps students develop critical thinking and visualization skills in communicating ideas through video (Ellozy et al., 2010).

Other scientists have compared the effectiveness of paper maps and electronic topographical maps in the formation of reading skills in their research. As a result, it became clear that the indicators of the students' map reading skills used in creating the two types of maps did not make much difference. The results of the research revealed that their learning progress and teaching style were not related to each other. As for the conclusions drawn from this, working with paper and electronic maps develops and strengthens map reading skills (Pedersen et al., 2005).

Hsiao-Ping Hsu and other scientists examined the effectiveness of the teacher's use of Google Earth in the classroom in the formation of topographic map reading skills of students. It can be seen from the results of the study that the topographic map reading skills of students with the help of Google Earth have improved somewhat compared to traditional teaching. This is explained in connection with the 3D visualization of the terrain and the availability of knowledge and skills of the learners about landforms in Google Earth. Activities often performed with such online services develop map reading skills (Hsiao-Ping Hsu et al., 2018). Ali Demirci, Ahmet Karaburun & Hatice Kılar examined the effectiveness of Google Earth as an educational tool in high school geography classes in their research. Interactive exercises on the types of formation of shores were created in Google Earth, and students performed them on their computers according to the instructions. It can be seen that the actions of completing such tasks affected the progress of the students. This study showed that Google Earth can be an effective educational tool only if it is used correctly for the purpose of the lesson, the material and the methods. The use of Google Earth as an educational tool of future geography teachers will contribute to the development of map reading skills (Demirci et al., 2013).

In order to assess the cartographic skills of students of all study periods, the researchers conducted several cartographic surveys. In the questionnaire, there are tasks about drawing point, line and district objects on the map. Based on the cartographic methodology, the students' skills were analyzed and evaluated through mental sketches. Research results are used in the process of evaluating the effectiveness of teaching (Nieścioruk, 2023). An online survey was conducted among Czech teachers about the use of school atlases as an integral part of geography education. The study was focused on the frequency and importance of using atlases, and the types of tasks that are often performed with the help of atlases and using additional educational tools were determined. The results of the study showed that 90% of the participants use atlases in daily lessons or every lesson. It was found that teachers with more experience used atlases more often than teachers with less experience. Teachers find thematic maps to be a problematic part of the atlas. The study made it possible to assess the importance of the atlas in geographic education. Carrying out more activities related to geographic atlases in geography education can develop the map reading skills of future geography teachers (Beitlova, 2021). Working with maps is important in geographic education. In pedagogical education, students have many difficulties in map interpretation and geological data analysis. Doing tasks using Google Earth will improve students' map reading skills and geographic thinking skills (Ilkka Ratinen & Tuula Keinonen, 2011).

The map of the world is created interactively in the application of the geoinformation system. In the research work, the process of transforming information by teachers with the help of real data was evaluated. The research project used a technical, scientific and collaborative approach. The results of the study showed the need to use high-level thinking skills in teacher training in structuring and systematizing real data (İneç, Z. F., Akpınar, 2020). Conducted research in the direction of developing spatial thinking skills of students through geographic information system. This, in turn, can be the basis for the formation of map reading skills (James Hickman, 2023).

Methods and organization of research

As a research tool, a structured questionnaire was compiled in Google Form, and its link was distributed to the respondents via WhatsApp to the respondents-students of the 2nd year bachelor's degree in geography at the Abai Kazakh National Pedagogical University located in Almaty. 47 students voluntarily participated in this questionnaire and answered within the specified time. The structured questionnaire consists of two parts: the first part contains demographic data of student respondents, and the second part contains questions related to map reading skills. 63,8% of the survey participants were women (30 students), and 36,2% were men (17 students) (see Table 1).

Table 1

Gender structure of survey participants

		Frequency	Percent
Valid	female	30	63.8
	male	17	36.2
	Total	47	100.0

Students of different ages participated in the survey. If we analyze the age of the participants, the number of students under 17-18 years old is 5 (10.6%), the number of students under 19-20 years old is 40 (85.1%), the number of students under 21-22 years old and older is 2 (4.3%) (see Table 2).

Table 2

Age structure of survey participants

		Frequency	Percent
Valid	17	5	10.6
	19	40	85.1
	21	2	4.3
	Total	47	100.0

Students were asked 3 questions in the survey to determine their baseline level of map reading skills. To determine map reading skills, the survey results were analyzed using the SPSS statistical program.

«What information do you get from geographic maps?» to the first question in the survey, 39 students (83%) answered only about geographical objects, 6 students (12.8%) about spatial data, 2 students (4.3%) about processes and phenomena (see Table 3).

Table 3

What information do you get from geographic maps?

		Frequency	Percent
Valid	Geographical objects	39	83.0
	Processes and phenomena	2	4.3
	Spatial information	6	12.8
	Total	47	100.0

It can be seen that the vast majority of survey participants are limited only to finding geographic objects on the map page. Lack of skills in geographic space and spatial thinking can hinder the development of map reading and analysis skills. In the case of the given question, students should be trained to think spatially and get spatial information while reading the map.

«Assess your reading skills in determining coordinates on a geographic map?» 13 students (27.7%) answered the second question as high, 4 students (8.5%) as average, 30 students (63.8%) as satisfactory (see Table 4).

Table 4

Your reading skills in determining coordinates on a geographic map

		Frequency	Percent
Valid	Average	4	8.5
	Satisfying	30	63.8
	Very good	13	27.7
	Total	47	100.0

Therefore, it can be seen that the vast majority of students have a satisfactory level of map reading skills. It can be seen that there are problems in the development of students' map reading and analysis skills at a high level.

«What is the problem when working with geographic maps?» to the third question in the survey, 19 students (40.4%) indicated in their answers that they have difficulties in scale transformation, 16 students (34%) in understanding features of the terrain, and 12 students (25.5%) in working with conventional symbols of the map (see Table 5).

Table 5

What are the challenges when working with geographic maps?

		Frequency	Percent
Valid	Working with conventional signs	12	25.5
	Scale transformation	19	40.4
	Understanding the features of the terrain	16	34.0
	Total	47	100.0

Most of the students still do not have enough skills to work with the scale of the map. The physical map lacks the skills of working with isogyps lines in determining terrain features. It can be seen that map reading skills are insufficiently developed in determining the geographic latitude and longitude of the object on the map.

Based on the analysis of the results of the survey, it was revealed that there are a number of difficulties in the development of map reading skills of future geography teachers. Map reading skills are considered the most important in daily lessons and educational and research activities. Because an important way to develop map reading skills is through paper map and electronic map activities. Any geography teacher's activity should start with a map and end with a map.

In the survey «What information do you get from geographic maps?» to the first question, the vast majority of respondents indicated that they can get information about geographical objects from the map. This is a basic level of map reading skills. It can be seen that reading

skills are formed at an insufficient level in obtaining information about the spatial location of geographical objects. Students should increase activities aimed at studying geographical phenomena and processes from the map. Learning how to find differences in geographical phenomena and processes on a map will have a positive effect on the development of students' map reading skills.

Presented in the survey «Assess your reading skills in determining coordinates on a geographic map?» to the question, most of the respondents answered that it was at a satisfactory level. It is necessary to offer more tasks aimed at teaching ways of calculation using the geographic coordinate system, geographic latitude and longitude map. When the algorithm for determining geographic coordinates is properly presented, by using more maps in the classroom and determining the geographic coordinates of the local area, the map reading skills of students will undoubtedly develop at a higher level in the future.

Presented in the survey «What are the difficulties when working with geographic maps?» to the question, the respondents mentioned that they have difficulty working with the scale. Any map is made to scale. Students' map reading skills can be developed at a higher level if tasks aimed at working with types of scale, with a physical map, and more tasks for reading the system of conventional map markings are offered.

Organization and methods of research

Teachers plan and conduct lessons according to the PDCA (plan-do-check-act) cycle. Research participants used frames to interpret student data. The results of the study showed that it had a positive impact on their professional development (M. Dam et al., 2020).

Prospective chemistry teachers used the four phases of PDCA (preparation, execution, verification, evaluation, and observation) in metacognitive teaching strategies to explain phenomena scientifically to students. The result of the study showed that this strategy is effective in explaining in depth the connection between mixed concepts of natural sciences (Parlan et al., 2018).

The PDCA concept "plan-do-check-act" is used in the implementation of case methods in the higher education system of Taiwan. The results of the study showed that this concept had an effective effect (Ruey, 2012)

Online learning has become a major trend in education. It is necessary to develop the online teaching competence of university teachers. The planning, implementation, and improvement stages of PDCA strongly helped teachers adapt to the virtual learning environment. Activities during this period directly affected the quality of teaching, continuous improvement improved teachers' online teaching skills (Chi et al., 2023).

The teacher used the "plan-do-check-act" (PDCA) cycle when performing the team task in the classroom and analyzing and evaluating it. The result of the study showed that the PDCA cycle significantly contributed to the improvement of students' team skills (Morgan et al., 2017).

In our research, we will develop the map reading skills of future geography teachers through the four phases of PDCA (planning, doing, checking, improvement).

Stage 1 of developing map reading skills «Planning»

Stage 2 of developing map reading skills «Doing»

Stage 3 of map reading skills development «Checking»

Stage 4 of map reading skills development «Improvement»

Stage 1 of developing map reading skills «Planning»

In geographic education for the implementation of activities related to planning:

- choose the type of map and familiarize yourself with its scale and conventional signs;
- ways to work with the map;
- map work;

- it is necessary to plan the preparation of the necessary cartographic materials.

Types of activities performed during the «planning» stage: choosing the necessary types of resources (physical map of North America, or geographical atlas of North America, handbooks, dictionaries, encyclopedias), familiarizing with the name of the map, conventional signs, scale. Finding large geographic objects from a physical map or geographic atlas of North America, distinguishing object types, classifying them into semantic subgroups: mountain (Appalachian, McKinley), river (Mississippi, Missouri, Rio Grande), lake (Athabasca, Winnipeg, Huron), sea (Sargass), ocean (Atlantic, Pacific)).

Using the map, based on the analysis of the composition of geographical names in North America, it is possible to distinguish 5 main semantic subgroups of toponyms: oronyms (denoting the characteristics and types of terrain); potamonyms (river names); limnonyms (names of lakes, ponds); pelagonyms (names of the sea and its parts); oceanonyms (names of the ocean and its parts).

At this stage, students choose the type of map to perform the task, get acquainted with its scale and conventional signs. Prepares the necessary cartographic materials in advance. Therefore, students can determine the type of map they need, get acquainted with the types of scales, the system of conventional symbols, and properly plan their work with the map. As a result, students' enthusiasm for map reading increases and their map reading skills develop.

Stage 2 of developing map reading skills «Doing»

- perform actions related to map scale conversion;
- implementation of tasks to be done with maps.

Actions performed during the «Doing» phase: carrying out work related to the map according to the plan, providing instructions, giving advice on the task related to the map. Tabulate the list of toponyms in North America by types of objects, write down the meaning of the names of geographical objects. Interpretation and Image Mapping of North American Toponym Groups (see Figure 1).

Figure 1

Toponym groups

To analyze and compare the meaning of the names of mountains, rivers, lakes, seas, oceans in North America, connecting them with their location on the map. Write the names of major geographic features of North America on a picture map (for example, the name of a river in blue). At this stage, students perform toponym mapping activities. Performs practical tasks related to the map. As a result, students' map reading skills will develop.

The 3rd stage of map reading skills development «Checking»

- collection and processing of information about map works;
- working with the results of the work done with the map;
- to analyze the work done with the map;

Actions performed during the «Checking» period: viewing and checking the results of work performed with the map, analysis and processing of work results.

At this stage, students check the results of the tasks performed with the map again. He sees the progress of his work. At this stage, the teacher checks and evaluates the work done with the image map.

The 4th way to develop map reading skills «Improvement»

- consider ways to improve the work done with the map;
- to improve the level of performance of tasks related to the map;

Actions performed during the «Improvement» stage: making recommendations or decisions aimed at improving the results of the work performed related to the map, showing responsibility. Stay up-to-date with information on changes in geographic names in North America. Find and view the names of newly appeared geographic features on the map. Explain the meaning of the name.

At this stage, students take into account the shortcomings of the work done with the map and consider ways to improve it. Constantly repeats actions in order to improve the level of performance of the task.

The results of the study and their analysis

Before the research work, 47 students were asked to perform tasks related to maps using the traditional method. Before the experiment and after the experiment, the results of the task were processed in the SPSS program. The final result of control work of experiment 1 was obtained at 8 weeks, and the final result of control work of experiment 2 was obtained at 15 weeks. Students were given tasks and test questions for reading the map. For 7 weeks, the students completed the tasks for reading the geographical map according to PDCA stages. The results of the two interim monitoring were analyzed and processed by SPSS (see Table 6).

Table 6

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Points before experiment	69,62	47	18,464	2,693
	Points after the experiment	83,04	47	8,003	1,167

From the data analysis carried out in SPSS, the following can be seen:

- The average score of students before the experiment was 69.62 with a standard deviation of 18.464.
- After conducting an experiment with the formation of skills in reading geographical maps, the average score of students increased to 83.04 with a standard deviation of 8.003.

It is important to note that the standard deviation for the average score after the experiment decreased significantly compared to the original data. This may indicate that students performed more consistently after the training.

Based on the data obtained, we can conclude that the conducted pedagogical experiment on developing geographic map reading skills among 2nd year students was positively effective. The increase in mean score and decrease in standard deviation after the experiment suggests that the training did have a positive impact on the students' level of preparation in this field.

Pairwise correlation was used to analyze the test results before and after the experiment on map reading skills. The correlation between the scores before and after the experiment was

0.817, which is a fairly high indicator. P -values less than 0.001 for both one-tailed and two-tailed tests indicate statistical significance of this correlation (see Table 7).

Thus, based on the results of the analysis by the SPSS program, we can conclude that there is a strong positive correlation between students' scores before and after the experiment on developing geographic map reading skills. This suggests that students made significant progress in mastering these skills after 7 weeks of specific tasks and training.

Table 7

Paired Samples Correlations

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Points before experiment Points after the experiment	47	,817	<,001	<,001

From the data presented in the table, a t-test was used to analyze the test results before and after the experiment on map reading skills (see Table 8). According to the t-test conducted, the mean value of the difference between the scores before and after the experiment is -13.426. Thus, on average, participants in the experiment showed a decrease in results after completing a training course in reading geographic maps. The standard deviation of the difference between scores was 12.785, which indicates a spread of data around the average value of changes in scores. The standard error of the mean of the difference is 1.865, which indicates the accuracy of the estimate of the mean change in scores. The confidence interval for the difference between the scores before and after the experiment (95% confidence interval) was -17.179 to -9.673. This means that with a 95% probability the average difference between scores will be in the specified interval. Thus, based on the results of the analysis by the SPSS program, we can draw a conclusion about the dynamics of changes as a result of testing students before and after the experiment on reading geographic maps. Participants' average scores dropped by 13,426 points, a change that was statistically significant.

Table 8

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. ErrorMean	95% Confidence Interval of the Difference
					Lower
Pair 1	Points before experiment Points after the experiment	-13,426	12,785	1,865	-17,179

Research results and their discussion

Task performance activities for each stage of map reading skill development were considered to achieve the research objective. Analyzing the research results, the effectiveness of developing map reading skills of future geography teachers was determined.

Map reading skills can improve students' geographical culture and cartographic knowledge, develop the ability to work with maps, map reading, work with the system of conventional signs, map scale conversion, map task performance activities. Because it allows them to plan their preparations.

World experience proves the need to be able to read maps in continuous education in geography. Artvinli & Dönmez found in their research that school geography textbooks influence the level of cartographic skills, enable critical thinking and problem solving, and that maps are a means of communication. Research has shown that people with map skills can easily navigate in unfamiliar environments and can create and analyze global maps. The concept of skills is considered to be important in all stages of learning for a person's life (Artvinli & Dönmez, 2020). It is very important to use information and communication technologies and platforms in the development of map reading skills. Ineç Zekeriya Fatih assessed teachers' skills through content analysis, and reflective skills through descriptive analysis.

In order to study the cartographic literacy of teachers, the task of transferring the world map to an interactive and dynamic environment has been completed. As a result, the information obtained from the virtual map determined the basis of the cartographic literacy of teachers to understand and interpret symbols, determine the coordinates of the place of residence, measure the distance, and read the map. (Ineç, 2021).

Cartographic education of higher educational institutions has a systematic character within the curriculum and plays an active role in the formation and development of map reading skills. Naeema Mohamed Dawood Alhosani & M.M. Yagoub's research examined students' skills in map reading, designing, understanding directions, and calculating distances. As a result, the strengths and weaknesses of the geography curriculum in the formation of skills were identified and the need for revision was shown. Recommendations for improving geographic skills are provided in the research paper (Naeema & Yagoub, 2015).

We believe that it is necessary to strengthen the system of tasks aimed at reading, understanding, using, analyzing and synthesizing a geographical map in the content of visual subjects in the «6B01515-Geography teacher training program».

He studied the impact of map reading on the professional growth of teachers and strengthening their academic skills and competencies. This, in turn, improves students' academic results (Moles et al., 2016). Map reading skills are based on navigation, measurements and visualization, which builds cartographic literacy in students. To read a paper map or electronic map, one must begin by understanding the conventions and symbols. Only then can cartographic literacy be developed. Gillian Kidman & Chew-Hung Chang show in their research that it will develop (G. Kidman & Chew-Hung Chang, 2019).

Based on the results of this study, it can be said that the PDCA stages of «plan-do-check-improve» can be a method and a reliable tool for developing map reading skills. The results of the survey revealed that students have difficulty in recognizing conventional signs and symbols, working with a scale, and determining geographic coordinates when reading a map. Da Silva suggested the development of map symbol recognition using interactive digital games (Da Silva, 2015).

And we have shown that by mapping nomenclature, mountains, rivers, lakes and other geographical objects, activities to understand geographic coordinates and recognize symbols develop map reading skills.

During the discussion of the results, we can conclude that the method of «planning-executing-checking-improving» method of «PDCA» proposed as a methodical aid to students can develop map reading skills. This method contributes to improving the experience of teachers working with maps and developing their professional competences. If all stages are carried out in sequence, systematically and according to requirements, it is possible to get positive results in future research work. Effective development of map reading skills of future geography teachers leads to the formation of cartographic competence. Allows for increased ability to perform a problem or task associated with any map.

Conclusion

A review of the works and research works of foreign scientists on the issue of developing map reading skills in the training of future geography teachers was made. As a result of the analysis of foreign experiences and works of scientists, it was determined that map reading skills are a very important skill in the formation of professional competence of geography teachers and that map-related works should be systematically taught in the visual subjects of the university curriculum. The research focused on the stages of development of map reading skills of future geography teachers. These stages allow you to carry out map activities in a systematic manner. The results of the conducted research, according to the scientific researches and works related to the topic, «map reading skills» form the basis of the basic subject competencies of future geography teachers. Map reading skills are developed by regular practical work with a geographical map. These activities should be carried out regularly. The importance of developing map reading skills will contribute to the formation of cartographic competence of future geography teachers.

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Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Beikitova Albina: Data curation, Writing - Original draft preparation, Software, Supervision, Writing- Reviewing and Editing, Investigation, Project administration. Kaimuldinova Kulyash: Conceptualization, Methodology, Resources. Borankulova Dina: Validation, Formal analysis, Visualization.

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RESEARCH PRODUCTIVITY AND MAIN PUBLISHING INSTITUTIONS IN KAZAKHSTAN

Abstract: Research productivity plays a vital role in advancing knowledge, strengthening academic institutions, and bolstering national development. In Kazakhstan, the research and publishing landscape is undergoing significant changes, shaped by institutional dynamics and external pressures. This study assesses the current state of research productivity in Kazakhstan, focusing on key contributing institutions. A quantitative methodology was employed, leveraging data from academic databases Scopus to analyze citation metrics, publication outputs, and institutional contributions. SciVal analytical tool was used to access the research performance of Kazakhstan and Kazakhstani universities. The findings reveal a notable rise in Kazakhstan's research output in recent years, driven by contributions from leading universities. Despite this progress, challenges such as insufficient funding, inadequate research infrastructure, and limited international collaboration hinder further advancement. This article also identifies and examines the pivotal role of key publishing institutions in shaping the nation’s academic productivity. The insights provided aim to inform policy strategies for fostering a more robust and competitive research ecosystem in Kazakhstan.

Keywords: research productivity, publications, Scopus, Scival, institutions, Kazakhstan.

Introduction

Research productivity is a critical indicator of a nation's intellectual and innovative capabilities, reflecting its commitment to advancing knowledge and contributing to global scientific discourse. Focusing on enhancing research output and establishing the country as a regional academic hub led Kazakhstan’s higher education sector to significant developments in recent years. The government's strategic initiatives have played a pivotal role in this transformation. Policies supporting the growth of the publishing industry through subsidies and grants have been instrumental in promoting local content, thereby stimulating market demand. Additionally, establishing foreign university branches, such as De Montfort University and Coventry University, has introduced advanced teaching methodologies and research capabilities, reshaping Kazakhstan's education system and enhancing its global academic standing (The Astana Times, 2024).

Despite these advancements, challenges persist. The economic slowdown in the first half of 2024, with a growth rate of 3.2% compared to 5.3% in the previous year, has highlighted weaknesses in investment and government spending, potentially impacting funding for research and development (The World Bank, 2024). Moreover, the ongoing efforts to build a customer-centric, open, and competitive digital economy underscore the need for a robust digital infrastructure to support research activities.

This article analyzes the trends in research productivity in Kazakhstan during 2022–2024, identifies the leading publishing institutions contributing to this output, and assesses their impact on the country's national and international research visibility. By examining these aspects, the research paper seeks to provide insights into the effectiveness of current policies and initiatives and offer recommendations for sustaining and enhancing research productivity in Kazakhstan.

Literature Review

Research productivity is a key indicator of academic and institutional performance, reflecting the capacity of researchers to generate impactful scientific contributions. Scientometric analysis, which quantitatively assesses research output using bibliometric indicators such as citation impact, H-index, and international collaboration metrics, has become an essential tool for evaluating research performance at national and institutional levels (Moed, 2022; Sugimoto and Lariviere, 2023). Nations with strong research ecosystems demonstrate higher economic competitiveness and innovation capacity while developing countries often face structural barriers that hinder research productivity (Leydesdorff and Wagner, 2022).

Kazakhstan's higher education system has undergone notable reforms aimed at aligning with international standards, including integration into the European Higher Education Area through the Bologna Process (OECD, 2017). These reforms have emphasized the importance of research output, resulting in a steady increase in the number of publications indexed in international databases like Scopus and Web of Science (Abenova et al., 2022). Despite these gains, scientometric studies suggest that Kazakhstan's research impact, as measured by citation rates and H-index, remains relatively low compared to leading research nations (Kozhamkulova and Karazhan, 2020).

Bibliometric analyses indicate that Kazakhstan’s international research collaboration has played a crucial role in enhancing publication visibility. Co-authorship with researchers from Europe, China, and Russia has led to higher citation counts and increased participation in high-impact journals (Glanzel and Schubert, 2022). However, local challenges such as language barriers, a preference for publishing in non-indexed national journals, and insufficient research incentives continue to limit overall impact (Kassymova et al., 2021). Moreover, the COVID-19 pandemic disrupted research activities globally, including in Kazakhstan, temporarily reducing publication rates and delaying research projects.

Publishing institutions, particularly universities and research centers, serve as Kazakhstan's primary drivers of scientific output. Leading institutions such as Al-Farabi Kazakh National University and Nazarbayev University have significantly contributed to the country’s publication volume and citation impact (Yessimova et al., 2023). These institutions have actively fostered research cultures by supporting grant-funded projects, hosting international conferences, and encouraging interdisciplinary collaboration. However, smaller institutions often face challenges such as insufficient funding and limited access to global research networks, resulting in unequal contributions to the country's overall productivity. While previous studies have provided valuable insights into Kazakhstan’s research productivity, there is a lack of comprehensive scientometric analyses tracking institutional contributions over time. This study aims to address this gap by analyzing research productivity trends from 2022 to 2024, identifying the top publishing institutions, and assessing their impact on the national and international research landscape.

Methodology

The study employs a bibliometric analysis to examine research productivity and the contributions of publishing institutions in Kazakhstan during the period 2022–2024. Bibliometric analysis is a quantitative method used to evaluate research output, trends, and institutional performance based on publication data (Zhao et al., 2020). This approach is suitable for identifying patterns in research activity and assessing the impact of publishing institutions. The data for this study were collected from the Scopus database one of the largest abstract and citation databases of peer-reviewed literature, used to verify research output and institutional affiliations. The study focused on publications that published between January 1, 2022, and December 4, 2024, authored by researchers affiliated with institutions in Kazakhstan and covered all disciplines. Data for analysis included all types of publications – articles,

reviews, conference papers, and book chapters. All data used in this study were obtained from publicly available sources or through authorized tools like SciVal. The study did not involve human participants, and no confidential information was accessed.

For the data analysis variables and metrics such as number of publications, citation metrics, institutional rankings and collaboration metrics were considered to evaluate research productivity and institutional performance:

− Number of publications is total research output by Kazakhstani institutions during the study period.

− Citation metrics are average citations per publication to measure the quality and impact of the research.

− Institutional rankings are contributions of leading institutions based on their research output.

− Collaboration metrics are Proportion of publications involving international and domestic co-authorship.

The data collected were analyzed using bibliometric tool - statistical software SciVal. SciVal is an advanced analytics tool that provides comprehensive insights into research performance based on Scopus data. SciVal was used to analyze institutional contributions, research trends, and collaboration networks.

SciVal's benchmarking module was used to compare the performance of Kazakhstani institutions across key metrics such as publication volume, citation impact, and collaboration rates. The research trends module provided insights into emerging research areas and disciplines with high productivity. Collaboration metrics, including co-authorship networks and institutional partnerships, were visualized.

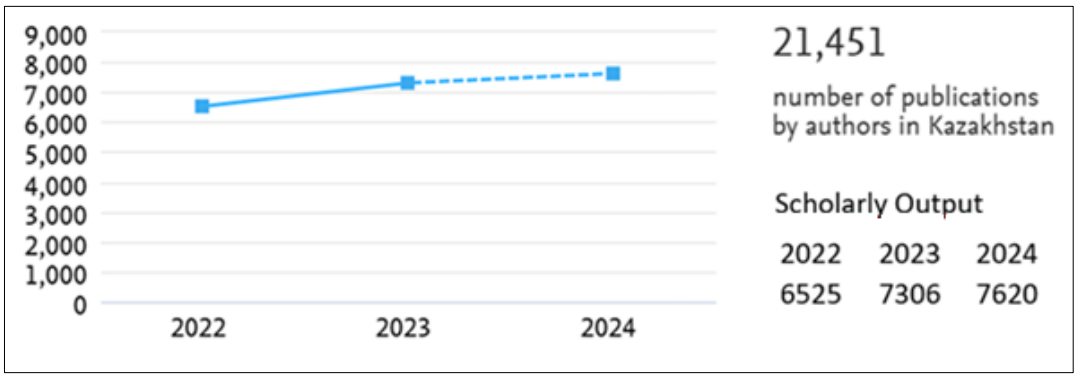
Results and Discussion

Publication and citation

The Scopus database published 65512 articles affiliated with the universities of Kazakhstan for the entire period. For the last 3 years, this indicator is 21451 (Figure 1). Between 2022 and 2024, research output in Kazakhstan demonstrated steady growth. The total number of publications indexed in Scopus increased by approximately 15%, from 6525 publications in 2022 to 7620 publications in 2024. The significant growth was observed in 2023, with a 12% increase in publications compared to 2022, reflecting a post-pandemic recovery in research activity. In 2024, scholarly output further increased to 7,620, which is a 4.3% growth compared to 2023.

Figure 1

Research Productivity Trends (2022–2024)



The data in Figure 1 shows a steady upward trend in scholarly output over the three years. The growth rate was higher between 2022 and 2023 (12%) than between 2023 and 2024 (4.3%), indicating a slight slowdown in the pace of growth. The consistent increase in scholarly output suggests a sustained focus on academic productivity. However, the decreasing growth rate may highlight the need for targeted interventions, such as enhanced research support systems, funding opportunities, or collaborations to maintain or accelerate growth.

Figure 2

Citation number by publications in Kazakhstan

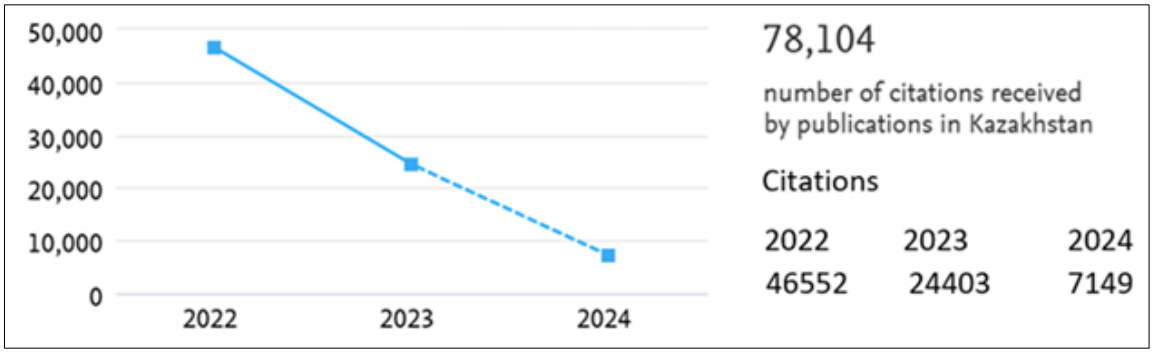


Figure 2 presents citation data for 2022, 2023, and 2024. It is important to note that 2024 is an incomplete year, and the citation count for this year may still increase as the year progresses. In 2022 citations were 46 552, the highest among the three years, reflecting the continued impact of previously published research. In 2023 citations decreased to 24 403, marking a 47.6% decline compared to 2022. This could be attributed to newer publications not yet achieving significant visibility or citation results. In 2024 citations so far stand at 7 149. Since 2024 is still incomplete, this number is expected to rise by the end of the year as publications gain more exposure.

While scholarly output steadily increased from 6 525 in 2022 to 7 620 in 2024, citations show a delayed impact. This is common because citations tend to accumulate over time, and newer publications (especially those from 2023 and 2024) may not yet have had sufficient time to be cited widely.

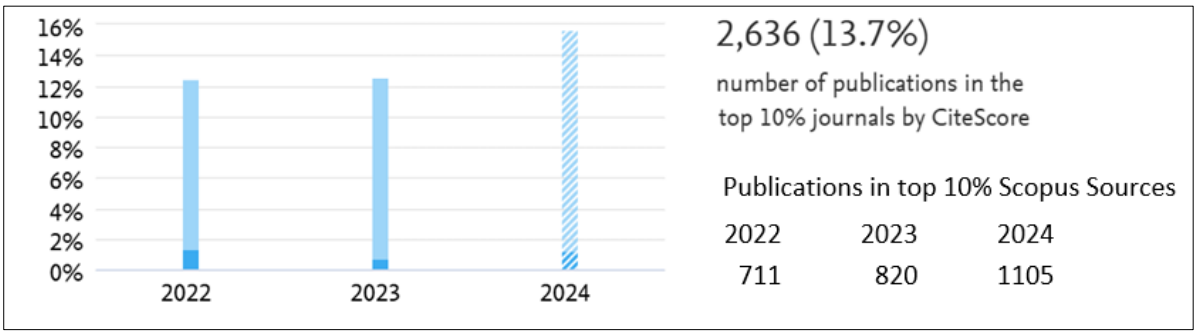
The high citation count in 2022 likely reflects the impact of research published in earlier years. The sharp drop in citations in 2023 and 2024 may not necessarily indicate a decline in quality but rather a time-lag effect - it takes time for publications to be cited, particularly in high-impact journals. For 2024, since the year is incomplete, the current citation count (7,149) is not a definitive measure of the year's impact.

While scholarly output has shown consistent growth, citations for recent years appear lower due to the natural time lag in citation accumulation. Moving forward, it will be essential to track citation trends for 2023 and 2024 publications over the next few years to assess their long-term impact.

Publication sources

Publication sources are journals, books and book chapters indexed in the databases. However, only journals indexed in Scopus are ranked by quartiles. Figure 3 provides a breakdown of Kazakhstani publications by percentile rankings in Scopus Sources (CiteScore Percentiles) from 2022 to 2024. It highlights both the absolute publication numbers and the percentage of total publications. CiteScore is a simple way of measuring the citation impact of serial titles such as journals.

Figure 3
Publications in Kazakhstan in the top 10% of journals



In three years overall 2636 publications (13.7%) by Kazakhstan scholars were published in the top 10% Scopus sources. In 2022 publications in 711 (12.5%) sources, in 2023 in 820 (12.6%) journals, and in 2024 articles were published in 1105 (15.7%) top 10% Scopus sources. The percentage of publications in the top 10% of journals shows a steady upward trend, with a significant increase in 2024. This indicates a continued push toward publishing in high-quality journals. The rising trend in publishing within higher-ranked journals reflects a concerted effort to improve the quality and visibility of research output in Kazakhstani universities.

Table 1
Publications by Kazakhstan in Scopus journals

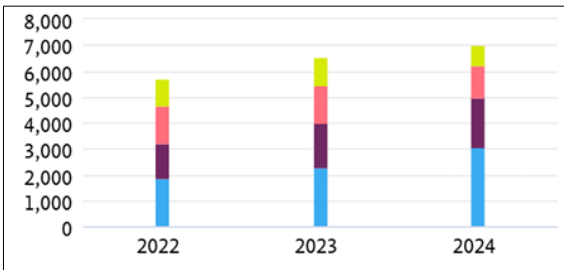
Scopus CiteScore quartile	Overall	2022	2023	2024
Q1	7220	1878	2260	3082
Q2	4968	1319	1736	1913
Q3	4223	1494	1476	1253
Q4	2841	998	1057	786
Total	19252	5689	6529	7034

Table 1 above categorizes publications from 2022 to 2024 into CiteScore quartiles, offering insights into their placement in journals ranked by quality. Quartiles range from Q1 to Q4, with the total publications provided for each year.

Overall, 7220 articles (37.5% of the total) were published in Q1 journals (Figure 4). Publications in Q1 journals show a strong upward trend, with a significant increase in 2024, reaching nearly 44% of total publications. This indicates a strategic focus on publishing in high-quality impactful journals.

Figure 4

Share of publications per journal quartile



Quartiles	Publications	Publication share (%)
Q1 (top 25%)	7,220	37.5
Q2 (26% - 50%)	4,968	25.8
Q3 (51% - 75%)	4,223	21.9
Q4 (76% - 100%)	2,841	14.8

Cumulative shares	Publications	Publication share (%)
Q1 to Q2 (top 50%)	12,188	63.3
Q1 to Q3 (top 75%)	16,411	85.2

Publications in Q2 journals are also steadily increasing. The percentage of Q2 publications grew from 23.2% in 2022 to 27.2% in 2024, showing broader engagement with medium-to-high-quality journals. Publications in Q3 journals are declining, both in absolute numbers and percentages. In 2024, only 17.8% of publications appeared in Q3 journals, compared to 26.3% in 2022, suggesting a shift toward higher-quality journals (Q1 and Q2). Publications in Q4 journals are declining significantly, dropping from 17.5% in 2022 to only 11.2% in 2024. This reflects a clear focus on avoiding lower-tier journals.

The total number of publications increased steadily from 2022 to 2024, with a notable emphasis on Q1 and Q2 journals, driving up the overall research quality. Publications in Q1 journals saw a significant increase from 33% in 2022 to 43.8% in 2024, reflecting a clear prioritization of publishing in top-tier journals. Publications in Q3 and Q4 journals decreased significantly, showing a deliberate move away from lower-tier journals. The overall number of research productivity (publications) increased each year, with a simultaneous improvement in journal quality.

Publications by subject area

Publications by Kazakhstani universities were published across various subject areas introduced in Table 2 and Figure 5 focusing on scholarly output, citations, authorship dynamics, and impact metrics (citations per publication and field-weighted citation impact). Top three subject areas with high scholarly output are engineering: 1015 publications (declined by -8.2%); physics and astronomy: 1005 publications (declined by -13.4%); and computer science: 873 publications (grew by 8.3%).

Despite being the leading areas by volume, engineering, physics and astronomy experienced declines in output, while computer science showed moderate growth.

Pharmacology, toxicology, and pharmaceutics: 161.1% growth (138 publications), biochemistry, genetics, and molecular biology: 56.5% growth (371 publications), arts and humanities: 58.1% growth (306 publications), agricultural and biological sciences: 48.1% growth (518 publications); economics, econometrics, and finance: 45.9% growth (212 publications) are rapidly growing subject areas. strong growth in life sciences and social sciences suggests a shift in research focus to areas with societal relevance and multidisciplinary appeal. The rise in arts and humanities (58.1%) highlights increasing attention to these fields, often underrepresented in publication metrics.

Subject areas with the highest citations per publication are dentistry: 20.5 citations per publication (10 publications); medicine: 20.8 citations per publication (471 publications); multidisciplinary: 10.5 citations per publication (100 publications); pharmacology, toxicology, and pharmaceutics: 7.8 citations per publication (138 publications). Medicine demonstrates the strongest overall impact due to both high scholarly output and exceptional citation rates. Dentistry, though small in volume, achieves high citation visibility.

Areas with High Field-Weighted Citation Impact (FWCI) are Economics, Econometrics, and Finance: FWCI = 1.28; Multidisciplinary: FWCI = 1.22; Neuroscience: FWCI = 1.89; health professions: FWCI = 1.1; Neuroscience and Economics stand out as highly impactful areas, even with modest publication volumes. Multidisciplinary research demonstrates significant global impact, emphasizing its importance in high-citation journals.

Table 2

Subject areas of Kazakhstan publications

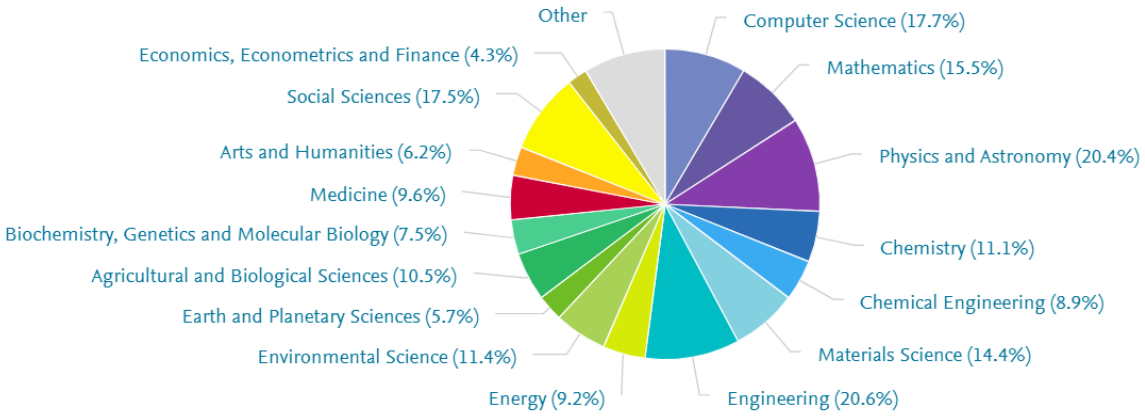
Subject Area	Scholarly Output	Scholarly Output (growth %)	Citations	Authors	Authors (growth %)	Citations per Publication	Field-weighted Citation Impact
Engineering	1015	-8,2	5042	1077	18,2	5	0,75
Physics and Astronomy	1005	-13,4	5457	931	1,2	5,4	0,77
Computer Science	873	8,3	2768	938	22	3,2	0,66
Social Sciences	859	16	2292	1098	25,8	2,7	0,76
Mathematics	760	0	2607	745	14,3	3,4	0,69
Materials Science	708	-5,5	4721	746	31,7	6,7	0,72
Environmental Science	563	29	3056	757	54,5	5,4	0,93
Chemistry	544	8,8	3789	714	40	7	0,69
Agricultural and Biological Sciences	518	48,1	1629	697	22,5	3,1	0,66
Medicine	471	0	9786	454	26,4	20,8	3,99
Energy	454	-11,3	3352	674	21,4	7,4	0,95
Chemical Engineering	436	-10,8	2507	607	31,7	5,8	0,61
Biochemistry, Genetics and Molecular Biology	371	56,5	2694	532	91,7	7,3	0,87
Arts and Humanities	306	58,1	281	414	53,3	0,9	0,56
Earth and Planetary Sciences	281	14,5	1134	373	12,6	4	0,9
Economics, Econometrics and Finance	212	45,9	1199	242	89,7	5,7	1,28
Business, Management and Accounting	203	35,9	975	283	47,5	4,8	0,67
Pharmacology, Toxicology and Pharmaceutics	138	161,1	1072	215	138,5	7,8	0,91
Decision Sciences	136	12,9	276	221	52,9	2	0,87
Multidisciplinary	100	16,7	1046	207	17	10,5	1,22

Immunology and Microbiology	87	-4,8	483	123	-18,9	5,6	0,63
Psychology	79	100	171	124	44	2,2	0,96
Neuroscience	38	0	252	56	-15,4	6,6	1,89
Health Professions	38	75	132	75	0	3,5	1,1
Veterinary	29	-25	141	34	-54,5	4,9	0,91
Nursing	19	0	30	25	-	1,6	0,7
Dentistry	10	-50	205	10	50	20,5	1,84

Veterinary and Dentistry are experiencing steep declines in scholarly output, reflecting decreased research activity in these areas. Declines in traditional STEM fields like Physics and Engineering might be due to shifts toward applied and multidisciplinary research areas.

Figure 5

Share of Kazakhstani publications by subject areas



Subject areas such as Pharmacology, Toxicology, and Pharmaceutics: 161.1% growth in authors and 138.5% growth in publications; psychology: 100% growth in scholarly output (79 publications); and Health Professions: 75% growth (38 publications) emerged with high growth. Significant growth in health-related fields and psychology reflects global research trends focusing on mental health, public health, and pharmacological innovation.

High growth in fields like Pharmacology, Biochemistry, and Multidisciplinary research reflects a strategic shift toward impactful and collaborative studies. Decreases in Engineering, Physics, and Veterinary sciences indicate a potential redirection of research priorities or funding. Medicine and Dentistry maintain high citations per publication, signaling strong global relevance. Fields like Environmental Science (54.5%) and Chemistry (40%) show substantial growth in author participation, indicating increased collaborations and research engagement.

Kazakhstan's Collaborations

Kazakhstan scholars collaborate extensively worldwide, reflecting strong international research engagement. Kazakhstan's collaboration in research through co-authored publications across different world regions is presented in the Table 3 and Figure 6. Kazakhstan in recent three years collaborated with 190 countries publishing 21 153 articles in co-authorship.

Europe is the leading region for Kazakhstan's research partnerships, contributing the highest number of co-authored publications (68% of the total). This dominance may result from

geographic proximity, historical ties, and strong academic networks. Asia Pacific (39 countries, 6,189 publications) ranks second, likely due to Kazakhstan's location in Central Asia and its strategic partnerships within the Asia-Pacific. Middle Eastern countries are significant collaborators, possibly driven by shared research interests in energy and natural resources.

Figure 6

Distribution of Kazakhstan publications worldwide

North America, especially the U.S. and Canada, likely provides advanced research collaboration opportunities, despite fewer partnerships than Europe or Asia-Pacific. Africa ranks lower despite having the highest number of collaborating countries, suggesting partnerships may be more scattered or less intensive. South America shows the least collaboration, likely due to geographic distance and fewer shared research priorities.

Table 3

Kazakhstan's collaboration with world regions

Region totals	Collaborating Regions	Co-authored publications
Worldwide	190	21153
Africa	51	1249
Asia Pacific	39	6189
Europe	45	14408
Middle East	18	3632
North America	24	2658
South America	13	553

Kazakhstan's strongest partnerships are with Europe and Asia-Pacific, driven by geographic proximity and historical ties. Despite collaborating with 51 African countries, research output remains relatively low, indicating potential for deeper partnerships. Expanding collaboration with underrepresented regions like South America and Africa could enhance global research integration.

Table 4 below highlights Kazakhstan's top 10 collaborating countries based on co-authored publications, showing growth trends and institutional involvement. The highest research output of the co-authorship of Kazakhstan is with Russia (7,327). Longstanding academic ties explain this leading position despite moderate growth (11.2%).

Table 4

Top 10 collaborated countries

Country/ Region	Co-authored publications	Co-authored publications (growth %)	Co-authors in Kazakhstan	Co-authors in Kazakhstan (growth %)	Institutions
Russian Federation	7327	11,2	8488	22,4	679
United States	2269	41,7	2899	60,7	935
China	1935	46,8	1725	89	623
Ukraine	1818	6,9	1699	72,4	206
Poland	1500	-8,8	1772	79,5	190
United Kingdom	1468	39,6	1597	57,2	513
Turkey	1361	102,2	1828	116,8	271
Germany	1193	20,4	1576	25,8	353
India	1133	100,9	943	69,1	512
Italy	1018	43,9	1071	65	294

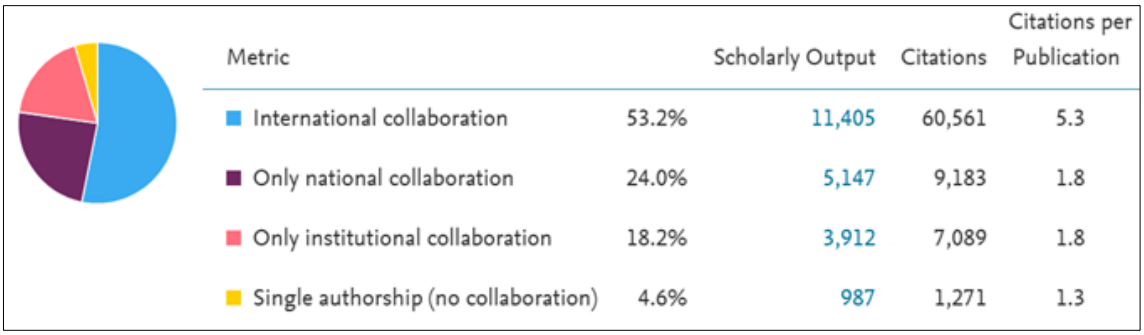
Kazakhstan has rapidly growing partnerships with research powerhouses such as the United States (2,269, +41.7%) and China (1,935, +46.8%). Collaboration with Saudi Arabia (+254.5%) and Uzbekistan (+166.7%) resulted in the fastest growth, possibly linked to recent agreements or shared research projects.

In the collaboration of Kazakhstan with other countries, the most institutions involved in this partnership from the United States (935), Russia (679), and Germany (353). This suggests extensive institutional networks of Kazakhstani universities with leading research hubs.

Kazakhstan's collaboration landscape reflects historical ties (Russia, Ukraine), emerging partnerships (China, India), and strategic expansions (Saudi Arabia, Pakistan). Rapid growth with countries like Iran, Pakistan, and Saudi Arabia could be driven by shared interests in technology, energy, and STEM fields. Collaborations with Europe, the US, and China yield the highest citation impacts, emphasizing the global significance of these research projects.

Figure 7

International, national, and institutional collaboration in Kazakhstan



Kazakhstan's research collaboration patterns are based on four collaboration types: international collaboration, national collaboration, institutional collaboration, and single authorship (Figure 7). International collaboration in Kazakhstan takes 53.2% of research productivity. International collaboration generates the highest scholarly output and citations,

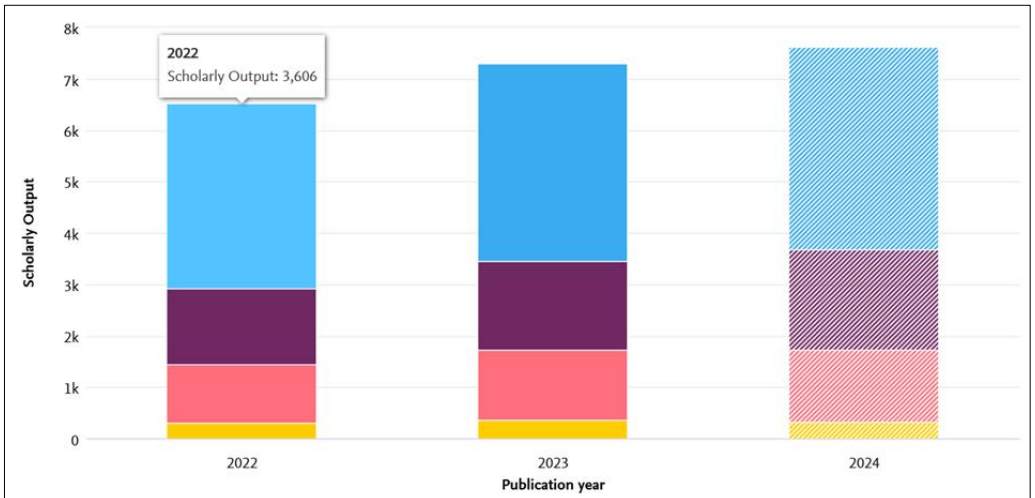
reflecting the significant impact of global partnerships. Kazakhstan's international research is cited 49% more than the global average, emphasizing quality and visibility.

National collaborations produce fewer publications (24.0%) and receive relatively low citations per publication (1.8). These papers are cited less frequently than the global average, suggesting limited international reach or niche research fields. Institutional-level collaboration has moderate output (18.2%) and citation impact.

Single-author publications produce the least output (987) and have limited citation impact (Figure 8). Single-author work may lack the visibility and collaborative benefits of multi-authored publications.

Figure 8

International, national, and institutional collaboration over time



Type of collaboration	2022	2023	2024	Overall
International collaboration	3,606	3,861	3,938	11,405
Only national collaboration	1,479	1,715	1,953	5,147
Only institutional collaboration	1,129	1,376	1,407	3,912
Single authorship (no collaboration)	311	354	322	987
Total	6,525	7,306	7,620	21,451

Figure 9 highlights the impact of academic-corporate collaboration on research in Kazakhstan compared to research without such collaboration. Despite contributing only 1.2**%** of total research output, academic-corporate collaboration generates exceptionally high citations. These papers are cited 12 times more frequently than non-corporate collaborations, indicating groundbreaking or industry-relevant research.

Figure 9

Academic-corporate collaboration by Kazakhstan

Metric		Scholarly Output	Citations	Citations per Publication	Field-Weighted Citation Impact
Academic-corporate collaboration	1.2%	249	9,705	39.0	16.28
No academic-corporate collaboration	98.8%	21,202	68,399	3.2	0.94

The bulk of research output comes from non-corporate academic collaborations, 21,202 (98.8%). Citations per Publication (3.2) are considerably lower, indicating average research visibility on a global scale.

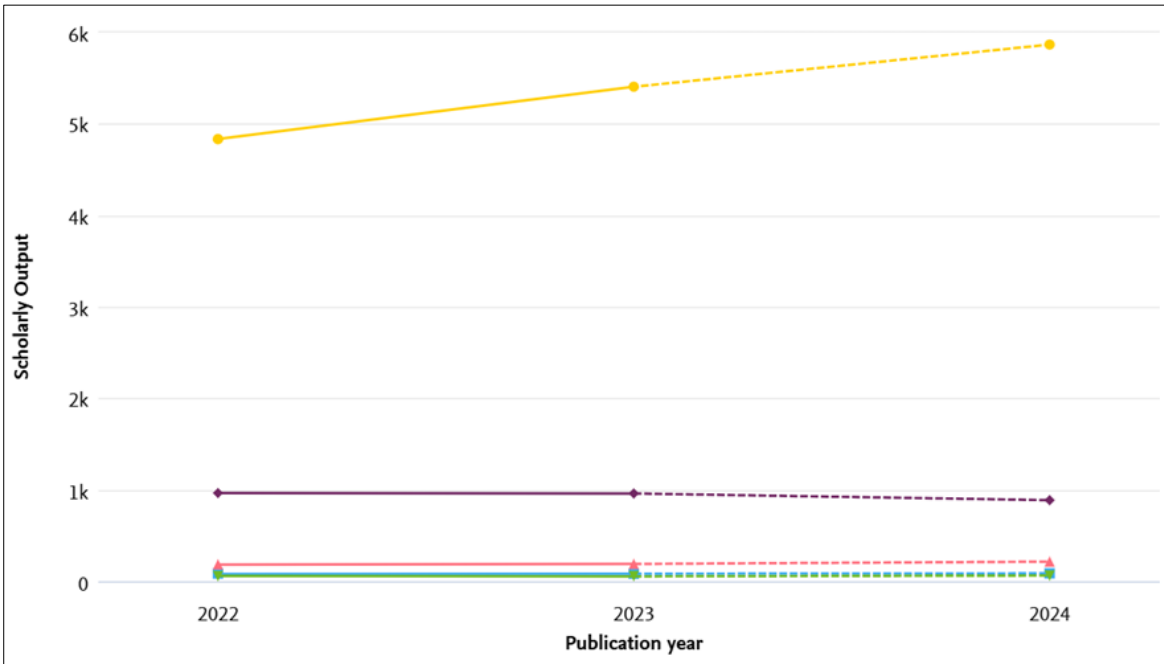
Although academic-corporate collaboration is rare, these partnerships yield significantly higher-impact research. Expanding such collaborations could boost Kazakhstan's global research standing and drive innovation. Encouraging more partnerships with corporations, especially in the technology, energy, and engineering sectors, could improve overall research productivity.

Various types of research collaborations in Kazakhstan over the years 2022, 2023, and 2024, with the total number of collaborations in each category for each year and overall are presented in Figure 10.

Academic-corporate collaborations have shown a steady increase over the years. The growth from 79 in 2022 to 87 in 2024 indicates a moderate upward trend. Corporate partnerships with academia may be becoming more common, suggesting a growing focus on research and development collaboration or industry-academic knowledge transfer.

Figure 10

Collaboration of Kazakhstan with different sectors over time



Type of collaboration	2022	2023	2024	Overall
Academic-corporate collaboration	79	83	87	249
Academic-government collaboration	965	960	887	2,812
Academic-medical collaboration	182	190	215	587
Academic-other collaboration	59	54	63	176
Academic only collaboration	4,834	5,406	5,867	16,107
Total	5,936	6,535	6,908	19,379

Academic-government collaboration category shows a slight decline over the years, with a reduction from 965 in 2022 to 887 in 2024. While the number remains high compared to other types of collaborations, there is a noticeable decrease, particularly from 2022 to 2024.

Government-academic collaboration remains significant but is on a slight downward trajectory. This could indicate changes in funding or government priorities, or possibly a shift towards different types of collaborations.

The number of academic-medical collaborations shows consistent growth, increasing from 182 in 2022 to 215 in 2024. This suggests a positive trend in partnerships between academia and the medical sector. The rise in academic-medical collaborations could be indicative of greater attention to medical research, healthcare innovations, or increased funding for biomedical research.

Academic-other collaboration fluctuates slightly, with a decrease in 2023 followed by an increase in 2024. The overall number is relatively small compared to other categories. "Other" collaborations could refer to a wide range of non-corporate, non-government, and non-medical partnerships. The variability in this category might reflect changes in non-traditional academic partnerships or projects.

Academic-only collaboration shows a strong and consistent increase year over year, with a significant rise from 4834 in 2022 to 5967 in 2024. Academic-only collaborations (likely referring to inter-institutional collaborations, internal academic projects, or purely academic research) dominate the data. The significant growth in this category suggests that universities and research institutions are increasingly engaging in internal or academic-only research projects.

The total number of collaborations has steadily increased over the years, with a noticeable rise from 5936 in 2022 to 6908 in 2024. The total collaborations reflect the increasing trend across all categories, indicating a general growth in academic collaboration.

Analysis of collaboration with different sectors over time highlights the dynamic nature of academic collaborations and the varying trends across different sectors. Further investigation could help to understand the underlying causes of these trends, such as funding patterns, policy shifts, or institutional strategies.

Leading Publishing Institutions

The world of publishing is vast and dynamic, encompassing a rich network of institutions that shape the flow of ideas, culture, and knowledge. At the heart of this industry lie the leading publishing institutions - organizations that play a pivotal role in bringing books, journals, research, and other forms of written content to readers worldwide. These institutions, ranging from well-established conglomerates to specialized independent publishers, are integral to the distribution of both mainstream and niche literature, as well as scholarly work.

The top 10 institutions in the Kazakhstan contributing to research productivity during the last three years period are Al Farabi Kazakh National University, Nazarbayev University, L.N. Gumilyov Eurasian National University, Satbayev University, Abay Kazakh National Pedagogical University, Kazakh National Agrarian University, Kazakh National Medical University, Buketov Karaganda State University, Kazakh British Technical University, South Kazakhstan State University.

Table 5

Major institutions contributing to research productivity in 2022-2024

Universities in Kazakhstan	Overall	2022	2023	2024
Al Farabi Kazakh National University	3750	1170	1201	1379
Nazarbayev University	3695	1211	1211	1273
L.N. Gumilyov Eurasian National University	2551	716	895	940
Satbayev University	1605	433	557	615
Abay Kazakh National Pedagogical University	853	278	245	330
Kazakh National Agrarian University	750	215	282	253

Kazakh National Medical University	639	156	208	275
Buketov Karaganda State University	631	208	231	192
Kazakh-British Technical University	602	184	181	237
South Kazakhstan State University (SKSU)	599	176	205	218

Table 5 lists the leading publishing universities in Kazakhstan, showing their overall scholarly output and annual publication counts from 2022 to 2024. These 10 universities could be divided into three groups by their scholarly output.

1. Top Performers by overall output:

- Al-Farabi Kazakh National University (3,750 publications) is consistent in yearly growth from 1,170 (2022) to 1,379 (2024). The top research institution, benefiting from diverse academic disciplines and established international collaborations.
- Nazarbayev University (3,695 publications) has a steady output, averaging over 1,200 publications yearly. Focus on cutting-edge research in science, engineering, and technology boosts its global visibility.
- L.N. Gumilyov Eurasian National University (2,551 publications) shows a remarkable increase from 716 (2022) to 940 (2024). Rapid growth suggests expanding research programs and strengthening global partnerships.

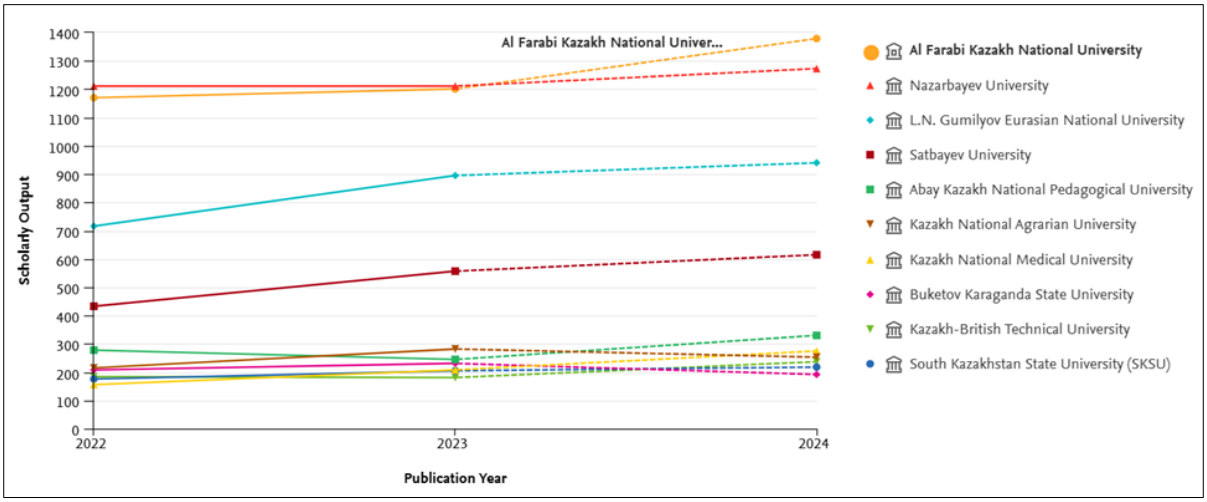
2. Emerging Universities with moderate growth:

- Satbayev University (1,605 publications) shows a steady increase from 433 (2022) to 615 (2024), likely driven by engineering and technical research expansion.
- Abay Kazakh National Pedagogical University (853 publications) displays a recovery from a slight decline in 2023 to a strong rebound in 2024 (330 publications).
- Kazakh National Agrarian University (750 publications) shows **f**luctuating output with a slight dip in 2024 (253), which is driven by research in agriculture, food security, and sustainability.

Top 10 Kazakhstani institutions scholarly output trend in 2022-2024 years presented in figure 11. The trend shows that most universities (6) are at the same level scholarly output for three years. Leaders maintain their positions over the years.

Figure 11

Scholarly output trend of Top 10 Kazakhstani institutions in 2022-2024



Niche Institutions

Kazakh National Medical University (639 publications) has consistent yearly growth, reaching 275 in 2024, reflecting increased medical and health research after the pandemic.

Buketov Karaganda State University (631 publications) shows a slight decline from 231 (2023) to 192 (2024). Academic diversification and improved partnerships could boost future performance of the university.

Kazakh-British Technical University (602 publications) has a strong rebound in 2024 (237 publications), likely strengthened by industry-focused research in technology and energy.

South Kazakhstan State University (599 publications) displays a steady increase from 176 (2022) to 218 (2024). Potential growth areas of the university are applied sciences and engineering.

Al-Farabi Kazakh National University and Nazarbayev University dominate, driven by international collaboration and multidisciplinary research. L.N. Gumilyov Eurasian National University and Satbayev University show significant upward trajectories. Universities like Buketov Karaganda State and Kazakh National Agrarian University could benefit from targeted research funding and international partnerships.

Conclusion

This study analyzed the research productivity and contributions of leading publishing institutions in Kazakhstan from 2022 to 2024. The findings reveal substantial growth in research output, driven by strategic reforms, increased funding, and international collaborations. Al-Farabi Kazakh National University and Nazarbayev University have played pivotal roles in shaping the nation’s research landscape. However, the slightly below-average Field-Weighted Citation Impact (FWCI) highlights the need to focus not only on quantity but also on the quality and global relevance of research. International collaborations have been instrumental in enhancing visibility and impact, but the limited domestic collaboration network suggests an opportunity to strengthen national research integration. While Kazakhstan has made commendable progress, challenges such as language barriers, low representation in high-impact journals, and underdeveloped domestic research networks must be addressed to achieve sustainable and globally competitive research outcomes.

This study has certain limitations. Firstly, SciVal relies on Scopus data, which may exclude publications not indexed in Scopus, potentially underrepresenting research output in certain disciplines or local journals. Second, the focus on quantitative metrics may overlook qualitative aspects of research, such as societal impact or innovation. Thirdly, institutional affiliations in publications were self-reported, which could introduce inaccuracies in attribution.

Future studies could investigate the long-term effects of institutional reforms, such as changes in funding structures, research policies, and academic governance, on the research output and quality in Kazakhstan. This could include examining how specific reforms impact different academic disciplines and institutional types. Although this study highlights the importance of international collaborations, a deeper analysis of domestic collaboration networks is needed. Future research could explore how intra-national collaborations influence research productivity and identify barriers to greater cooperation among Kazakhstani institutions. Comparative research on research productivity in Kazakhstan and other Central Asian countries could provide regional insights and best practices. This could help identify common challenges, regional disparities, and opportunities for collaboration in the Central Asian academic landscape. These directions for future research could provide a deeper and more comprehensive understanding of Kazakhstan's research environment and help refine policies and strategies to enhance research productivity and impact.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author contributions

The author confirms the sole responsibility for the conception of the study, presented results and manuscript preparation.

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THE ROLE OF PHYSICAL PRACTICAL COURSE IN IMPROVING RESEARCH SKILLS OF FUTURE TEACHERS

Abstract: The article separately reveals the main components of a special physical workshop. It discusses the theoretical support of the workshop and a set of laboratory works related directly to the research work, and analyzes their main goals. The level of scientific research competencies "before and after" of the controlled groups is compared using research methods, including surveys.

Based on the physics workshop, it will be shown what impact the presentation of educational and teaching aids has on the formation of scientific and research competencies of future physics teachers, as well as the innovation of these tools and the positive impact they have on the teacher and student. In addition, by analyzing the place of methodological recommendations and applications in the educational process, he offers the advantages of a logical continuation of his independent scientific and design work. A selection of the results of the analysis with a comprehensive study of the current topic is demonstrated. Considering the purpose and main objectives of the proposed physics workshop to solve the problem, its influence on the student and the importance of his place in solving the problem are proven. The importance of the main components of knowledge, skills and abilities in performing laboratory work does not lag behind. Thus, the need to provide educational and teaching aids for physics workshops is proven. That is, it shows what role the course plays and reveals its relevance. The result is a positive growth of 42%.

Key words: physics teacher, physics workshop, laboratory work, research competence.

Introduction

The main component of the development of methodological foundations for the formation of scientific research competencies of future physics teachers is a physics workshop. The main goal of the physics workshop is to develop the scientific research competencies of future physics teachers using the example of X-ray diffraction. This aligns with research findings emphasizing the role of practical coursework in fostering research skills among teachers (Plotskaja et al., 2023; Kurbanbekov et al., 2018).

Considering physics teachers in a general sense, they are professionals with developed skills of comprehensive critical thinking, who are fully proficient in the educational methodological complex and have research competencies, since physics is a fundamental science. The necessity of such competencies has been highlighted in various studies, particularly in relation to improving assessment literacy among teachers in Kazakhstan (Shmigirilova et al., 2022; Testov & Perminov, 2023).

The special course is called "X-ray diffraction." The main goal of the course is to become an integral part of the methodology and formation of research competencies of bachelor students and master's degree students of the educational program "Physics," i.e., future physics teachers. This approach is comparable to methodologies employed in developing functional competencies in STEM education (Jeonga et al., 2019; Zanabazar et al., 2023). A special elective course is studied by future physics teachers, specifically 4th-year undergraduate

students and 2nd-year master's degree students. Physics workshops consist of educational and teaching aids, which play a crucial role in strengthening research skills (Mok et al., 2023).

The manual was written to cover the theoretical part of the physics workshop. That is, we can say that the main lectures of the workshop have been compiled. It is important to note that this will serve as a continuation of the tutorial, ensuring the application of theoretical knowledge in laboratory and research activities. Similar methodologies have been successfully applied in STEM education, demonstrating the effectiveness of hands-on experience in enhancing research capabilities (Tang & Zi, 2023; Shumeiko et al., 2024).

The educational manual is based on several laboratory works, aimed primarily at diffraction analysis of X-rays. Laboratory work will help future physics teachers develop scientific research competencies and effectively use the acquired knowledge and skills in the future. Moreover, each laboratory work is complemented by control questions to reinforce understanding. The use of advanced equipment such as the X-ray diffractometer aligns with contemporary approaches to physics education, ensuring students engage with complex scientific methodologies (Kabanova, 2023).

This approach is in line with the findings of "The Role of Physical Practical Course in Improving Research Skills of Future Teachers," which emphasize the importance of integrating research-based coursework into teacher training programs. The development of such competencies is crucial for ensuring that physics teachers can not only convey fundamental concepts but also engage in scientific inquiry and innovation in their professional activities.

The main goal of the article is to prove the need to provide educational and teaching aids for physics workshops. That is, to show what role the course plays and reveal its relevance. This:

1. Prove in the form of a pedagogical expert the influence of a physics workshop on the formation of scientific research competencies of future physics teachers.

2. Show the positive impact of the proposed innovations on improving research skills.

The textbook is called "Theoretical Fundamentals of X-Ray Diffraction" (Skakov & Dalabayev, 2024). As an innovation, several types of tasks are offered. For example, research paper topics for independent work. This section presents topics of research work aimed at developing the scientific research competencies of future physics teachers (Skakov, Dalabayev, Choruh, & Nurizinova, 2024). At what level students receive the knowledge gained from the physics workshop and the skills they develop, topics are offered as the main final material of this workshop. We expect that research topics will be successfully defended with the help of high-quality knowledge obtained from the workshop (Skakov & Dalabayev, 2024).

We will also write a short guide to the proposed extensive topic. That is, students understand how to develop a topic by mastering special instructions (Skakov & Dalabayev, 2024). Thus, the scientific research competencies of future physics teachers will develop, which will allow them to be used in the future in other topics in the field of physics (Litvinov & Gorelik, 2024).

The textbook presents the theoretical foundations of x-ray diffraction in higher education institutions. Here, theoretical information on the topic is transmitted together with control questions. As a continuation of this manual, a set of laboratory work is proposed in the form of a teaching aid. In addition, this work provides special tasks to consolidate the topic under consideration. These tasks are intended to develop students' scientific research competencies (Alimbekova, 2020). Problems and information were developed under the guidance of STEM technology and other modern methods were used effectively (Kasymova, 2019). Developmental tasks help improve the student's critical thinking. The work is competently written in academic language, fully reveals its topic, and contains the most necessary information (Generalova, 2021).

The textbook is intended for university teachers, young professionals, as well as for students and master's degree students studying in a special course "X-ray diffraction".

The materials and methods of the study

The main research method used is observation, interviews, surveys, questionnaires, testing, photography, counting, measurement, comparison.

Scientific examinations bachelor department of the East Kazakhstan University named after Sarsen Amanzholov 6B015 training of natural science teachers, including B010 training of physics teachers, students of the educational program 6B01502 Physics.

Master's degree students of the educational program 7M01502 Physics for the training of teachers in natural science disciplines 7M015 of the master's department of this educational institution, including the training of physics teachers M011, were also involved. Also, the bachelor department of Khoja Akhmet Yassawi International Kazakh-Turkish University 6B015 training of natural science teachers, including B010 training of physics teachers. Students of the educational program 6B01520-Physics and master's degree students of the educational program 7M015 in natural science subjects of the master's degree, including training of physics teachers M011 master's students of the educational program 7M01520 Physics, were taken under control. (Table 1-A and 1-B) The surveys are shown in the figure below:

Table 1-A

Survey for students and master's degree students

Survey for Students and Master's Students Dear student! Please provide complete answers to the questions below.		
No	Question	Answer
1	Provide the definition of the phenomenon of diffraction:	
2	What is the difference between geometric optics and wave optics?	
3	Are you familiar with the concept of X-ray diffraction?	1 - Yes 2 - No 3 - I forgot. If you are familiar with it, please provide the definition:
4	Please present the formula based on Bragg-Wulf theory:	1-2dsinθ=nλ 2-5dsinθ=2λ 3- I find it difficult to answer
5	In what year did Conrad Röntgen discover the properties of X-rays?	1-1900 2-1895 3-1850
6	Is it necessary to develop the methodological foundations for forming research competencies of future physics teachers using the phenomenon of diffraction as an example?	1-necessary 2-not necessary 3- I find it difficult to answer If necessary, why?
7	Have you been to the National Scientific Laboratory for Collective Use?	1- yes 2-no 3- I have no information about the laboratory if you are, for what purpose
8	Are you familiar with the X-ray diffractometer equipment at the national scientific research laboratory for collective use based at Sarsen Amanzholov East Kazakhstan University?	1-yes 2-no 3- I find it difficult to answer "If you are familiar, could you please describe the structure and working principle of the X-ray diffractometer?"
9	Are you engaged in scientific research activities?	1-I am currently engaged in it. 2-I have not been involved in scientific research activities. 3-There is no demand for scientific research activities. Why have you not been involved in scientific research activities?

10	Did you encounter any known or unknown difficulties during your involvement in scientific research activities?	1- Yes, difficulties arose 2- No, difficulties did not arise. 3- I find it difficult to answer If difficulties arose, what difficulties did you encounter?
Thank you for taking the time to respond to the survey!		
Holder of the State Prize of the Republic of Kazakhstan in the field of science and technology named after Al-Farabi, Doctor of Physico-mathematical Sciences, Professor, Academician of Kazakhstan National Academy of Natural Sciences, Professor of the Department of Physics and Technology at "Sarsen Amanzholov East Kazakhstan University.		Skakov M.K. _____ (sign)
PhD student of the 1st year of the educational program 8D01502 – "Physics."		Dalabayev T.N. _____ (sign)

Table 1-B

Survey for university teachers

For University Teachers SURVEY "Dear Colleague! We kindly ask you to provide complete answers to the questions presented below."						
Teacher's full name:..... Total number of students: ..... of which the number of groups in the Physics major: ..... Please assess how well the skills listed below have been developed in your students using a five-point scale. We kindly ask you to place a '+' sign in the appropriate column.						
No.	Assessable Research Competency	1	2	3	4	5
1	Collection and Systematic Analysis of Scientific Data					
2	Ability to Make Preliminary Hypotheses					
3	Setting Personal Goals for the Research Topic					
4	Defining the Objectives of the Research Work					
5	Defining the Subject and Object of the Research					
6	Ability to Present One's Perspective					
7	Applying Observation or Other Research Methods					
8	Implementing or Organizing the Research Work					
9	Analyzing the Results of Scientific Research Work					
10	Documenting and Presenting the Results of Scientific Research Work According to Requirements					
Holder of the State Prize of the Republic of Kazakhstan in the field of science and technology named after Al-Farabi, Doctor of Physico-mathematical Sciences, Professor, Academician of Kazakhstan National Academy of Natural Sciences, Professor of the Department of Physics and Technology at "Sarsen Amanzholov East Kazakhstan University.		Skakov M.K. _____ (sign)				
PhD student of the 1st year of the educational program 8D01502 – "Physics."		Dalabayev T.N. _____ (sign)				
Thank you for taking the time to respond to the survey!						

In order to systematically conduct research work, we divided the supervised students and master's degree students into groups A, B, C, D. To determine the effectiveness of the surveys and physical workshops, depending on the main research plan of the groups, we classified the proposed educational and teaching aids into parts A and B, C and D, depending on assimilation. (Table 2) Information about the groups monitored is presented in the table below:

Table 2

Information about participants

№ Group number	Group educational program code	Name of the group during the pedagogical experiment	Number of students in the group
1	7M01502	A	12
2	6B01502	B	8
3	6B01502	B	15
4	6B01520	C	20
5	6B01520	C	13
6	7M01520	D	22
Total number of participating groups: 6			Total number of students 90

There are 6 groups participate in the pedagogical experiment. Three groups will be the control group. That is, let's designate the groups participating in the experiment as A, B, C, D. Groups A and B will be the primary control groups. They are limited only to mastering the textbook and completing tasks of the same work. And groups C and D completely complete physical workshop.

The main goal is to compare changes “before and after” in the development of research competencies among future physics teachers with a comparison of groups.

Table 3

Comparison table

Completed work	Group A and B	Group C and D
Mastering the theoretical sections of the textbook	+	+
Physical dictation	+	+
Word cloud	+	+
Make up the formula	+	+
Physical puzzle	+	+
Developing the set of laboratory works of the educational and methodological manual	-	+
Laboratory work № 1	-	+
Laboratory work № 2	-	+
Laboratory work № 3	-	+

The table above (Table 3) shows the mastered sections of the primary groups A, B and control groups C, D, depending on the proposed methodological foundations.

The key distinction between the experimental groups lies in the scope and depth of their engagement with research activities. Groups A and B primarily focused on mastering theoretical sections of the textbook and completing structured exercises such as physical dictation, word clouds, formula creation, and physical puzzles. In contrast, Groups C and D engaged in a more comprehensive approach, integrating hands-on experimental work through the development of laboratory activities outlined in the educational and methodological manual.

Additionally, while all groups covered core theoretical material, only Groups C and D participated in laboratory experiments (Lab Work №1, №2, and №3), allowing them to apply theoretical knowledge in practical settings. This hands-on experience aimed to enhance their research competencies beyond passive learning.

By comparing the "before and after" results across these groups, the study evaluates how direct participation in physical workshops influences the development of research skills among future physics teachers. The inclusion of laboratory tasks in Groups C and D is expected to

provide a deeper understanding of scientific concepts and foster stronger investigative abilities compared to the control groups (A and B).

Although the vast majority of topics presented in the textbook, which is the main component of the physics workshop, are areas of scientific physics, changes and additions are allowed in order to direct these topics into a scientific and pedagogical direction.

Research skills are an essential component of the professional training of future physics teachers, as they contribute to the development of critical thinking, analytical abilities, and problem-solving competencies. In the context of physics education, research skills encompass the ability to formulate scientific questions, design and conduct experiments, analyze and interpret data, and effectively communicate findings.

Key components of research skills:

- Formulation of research questions – The ability to identify relevant scientific problems, formulate hypotheses, and structure research objectives. This skill is fundamental for engaging in meaningful scientific inquiry.
- Experimental design and implementation – The competence to develop and carry out experiments using appropriate methodologies, tools, and techniques. This includes working with laboratory equipment such as X-ray diffractometers, which play a crucial role in solid-state physics research.
- Data collection and analysis – The ability to systematically collect, process, and interpret experimental data using statistical and computational methods. Proper analysis is crucial in verifying hypotheses and drawing scientifically valid conclusions.
- Scientific communication – The capacity to present research findings in written and oral formats, including writing research papers, reports, and presentations. This skill is essential for participation in scientific discussions and the dissemination of knowledge.
- Critical thinking and problem-solving – The ability to critically evaluate existing scientific literature, identify gaps in knowledge, and propose innovative solutions to scientific challenges.

Evaluation criteria for research skills:

To assess the research competencies of future physics teachers, a set of objective evaluation criteria has been established. These criteria ensure a structured approach to measuring students' progress and capabilities in conducting scientific research.

1) Clarity and relevance of research questions – the extent to which students can define a research problem and formulate clear, logical, and scientifically relevant hypotheses.
2) Experimental proficiency – the ability to conduct experiments independently, demonstrating proficiency in handling laboratory instruments, following safety protocols, and applying appropriate research methods.
3) Data interpretation and analytical skills – the accuracy and depth of data analysis, including the use of appropriate mathematical models and software for data processing.
4) Scientific writing and presentation – the effectiveness of presenting research results in a well-structured, coherent, and scientifically rigorous manner, following academic writing standards such as APA format.
5) Originality and innovation – the ability to propose creative and original solutions to research problems, contributing new insights to the field of physics education.
6) Collaboration and adaptability – the capability to work effectively in research teams, engage in academic discussions, and adapt to new scientific challenges.

By integrating these research skills into the physics practical course, future teachers not only gain a deeper understanding of fundamental physics concepts but also develop the competencies necessary for lifelong learning and scientific inquiry. The implementation of

these criteria ensures that students are adequately prepared for academic and professional challenges in physics education and research.

For example, Topic No. 1 “X-ray diffraction analysis and study of the strength properties of copper”, Topic No. 2 “X-ray diffraction analysis and study of the strength properties of aluminum”, Topic No. 3 “examples of encounters with the phenomenon of diffraction at home in secondary schools and independent laboratory work at home conditions." Then, first of all, students master the theoretical textbook of the workshop.

The textbook consists of an introduction, conclusion, list of references, and 10 sections. Main topics include the physics of X-rays, discovery of the concept of X-rays, the electromagnetic spectrum, characteristics of radiation, refraction of X-rays, scattering of X-rays, and fluorescent radiation. Additionally, it covers the basics of X-ray diffraction, the general diffraction phenomenon, X-ray diffraction, the crystal structure of solids, crystal lattices, Bravais lattices, and nodal rows in a crystal lattice. The textbook also discusses X-ray grating diffractometers, goniometers, types of focusing, types of X-ray diffractometers, including DRON and X PERT PRO models, intensity factors, atomic scattering function, interference analysis function, ray scattering of atomic groups, influence of the temperature factor, X-ray diffraction patterns, and X-ray diffraction analysis of copper (Cu) and aluminum (Al).

To enhance the learning experience, the textbook provides research topics for independent work, a set of theoretical problems, and various engaging activities such as physical dictation, word cloud, "Make up a formula," and physical puzzles. The inclusion of these tasks is aimed at improving students’ research competencies by integrating modern approaches to physics education (Skakov & Dalabayev, 2024; Litvinov et al., 2021; Generalova, 2021). The methodology is aligned with contemporary educational standards, incorporating STEM-based learning principles and case-based instruction to foster a deeper understanding of the subject (Alimbekova, 2020; Kasymova, 2019).

Thus, having mastered the theoretical material and fully answered the control questions, students begin to complete developmental tasks for the formation and development of scientific research competencies. It should be noted that even through the quality of these tasks, the teacher can assess the quality of mastering the theory. Next, a set of theoretical tasks.

In other words, the above examples of tasks will be presented in the tutorial. All the groups that participated in the research work fully assimilated the proposed textbook, which is the main component of the physics workshop. In turn, the textbook received certificate No. 42606 “On entering information into the State Register of Copyrighted Objects”.

Thus, after all the controlled groups have mastered the whole-blooded textbook, the second stage of research work begins. Now half of the supervised groups will limit themselves to the first stage, and the other half will begin to master the proposed educational and methodological manual in order to fully master the physical workshop.

Results and discussions

After studying a physics workshop, students will develop a desire for research activities, and develop research competencies that have been developed over the years. The textbook, called Theoretical Fundamentals of X-Ray Diffraction, complements the main theoretical basis of the workshop, that is, it can be considered a set of lectures. And this teaching aid can be considered a continuation of the above-mentioned teaching aid.

The teaching aid is based on the textbook “Theoretical Fundamentals of X-Ray Diffraction”. That is, it can be considered as a continuation of the textbook. The textbook “Theoretical Fundamentals of X-Ray Diffraction”, dedicated to the special course “X-Ray Diffraction”, is supplemented in the form of lectures, then There is a theoretical approach, this

educational manual presents laboratory work and methodological applications for the practical application of the acquired theoretical knowledge.

Test questions cover laboratory work aimed at conducting X-ray diffraction analysis, formation and development of scientific research competencies of future physics teachers. In this case, the criteria for assessing laboratory work are provided to help the teacher. An innovation has been introduced in maintaining a student development schedule. New ideas on modern topics were also written using assessment sheets, interesting ways to conduct laboratory work, and writing conclusions for laboratory work.

The educational and methodological manual is recommended for use by students of master's and bachelor degree of the educational program "Physics", studying in a special elective course "Theoretical Foundations of X-ray Diffraction", as well as university teachers and young specialists.

The educational manual consists of an introduction, a conclusion, a list of references and 9 sections. Main sections: laboratory work № 1, familiarization with the principle of operation of an X-ray diffractometer, laboratory work № 2, conducting X-ray diffraction analysis of aluminum, laboratory work № 3, determining the second unknown with diffraction analysis of copper, topics of scientific research projects (as a continuation of scientific research work) , criteria for evaluating laboratory work, student progress chart, Evaluation sheet, Writing a conclusion for laboratory work, Interesting ways to conduct laboratory work.

In this section of the textbook, you will be presented with topics for research projects. Students begin to study these topics after completing the workshop, using the research competencies gained and developed from this physics workshop. Then these topics will become a continuation of the development of methodological foundations for the formation of research competencies of future physics teachers. The topics presented to you are divided into scientific-pedagogical and pedagogical. Because this workshop will study the main specialties of the educational program in physics. Topics can be used by students in combination with the topics of the thesis and master's dissertation.

That is, this will be an advantage of the proposed physics workshop. Because after completing the workshop, students do not stop and continue it as independent work. Let's take the following topics as an example.

"This, (scientific and pedagogical direction)" is the implementation, with the help of research bases, of independent scientific research work of students of the physics program at universities, "(scientific direction)" generalization of the results of X-ray diffraction analysis of cobalt."

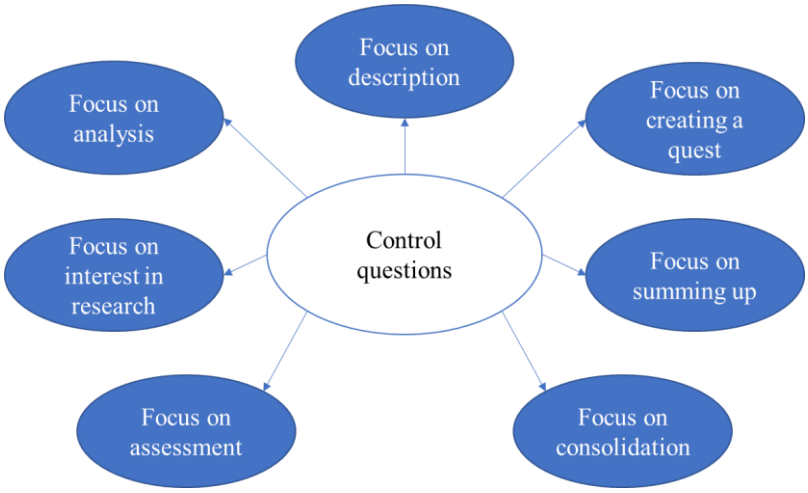
The main goal in the educational process is to assess the achievements of a student. Therefore, it is currently becoming relevant to provide special assessment criteria on the topic. If we determine through the tasks how well we have received knowledge on the topic we have passed, special criteria should also be proposed for these tasks. Advantages of presenting the assessment criteria:

- clarity of the learning process,
- high-quality feedback between students and teachers,
- based on the criteria, students understand their level from the inside,
- optimization of the evaluation process.

Test questions are questions that help determine how comprehensively a student has understood a lab before summarizing the lab and lead to the student's search and opinion being organized. Before answering a question, the student must be fully familiar with the lab's progress and complete the objective of the lab. When answering test questions, it is best to provide evidence for each question from the point of view of physical science. The teacher may also ask additional clarifying questions.

Test questions are based on the directions shown in Figure 1. Each direction corresponds to one separate point. That is, test questions are focused primarily on assessment, and then on consolidating the topic, summing up, searching, describing a specific physical phenomenon, attracting the student to study, and analyzing the topic.

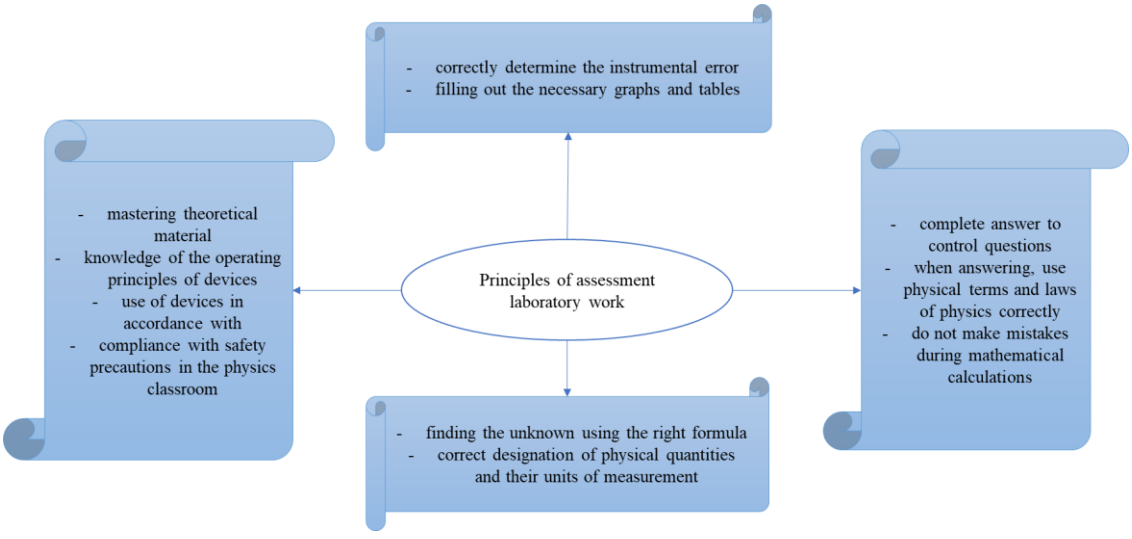
Figure 1
Directions of test questions



When assessing laboratory work, special attention should be paid to the student's level of knowledge of theory, knowledge of the direction and operation of equipment, and high-quality answers to test questions. Each of them, in turn, is assessed on the basis of clear rules, such as correctly stating and proving physical laws and rules, creating the following formula using the necessary formulas.

Traditionally, we know that the assessment format includes mainly the generalized skills required. Therefore, when evaluating laboratory work, it is necessary to diverge from traditional evaluation and adhere to the basic principles outlined in the figure below. This is shown in Figure 2.

Figure 2
Principles of assessment



Considering that assessment work is the most important component of the educational process, it can be understood that this greatly helps the teacher and the student. This is because the effective evaluation of each laboratory work affects the effectiveness of the research work.

Based on the assessment principles presented above and the assessment criteria for the topic, we recommend writing a clearly violated principle on this assessment sheet. The assessment sheet is shown in the following Figure 3.

Figure 3

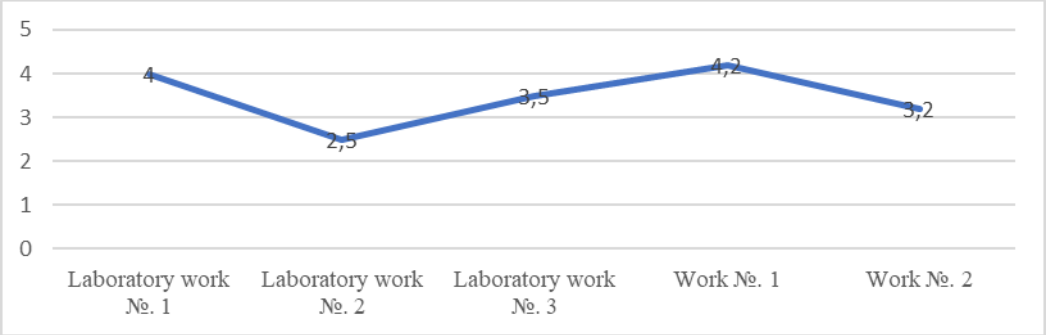
Assessment sheet

discipline: "Physics"	Laboratory work №. 1	Topic:
Date:	Group:	Student:
№	Principles of assessment:	Assessment:
Warning:	Violated principle:	Ways to fix:

That is, if students completed 4 laboratory works, then 4 such assessment sheets will be completed for each of them. The student's progress is then graphed as shown below. This is shown in the following Figure 4.

Figure 4

Student progress graph



In this way, all these applications will systematically fix the problem at hand and point the way to the next step. It is an indispensable addition that creates a relationship between teacher and student.

The knowledge progress graph is an application that is an indispensable assistant to the teacher, showing how well all laboratory work has been completed as a whole and how well the knowledge has been acquired by those who completed it. Not only for the teacher, but also for the student. This is because by looking at the score chart, you can find out which labs have errors and which labs performed poorly and which performed well. Thus, one should come to a generalized conclusion and carry out additional work to correct the missing gap. Looking at the graph above, we can see the success of knowledge. First of all, help the teacher. This is because a graph can be used to present to the learner what should be repeated as feedback. Of course, this chart can be used for other purposes. The main thing is that all the work carried out

produces results and becomes an integral part of the methodology for developing the research competencies of future physics teachers.

To use the above tasks, first of all, students get acquainted with the set of lectures in a special textbook presented for the workshop, and answer test questions at the end of these sections. Students who have theoretical knowledge begin to perform laboratory work, completing tasks in the process of developing scientific and research competencies.

For clarity of comparison and pedagogical experiment, we present below fragments of laboratory work in the complex of basic laboratory work. That is, a total of 3 laboratory works is offered. They are aimed at developing the scientific research competencies of future physics teachers using theoretical knowledge in practice. Below is a short excerpt from the labs presented to you!

1. Laboratory work №. 1

Topic: "Introduction to the operating principle of an X-ray diffractometer."

Work objective:

(Operator) familiarization with equipment for obtaining diffraction samples under the guidance of a research assistant, reading the operating principle of a diffractometer, mastering the choice of shooting conditions, techniques for manufacturing and installing samples, obtaining diffraction laws.

Equipment: X-ray diffractometer X'Pert PRO. Students will learn the operating principle of the above tool and the work of developing the model.

2. Laboratory work № 2

Topic: "Conducting X-ray diffraction analysis of aluminum."

Work objective:

(Operator) Obtaining a diffraction X-ray sample of aluminum under the supervision of a research assistant.

Equipment: X'Pert PRO X-ray diffractometer, aluminum model.

That is, according to the study, they should get a diffraction pattern below. Thus, in this laboratory work, students apply the acquired skills in practice.

3. laboratory work No. 3

Topic: "Determining the second unknown by performing diffraction analysis of copper."

Work objective:

(Operator) identification of an unknown element in a mixture by taking an X-ray diffraction sample of copper under the direction of a research assistant.

Equipment: X'Pert PRO X-ray diffractometer, copper sample (with impurity).

That is, according to the study, he should obtain the diffraction pattern below and detect an unknown substance.

Thus, in this laboratory work, students apply the acquired skills in practice and identify an unknown substance.

The main component of laboratory work is the conclusion.

The formulation of conclusions is a critical aspect of research work, reflecting the researcher's ability to analyze results and synthesize key findings. In the context of physics education, particularly in laboratory-based courses such as X-ray diffraction analysis, well-structured conclusions contribute to the development of students' research competencies. As noted in studies on research skill formation in future physics teachers, the ability to draw scientifically grounded conclusions is integral to their professional development (Shirina, 2019; Appendix 112, 2022; Evstifeev, 2017). This aligns with our approach in "The Role of Physical Practical Course in Improving Research Skills of Future Teachers," where we emphasize hands-on experience and systematic reflection as key components of scientific competency formation.

- Direct communication with the purpose of laboratory work.

- Reveal your work.
- Coverage of achieved goals.
- Description of the progress in achieving the goal of the laboratory work.
- Show the reason for the occurrence of a physical phenomenon or pattern in the topic of laboratory work as a real phenomenon from a scientific point of view and in practice.
- Adding used basic tools and formulas as keywords and much more.

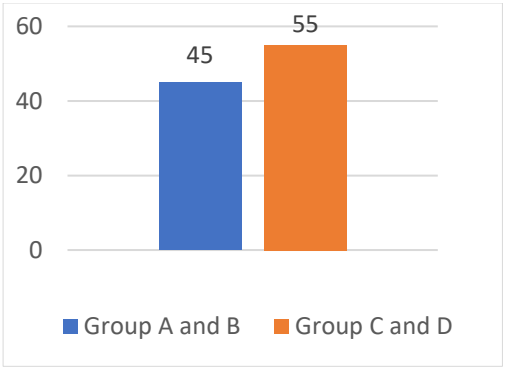
In order for the basic requirements to be met, the student must first fully complete and understand the laboratory work. Looking only at the conclusions, you can understand how correctly the student acted, how correctly he formulated the thought.

The requirements for all laboratory work are the same. They are:

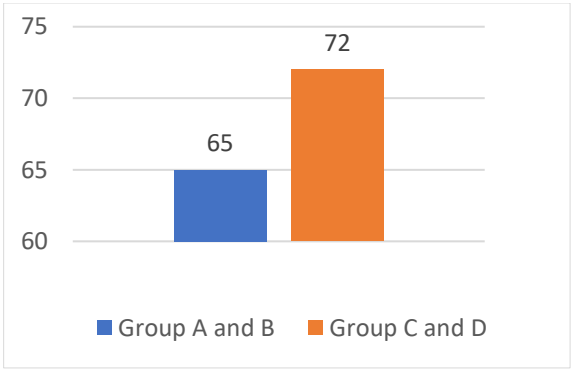
- Availability of the purpose of laboratory work;
- Indicate the list of equipment used in the work;
- Drawing up a laboratory work plan;
- Presentation of theoretical data of laboratory work (brief and accurate data about the phenomenon or pattern under consideration);
- Content in the theoretical part of the formulas used in the work;
- Providing additional materials such as tables and graphs and the like;
- Sequence of work;
- Availability of final or test questions.

Before comparing the control groups, a survey was conducted of the teachers who taught these groups (Tab. 1-B). Based on the results of the survey, teachers of scientific research competencies of students and master's degree students, future physics teachers showed the following results. It is shown in lower Figure 5(a).

Figure 5 (a,b).
Teacher surveys: results (%)



a) Results of the first teacher survey



b) Results of the final teacher survey

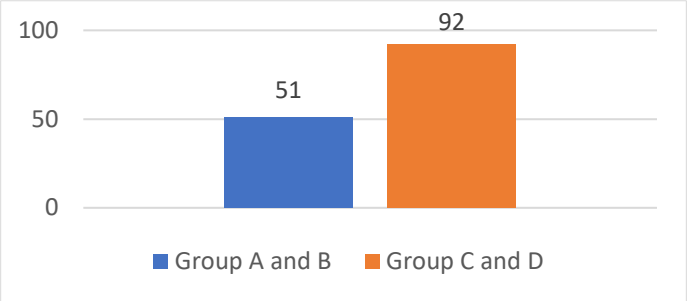
Teachers in absentia determined the main areas of scientific research competencies of their students and undergraduates by responding to a survey. According to the results, the indicator of groups A and B showed 45%, and the level of groups C and D - 55%.

In conclusion, the pedagogical expert once again conducted a survey of teachers studying in groups (Tab. 1-B). That is, we can say that correspondence teachers are the indicators of their students after mastering the educational and teaching aids, in general, the proposed course. It is shown in the figure below (Fig. 5 b).

Thus, the results of the survey for teachers received a positive result when the level of groups A, B increased from 45% to 65%, and the level of groups C, D-s from 55% to 72%. We come to the conclusion that this proves the effectiveness of the proposed special course.

The research work, based on a pedagogical experiment, and the quality of completing the tasks presented in the textbook and educational manual, showed the following results (based on a 100-point calculation indicator) (Fig. 6).

Figure 6.
Quality of completion of tasks presented in the textbook and educational manual (%)



That is, the primary groups A, B showed lower performance than the control groups C, D. In particular, the gap between the control groups was 42%. Let us turn to the fact that this is directly related to the fact that groups A and B acquired only theoretical knowledge.

And we conclude that controlled groups C, D are the result of complete mastery of the physics workshop, which will become an integral part of the methodological foundations for the formation of scientific research competencies of future physics teachers. That is, the proposed workshop has proven its effectiveness. As a result, we conclude that the scientific research competencies of students developed with the formation.

Conclusion

As a result, the need to provide educational and teaching aids for physics workshops and their novelty were proven. That is, the methods that were used in the works, applications presented to help the teacher, namely a graph of the student's progress, a assessment sheet, assessment criteria for laboratory work and their test questions and developmental tasks with suggested lectures and a word cloud, drawing up formulas, physical dictation and so on, so that these recommendations and innovations are based on the topic of the textbook, I concluded that the educational manual will be a contribution to the development of comprehensive work and methodological complex.

The following key findings emerged from the research conducted:

1) The influence of the physics workshop on the formation of scientific research competencies of future physics teachers has been proven by a pedagogical expert and has shown positive results.

2) The positive impact of the proposed innovations on improving research skills was noted.

It should be noted that due to the limited sample of study participants, the findings of the study also have limitations. The research assesses improvements in research skills immediately after the course, but does not analyze long-term retention or application of these skills in professional practice. The study relies on surveys and comparative analysis, which may not fully capture the depth of cognitive and practical skill development. More diverse assessment tools, such as direct observation or longitudinal tracking, could provide richer insights. Also the effectiveness of the physics workshop may be influenced by the availability of equipment, teaching aids, and institutional support. Future research can be applied by expanding the research to compare different teaching methodologies (e.g., traditional lectures vs. research-

based workshops), studying the impact of modern digital simulations and conducting similar studies in different educational settings.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Skakov Mazhyn: Validation, Writing - Review & Editing, Project administration. Choruh Ali: Formal analysis, Supervision. Dalabayev Tleubek (corresponding author): Conceptualization, Methodology, Investigation, Data Curation, Writing - Original Draft, Writing - Review & Editing. Nurizinova Makpal: Software, Resources.

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USING MACHINE LEARNING ALGORITHMS IN TRAINING FUTURE COMPUTER SCIENCE TEACHERS

Abstract: The beginning of the application of artificial intelligence in various areas of society in recent years has put forward the requirements for the introduction of innovative technological methods into education. Improving the knowledge of future computer science teachers is being connected with the directions of modern artificial intelligence. In the process of training computer science teachers in the higher education system of the country, new disciplines are taking a place in the composition of educational programs. In particular, the direction of artificial intelligence machine learning is included in educational programs for training computer science teachers and gives positive results. In the educational process, the theoretical foundations of machine learning are being practically implemented in modern programming languages; in particular, the Python language with the use of the ChatGPT chatbot and the R language for programming scientific problems are being used.

Keywords: knowledge improvement, machine learning, computer vision, computer science teachers, application of machine learning in the learning process.

Introduction

Humanity is on the threshold of the age of artificial intelligence. This concept was originally associated with a computer program designed to automatically prove mathematical theorems. Later, the system went beyond algorithmic work, functions such as collecting knowledge, analyzing, solving problems, Planning and forecasting were integrated, and the ability to think was introduced into artificial intelligence. For this purpose, a digital copy of the neural networks of the human brain was created.

Despite the achievements of neural networks, artificial intelligence is still in its early stages of development, but this level alone is enough to increase the effectiveness of teachers. Experts say that the use of artificial intelligence and machine learning technologies will soon become a key factor in the evolution of the entire education system [author not available, 2024]. Machine learning is different from the traditionally understood concept of program learning or computer learning, that is, machine learning should be understood as a branch of artificial intelligence.

Work is being carried out from a scientific, educational and methodological point of view in the professional training of future computer science teachers at the Department of Computer Science within the Faculty of Information Technologies of the Eurasian National University named after L.N.Gumilev. Intensive development of new information and communication technologies, including distributed data organization technologies, high-performance computing, parallel computing technologies, cloud computing, creation of large data sets, mobile autonomous robotics, computer vision, information storage and security issues are being introduced into the educational process in the training of future computer science teachers.

Machine learning is considered a branch of artificial intelligence, based on the ability to self-teach and create an algorithm by itself based on the first data entered into the computer, it gives the concept of machine learning. According to the conventional understanding, we first create a program, and the computer produces results according to our created program. Researchers and engineers thought that why not do the opposite, let the computer itself create an algorithm and show us the result, and they equate the implementation of those ideas with the concept of machine learning, that is, technological operations have begun to be implemented here, based on engineering solutions.

Currently, thousands and millions of data embedded in the computer are based on such a process. As the amount of data increases, the results obtained from the training data become more accurate. A part of such large volume of data is used for testing and results are obtained using the remaining large volume of data. For example, in a dataset consisting of 70,000 elements, 10,000 test data and the remaining 60,000 data are considered as training data.

In machine learning, as the amount of data increases and the algorithm is reused, the algorithm improves and the results become more accurate.

For example, if we consider optimizing the delivery of information search results to the user on the Google network. When we enter the required word (query) in the search bar, we are offered many links on several pages. We click and select one of the links on the first page and browse the information on the page, that is, we spend some time reviewing the information on this page. At this point, Google "understands" that we've found the information we're looking for.

Machine learning is used in various ways in the field of education, its application in the field of general education is considered in such directions as acceleration and improvement of the learning process. Some technical higher education institutions of well-known foreign countries and our country pay a high level of attention to the problem of artificial intelligence, including the field of machine learning. The main goal of our work is related to the training of teachers currently working in schools and future computer science teachers studying in higher educational institutions in machine learning.

Let us focus on the scientific and methodological works on the application of machine learning in the field of education, one of the directions of artificial intelligence.

Literature review

Educational Data Mining (EDM) is considered to be an important resource where large amounts of data play a crucial role in helping academic policymakers make decisions in the field of education today. This database mentions that machine learning is used to predict student performance, academic grades, dropoutrates, andmore [Ben Said et al., 2024].

In the work on the use of artificial intelligence in lesson planning, using the method of least squares and PLS-SEM-ANN artificial neural network, the authors studied the effect of artificial intelligence on lesson planning of teachers in their research, that is, they considered the effect of productivity, strength, habit, hedonic motivation, social conditions. The use of artificial intelligence was found to be one of the most important positive predictors of social influences in less on planning [Acquah et al., 2024], - noted.

The authors used a ready-made program, and in our work, students were taught how to create such programs, mastered and used in their future work. It continues with mastering the creation of neural networks in a type of machine learning called deep learning.

They emphasize that machine learning can be used in individual training as one of the works in the direction of using ready-made software, and note its role in this regard: The individual training has not been paid attention to in the education system, and the importance of machine learning for the possibility of real-time feedback between the teacher and the

student [Mukhamedyeva, 2020, p. 76] and its possibilities for use in the field of higher education [Tokzhigitova et al., 2022].

The World Economic Forum also mentioned that artificial intelligence will fundamentally change the labor market in the next five years. At the same time, it also shows the idea that such new technology will become a teacher's assistant, and that it is too early to say that artificial intelligence will replace humans [Kudaibergen, 2023].

Using different machine learning models to predict student performance and compare results, the paper states: «At the heart of developmental progress is knowledge, which requires the study and implementation of various modern methods to ensure the success of learners at various levels. However, there are obstacles to this success, which can be divided into three main groups: personal factors, family factors and social factors. These factors can manifest in the form of absenteeism and boredom, which threaten the future of both learners and society at large. Teachers may have difficulties in solving such problems. The purpose of this work is to use a wide range of methods for selecting and applying features that are unconventional in some educational sectors, but proven reliable in other areas.By combining machine learning (ML) and deep learning (DL) models, we attempt to predict learner learning performance based on these identified factors. Subsequently, taking into account the importance of various factors, a comparative analysis is conducted to determine the most effective model» (Laakel et al., 2024). From this, the teacher is shown how to solve the problems encountered in the lesson process.

Online learning has made education accessible. But the question arises as to how much artificial intelligence has to do with it. Here, the question is not only about the quality of teaching, but also about solving the problem of bad teachers. Artificial intelligence can identify and distinguish teachers who do not strive to improve their teaching methods or do not really care about the success of their students, and it can identify teachers who do not care about achievement. In addition, artificial intelligence can expand and improve the abilities of good teachers. While artificial intelligence can solve some aspects of education, it can never replace the human interaction of a dedicated teacher who builds strong relationships with students, creates an immersive learning environment, and truly cares about their success (author not available, 2024), - concludes the thought.

The following thoughts are expressed on the use of ready-madesoftwareequipment: Machinelearningmethodscan be used to simplify manual labor and reduce workload during exam grading. This allows teachers to spend more time on other tasks. However, when it comes to grading exams, completely eliminating manual labor is not possible even with highly accurate automated grading, as any grading errors can have serious consequences for students. Here, the automated grading approach is extended from measuring the workload relative to the accuracy of the automated grading to measuring the total workload required to score the exam with the support of machine learning.

The time spent on various assessment activities was measured along with the effort reduction achieved by clustering responses and using automated scoring. The overall workload reduction was significant, from 74% to 64% compared to fully manual assessment (Weegar et al., 2024).

Experts work with clients around the world to develop technology solutions for education. From language learning apps to chatbot virtual assistants, engineers are working on powerful solutions that transform the learning experience. Powerful tools are offered to make education fun and accessible (author unknown, 2024)

Another example is “the application of the machine learning algorithm in text grouping:

- the written language of the text is determined;
- documents are checked for similarity to each other; the algorithm determines the keyword from the text;

- adaptation to the Kazakh language is performed using a known algorithm for keyword detection; incorrect words are corrected using the necessary algorithm during keyword detection," it is stated (Iskakov, 2015). As we have already noted, this work is not intended to use ready-made programs for machine learning, but to improve the professional competence and programming skills of future specialists.

Machine learning algorithms were used to analyze consumer loan portfolios of Kazakhstani banks. The study is an attempt to assess the creditworthiness of individuals using machine learning algorithms based on data provided by second-tier banks to the National Bank of the Republic of Kazakhstan. Assessing the creditworthiness of borrowers allows the National Bank of the Republic of Kazakhstan to study the quality of loans issued by second-tier banks and predict potential systemic risks. Two-linear and six-dimensional nonlinear classification methods were used in this study. Nonlinear models show more accurate predictions than linear models. In particular, the most promising results were shown by the random forest and k-nearest neighbors nonlinear models on re-discredited data (Baikulakov et al., 2021), it is noted. The authors link their work to the concept of mastering machine learning from a technical and technological perspective.

The authors further justify with the following concepts: First, the following concepts will be discussed: The central idea of machine learning is the mathematical relationship between any combination of inputs and outputs. In a machine learning model, it is not possible to know this relationship in advance, but it can be created if a sufficient data set is given. This means that each machine learning algorithm is built around a mathematical function that can be transformed. The foundations of machine learning are focused on the principle that all complex databases can be mathematically related to computer systems if they have enough data and computing power to process this data. Therefore, the accuracy of the output data is directly proportional to the size of the input data (Baikulakov et al., 2021).

With the rapid growth of user-generated content, multi-scene learning has become a rapidly developing trend in the fields of pattern recognition and data analysis. Due to the significant application value of multi-scene learning, research based on machine learning methods and traditional deep learning paradigms has been continuously emerging. The main challenge in multi-scene learning lies in using consistent and additional information to build a unified, comprehensive representation. However, many multi-scene learning tasks are based on graphical structured data, which makes existing methods unable to effectively extract information contained in multiple data sources for input. Among them, graph neural network (GNN) methods are widely used to work with non-Euclidean data. Therefore, it is very important to combine the advantages of GNN models and the powerful learning ability of multi-scene data. According to the input form of the models, the taxonomy of GNN-based multi-scene learning methods is considered, namely multi-relation, multi-attribute, and mixed attribute. Then, applications of multi-scene learning are introduced, including recommendation systems, computer vision, etc. In addition, several common datasets and open source codes are introduced for implementation. Finally, the challenges of applying GNN models to various multi-scene learning tasks are analyzed and new future directions in this field are discussed (Xiao et al., 2024).

Using advanced analytical techniques such as artificial intelligence (AI), automated prediction of students' enrollment and graduation has recently attracted the attention of educators in both theory and practice. Although various concepts and theories have been proposed to analyze and assess the topic, most of the existing methods cannot technically represent some of the factors of the known difficulties. For this purpose, the retention and graduation data collected in higher education settings about students are considered. This study proposes a machine learning model called RG-DMML (Retention and Graduation Data

Processing and Machine Learning), which is an algorithm for predicting enrollment and graduation status (Okoye et al., 2024).

Research methodology

Thus, the application and mastery of machine learning in various fields and areas, in particular, the mastery of robotics, machine vision, neural networks, expert systems, etc. by students is a matter of time.

In machine learning, algorithms use input data sets that are built as we know them, without pre-programmed instructions. The computer is given a large set of data, told the correct answers, and then the computer itself constructs algorithms that satisfy these answers. We have already seen that as the amount of data increases, the learning of the algorithm improves and the accuracy of the prediction also improves.

Another feature of machine learning is the ability to implement computer vision. By using the camera of a computer, smartphones, you can use the achievements of performing activities such as computer vision, video recognition in real time and through saved files.

The questions under consideration are also implemented on the basis of methods of the main areas of machine learning - supervised learning and unsupervised learning. In the form of supervised learning, a prediction is made, and as a result, the fulfillment of that prediction is monitored. The type of unsupervised learning allows self-learning (training), as a result of which the unknown required data can be determined.

In 2-3 years, the subjects of the educational program will be supplemented with the content of rapidly improving technologies, provided with educational and methodological programs. Currently, educational-methodical, practical works are included in the training process of teachers of computer science, physics and computer science of Eurasian National University named after L.N. Gumilev and Karaganda University named after Academician E.A. Buketov. In the process of training doctoral students at the Department of Computer Science of Eurasian National University named after L.N. Gumilev, the results of the research work are being implemented, and they are presented in the composition and content of the dissertation work.

In the process of training computer science teachers in secondary schools and specialized vocational and technical education systems, starting from the 2016-2017 academic year, we began to introduce the use of machine learning in a number of educational institutions of the country, that is, original subject plans were developed and introduced on the following issues: cloud computing and parallel computing technologies, remote database organization platforms and use of resources through cloud technologies, BigData, Data Mining, Data Set, computer vision, creation and use of neural networks in deep learning, organization of parallel computing on multi-stream data, STEM and computer science, creation of mobile social robots, information security.

The research methods were based on the work "Fundamentals of Scientific and Pedagogical Research" proposed by Esekeshova (2018).

The purpose of the study is to determine the application situation and practical implementation of machine learning algorithms in the training of future computer science teachers. The tasks are related to consideration of ways of introduction of machine learning into the field of education and improvement of knowledge and formation of new knowledge and skills of students based on creation of neural networks in machine learning in the training of future computer science teachers.

Theoretical analyzes were made in the first defining period of the research. The state of inclusion of subjects on machine learning in educational programs of higher educational institutions was differentiated. It was determined that this issue should be given a high level of attention across the country. There were cases where the concept of machine learning was not

fully mastered and not understood.

Since the content of the work depends on machine learning algorithms and technologies in the formative period, a special course is introduced, in its content students use mathematical methods and engineering solutions.

The empirical method was carried out by preparing survey questions and conducting a survey in the Google environment, rating evaluation in the Platonus environment, and taking an exam. The results of the observation method were implemented when assigning rating grades and taking an exam, and the question-and-answer method was implemented when conducting surveys.

During the implementation of our work, we focus on the following methods of using machine learning algorithms:

- data analysis to solve the task in the implementation of machine learning;
- familiarization with machine learning applications;
- learning to choose machine learning algorithms.

Activities to be focused on during practical lessons:

- selection of machine learning algorithms and model creation;
- choosing a programming environment, programming language;
- if there are errors in writing the program code, the ability to use AI-Google CoLab artificial intelligence capabilities and resources;
- differentiating the result.

Implementation of human face recognition technology, use of Python Open CV (Open Source Computer Vision Library) library (recognition of faces from photos and webcams) in the application of computer vision of machine learning in the field of education; application of DLib library (using "manual" or machine learning to mark people in photos, photo enhancement, face analysis, face verification by the DLib library); use of the Face recognition library to detect faces using the camera online; using Haar and MTCNN algorithms to detect and recognize face geometry; the methods of using the DeepFace library to determine a person's age, gender, and emotions by means of faces and ready-made photos were implemented in the learning process.

Results and discussion

Machine learning fundamentals are currently being introduced and implemented in the training of computer science teachers at the L.N. Gumilyov Eurasian National University, and in the educational process of the future computer science and physics and computer science majors at the Academician E.A. Buketov Karaganda University. Surveys were conducted among students of these educational institutions. The survey was conducted using the Google Disk platform. Figure 1 shows excerpts from the survey questions. The survey questions are posted on the Google Disk platform.

Figure 1

Survey questions organized on the basis of the Google Disk platform

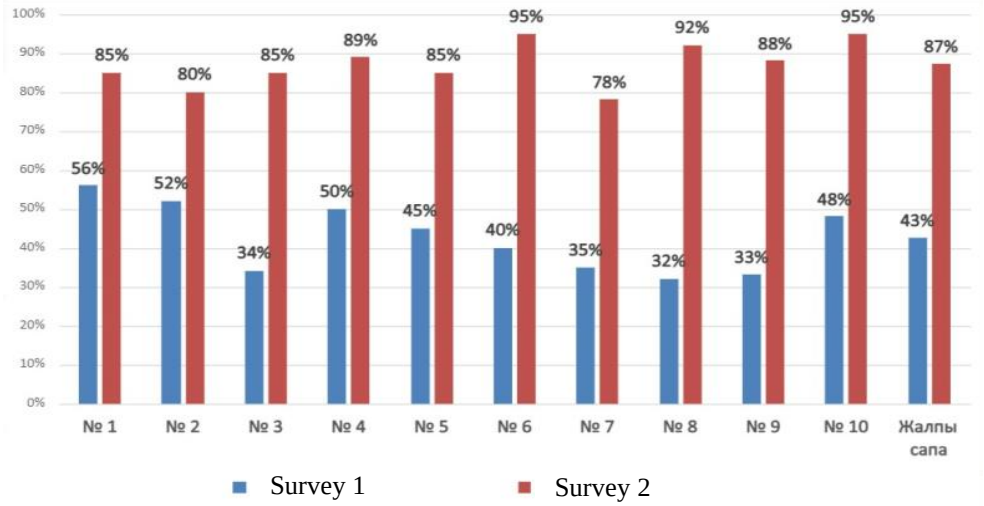
Show the directions of artificial intelligence (you can select multiple options)
• computer vision
• machine learning
• deep learning
• expert systems
• natural language processing
• voice recognition
• media reports
• mathematical equations

To what point do the Haar and Dlib recognition concepts correspond?
• libraries for various educational materials
• proctoring system
• computer vision
• face recognition
• to type mathematical formulas
• DataSet
• STEAM directions

Students participated in the survey voluntarily, and it was explained in advance that it would be conducted anonymously. The purpose of the survey was to determine the level of knowledge on such modern topics as distributed data, machine learning, application of machine learning in industries, and STEM education. As a result of the survey, students had high scores on the motivational component, while the previous score on the content and technological components was about 43%, and after completing the subject, they had a score of 87%. Figure 2 shows one of the results of the experimental work of 3rd-year students of the educational program "6B01511-Informatics" of the Eurasian National University named after L.N. Gumilyov on the topic of facial recognition. The study results were sorted using the MS Excel program. Currently, 68 students are improving their knowledge on the research topic in the experimental experimental group. In the next new academic year, it is planned to introduce it into the educational process of other higher educational institutions of the republic, and educational programs are being developed.

Figure 2

Overview of survey results for the subject "Fundamentals of Machine Learning"



Pearson's χ^2 criteria were used to calculate the final results of the research work. For the content component, χ^2 =10.50. The degree of freedom was 2. Compared to the critical value, 10.50>9.21, that is, the calculated value was in the required range. The null hypothesis H_0 was rejected, and the alternative hypothesis H_1 was accepted, which confirmed the hypothesis that the content results of the research work conducted on students confirmed.

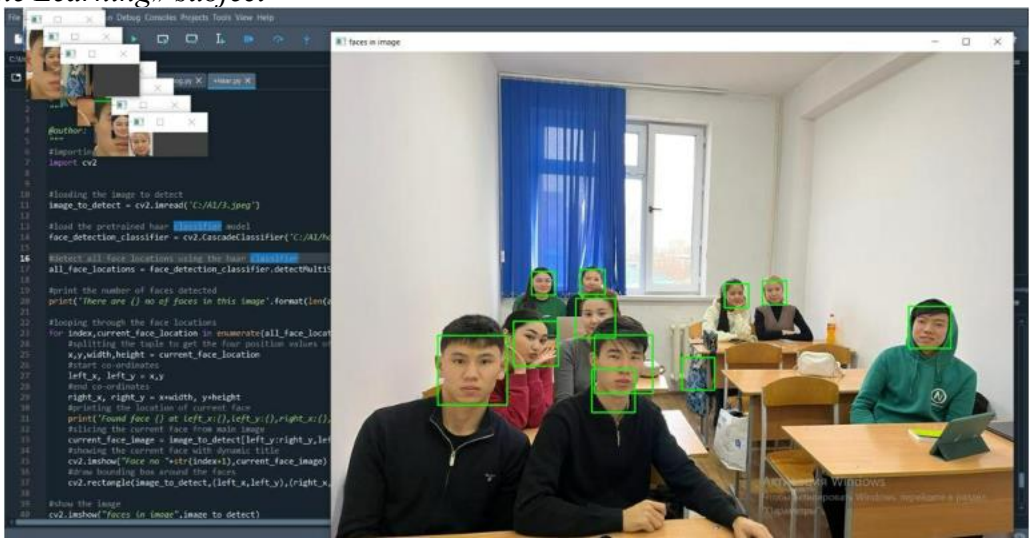
Practical-experimentalworksrelatedto embedded machine learning are included in the syllabus of «Fundamentals of Machine Learning» at the bachelor's level, «Management of large-scale data» at the master's level, in the content of the teaching-methodical complex. For example, the subject plan of the subject «Basics of Machine Learning» is «Concept and basic methods of the basics of machine learning. Building a neural network in multidimensional computing» and «Computer vision. Methods of identifying and recognizing faces (objects)» modules are considered.

The first module includes machine learning - artificial intelligence; the connections and differences between artificial intelligence, machine learning, deep learning, and data; supervised and unsupervised types of machine learning (also referred to as tutored and untutored), methods and basic algorithms used; topics such as machine learning, deep learning type of machine learning and neural networks in deep learning, open big data sets are covered, and in the next module, computer vision, human face or object detection and recognition system, how to install libraries; traditional methods of facial recognition, modern methods; human emotion prediction algorithm; includes such topics as the implementation of the algorithm for predicting human emotions, age and gender using traditional methods (the number of data 30-50000) and the implementation of the algorithm for predicting percentages using modern methods (the number of data 3-120 million). Implementation of these theoretical materials was carried out in Python language, R language, GoogleColab, Anaconda, Spyder, PyCharm environments, Excel program.

Our research work is being carried out with the aim of introducing this modern direction into the field of education, improving the knowledge of students, and forming new skills and abilities. Figure 3 below shows an example of a scene from the lesson "Computer Vision" of the subject "Fundamentals of Machine Learning" of 3rd year students of the educational program "6B01511-Informatics" on the topic of using machine learning algorithms.

Figure 3

A scene from the face detection methods topicin the practical lesson of the «Basics of Machine Learning» subject



The university's doctoral students are working on deep learning, a branch of machine learning, including the creation of multidimensional neural networks, and are using it in their research.

Working with large data (Big Data, DataSet), using modern programming languages, using the server platforms and resources of large foreign companies (Serik et al., 2022), as well as using the university's Param-Bilim supercomputer through a special application, and using the IBM Quantum Experience quantum computer for programming have become a great foundation for the formation of new skills and abilities in students (Yerlanova et al., 2021).

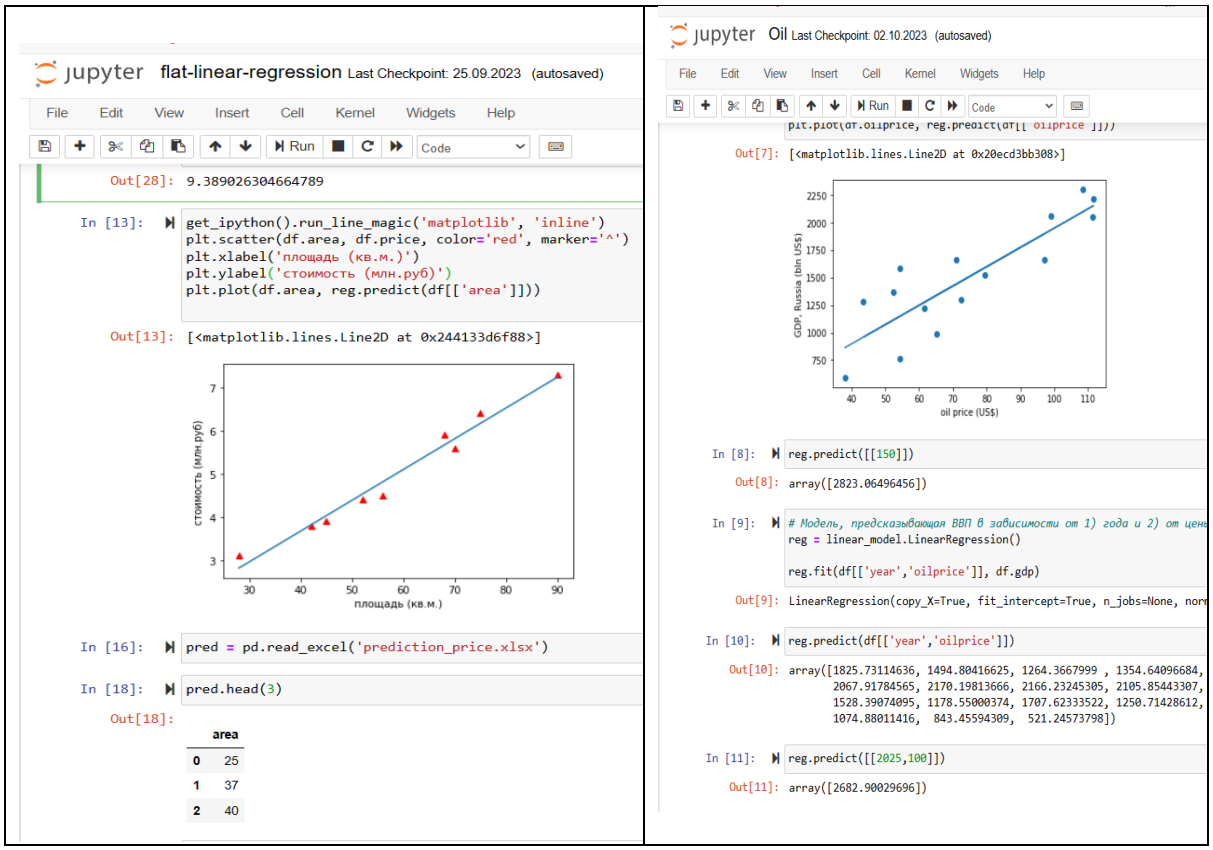
While third-year students studying Computer Science are studying machine learning algorithms in Python in the Jupyter environment of the Anaconda system during a practical lesson on the subject "Fundamentals of Machine Learning" (Figure 4), undergraduates of the "7M01511-Informatics" educational program are using the machine learning algorithm "Linear Regression" in R to process BigData on a topic related to the use of DataSet, and are achieving good results (Figure 5).

The content of the topics considered in our work is taken from real life. In particular, analyzing and processing the price of apartments in Karaganda using the regression method in big data processing and producing results.

Prior to work, learners will need to master techniques such as loading and formatting large DataSets.

Figure 4

Application of machine learning "Linear Regression" algorithm to predict the price of apartments on the left and oil on the right

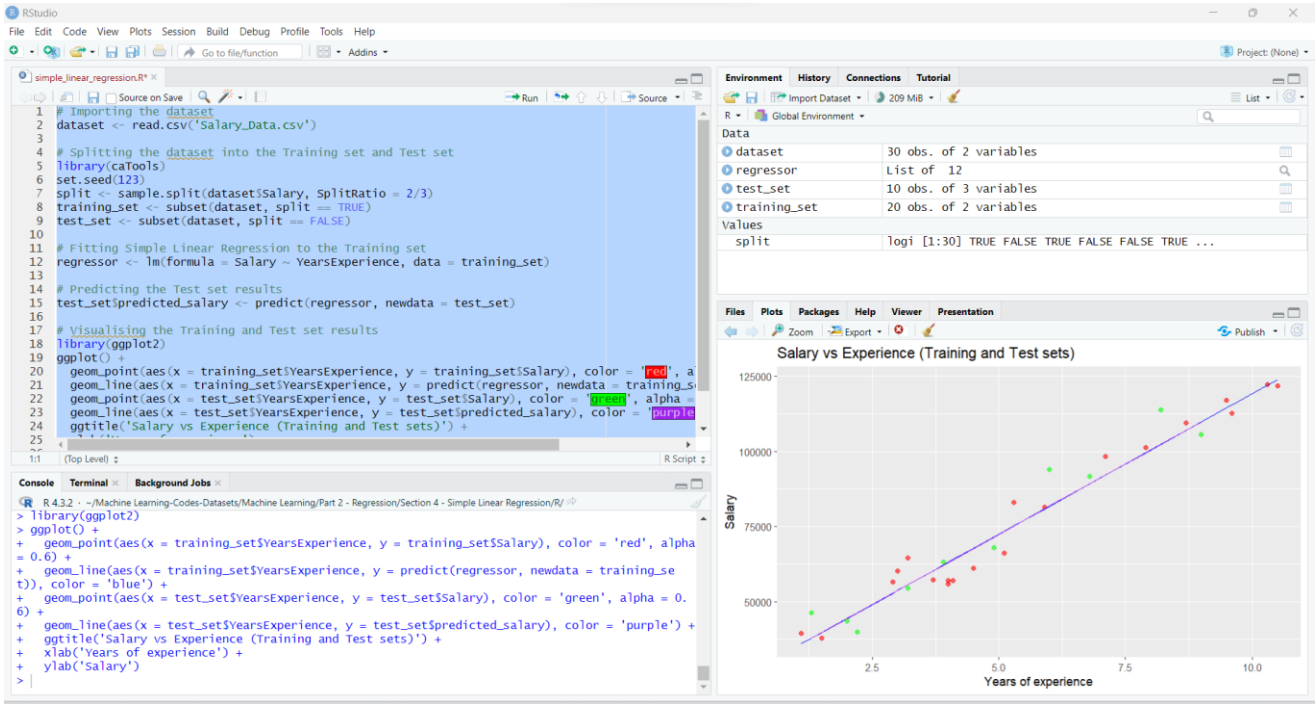


In the educational process, methods for creating and using neural networks in deep learning, a branch of machine learning, have been implemented in the construction of robots (Serik et al., 2022). These topics have been included as new courses in the educational programs for undergraduate and graduate students studying computer science.

Neural networks are increasingly being used in machine translation based on machine learning and deep learning principles. Neural machine translation has achieved significant success and has become a fundamental method in practical systems. The application of neural networks focuses on computer architecture, decoding, and data augmentation techniques (Tan Zh. et al., 2020). As mentioned above, our presented information is related to engineering solutions, where neural networks in computer vision are based on the mathematical foundations of machine learning. Data augmentation and increasing data volume in computers enable the training of neural networks, leading to effective results. Thus, machine learning is no longer solely reliant on statistical data but has evolved into a technology-driven approach based on modern engineering solutions. This is also highlighted in the work of Zhu W. et al. (2022). Machine learning primarily relies on experts' knowledge to solve learning tasks, data processing, model development, optimization algorithms, and evaluation metrics, making it a labor-intensive process. In education, we observe a growing demand for specialists equipped with such modern and essential competencies.

Figure 5

An example of the application of the "Linear regression" algorithm in salary calculation

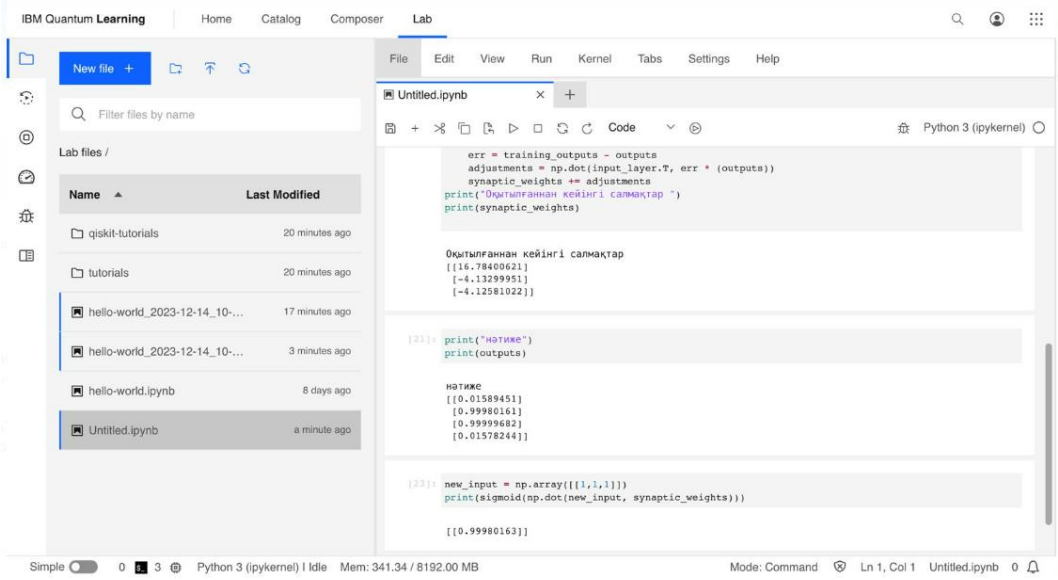


The topic "Neural Networks" was covered using the IBM Quantum Experience quantum computer. In this case, sigmoid or ReNU functions were used as activation functions in building a neural network.

We considered the following example to help students master the creation of a neural network with three inputs and one output and the training of a neural network. In this topic, they understood the concepts of "weights" and "shifts" for connections in the layers of a neural network and mastered the questions of algorithms (Figure 6).

Figure 6

An example of building a neural network on the "IBM Quantu" quantum computer



On the basis of the practical work carried out, we noticed a qualitative change in the training of computer science teachers based on the introduction of the above-mentioned subjects, surveys and rating and examination evaluation of the levels of education. When going to work at the school, the graduate goes to the field of artificial intelligence as a ready specialist with advanced professional knowledge and skills in machine learning. We notice that mastering such a complex direction as artificial intelligence programming is causing difficulties. Work is underway to familiarize graduates who are currently working in schools, but did not study such subjects, with the content of digital educational resources.

The training of specialists in the areas of artificial intelligence, including the training of computer science teachers, requires the improvement of the content and quality of knowledge on modern technologies such as artificial intelligence, machine learning, etc. We note that the content of the educational programs of the Faculty of Information Technologies of the Eurasian National University named after L.N.Gumilev, Department of "Computer science" has been updated and supplemented with author's courses::

- Content of the 4th semester of the educational program "6B01511- Computer Science" is "Information security", contents of the 5th semester are "Fundamentals of machine learning", "Robotics on the Arduino platform", "Methods of teaching high-performance computing", "Parallel computing", the content of the 6th semester has been updated with subjects such as "Fundamentals of cloud technologies in education", the contents of the 7th semester are "Creating mobile applications", "Distributed database management systems", "Big data processing";

- The content of the first semester of the educational program "7M01511-Computer Science" was combined and supplemented with subjects such as "Extensive data management", "Multilevel client-server technologies", "Robotics" in the second semester, "Modern programming languages" currently in use in the third semester, as "Parallel and cloud computing" subject;

- The educational program "7M01525-STEM education" implemented in 2020-2021 is considered an innovative educational program, graduate students are being trained based on the results of the Erasmus+ program project.

- The results of the research were incorporated into the educational process of the

master's students of the Computer Science specialty of the Nukus State Pedagogical Institute named after Ajiniyaz, lectures and practical classes were conducted online.

All of the proposed author's courses are closely related to machine learning as a modern direction of information and communication technologies.

A lot of attention was paid to the creation of digital didactic materials for mastering topics related to machine learning. The teaching-methodical complex of the subject, digital educational resources built on neural networks are widely used. On the basis of the educational program for the training of computer science teachers, an informational educational portal related to machine learning is being created. Currently, for the first version, hosting, server space is being taken, and the portal is being tested. The content of the information portal is closely related to the issue of information security. It will be possible to log in and use the user's biometrics, using a QR code and using a personal registration record. The portal of information education was one of the information resources used by users in the learning process, in the classroom.

Based on the implementation of such works, we emphasize that training of highly qualified specialists cannot be slowed down when the level of creation and use of technical tools is higher than the leveloftheiruse.The research work was related to the process of training future computer science teachers at the L. N. Gumilyov Eurasian National University. In the future, research work will continue in the educational process of other higher educational institutions of the Republic.

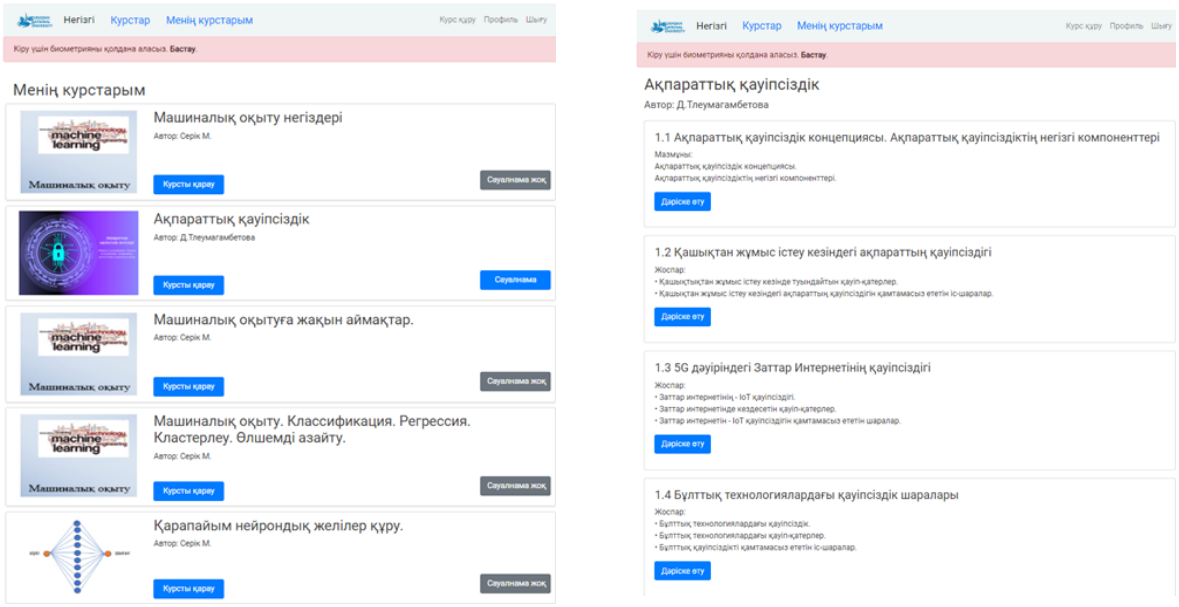
Conclusion

It was mentioned that the use of machine learning applications in the field of education is limited.The purpose of our work is for students not only to use ready-made applications and systems, but also to create the applications and systems themselves, to improve their knowledge of artificial intelligence and to form new skills and abilities, to learn complex algorithms for creating applications in the educational process, that is, to master the programming of new network distributed technologies of artificial intelligence related to the training of computer science teachers.

In addition, the "Computer Science" department conducts subjects related to information and communication technologies and digital technologies in all specialties of the university. Therefore, the perspective of the research work is to introduce ready-made technologies and applications in the educational process in the directions of artificial intelligence in the training of students studying in pedagogical specialties.

In the learning process, an informational education portal has been developed, and the results of the mentioned studies are presented as an open informational resource (Figure 7). The informational resource used in the learning process is implemented in the following model: security.org.kz.

Figure 7
View from the information resource model (in Kazakh)



The results of the work are used in the educational process of students studying in technical, natural sciences, and other specialties related to information and communication technologies. At the same time, it can be incorporated and used in the learning process for students studying in secondary vocational and technical education systems.

In the training of future computer science teachers, new subjects such as machine learning, big data, social and autonomous robots, high-performance parallel computing, cloud computing, and others have been introduced into the curriculum. The content of these subjects widely incorporates artificial intelligence approaches and machine learning algorithms.

The research focuses on the process of training future computer science teachers. In the future, the research materials and findings will be utilized by students in other IT fields, as evidenced by over 600 accesses to courses available on the aforementioned educational portal. Faculty members and students from several universities in Kazakhstan are actively using these resources.

The future strategy of the research will be related to the use of machine learning algorithms and methods in STEM areas, which are currently being implemented at all levels of education. Work is also being carried out in this direction in the process of training computer science teachers. . The base university of the research work was connected with the process of training future computer science teachers at the Eurasian National University named after L.N. Gumilyov. In the future, the research work will be continued in the educational process of other higher educational institutions of the republic.

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Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

M. Serik: Conceptualization, Methodology, Project administration A.K. Sadvakassova: Data curation, Writing- Original draft preparation. N.A. Duisegaliyeva: Visualization, Software. M.H. Alaminov: Formal analysis, Supervision. K.U. Karieva: Resources, Validation. D.Sh. Tleumaganbetova: Writing- Reviewing and Editing, Investigation.

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ENHANCING COMPETENCIES AND MOTIVATION: THE IMPACT OF 360-DEGREE VIDEO TECHNOLOGY ON FUTURE FOREIGN LANGUAGE TEACHERS

Abstract: This study examines an innovative approach to the training of foreign language teachers using 360-degree video technology. The current method is a unique combination of existing techniques, combining immersive learning and the development of professional competencies. The investigation highlights the novelty of the problem, which lies in the lack of development of approaches that integrate immersive technologies into the professional education of teachers. The research conducted among students of the Eurasian National University who completed a course on integrating 360-degree video into the educational process. The focus is on analyzing the impact of 360-degree video technology on the development of key professional competencies: pedagogical adaptability, cultural awareness, classroom management skills, reflective practices, technology proficiency, and student engagement strategies. The model presented in the study demonstrates the interrelationship of these competencies, suggesting a new research paradigm for teacher education. The results showed a significant improvement in all competencies after using technology, especially in the areas of creative thinking (+7 points) and technological competence (+7 points). There was also an increase in student motivation due to the use of new teaching methods.

Keywords: 360-degree video, intercultural competence, authentic educational situations, technological competence, creativity thinking, differentiated approach, methodological competence.

Introduction

The integration of 360-degree video technology, also known as spherical video-based virtual reality (Ye et al., 2021), offers a transformative approach to language education, particularly for future foreign language teachers. This technology allows for the creation and viewing of 360-degree videos using specialized cameras (Rupp et al., 2019). Such videos can be accessed through smartphones, tablets, computers, or head-mounted displays (HMD), providing a flexible and immersive learning experience. Users can control the viewing direction by moving their heads or using interactive tools like touchscreens or mouse clicks (Snelson & Hsu, 2020; Repetto et al., 2021). This immersion fosters an engaging learning environment, which is crucial for training foreign language teachers who must be equipped with the skills to facilitate interactive, student-centered classrooms.

Despite the growing interest in the use of 360-degree video in education, its impact on the development of professional competencies of future foreign language teachers, as well as its role in increasing their motivation, remain insufficiently studied. Most existing research focuses on the impact of virtual reality (VR) on students learning foreign languages and its potential to increase engagement and create an authentic language environment (Concannon et al., 2019; Chen et al., 2021). However, the impact of 360-degree video on the formation of key pedagogical competencies, including technological, methodological, and intercultural competence of future teachers, remains poorly understood.

Unlike previous studies, this study focuses specifically on the pedagogical training of future foreign language teachers, examining how 360-degree video contributes to the development of their professional skills. While existing studies (Fukuta et al., 2021; Wu et al., 2021; Kittel et al., 2019) confirm the effectiveness of VR in medicine, science, and sports, their results are not always applicable to language education. Moreover, few studies compare the impact of various VR tools on the teaching process of teachers, which leaves a gap in understanding the most effective methods of integrating 360-degree video into the educational process.

Thus, this study fills in the existing gaps by offering an empirical justification for the impact of 360-degree video on the professional development of future teachers. It not only evaluates changes in the competencies and motivation of participants, but also offers recommendations on the implementation of this technology in teacher training programs, which makes it a significant contribution to the development of foreign language teaching methodology.

Literature review

The use of 360-degree video in language teaching

Scientists recognize the 360-degree video technology as a promising tool for learning foreign languages. One of the key problems of language learning in real life is the lack of an authentic language environment (Shadiev & Yu, 2021). However, 360-degree video, as a form of virtual reality, provides an opportunity to create a realistic educational environment. This format is based on real video recordings (Snelson & Hsu, 2020), which allows students to immerse themselves in an authentic language context and feel present in a real situation (Huang et al., 2020).

Unlike traditional virtual reality based on 3D animation, which requires significant costs and sophisticated technology, 360-degree video is more accessible and easier to use. This makes it a suitable tool for teachers and students in school settings (Shadiev et al., 2024). Moreover, a number of studies have shown that teachers and students have successfully created their own content in 360-degree video format, integrating it into the language learning process (Chen & Hwang, 2020).

Despite the growing number of studies on language learning using 360-degree video, literature review of this issue remains limited. For example, the works of Chen et al. (2020) and Concannon (2019) mainly focused on language learning using immersive virtual reality based on 3D computer technology. According to Shadiev (2021) virtual reality can classified as low-immersion (LiVR) and high-immersion (HiVR). LiVR involves interacting with VR content through a flat screen using a mouse or keyboard, while HiVR requires the use of a headset (HMD) and additional controllers, providing a deeper immersion in the virtual environment.

HiVR creation technologies can include both computer-generated 3D animations and 360-degree video. These approaches vary in cost, authenticity, presence, and flexibility (Shadiev et al., 2021). In particular, 360-degree video recorded with a camera displays scenes, objects, and people as they exist in the real world, which provides a higher level of authenticity and realism. At the same time, the cost of creating it remains significantly lower compared to 3D animation.

Many users experience physical discomfort, including motion sickness, when using head-mounted displays (HMDs), with studies by Huber et al. (2017) and Taylor & Layland (2019) highlighting the impact of immersion duration on user experience. Additionally, a significant challenge lies in the limited availability of 360° educational videos, as noted by Johnson (2018) and Harrington et al. (2018), who emphasize the lack of specialized content for disciplines like medicine, restricting the full potential of this technology in education.

Furthermore, while 360° video technology may seem accessible in terms of hardware, Harrington et al. (2017) discuss the ongoing concerns regarding the costs of production and implementation, raising important questions about its long-term feasibility and effectiveness in educational settings. However, in this study, students did not report significant adverse health effects, suggesting that the duration and nature of immersion were well-balanced. Additionally, the high cost of VR technology remains a temporary obstacle, as history has shown that prices tend to decrease over time, making advanced educational tools more widely accessible in the future.

Influence on the competence and motivation development of future foreign language teachers

The use of 360-degree video in the training of future foreign language teachers helps to develop important professional competencies. First, students can develop their skills of reflection and observation by analyzing various pedagogical practices and developing their own methods of working with students. Secondly, by observing the teaching process in real-world settings, future teachers gain experience interacting with diverse students, which is key to successful language teaching in diverse classrooms (Shadiev et al., 2024).

In addition, this technology provides an opportunity to see how effectively an authentic language environment is used, allowing teachers to learn from the example of real teachers and directly adopt their strategies for their own teaching.

The Common European Framework of Reference for Languages (CEFR) defines key competence dimensions for teaching English, encompassing linguistic, sociolinguistic, pragmatic, pedagogical, intercultural, digital, assessment, and classroom management competencies. While CEFR primarily focuses on proficiency levels (A1-C2), it also highlights the importance of intercultural competence, enabling teachers to promote cultural awareness and integrate authentic materials into lessons. Pedagogical competence involves selecting appropriate methodologies and scaffolding techniques, while pragmatic and sociolinguistic competencies confirm that learners grasp discourse structure and social language norms. In the modern classroom, digital and technological competence is crucial, with tools like 360-degree video offering immersive learning experiences that enhance engagement. Teachers must also possess assessment and evaluation skills, applying CEFR-based criteria to measure progress effectively, alongside classroom management strategies to adapt teaching for diverse learners. However, traditional teacher training programs often emphasize linguistic and pedagogical knowledge while neglecting technological and intercultural competencies, which are increasingly vital in modern language education. A major gap in current teacher education is the lack of systematic integration of immersive technologies in training programs. Many future teachers obtain limited exposure to interactive, technology-enhanced learning environments, despite the growing demand for digital literacy and adaptive teaching strategies. Furthermore, the need for differentiated instruction is often overlooked, whereas 360-degree video technology can provide tailored learning experiences for students of varying proficiency levels.

The use of 360-degree video technology in the training of foreign language teachers contributes to the development of a number of key professional and pedagogical competencies that are important for a successful career in education (Table 1).

Table 1

Why are the competencies of future foreign language teachers developing so effectively after using 360-degree video technology?

Competencies	***Explanations***	***Theories***
Intercultural competence	*The 360-degree video allows future foreign language teachers to immerse themselves in real cultural contexts by observing interactions in various cultural and linguistic environments. It helps to develop the ability to understand and interpret cultural differences, which is especially important for teaching foreign languages, where intercultural interaction is an integral part of the learning process.*	***The theory of intercultural communication*** *(M. Bennett, 1998):* *This theory focuses on the individual's ability to interact effectively with representatives of other cultures, understanding and accepting their differences.*
To create authentic educational situations	*The use of 360-degree video technology helps future teachers create authentic language situations that cannot reproduced in a traditional classroom. This develops their ability to model real-world communications and learning contexts, which is an important skill for foreign language teachers, especially when organizing practical classes with native speakers or when teaching in multimodal educational environments.*	***Situational learning Theory*** *(Jean Lave, Étienne Wenger, 1991):* *This theory states that learning occurs most productively when it related closely to real-life situations. Authentic educational tasks allow students to participate in the "authentic practices" of the professional community, which promotes deep learning.*
Technological Competence	*Teachers learn to use VR technologies to create interactive and immersive educational scenarios, which helps to increase student effectiveness and engagement.*	***Technological Pedagogical Content Knowledge*** *(Mishra and Koehler, 2006). This theory explains how teachers can integrate technology into their professional practice. She emphasizes the need to combine three components: technological knowledge, pedagogical knowledge and knowledge of the content of the discipline.*
Creativity and innovative thinking	*360-degree video encourages students to analyze situations from different angles, propose new approaches and develop original ideas, which promotes the development of creative approaches and innovative thinking.*	***Theory of the Creative Process*** *(J. Guilford(Plucker, J.A,2022) Guilford conceptualized creativity as a factor within a general theory of intelligence, and in this regard, creativity was an individual ability involving divergent thinking that could developed through interaction between individuals and their environments.*
Differentiated approach to teaching	*VR technologies allow teachers to individualize learning by adapting materials to different levels of students' training and their needs. 360-degree video technology provides an opportunity to immerse oneself in different contexts (cultural, professional or educational), which allows students to take into account their interests.*	***Theory of Differentiated learning*** *(Carol Ann Tomlinson, 2000) Tomlinson argues that differentiated learning takes into account differences in students' abilities, interests, and levels of education, providing individualized approaches for each student to support their academic success.*
Methodological competence	*360-degree video provides an opportunity to simulate educational situations that include all the key elements of the system: educational material, teacher, students, and the educational environment. For example, students can immerse themselves in real or simulated classrooms, observing the relationship between these elements.*	***Theory of the systems approach (L. von Bertalanffy*** *1968****,*** *(F. Heylighen (2000) Methodological competence includes the ability to see the educational process as a system consisting of interrelated elements. The systematic approach emphasizes the importance of analyzing the structure, content, methods, and goals of learning, as well as taking into account external factors affecting the educational process.*

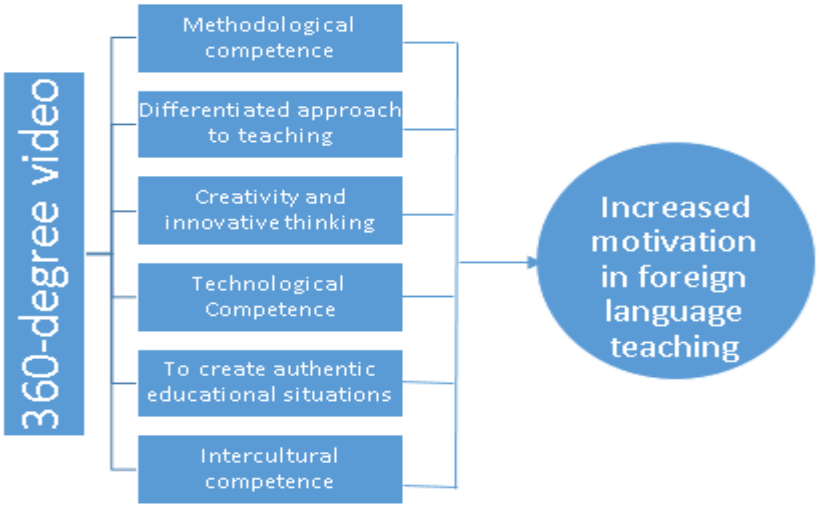
Motivation in teacher education can be lassified into extrinsic, intrinsic, and integrated motivation (Han & Yin, 2016). Extrinsic motivation is driven by external rewards, such as grades, salaries, or recognition, while intrinsic motivation stems from personal enjoyment and a sense of fulfillment in teaching. Integrated motivation occurs when teaching becomes an

essential part of an individual's identity (Deci and Ryan, 2000). VR technology primarily improves intrinsic motivation by providing interactive learning experiences, realistic teaching simulations, and autonomy in learning. Through immersive VR experiences, future teachers actively engage with classroom scenarios, practice teaching strategies, and receive instant feedback, leading to increased confidence and motivation. By developing their pedagogical, communicative, and technological competencies, their intrinsic motivation to teach increases (Mouatt, et al., 2020). This aligns with Self-Determination Theory, which highlights that motivation is strengthened when learners experience autonomy, competence, and relatedness. Thus, VR technology not only advances professional competencies but also serves as a powerful tool to foster deep and long-term motivation in future educators.

Thus, this study provides a model diagram illustrating the key competencies developed using 360-degree video technology in the training of foreign language teachers. It includes the six aforementioned competencies, grouped in such a way as to show how they support each other in the educational process (Figure 1).

Figure 1

Competency and motivation model for future foreign teachers



In this study, the hypothesis presented in Figure 1 will considered, as well as the following questions will answered:

1. How effective is 360-degree video technology for developing the competencies of future foreign language teachers?

2. Has the implementation of 360-degree video technology enhanced motivation for the teaching profession?

Methodology

Participants

The study carried out among second- and third-year students of the Eurasian National University at the Department of Theory and Practice of a Foreign Language. To conduct the research, a new optional course opened, and called "Using 360-degree video to enhance the professional competencies and motivation of future foreign language teachers." Out of the total number of students of the department (164 people), 26 volunteers participated in the study, including 24 women and 2 men. Participation in the elective course provided an opportunity for students to be acquainted with the innovative 360-degree video technology and explore its potential for professional development in the context of teaching.

Research Instruments

Meta Quest 2 (formerly known as Oculus Quest 2) is a popular virtual reality headset developed by Meta. It designed for immersive virtual worlds, gaming, learning, and various interactive experiences. It works without the need to connect to a computer or console.

The 360-degree videos used in the study taken from platforms such as YouTube and Vimeo, which provide a variety of videos in this format, including educational and cultural materials. To create a full-fledged immersive experience, the opportunity to travel to different parts of the world using Google Earth VR was also used, which allowed the study participants to interact with real cultural contexts and deepen their perception of the material

Research Procedure

The pre-test and post-test were used to measure changes in knowledge and competencies. At the first stage of the study, a pre-test was conducted, where participants assessed their professional competencies on the Likert scale, and at the end of the course, a post-test was conducted to determine changes after using 360-degree video. The questionnaire was used to study the motivation of the participants and included the Intrinsic Motivation Inventory (IMI) scale, which allowed us to collect data on the perception of technology and its impact on student motivation. The pre-test and post-test made it possible to quantify the progress of participants in the development of key competencies, and to analyze changes in competencies before and after the course, a 100-point assessment of students using the method ECTS (European Credit Transfer and Accumulation System) was used. Multivariate analysis of variance (MANOVA) was used to assess motivation after using 360-degree video, revealing significant differences between several motivation parameters. This statistical method was chosen because it allows for the simultaneous examination of multiple dependent variables while accounting for their potential intercorrelations.

Our study carried out from September to December 2024, and the study procedure shown in Table 2.

Table 2

Study procedure

Week 1	Pre-test (Initial competency assessment)
Week 2-3	The Cultural Intelligence Scale methodology
Week 4-6	Lesson design, cultural integration
Week 7-8	VR integration, lesson execution
Week 9-10	Creative tasks, engagement
Week 11-12	Differentiation, task variety
Week 13-14	Methodology, lesson analysis
Week 15	Post–test, the Intrinsic Motivation Inventory test

Week 1. There was an introduction to teaching participants' methods and tools for assessing progress in professional competencies after the introduction of 360-degree video into the educational process. To bring to an understanding what competencies can developed through 360-degree video, to teach how to assess progress in competencies, and how integrating 360-degree video can improve the quality of the educational process. Students explore examples of 360-degree video materials, discussing their potential to create immersive educational situations. In addition, a pre-test conducted to find out how well they know the above competencies using the Likert scale (from 1 to 5, where 1 is "Completely disagree", 5 is "Completely agree"). Each statement verifies one of the competencies. For example, "I can create educational materials that reflect the diversity of cultures," "I am confident that my teaching methods help develop creative thinking among students," and so on.

Week 2-3. Intercultural competence. The Cultural Intelligence Scale (CQS) methodology used to measure intercultural competence. In the initial testing (Pre-test), the participants tested using the CQS methodology, which includes 20 questions. The test assessed four components of cultural intelligence: a) the motivational component (interest in other cultures), b) the cognitive component (knowledge of cultural differences), c) the metacognitive component (the ability to recognize and correct one's behavior in intercultural situations), d) the behavioral component (the ability to interact effectively in different cultural contexts). The test results recorded for each participant in an individual protocol. After the initial testing, participants asked to watch three 360-degree videos covering various cultural contexts: traditional Japanese tea ceremony, Brazilian carnival in Rio de Janeiro, daily life and dialogues on the streets of London. The video watched in groups using VR headsets to ensure maximum immersion. Each video accompanied by an introductory explanation of its content and a post-test discussion so that participants could analyze what they saw. After watching the video, the participants repeatedly answered 20 questions of the CQS methodology. Secondary testing implemented to assess changes in cultural intelligence levels. The results obtained (before and after watching the video) compared using statistical analysis. Special attention paid to changes in each of the components of cultural intelligence. After the testing completed, a questionnaire conducted and an open discussion held with the participants. They shared their impressions of the videos they watched and answered questions about how they perceive the impact of VR technologies on their intercultural learning.

*Week 4-6. To create authentic educational situations***.** Participants watch 2-3 videos dedicated to studying in an intercultural environment (universities in the UK). During the viewing, participants take notes, paying attention to: cultural characteristics (etiquette, language, gestures, and behavior), lexical elements (phrases, specific vocabulary), and authentic communication situations. Each student developed their own lesson plan, and they were presented with a template. The students presented their ideas in small groups, received feedback, and finalized their projects. After completing the project, participants discuss what they learned from the assignment, write a short essay (200-300 words) on the topic "What did I learn in the process of developing an authentic educational situation?", "How did watching a 360-degree video help me create a lesson?".

Week 7-8. Technological Competence. The ability of a future foreign language teacher to apply 360-degree video in the educational process to achieve learning goals evaluated. The participants conducted a developed lesson fragment using 360-degree video for other students. Participants asked to choose a 360-degree video that would be the basis for an educational situation. The videos related to an educational topic (travel, holidays, daily life, and cultural peculiarities). The lessons consisted of three stages: preparatory, main and final. The participants deduced the topic of the lesson, activating the previous knowledge of the students and preparing them for the perception of the video. The participants organized 360-degree video viewing with the completion of tasks, summed up the lesson and consolidated the material they had learned.

Week 9-10. Creativity and innovative thinking. In 10-15 minutes, the participants offer as many ideas as possible on how to use the watched 360-degree video in teaching foreign languages. The students answered the following questions: a) what non-standard tasks can given to students based on videos, b) how can video used to prepare students for real-life situations, c) how do I adapt videos for different age groups. After that, the participants' ability to create creative tasks based on videos tested. The participants developed a game related to the watched video "Virtual Safari in Africa". The participants created a quiz about animals and natural conditions in Africa based on what they saw.

Week 11-12. Differentiated approach to teaching. To test the formation of skills of a differentiated approach, it is important to assess how the participant: a) takes into account the

individual characteristics of students (level of knowledge, interests, learning styles, cultural background). In addition, b) creates tasks of different levels of complexity; c) applies various forms of work (group, individual, paired); d) suggests adapting the lesson content for different categories of students. The students have developed a differentiated lesson. Their lesson planning evaluated, taking into account the diverse learning needs of students. The participants developed a lesson plan that integrates 360-degree video with differentiated tasks for: a) students with a high level of language proficiency; b) students with a low level of language proficiency; c) visual, auditory, kinesthetics; d) students with different cultural experiences. The video viewed: "360° Virtual Tour of the Louvre Museum". The following tasks were presented: a) for students with a high level: write an essay on the topic "How does art reflect cultural values?" using examples from the video; b) for students with a low level of: choose three exhibits from the video and describe them using the proposed lexical minimum ("painting", "sculpture", "color", "material"). Also, c) for visual artists: create a graphic poster with a description of one exhibit, for audios: create an audio guide to the selected museum hall, for kinesthetics: recreate one of the elements of the exposition (using improvised materials) and describe the process. In this assignment, it checked: a) the variety and adaptation of tasks, b) compliance with the level of students, c) consideration of individual preferences and abilities.

Week 13-14. Methodological competence. This part of the study improved the teacher's ability to: a) choose and apply effective teaching methods, approaches and technologies; b) develop structured lessons with clear goals, milestones and expected results; c) evaluate the effectiveness of their methods and adapt them depending on the context and needs of students. To check whether this competence improved after working with 360-degree video, the following was used comparative analysis before and after. The participants analyzed their own lessons before and after working with 360-degree videos. The participants chose two of their lessons: 1) one conducted before the introduction of 360-degree video, b) the second, created based on video. We compared the structure of lessons, methods, and assignments. They drew conclusions about how the use of 360-degree video influenced their methodical approach.

Week 15. The final stage of summing up and reflection held. It turned out that the participants learned the material and achieved the objectives of the lesson. The participants given the opportunity to summarize their knowledge, express their opinions and receive feedback, and pass the competency assessment post-test. Conditions have created for self-analysis and awareness of how competence research will affect their future teaching practice. In addition, the Intrinsic Motivation Inventory (IMI) test implemented to identify the motivation for using 360-degree videos of the participants. The Intrinsic Motivation Inventory (IMI) is a widely accepted instrument for assessing an individual’s intrinsic motivation, defined as the desire to engage in an activity driven by genuine interest or enjoyment (Ryan & Deci, 2000). Responses to the 37 IMI items were analyzed using descriptive statistics to measure central tendency (mean scores) and variability (standard deviations) across key dimensions such as interest/enjoyment, perceived competence, and effort/importance. Multivariate analysis of variance (MANOVA) used to examine group differences in motivation levels and the impact of 360-degree video on student motivation.

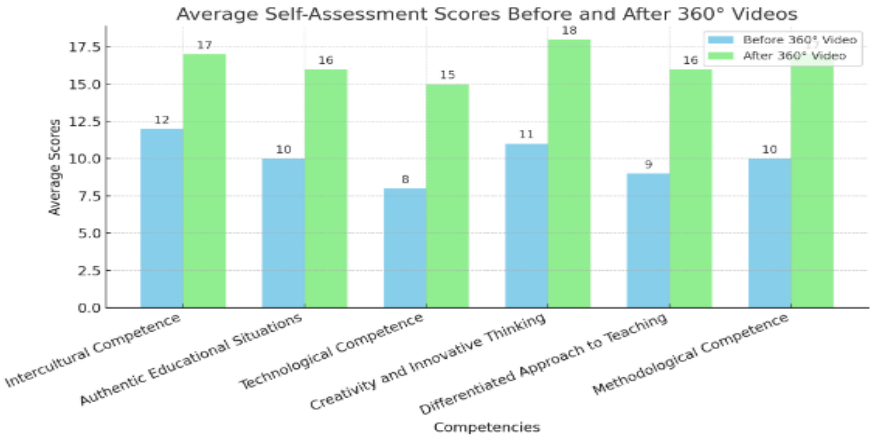
Results

Research question 1. How effective is 360-degree video technology for developing the competencies of future foreign language teachers?

Week 1. The figure below (Figure 2) showed the average self-assessment scores of 26 participants in six key competencies before and after using 360-degree video.

Figure 2

Average self-assessment score before and after 360-degree videos

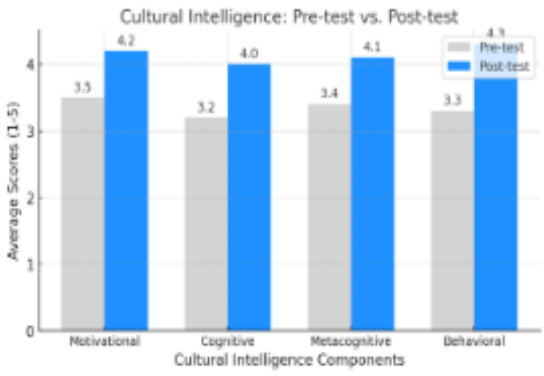


For all competencies, there is a significant increase in average scores after watching the video. The largest increase observed in the following competencies: 1) Technological Competence: an increase of 7 points; b) Creativity and Innovative Thinking: an increase of 7 points. Other competencies also showed steady growth, for example, "Intercultural Competence" and "Methodological Competence" increased by 5-6 points. The participants significantly improved their competencies after using 360-degree video. This demonstrates the effectiveness of this technology for the professional development of future teachers.

Week 2-3. At this stage, the results of pre- and post-test testing compared for each component (motivational, cognitive, metacognitive, and behavioral). As well as the distribution of responses from the post-test questionnaire on the alleged effect of virtual reality on intercultural learning.

Figures 3, 4

Average scores for the four components of cultural intelligence and distribution of responses



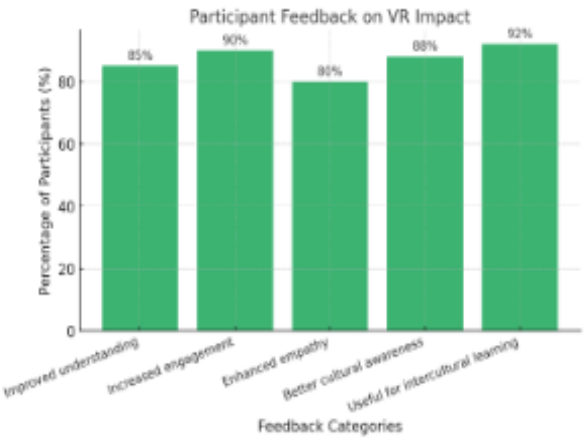
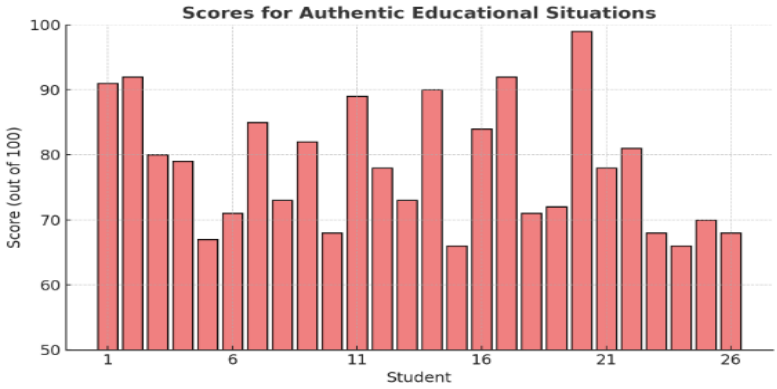


Figure 3 shows the average scores for the four components of cultural intelligence (motivational, cognitive, metacognitive, behavioral) before and after watching a 360-degree video. After testing, significant improvements were recorded in all components, with the highest result in the behavioral component (M = 4.3). Figure 4 shows the to questions about the impact of VR on intercultural learning. The largest percentage of participants noted the categories "Useful for intercultural learning" (92%) and "Increased engagement" (90%), which indicates the high effectiveness of VR in the formation of intercultural competence.

Week 4-6. The following results (Figure 5) obtained: a) the development of skills in designing authentic educational situations, b) the ability to integrate cultural and linguistic aspects into lessons, c) the ability to find and adapt materials from real intercultural contexts.

Figure 5

Scores for authentic educational situations

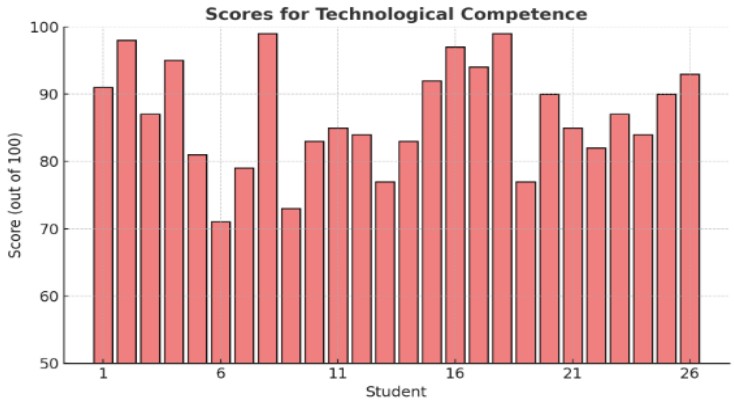


Most of the students scored 85+ points, demonstrating confidence in creating authentic educational situations. In addition, the majority of students demonstrated a high level, scoring from 65 to 99 points.

Week 7-8. This approach allowed to test how well the future teacher: a) knows how to select suitable 360-degree videos, b) develops tasks that meet educational goals, and c) integrates VR technologies into the learning process.

Figure 6

Scores for authentic technological competence



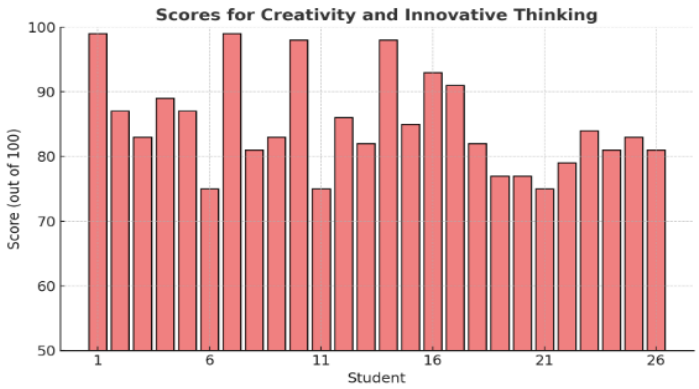
Results range from 70 to 98, showing confidence in the use of technology.

Week 9-10. The result of creativity was the ability to come up with original ideas, generate non-standard solutions for educational tasks and create creative assignments for

students, which contributes to the development of an innovative approach to learning. Innovative thinking, in turn, involves the ability to integrate new technologies, including 360-degree video, into the educational process, the development of non-standard teaching methods, and the ability to transform traditional approaches to learning, opening up new opportunities to improve the effectiveness of the educational experience.

Figure 7

Scores for creativity and innovative thinking

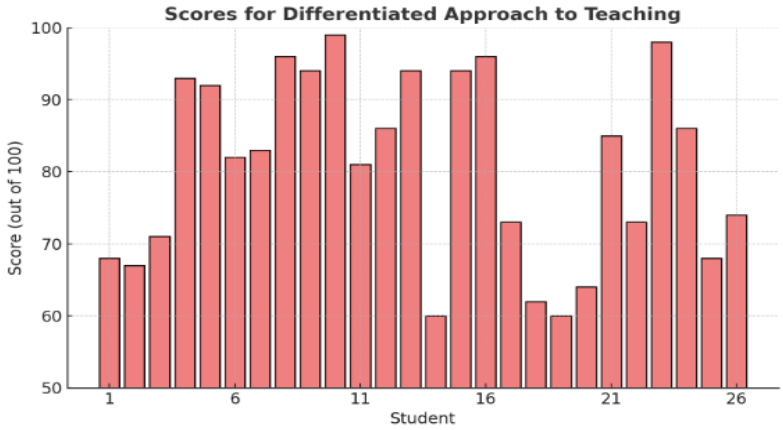


The highest scores (75-100), demonstrating the development of creativity.

Week 11-12. The results of the test of the formation of skills of a differentiated approach reflected how the participant takes into account the individual characteristics of students. Such as the level of knowledge, interests, learning styles and cultural background, and also creates tasks of different levels of complexity, applies various forms of work (group, individual, paired) and offers adaptation of the lesson content for different categories of students, thereby ensuring more effective and personalized learning.

Figure 8

Scores for differentiated approach to teaching

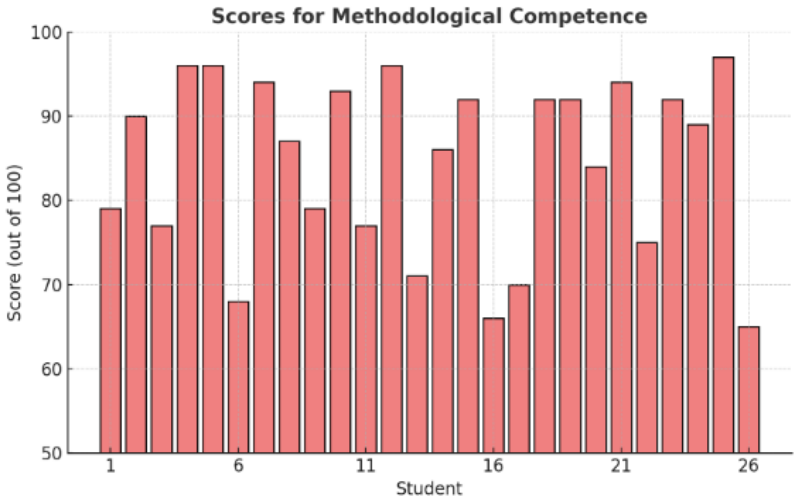


Good performance, which indicates the development of a differentiated approach to learning. The range is from 60 to 97, which indicates the advanced skills of a differentiated approach.

Week 13-14. The results of this stage, the following evaluated: a) depth of analysis, b) the ability to identify changes and improvements, c) reasonableness of conclusions.

Figure 9

Scores for methodological competence



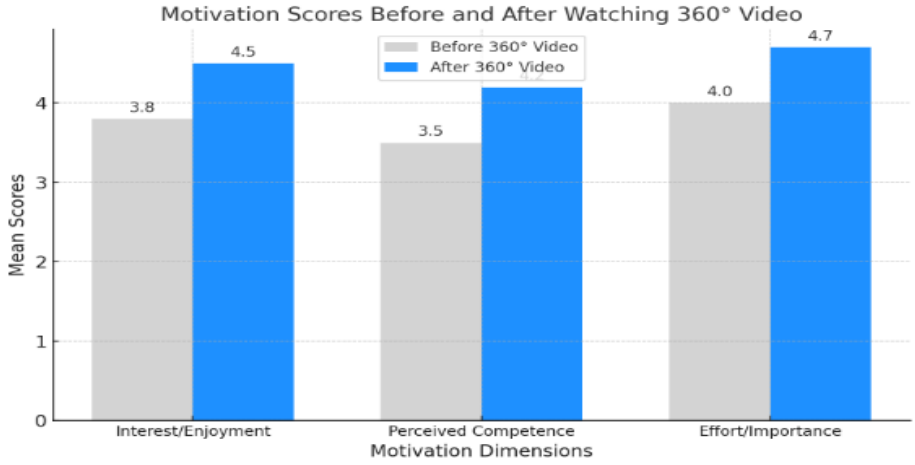
The students showed a high level of methodological skills. Results from 65 to 99, emphasizing methodological development.

Research question 2. Has the implementation of 360-degree video technology enhanced motivation for the teaching profession?

As Figure 10 showed, the average values of motivation indicators increased after watching the videos, which may indicate the positive impact of technology on participant engagement.

Figure 10

Motivation scores before and after watching 360 degree video



Motivation analysis before and after watching 360 degree videos showed a significant increase in all three parameters: interest/pleasure (up to: M = 3.8, SD = 0.7; after: M = 4.5, SD = 0.6), perceived competence (up to: M = 3.5, SD = 0.6; after: M = 4.2, SD = 0.5) and effort/importance (before: M = 4.0, SD = 0.7; after: M = 4.7, SD = 0.5). Multivariate analysis of variance (MANOVA) revealed significant differences in motivation levels before and after watching, indicating a positive effect of 360 degree video on student motivation.

Wilks' Lambda (0.76): This indicator demonstrates how much of the total variance is not explained by the differences between the groups (before and after watching the video). The

lower the Lambda value, the more pronounced the differences between the groups. In this case, 0.76 indicates a significant impact of 360-degree video on student motivation.

$F(3, 23) = 5.8$, $p < .01$:

The value of the F-statistic (5.8) confirms the presence of significant differences between the groups. $p < .01$ indicates a high statistical significance of the result (less than 1% probability that the effect is random).

Discussion

This study examined the use of 360-degree video technology for the training of foreign language teachers. The results confirmed that this innovative approach contributes to the development of key professional competencies necessary for successful teaching in a modern educational environment.

The main contribution of the research is to identify six key competencies: pedagogical adaptability, cultural awareness, classroom management skills, reflective practices, technology proficiency, and student engagement strategies. These competencies form an interconnected model, where each supports the other, which enhances the overall effect of the educational process. For example, pedagogical adaptability enhanced through reflective practices, and cultural awareness contributes to more effective student engagement.

The results confirmed the hypothesis that 360-degree video technology is a transformative medium for teacher training. Immersive content allows simulate real-world classroom situations, improving understanding of theory and its practical application. The increase in professional competence indicators demonstrates the effectiveness of technology: the greatest improvements observed in technological competence, creative thinking and the ability to adapt learning to the needs of different groups of students.

The growing intercultural competence of the participants confirms the importance of immersion in authentic cultural contexts, which corresponds to Bennett's theory of intercultural communication. The development of divergent thinking noted by the participants is consistent with Guilford's ideas about the role of new media in stimulating creative analysis.

In addition, the use of technology has contributed to the introduction of a differentiated approach, which confirms Tomlinson's theory about the importance of taking into account individual differences. The participants noted an improvement in lesson planning, which corresponds to Bertalanfi's systematic approach. The increased motivation revealed by the results of the IMI test confirms Desi and Ryan's theory about the importance of intrinsic motivation in professional development.

Thus, the study showed that 360-degree video not only increases the level of professional competencies of future foreign language teachers, but also provides them with high motivation, offering integration of theoretical knowledge and practical experience into a single educational system.

Conclusion

The conducted research has demonstrated that the use of 360-degree video technology in the training of future foreign language teachers is an innovative and effective method that contributes to the formation of key professional competencies. The development of skills such as intercultural, technological and methodological competence was most noticeable, which confirms the importance of authentic experience and immersion in real educational situations.

In addition, the 360-degree video allowed the participants to analyze the lessons from different perspectives, which led to an improvement in their ability to reflect and improve themselves. This approach is consistent with the theory of situational learning, according to which interaction with real educational contexts promotes deep learning.

The significant growth of the participants' creative and innovative thinking confirms the importance of using non-standard methods and technologies in education. The participants learned how to adapt materials for students with different levels of education, which indicates the development of a differentiated approach to learning.

In terms of motivation, the study found that using 360-degree video not only promotes professional development, but also significantly increases the internal motivation of participants. This confirms the hypothesis that the development of competencies directly related to the growth of interest in the profession.

However, the study has a number of limitations. A small sample and a short study period limit the ability to generalize the results. In addition, using specific tools such as Meta Quest 2 and certain videos can be difficult given limited resources.

Although the cost of VR headsets remains high, their advantages in language learning far outweigh the drawbacks. A similar situation prevailed in the early 2000s when many schools in Kazakhstan had little to no access to computers, making the use of laptops nearly impossible. However, today, computers are an essential part of every classroom, seamlessly incorporated into the educational process. Likewise, VR technology is anticipated to follow this trajectory, gradually becoming a standard tool in education and an integral part of daily learning.

Therefore, the study and development of VR technologies in education represent a crucial scientific endeavor with overwhelmingly positive outcomes. Further exploration of 360-degree videos and the growth of its capabilities will undoubtedly elevate language learning methodologies to new heights, enhancing engagement and effectiveness for future teachers.

For further research, it recommended to expand the sample to include students from different educational institutions, as well as to study the impact of 360-degree video on long-term learning outcomes. It is also important to consider the possibilities of integrating this technology into different stages of the educational process in order to maximize its potential.

Overall, the results confirm that 360-degree video can be a valuable tool in teacher training, contributing to the formation of the necessary competencies and motivation for successful professional activity.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Ainash Kussainova: Conceptualization, Methodology, Writing – Original Draft Preparation. Roza Zhussupova: Investigation, Data Curation, Writing – Review & Editing. Rustam Shadiev: Supervision, Validation, Visualization.

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TEACHING THE FUNDAMENTALS OF MOLECULAR SYMMETRY IN HIGH SCHOOL THROUGH THE USE OF THE INTERACTIVE ONLINE RESOURCE SYMOTTER

Abstract: Molecular symmetry is a fairly complex branch of chemistry that requires special teaching methods, including the integration of traditional approaches with modern visualisation and modelling technologies. The article discusses the possibilities and results of using the Symotter online resource for studying the fundamentals of molecular symmetry in high school. The visual module and rich theoretical material in the resource enable students of natural science specialties to more effectively learn the fundamental concepts of molecular symmetry, search for symmetry elements, and identify point groups of molecules. The results of a three-year implementation show a positive impact on student engagement in the course as well as academic performance. By using the Symotter resource, the students' level of mastery of the teaching material is consistently high at over 80%. A crucial role in the effectiveness of the study is played by the 3D visualization of molecular structures, symmetry elements and symmetry operations with the possibility of carrying out exercises for determining a point group of molecules both under the guidance of a teacher and independently. The resource provides invaluable assistance to both students and teachers in learning the concept of molecular symmetry.

Keywords: molecular symmetry, point groups, digital technologies, online-platform, methods of teaching chemistry, symmetry of molecules

Introduction

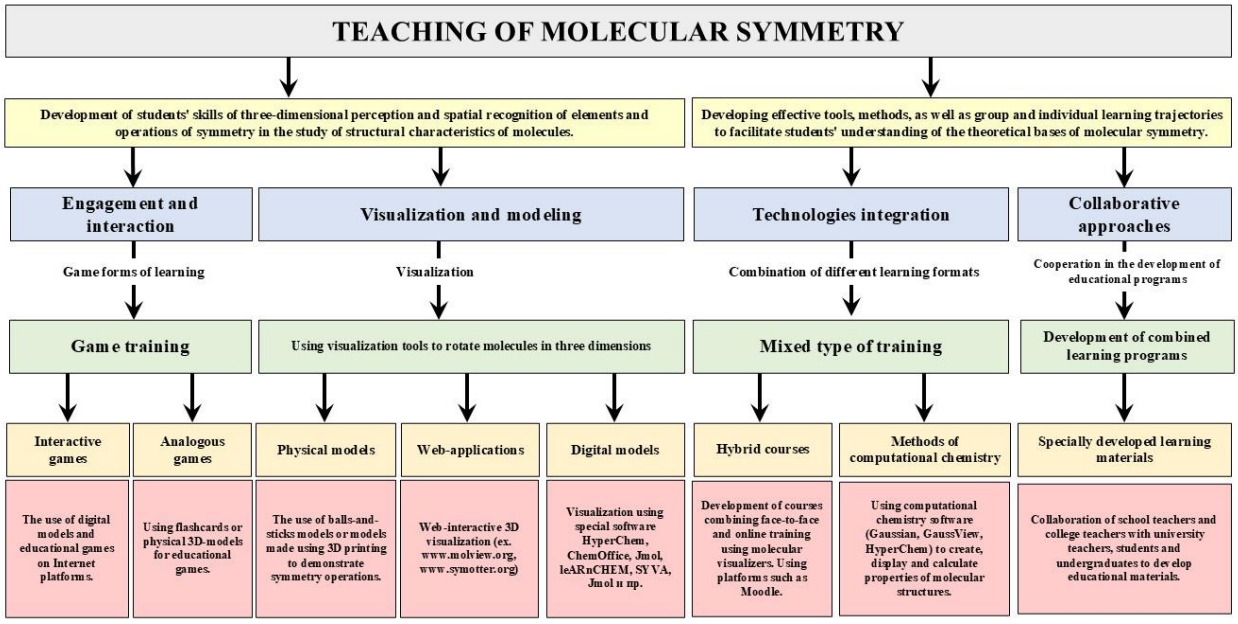
The practical relevance of molecular symmetry to quantum chemistry (Pauncz, 2018) and molecular spectroscopy (Bunker & Jensen, 2006) makes it one of the major fields of chemical science. The study of molecular symmetry enables a deeper understanding of molecular properties and intermolecular interactions. The fundamentals of molecular symmetry include the study of symmetry elements and corresponding symmetry operations, which help students better understand the structural and optical properties of molecules. Although the concepts associated with molecular symmetry are not so difficult, their accurate understanding requires the use of a fairly serious mathematical apparatus and the provisions of group theory (Vázquez-Vidal, 1996). However, when molecular symmetry is taught in high school, there are several problems that make it difficult to understand what is, at first glance, quite difficult material, as there is currently no common system and uniform teaching methods of the molecular symmetry fundamentals.

The main difficulty in studying molecular symmetry is the need to visualize molecules in 3D from 2D images in order to find symmetry elements and operations that determine the belonging of a molecule in a particular point group (Rattanapirun & Laosinchai, 2023). Students often find it difficult to visualize the 3D shape of a molecule, especially in the early stages of familiarity with the concepts of molecular symmetry (Rattanapirun & Laosinchai, 2021). Furthermore, in many cases it is difficult to identify second-order axes (C_2), which perpendicular to axes C_n, and to find the σ_d planes that passing through the C_n axis dividing the angles formed by the neighboring C_2 axes in dihedral point groups (Chen и др., 2015). Therefore, the effective teaching of molecular symmetry requires a structured pedagogical

approach that fosters both conceptual understanding and practical application. Fig. 1 presents a framework that reflects a multifaceted strategy aimed at developing students' three-dimensional perception and spatial recognition of symmetry elements in molecular structures.

Figure 1

Comprehensive pedagogical framework for teaching molecular symmetry.



To effectively learn the fundamentals of molecular symmetry, two main tasks must be solved:

- to develop students' skills in the 3D perception of molecular structures and
- to develop effective tools and methods to facilitate students' perception of the theoretical fundamentals of molecular symmetry.

To achieve these goals, the framework is organized into four key pedagogical components: engagement and interaction, visualization and modeling, technology integration, and collaborative learning approaches. Each of these components plays a critical role in reinforcing students' understanding of molecular symmetry by leveraging different teaching methodologies and tools.

In the context of molecular symmetry, game-based learning is employed to create an interactive and immersive educational experience. This approach encompasses both digital and physical learning tools. The integration of digital educational platforms, including interactive molecular modeling software and online games, allows students to explore molecular symmetry through engaging and visually stimulating activities. Such platforms enable real-time manipulation of molecular structures, reinforcing students' ability to recognize symmetry operations. Traditional educational games, such as flashcards and three-dimensional physical models, are utilized to supplement digital approaches.

Modern educational methodologies emphasize the integration of multiple learning formats. Blended learning approaches that integrate face-to-face instruction with online molecular visualization tools provide students with a flexible and comprehensive learning experience. Platforms such as Moodle facilitate the delivery of interactive course content. The development of effective educational programs benefits significantly from collaborative efforts between educators, researchers, and students. This framework promotes the co-development of learning materials and programs through interdisciplinary cooperation. This approach

fosters a dynamic and inclusive learning environment that integrates theoretical knowledge with practical applications.

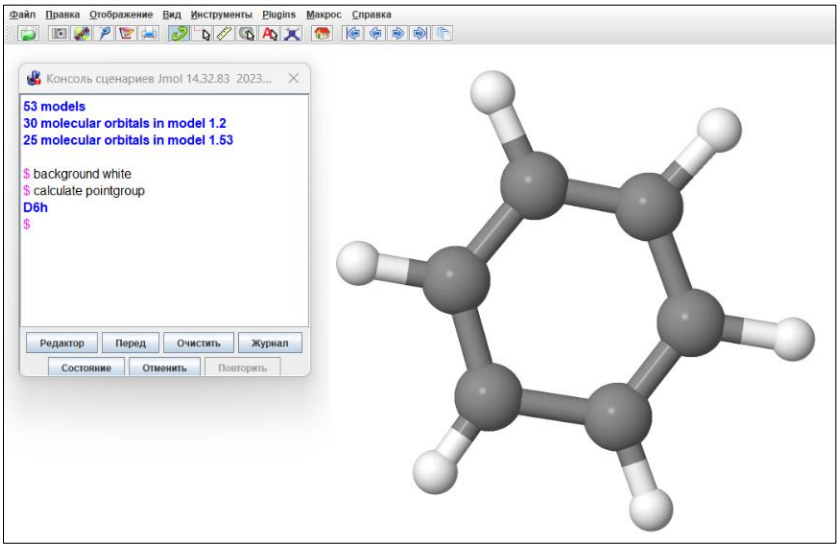
Given the inherently spatial nature of molecular symmetry, 3D visualization techniques are essential for facilitating students' understanding of symmetry operations. Ball-and-stick molecular models and 3D-printed structures serve as effective tools for demonstrating symmetry elements and their transformations. Such models provide students with a hands-on learning experience that enhances spatial reasoning skills. Online resources and advanced molecular visualization software provide interactive, web-based simulations that enable students to manipulate molecular structures and observe symmetry elements.

For these purposes, even before the emergence of mobile applications, various software products were developed (Meyer & Sargent, 2007), for example based on the ADDIE protocol (Korkmaz & Harwood, 2004) and even proposed to use the paper models (Sein, 2010). Some authors suggested the use of hybrid courses that combine online learning with traditional full-time courses (Antonoglou и др., 2011) or games (Dagnoni Huelsmann и др., 2018) or the use of models created with 3D printing (Savchenkov, 2020). The mobile augmented reality app leARnCHEM for symmetry visualization, developed in 2023, allows to search and animate molecules with symmetry elements and test the insights gained using quiz (Zambri & De Backere, 2024). The SYVA program has also been used to analyze molecular symmetry, which is compared with SYMMOL and molecule simulation programs such as NWChem or ORCA. SYVA can generate input files for molecular modeling programs and integrate them into GAMESS and MRCC (Gyevi-Nagy & Tasi, б. д.).

The program Jmol is also interesting - an interactive program for viewing molecular models on the computer (*Jmol: an open-source Java viewer for chemical structures in 3D. http://www.jmol.org/*). This open source program has long been used as a tool to study molecular symmetry (Cass и др., 2005). It is free for all users and can be successfully used to study molecular structures and develop training materials (Herráez & Herráez, 2007). However, Jmol is not a program for drawing structures. This requires another program, such as Spartan or Chem3D. To determine the point group of a molecule in Jmol, the appropriate "calculate pointgroup" command in the script console is required. After pressing the enter key, the result will be appeared in the next line, for example the definition of the point group for the benzene molecule (D_{6h}) (Fig. 2.).

Figure 2

Determination of the point group of a benzene molecule in the Jmol program.



The online resource Symmetry Resources at Otterbein University https://symotter.org has been successfully used for several years in the course “Contemporary perspectives on the structure of matter” in the master's program for studiyng the section “Molecular Symmetry". The resource is intended to make it easier for students and teachers to learn molecular symmetry and requires Microsoft Edge (Windows, macOS), Safari (macOS, iOS), Chrome (macOS, Windows, iOS, Android), or Mozilla Firefox (macOS, Windows, Linux, iOS, Android). The resource can be easily used on all types of digital devices: PCs, laptops, tablets, smartphones and interactive boards, without the need to install special software. At the same time, the device must have Internet access and a screen resolution of at least FullHD. To ensure complete and high-quality visualization, Symotter is accessible to students and teachers from anywhere and at any time, providing flexibility in learning, the ability to conduct online lessons and the opportunity to study learning material independently.

Even though traditional methods like using physical models or static diagrams are still useful, they have their limits because they can't represent the dynamic aspects of molecular symmetry. As an interactive online resource, Symotter offers significant advantages over traditional methods. It allows students to visualize and manipulate molecular structures in real time, improving material understanding and memorization. Unlike traditional methods where learning is often based on static images and models, Symotter provides dynamic and interactive learning that is more effective for understanding symmetry concepts. Symotter, on the other hand, allows students to experiment with various elements and operations of symmetry and immediately see the results of their actions, which contributes to the most comprehensive understanding and assimilation of the learning material.

This English-language resource, has intuitive navigation and contains several sections.

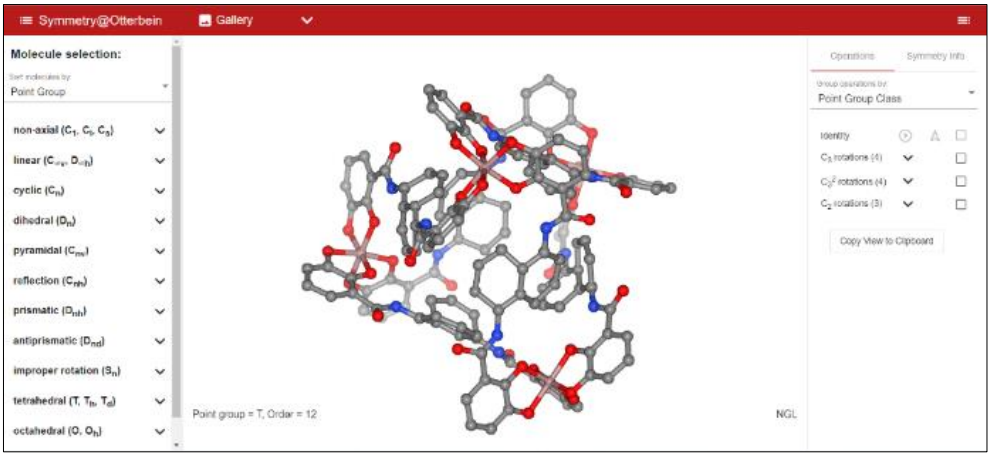
The “Tutorial” section briefly introduces the user to the elements and operations of symmetry. For a more detailed introduction to the theoretical foundations of molecular symmetry, the relevant literature is recommended (Bunker & Jensen, 2005; Hargittai & Hargittai, 2009; Pecharsky & Zavalij, 2005; Willock, 2009).

The "Gallery" section (Fig. 3A) contains an extensive collection of examples of different molecules for all 32 point groups. The data can be sorted by point groups, number of atoms, type of molecule, or in alphabetical order. The main feature of this section is the possibility of 3D visualization of elements and operations of symmetry, which, unlike paper or static models, allows a clear representation of the action of symmetry elements, which is useful for understanding the reversal and effect of mirror rotation axes. This gallery can also be used as an excellent lecture guide.

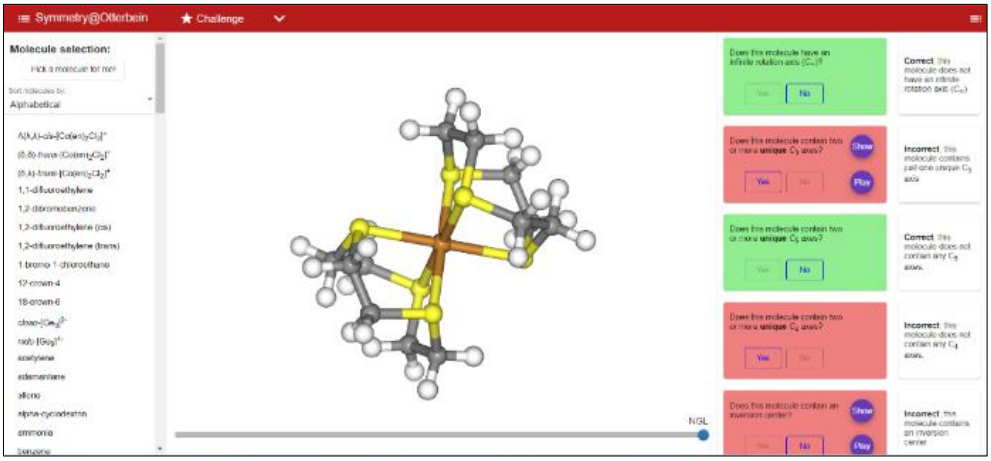
Figure 3

"Gallery" (A) and "Challenge" (B) sections of the online resource https://symotter.org

A



B



In the “Challenge” section (Fig. 3B), teachers can test students' acquired knowledge of defining the point group of a molecule. After clicking the “Pick a molecule for me” button, the system will automatically suggest one of the molecules present in the database and few consecutive questions to determine the point group. After all the answers have been completed, the system will prompt to verify their accuracy. Then, after clicking the "Check Answer" button, the system will highlight correct answers in green and incorrect answers in red. For each answer, a short explanation of the errors will also be receive. The “Show” and “Play” buttons visualize the corresponding elements and operations of symmetry. The functions of this section enable use in exams or interim controls.

Since the resource is English, it provides the opportunity to study the indispensable terminology in English, which must be done in the correct context when learning the discipline in Kazakh or Russian (Akatyev и др., 2023). Table 1 shows the basic terms in three languages for the section on molecular symmetry.

Table 1.
The fundamental terminology of the “Molecular Symmetry” section in three languages.

№	English	Kazakh	Russian
Common terms			
1	Symmetry	Симметрия	Симметрия
2	Molecular symmetry	Молекулалық симметрия	Молекулярная симметрия
3	Point group	Нүктелік топ	Точечная группа
4	Symmetry group	Симметрия тобы	Группа симметрии
5	Group theory	Топтық теория	Теория групп
6	Symmetrical figure	Симметриялық фигура	Симметричная фигура
7	Representations of point groups	Нүктелік топ көріністері	Представления точечных групп
8	Representations of symmetry operations	Симметрия амалдарының бейнелері	Представления операций симметрии
Symmetry elements			
9	Symmetry element	Симметрия элементі	Элемент симметрии
10	Symmetry axis	Симметрия осі	Ось симметрии
11	Inversion center	Инверсия орталығы	Центр инверсии
12	Rotation axis	Айналмалы ось	Поворотная ось
13	Mirror plane	Айна жазықтығы	Зеркальная плоскость
14	Plane of symmetry	Симметрия жазықтығы	Плоскость симметрии
15	Axis order	Ось реті	Порядок оси

16	Center of symmetry	Симметрия орталығы	Центр симметрии
17	Rotation-reflection axis	Айна-бұрылыс (инверсия) осі	Зеркально-поворотная (инверсионная) ось
Symmetry operations			
18	Symmetry operation	Симметрия амалы	Операция симметрии
19	Identity	Сәйкестік (ұқсас түрлендіру)	Идентичность (тождественное преобразование)
20	Rotation	Айналу	Вращение
21	Reflection	Шағылыс	Отражение
22	Inversion	Инверсия	Инверсия
23	Proper rotation	Меншікті айналым	Собственное вращение
24	Improper rotation	Меншікті емес айналу	Несобственное вращение

Methods and organization of the study.

As part of a control of the "Molecular Symmetry" section, master's students were asked to determine the point group of five molecules using the "Challenge" section of the Symotter source. Clicking the "Pick a molecule for me" button automatically select the molecule. To determine whether a molecule belongs to a particular point group, five questions had to be answered about the existence or absence of a particular symmetry element. It should be noted that when explaining the theoretical material in the lectures, the options in the "Gallery" section were used. The number of master's students in the academic years was: 15 in the 2021-2022 academic year, 16 in the 2022-2023 academic year and 12 in the 2023-2024 academic year.

The evaluation of the results was based on two criteria:

1) the number of specific point groups,

2) the total number of correct answers to questions for determining the elements of symmetry.

The need for such a distinction arises from the fact that to determine the point group of each molecule, all questions must be answered correctly. Even if one answer is wrong, it is not possible to determine the correct point group. However, at the same time, the student can correctly define several elements of symmetry. That is, if one mistake is made in three tasks, the student will not identify a point group for three molecules, but if three mistakes are made in one task—only one—and in both cases the same number of questions were answered. In this case, a student who identified more point groups will receive a higher score.

It should be clarified that the number of questions for determining a point group can range from 2 to 7, depending on whether the point group belongs to one or another category of symmetry. However, the number of questions is usually only five for most molecules in the resource database, which have between 4 and 20 atoms.

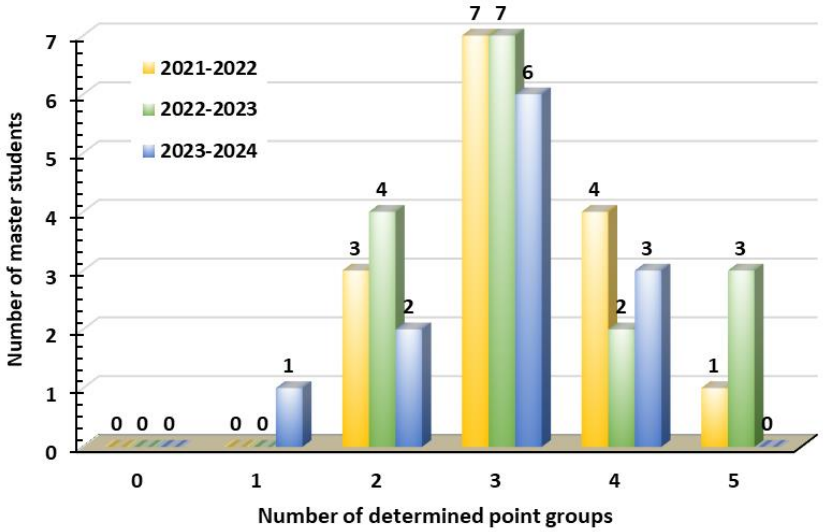
Results and discussion.

The analysis of the results of assessing the quality of knowledge of master's students according to specified criteria is shown in Figure 4.

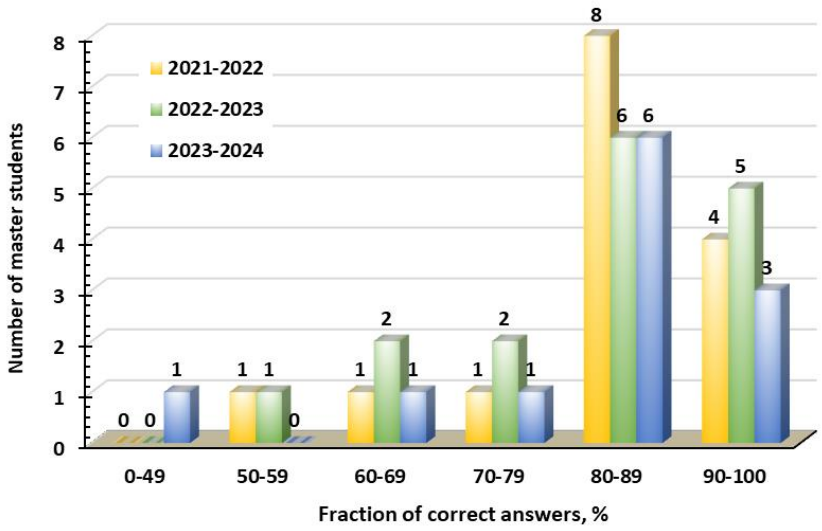
Figure 4

Results of assessing students' knowledge of the "Molecular Symmetry" using the Symotter online resource for three academic years: A - on criterion 1, B - on criterion 2.

A



B

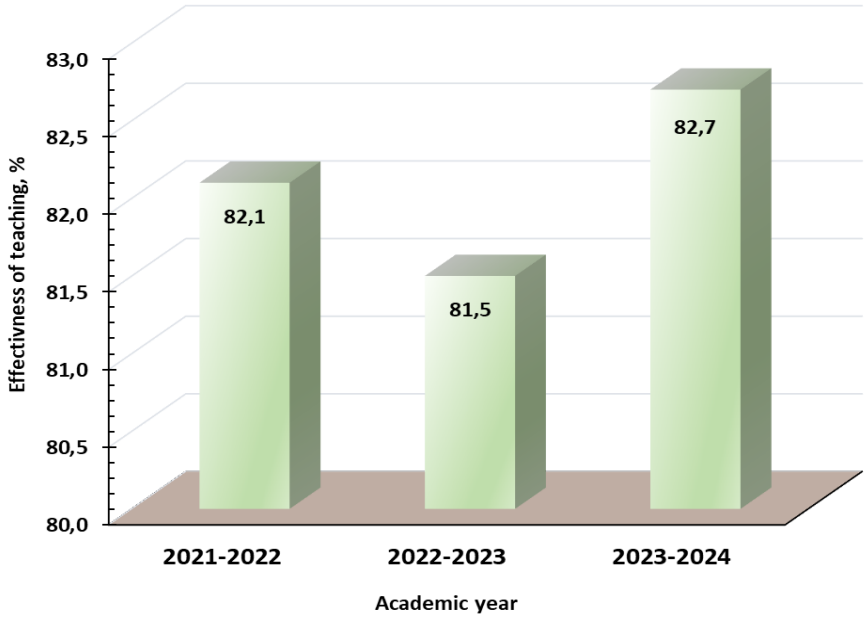


As can be seen, students are able to identify point groups of molecules and answer most of the questions asked, which is a very good indicator of the quality of learning. On average, each student is able to identify point groups of three out of five molecules. For molecules belonging to the lower and middle symmetry categories as well as special point groups ($C_{\infty v}$, $D_{\infty h}$), symmetry elements and point groups are easy for students to identify, while highly symmetric molecules belonging to a higher symmetry category sometimes cause difficulties.

The effectiveness of learning the fundamentals of molecular symmetry using the online resource Symotter over three academic years is shown in Figure 5.

Figure 5

The effectiveness of teaching the fundamentals of molecular symmetry using the Symotter online resource.



The results clearly demonstrate that using the Symotter online resource while learning the fundamentals of molecular symmetry leads to a very stable understanding of the subject by more than 80%. Additionally, a survey of students indicates that everyone finds this resource very useful and effective. The main advantages are intuitive navigation and excellent visualisation of symmetry elements and operations, as well as the possibility of making full use of the resource from any digital device, anywhere.

Conclusion

The use of digital tools promotes a deeper understanding of molecular symmetry aspects and provides students with the basic spatial reasoning and analytical skills that are essential for their future studies in chemistry and related fields. The Symotter online resource is a simple, affordable, and powerful tool for learning the fundamentals of molecular symmetry that can complement and exceed traditional methods due to its interactivity and ability to provide insightful and practical learning. Symotter is a learning platform that helps students learn about the elements and operations of symmetry and determine the point group of molecules, which is essential for understanding the properties of molecular structures. This approach improves the quality of knowledge and stimulates students' interest and involvement in the study of the subject, which further leads to better learning outcomes in other chemistry fields that use the concepts of molecular symmetry. To improve Symotter's educational capabilities, the developers plan to further integrate augmented reality technologies, which can significantly improve learning methods and provide full-fledged 3D interactive immersion in the learning environment.

Conflict of Interest Statement

The author declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

The use of artificial intelligence (AI)

During the preparation of the manuscript, the capabilities of AI were used to search and analyze references and perform preliminary language editing.

Author contributions

The author confirms the sole responsibility for the conception of the study, presented results and manuscript preparation.

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MODEL OF PSYCHOLOGICAL AND PEDAGOGICAL GUIDANCE FOR UNIVERSITY STUDENTS' SOFT SKILLS DEVELOPMENT

Abstract: In the context of dynamic changes in the economy and rapid technological progress, the process of developing soft skills is becoming an integral condition for the professional success of graduates of education institutions. This study aimed to create and substantiate from a scientific point of view a model of psychological and pedagogical guidance that promotes the development and strengthening of soft skills in university students. The study employed a comprehensive methodological approach, including a theoretical analysis of scientific and methodological sources, systematization of data, empirical study through a sociological survey of employers and HR specialists in the Pavlodar region (75 respondents), and modeling aimed at developing a scientifically based model of psychological and pedagogical guidance for soft skills development in university students. Particular attention is given to skills such as teamwork, creativity, critical thinking, problem-solving, and emotional intelligence. The developed model is an integrated structure that includes target, methodological, diagnostic, content, organizational, and result-oriented components. Each of these components is aimed at creating a favorable educational environment that helps strengthen the professional competitiveness of students and develop their personal stability and ability to successfully adapt to a dynamically changing labor market. The model presents programs focused on the systematic and effective development of soft skills, providing a comprehensive approach to this process through the integration of innovative methods, various forms of training and modern educational resources. Thus, the model focuses on creating an educational space that stimulates the development of soft skills and assumes active participation of all subjects in the educational process.

Key words: soft skills, psychological and pedagogical guidance, university students, model, educational process, labor market

Introduction

In the modern era of rapid social transformation and global digitalization, the ability to quickly adapt and possess versatile skills is becoming a fundamental factors for personal and professional success. In addition to traditional academic knowledge, employers are increasingly focusing on skills that ensure personal stability, successful social adaptation, and competitiveness in the labor market. Soft skills represent the ability to apply knowledge and utilize practical skills to complete tasks and solve problems (Eleje et al., 2024). These skills cover a wide range of competencies, including communication, adaptability, critical thinking, and emotional intelligence, making them indispensable in today's environment. In this regard, soft skills, which form the basis for graduates' professional and personal success, are becoming especially relevant (Cimatti, 2016). Soft skills are rightfully referred to as skills of the future, as they allow young professionals to adapt more quickly, integrate into work processes, actively participate in organizational activities, and unlock their potential (Workforce Development Center, 2023).

An analysis of the current trends in the labor market demonstrates that employers attach particular importance to the development of soft skills among their employees. The results of research conducted by LinkedIn confirm this fact: 85% of respondents believe that soft skills are as important for professional success as academic knowledge and specialized skills (Tongia & Jain, 2024). Despite the evident importance of soft skills, research indicates that the level of their development among university graduates often does not meet employers' expectations. Many young professionals face difficulties adapting to the workplace because of insufficient preparation in communication competence, critical thinking, teamwork skills, adaptability, and well-developed emotional intelligence (Cheng et al., 2022). As a result, employers are forced to conduct additional training and educational programs for new employees, which increases company costs and slows down the professional integration of graduates.

Educational practices demonstrates that the development of soft skills requires an integrated approach that includes both traditional and innovative teaching methods. The integration of active learning methods, digital technologies, social partnerships, and the incorporation of soft skills into academic disciplines have shown positive results in preparing specialists who can meet the modern labor market requirements. However, to date, there is a unified, scientifically based approach that ensures the systematic development of soft skills within the educational environment (Marin-Zapata et al., 2022).

Based on the above, the purpose of this study was defined as the development and scientific justification of a model of psychological and pedagogical guidance for soft skills development in university students.

To achieve this research goal, it is necessary to solve a number of objectives, including:

- A comprehensive study of the theoretical foundations and modern scientific approaches that reveal the essence and significance of the soft skills development process.
- Analysis of existing educational programs and methods that contribute to the effective development of these skills.
- Conducting a sociological survey among representatives of employers and HR specialists of the Pavlodar region to identify the most in-demand soft skills in the conditions of the modern labor market, followed by an interpretation of the obtained results for their further use in model design.
- Identifying key factors that influence the successful development of these skills in the educational environment.
- Designing a model of psychological and pedagogical guidance that ensures the targeted development of soft skills in students.

Implementation of the proposed objectives will ensure a well-founded approach to the development of soft skills in the university educational environment, which, in turn, will improve students' professional readiness, competitiveness, and adaptability to the requirements of the modern professional landscape.

Literature review

Educational institutions worldwide are implementing innovative approaches aimed at developing soft skills among students and recognizing their key role in the professional development of specialists. Abraham et al. (2021) emphasized the significance of in-person communication in soft skills development. According to the authors, reducing dependence on technology and focusing on personal meetings are currently key aspects for the effective development of these skills.

Simultaneously, findings from other studies highlight the need to combine traditional and digital learning to achieve positive dynamics in soft skills development. According to Coelho and Martins (2022), successful professional training programs are based on hybrid methods that integrate face-to-face interactions with online learning, fostering both communication and

analytical skills among students. Several educational programs have already demonstrated their effectiveness in this regard. For instance, the study by Garcia et al. (2020) describes the implementation of virtual simulations in specialist training, which made it possible to increase the level of interaction, adaptability and emotional intelligence in students. The use of interactive technologies, in combination with group discussions and role-playing games, contributed to the development of essential soft skills and facilitated their seamless integration into the professional community.

An essential aspect of soft skills development is extracurricular activities, which enable students not only to acquire theoretical knowledge during the learning process, but also to apply it in practical settings. Participation in student clubs, volunteer programs, sports sections, and professional competitions contributes to the development of skills such as teamwork, leadership, communication skills, time management, and emotional intelligence (Fakhretdinova et al., 2021). Additionally, a crucial direction in soft skills development is the expansion of social partnerships, integrating educational processes with real-world professional experiences. As noted by Uvarina et al. (2021), the effective cultivation of soft skills among young people requires active cooperation between educational institutions, employers, and public organizations. Social partnerships serve as a mechanism for engaging students in project-based activities, internships, and mentoring programs, thereby creating conditions for developing communication, adaptability, and leadership qualities in an authentic professional environments.

Another promising direction in soft skills development is the implementation of an interdisciplinary approach that enables the integration of these skills into various academic disciplines (Caeiro-Rodríguez et al., 2021). Current research indicates that incorporating soft skills into the curricula of technical, natural sciences, and humanities programs contributes to the formation of complex competencies in students (Sirbu A., & Georgescu M., 2023). In particular, project-based and problem-oriented learning, where students solve real-world cases from professional practice, not only improves their level of professional training but also develops teamwork, critical thinking, communication, and leadership skills (Glazunova et al., 2022). Such integration contributes to the creation of an educational environment in which soft skills are developed not separately, but in close connection with professional knowledge, increasing their relevance for graduates' future employment.

To effectively develop soft skills among university students, it is also important to equip teaching staff with modern methods and technologies for their development (Maren et al., 2021). Educators enhance soft skills and deepen their knowledge of their development through additional education systems based on personalized advanced training programs and individual professional growth trajectories. Self-education, mentoring, and practical pedagogical activities play important roles in this process. Special attention has been given to modern teaching methods, such as case technologies, information, and communication technologies, as well as active and interactive approaches: such as project-based and problem-oriented learning, blended models, and other innovative methodologies (Caeiro-Rodríguez et al., 2021). This approach allows not only to increase the professional competence of teachers in soft skills but also to create favorable conditions for the effective implementation of modern methods and technologies for their development in the educational process. Thus, advanced training of the teaching staff has become an important element of the strategy for preparing students for professional activities (Rozhnova et al., 2024).

The findings of previous studies demonstrates that the effective development of soft skills requires a comprehensive and multi-component approach. Scientific studies confirm the necessity of integrating various strategies, including formal education, digital technologies, extracurricular activities, social partnerships, and professional development of university faculty (Sancho-Cantus et al, 2023; Lamri J. & Lubart T., 2023). These conclusions serve as

the basis for designing a model of psychological and pedagogical guidance for soft skills development in university students.

Methods and organization of the research

A comprehensive methodological approach, consisting of several sequential stages, was employed in the study.

At the first stage, a theoretical analysis of scientific and methodological literature is conducted, as well as current research on the development of soft skills in the educational environment. The study of scientific works allowed for the identification of key concepts, approaches, and methods used in the practice of developing soft skills among university students.

At the second stage, the collected information was synthesized and systematized to identify main the factors and patterns influencing the development of soft skills. The most significant theoretical and practical aspects were determined, which subsequently formed the basis of this study.

At the third stage, an empirical analysis was conducted through a sociological survey aimed at identifying the most in-demand soft skills in the modern labor market and assessing their significance in the candidate selection process. To conduct the survey, a sample of 75 respondents was formed, including company executives, HR specialists, and employers from various industries of the Pavlodar region.

The survey was conducted using an online questionnaire and semi-structured interviews, which allowed us to obtain both quantitative and qualitative data. The main focus was on the following questions:

• What role do you think soft skills play in the selection of candidates for vacant positions in your organization?

• What soft skills do you consider the most valuable for the successful professional performance of employees?

• In your experience, which soft skills are most commonly underdeveloped among candidates?

The respondent selection process accounted for sectoral differences in soft skills requirements. The study included professionals from diverse fields, such as education (universities and colleges), industry, information technology, agriculture, trade, and the public sector. This comprehensive approach enables a nuanced analysis of the demand for soft skills across different economic sectors, facilitating the identification of the most essential skills required for professional success in the modern labor market.

Statistical data processing involved analyzing the distribution of the significance of soft skills across industries, conducting comparative assessments, and ranking skills based on their importance. Descriptive statistical methods were employed to identify the most in-demand soft skills, both within specific economic sectors and across the broader labor market. This methodology not only clarified industry-specific skill expectations, but also helped formulate a consolidated list of the most critical for ensuring successful employment and career advancement among university graduates.

At the fourth stage, based on the results of the analysis of theoretical and empirical data, a psychological and pedagogical guidance model was designed for the development of soft skills among university students. The modeling process was based on the integration of modern pedagogical approaches, such as activity-based, systemic, and personality-oriented approaches, while also incorporating best practices for embedding soft skills into the educational process.

Thus, the presented methodology provides a logical and sequential organization of the study, facilitating the development of a scientifically grounded model of psychological and pedagogical guidance for the development of soft skills in the university environment.

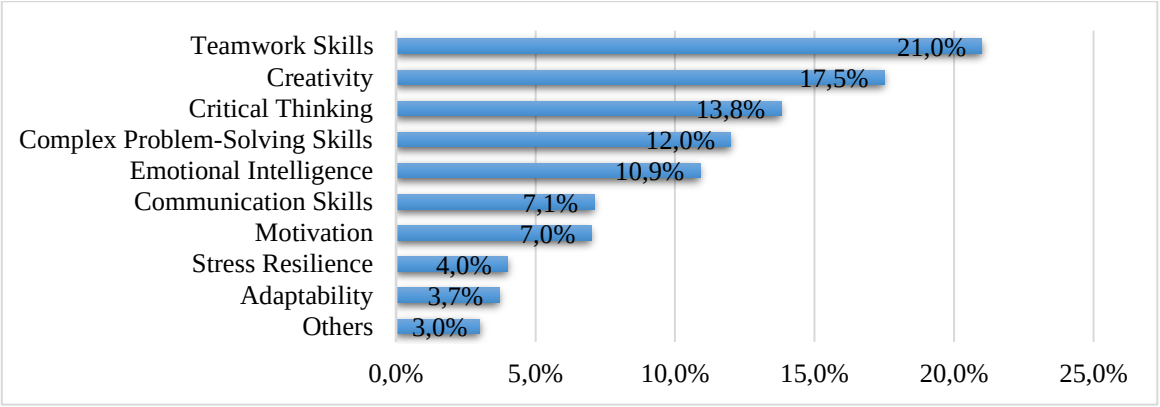
Research results and discussion

Based on a survey conducted among employers and HR specialists in the Pavlodar region, the key soft skills most in demand in the current labor market were identified. An analysis of the respondents' answers revealed that soft skills play a decisive role in selecting employees for vacant positions. More than 87% of respondents indicated that the presence and development of these skills is at least as important as professional knowledge and technical competencies. Employers emphasized that even highly qualified specialists may experience difficulties in adapting to the work process and advancing in their careers.

The survey identified the most essential soft skills that, according to respondents, modern specialists should possess. Among them, teamwork skills, creativity, critical thinking, problem -solving abilities, and emotional intelligence were highlighted as the key qualities (Figure 1).

Figure 1

Soft Skills Identified as Most In-Demand in the Modern Labor Market



Employers also pointed out the most problematic soft skills, insufficient development of which becomes a barrier to employment for graduates. Among the problem areas, respondents noted the inability of employees to work efficiently and productively in a team, a low level of critical thinking and poorly developed emotional intelligence.

Moreover, the comparative analysis conducted in this study reveals that the prioritization of specific soft skills varies across industries. In the field of information technology, employers value critical thinking, problem-solving abilities, and creativity, as these competencies are essential for operating in a rapidly evolving environment that demands innovative approaches and unconventional solutions. By contrast, teamwork skills and emotional intelligence are of primary importance in the industrial and agricultural sectors, where effective collaboration and adaptation to industry-specific working conditions are crucial.

In the trade sector, communication skills and problem-solving abilities are the sought-after, as success in these fields relies heavily on customer orientation and the ability to respond swiftly to emerging challenges. In education and the public sector, creativity, problem-solving skills, and emotional intelligence are regarded as key competencies, as these qualities enhance pedagogical effectiveness and facilitate decision-making in high-responsibility contexts.

Considering the identified trends, this study developed a universal model of psychological and pedagogical guidance aimed at fostering the most in-demand soft skills among university students. This model integrates general labor market requirements with industry-specific characteristics, ensuring a systematic approach to the development of key competencies such as teamwork skills, critical thinking, problem-solving abilities, creativity, and emotional intelligence. Its implementation will facilitate the creation of a flexible educational environment that prepares specialists capable of effectively adapting to

professional challenges, working across various sectors, and successfully integrating into modern socioeconomic conditions.

The proposed model comprises several key components that encompass the main aspects of psychological and pedagogical guidance, considering modern educational requirements: the target, methodological, diagnostic, content, organizational, and result-oriented components (Figure 2).

Figure 2

Model of Psychological and Pedagogical Guidance for Soft Skills Development in University Students

TARGET COMPONENT

Goal:
to develop key soft skills in university students through systematic psychological and pedagogical guidance aimed at enhancing their professional competitiveness, personal resilience, and social adaptation in the context of rapidly changing labor market.

Objectives:
- diagnosis and analysis of the level of soft skills development among university students;
- creation and implementation of psychological and pedagogical guidance programs;
- development of key soft skills;
- assessment and adjustment of the dynamics of soft skills development.

METHODOLOGICAL COMPONENT

Principles: *systematicity and consistency, collaboration, personalization.*
Approaches: *personal-oriented, systematic, activity-based.*

DIAGNOSTIC COMPONENT

Soft skills Components				
Teamwork	**Creativity**	**Critical Thinking**	**Complex Problem-Solving**	**Emotional Intelligence**
Diagnostic Tools				
Group Project Method	Torrance Test of Creative Thinking, adapted by E. E. Tunik	Critical Thinking Test by Starkey, adapted by E. L. Lutsenko	Case Method	Emotional Intelligence Test by N. Hall, adapted by E. I. Ilyin

CONTENT COMPONENT

Professional Development Course for University Stuff aimed at equipping them with the necessary knowledge and tools for the successful development of soft skills in university students.	Comprehensive Program For the Development of Soft Skills in University Students aimed at enhancing their competitiveness and successful adaptation in the labor market.

ORGANIZATIONAL COMPONENT

Psychological and Pedagogical Conditions: the creation of a supportive educational environment that fosters the development of soft skills through regular feedback and motivation for self-development; conducting trainings and consultations aimed at developing emotional resilience, communication skills, and self-organization abilities; the use of reflective practices and situational tasks to develop critical thinking and confidence in decision-making.

Forms:	Methods:	Tools:
- individual and group consultations; - training sessions; - psychological workshops; - seminars and master classes; - reflective sessions; - discussion clubs; - extracurricular activities.	- case study method; - reflective method; - project-based method; - role-playing method; - training method; - coaching; - mentoring; - active and interactive learning methods.	- diagnostic tools; - educational platforms and digital tools; - presentation materials, video content; - visualization tools (diagrams, maps, tables); - interactive whiteboards, flip charts, handouts; - reflection and personal development journals.

RESULT–ORIENTED COMPONENT

Teamwork: effectively interacts, distributes tasks, motivates, and supports colleagues.
Creativity: ability to generate original ideas, find unconventional approaches to problem-solving, demonstrate flexible thinking, and combine various concepts and methods to create innovative solutions.
Critical Thinking: ability to analyze information, identify logical connections, and make well-reasoned decisions. Capable of detecting contradictions, assessing the reliability of sources, and determining the strengths and weaknesses of proposed solutions.
Complex Problem Solving: identifies key issues, generates possible solutions, and selects the most optimal ones. Applies a systematic approach to analysis and problem-solving, considering risks and potential consequences.
Emotional Intelligence: recognizes and manages emotions, understands the feelings of others, and creates a positive atmosphere.

The target component defines strategic priorities and key objectives for the development of soft skills among university students. It establishes the conceptual foundation of the model, ensuring a structured approach for integrating soft skills into the educational process. The primary goal is to develop students' essential soft skills through a systematic psychological and pedagogical guidance framework, enhancing their professional competitiveness, personal resilience, and social adaptability in a rapidly evolving labor market.

To achieve this goal, the model includes the following key objectives:

- diagnostic assessment of students current soft skills proficiency;
- design and implementation of psychological and pedagogical programs for targeted skills development;
- creation of an engaging learning environment that encourages active student participation in skill-building activities;
- continuous evaluation and adaptation of educational practices.

The methodological component establishes the principles and approaches that ensure a structured, effective, and holistic process for developing soft skills among university students. This is based on the following three fundamental principles:

- systematicity and consistency – a step-by-step approach that begins with diagnosing students' initial skill levels, followed by targeted interventions, and concluding with performance evaluation;
- collaboration – emphasizing interaction among students, faculty, and other stakeholders to foster teamwork, communication, and self-management abilities;
- personalization – adapting the learning process to students' individual characteristics, motives, and competencies, thereby maximizing their personal and professional potential.

Three methodological approaches were integrated to ensure a scientifically grounded and practically applicable model:

- personality-oriented approach focuses on individualized learning trajectories, catering to students' abilities and motivation to enhance soft skills development;

- systematic approach embeds soft skills within both formal curricula and extracurricular activities, ensuring a cohesive educational framework that combines theoretical and practical learning;

- the activity-based approach prioritizes hands-on learning through active methodologies such as project-based work, case studies, and role-playing exercises. This approach immerses students in real-world problem-solving, improving adaptability, decision-making, and innovative thinking.

The diagnostic component. To ensure an evidence-based approach, the model included a robust diagnostic system designed to assess students' soft skills development over time. This system uses diverse assessment tools to provide comprehensive evaluations:

- Teamwork skills were assessed using the Group Project Method, which evaluates collaboration, role distribution, and communication efficiency.
- Creativity was measured using the Torrance Creative Thinking Test (adapted by E. E. Tunik), which assesses originality, flexibility, and problem-solving creativity.
- Critical thinking was evaluated using the Starkey Critical Thinking Test (adapted by E. L. Lutsenko), which assesses analytical reasoning and logical consistency.
- Complex problem-solving skills are analyzed using the Case Method, which involves real-world scenarios requiring strategic decision-making.
- Emotional intelligence was assessed using the N. Hall Emotional Intelligence Test (adapted by E. I. Ilyin), which measures self-awareness, emotion regulation, and empathy (Uaikhanova et al., 2024).

The content component. The model includes two integrated development programs:

1. A professional development program for university staff, equipping educators with innovative methodologies to foster soft skills in students.
2. A student soft skills development program integrating targeted skills training into the academic curriculum.

Table 1 outlines the structure of these programs.

Table 1

Structural and Content Characteristics of Soft Skills Development Programs for University Faculty and Students

No.	Aspect	Professional Development Program for University Stuff	A Student Soft Skills Development Program
1	Target Audience	University Faculty Members	University Students
2	Program Goal	Training teachers in effective methods for fostering soft skills among students	Enhancing students' key soft skills for professional success
3	Main Modules	- Innovative strategies for soft skills development - Active learning methodologies (case studies, project-based learning, role-playing) - Tools for diagnosing and monitoring soft skills growth - Effective mentoring and coaching techniques	- Teamwork Skills - Creativity - Critical Thinking - Complex Problem-Solving - Emotional Intelligence
4	Expected Results	- Enhancing faculty competencies in soft skills education - A more supportive learning environment	- Strengthened soft skills in students - Increased adaptability to labor market demands - Enhanced career competitiveness

The organizational component. To facilitate a structured approach to soft skill development, the model includes various methods and tools:

- Teaching Forms – seminars, masterclasses, discussion clubs, reflective sessions, etc.
- Teaching Methods – case studies, coaching, project-based learning, role-playing, etc.
- Learning Tools – diagnostic instruments, digital platforms, interactive whiteboards, reflection journals, etc.

By combining these elements, the model fostered an educational environment conducive to the development of holistic soft skills.

The result-oriented component. The final component of the model focuses on measuring progress and refining educational strategies. Key indicators include:

- improvements in students' soft skills proficiency measured through longitudinal assessments;
- increased graduate employability, tracked via employer feedback and alumni career progression;
- sustained faculty engagement assessed through participation in soft skills training initiatives.

By ensuring a structured implementation and evaluation process, the model provides a scalable framework adaptable to diverse higher education settings. It supports universities in preparing graduates who are not only knowledgeable in their respective fields, but also equipped with the essential soft skills required for professional success.

Conclusions

The proposed model of psychological and pedagogical guidance for the development of soft skills in university students represents an integrated system that combines theoretical and practical methods aimed at the effective development of soft skills within the educational environment. The model emphasizes the importance of not only targeted work with students but also the professional development of university staff, creating favorable conditions for the development of sustainable skills in students.

The implementation of this model in the educational environment of universities contributes to the comprehensive development of key soft skills, such as the ability to work in a team, creativity, critical thinking, the ability to solve complex problems and emotional intelligence. The implementation of the model opens up prospects for increasing the competitiveness of graduates in the labor market, strengthening their professional competencies, and readiness to effectively cope with the challenges of the modern world.

In the future, the proposed model should be piloted within the educational process of universities to assess its effectiveness and identify potential areas for improvement. To ensure effective implementation and assessment of the proposed model, a step-by-step plan was developed, including the following key stages:

1. *Diagnostic Stage.* This stage involves determining the initial level of soft skills development among university students.
2. *Design and* Implementation of Psychological and Pedagogical Support Programs. At this stage, educational strategies are developed and introduced to foster the most in-demand soft skills. The main activities include the following:

- Preparing faculty members for the application of active and innovative teaching methods;
- Developing and integrating new educational modules into the curriculum;
- Creating conditions for active student engagement in the process of soft skills development.

These programs are designed considering modern pedagogical approaches and specific features of the university’s educational environment.

3. *Monitoring and Evaluation of Effectiveness.* A system of regular monitoring was established to assess the outcomes of model implementation. The key assessment tools include the following:

- Retesting students to track their progress;
- Analyzing the dynamics of changes in the development of key soft skills;
- Conducting surveys of students and faculty to collect feedback.

Based on the results, adjustments to the methods and educational programs were made as needed.

4. *Institutionalization of the Model in the Higher Education System.* In the final stage, the model was integrated into the university's educational process at the institutional level. This includes:

- Developing methodological recommendations for embedding soft skills into academic programs;
- Preparing training materials for faculty members;
- Organizing seminars and training sessions for university staff;
- Disseminating best practices among the academic community.

This stage ensured the sustainability of the developed model and its adaptation to long-term educational strategies.

The presented model of psychological and pedagogical guidance for the development of soft skills among university students represents an integrated system that combines theoretical and practical methods aimed at fostering these competencies in the educational environment. The model emphasizes not only targeted work with students but also the professional development of university faculty, creating favorable conditions for the sustainable formation of soft skills among students.

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Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Meruyert Uaikhanova: Software, Validation, Formal analysis, Supervision, Murat Pshembayev: Conceptualization, Methodology, Writing - Original Draft, Project administration, Funding acquisition, Anara Khaimuldina: Investigation, Visualization, Resources, Khanat Kassenov: Data curation, Writing - Review & Editing

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LEARNING MOTIVATION AS AN INDICATOR AND CONDITION OF LEARNERS' PSYCHOLOGICAL WELL-BEING

Abstract: The article presents the relationship between learning motivation and psychological well-being of learners. Despite the wide range of works devoted to the study of learning motivation and psychological well-being of learners, the mechanisms of their mutual influence in the educational environment are not fully understood. In particular, comprehensive models of pedagogical design that take into account the two-way relationship of these phenomena have not been sufficiently developed. Learning motivation is analyzed by authors as an indicator and condition of learners' psychological well-being in the context of various theories of psychological well-being, including self-determination theory, positive psychology, humanistic theory, expectancy and value theories, and others. Unlike most existing works, the authors emphasize the importance of considering the two-way relationship between learning motivation and learners' psychological well-being in the pedagogical design of educational environments and propose practice-oriented principles of pedagogical design of educational environment aimed at creating conditions that stimulate intrinsic motivation, supporting learning activity and ensuring psychological comfort of learning. These include the individualization and support autonomy, relevance of learning outcomes, positive interaction, integration of engagement technologies into learning, ethical assessment and feedback, development of self-regulation skills and emotional stability.

Key words: learning motivation, psychological well-being, educational environment, instructional design, learners.

Introduction

The modern education system is increasingly focused not only on high educational outcomes for learners, but also on ensuring psychological well-being within the learning process. In pedagogy, researchers discuss the safety of the educational environment and its impact on the psychological well-being of participants in the learning process (Tuseyev et al, 2022).

This shift in emphasis reflects the growing importance of integrating psychological and pedagogical approaches to create conditions for harmonious personal development, and emphasizes the need to study the factors in the educational environment that affect the state of learners and to develop pedagogical support strategies.

Among the factors that determine the psychological well-being of learners, the motivation to learn is directly or indirectly considered. Under the conditions of digitalization, the rapid growth of information flows and the active influence of social networks, motivational mechanisms are undergoing changes. An example of the positive impact of digitalization on learning motivation is the personalization of learning, the use of digital technologies to increase engagement, access to educational resources, and quick feedback. Among the negative aspects of the impact of digitalization on learning motivation, one should single out a decrease in concentration against the background of rapid information consumption, dependence on external stimuli, a frightening increase in the flow of information, as well as problems with self-regulation in learning. All this requires understanding the structure of educational motivation and the tools for improving it in the modern educational process. All this requires

understanding the structure of educational motivation and the tools for improving it in the modern educational process.

In a broad sense, summarizing the views of different authors, learning motivation is a set of factors, conditions and motives that focus on different aspects of learning activity and act as an internal resource that initiates, directs and supports the learner's activity.

Despite the key role of learning motivation in achieving academic success and forming the basis for personal fulfilment, its importance in the learning process is often underestimated by educators. In addition, it is difficult to overestimate the influence that educators have on learners' motivation to learn through teaching methods, communication styles and personality traits, both stimulating and diminishing it. Awareness of the mechanisms of the impact of types and aspects of learning motivation on the learning process allows teachers to develop effective strategies to support and accompany the psychological well-being of learners who are experiencing learning difficulties, as well as those who are ahead of them.

Motivation to learn in the context of psychological well-being and personality development of learners of different ages is actively researched in the field of educational psychology.

Kulagina and Kravtsova (2022) note that junior school learners with a high level of psychological well-being are characterized by “cognitive motivation, motivation for self-development, awareness of the importance of learning activities for themselves and orientation to high performance”. Junior school learners with a low level of psychological well-being have an expressed external motivation to learn, which reflects “teacher's demands, subjective perception of learning difficulties, negative attitude to learning, pre-school type motivation”.

In the structure of psychological well-being of adolescents Vodyaha (2014) defines “satisfaction with relations with friends, parents, teachers, school and self-relationship”. The author, as a result of the conducted research, determines the differences between externally and internally motivated adolescent learners. Adolescents with high levels of self-determination are intrinsically motivated, independent of social conditions such as the prestige or utility of the activity. Learners choose their own goals and values, which makes their motivation autonomous and self-determined, focused on the enjoyment of the process of completing learning tasks. However, the author notes that self-determined adolescents are more likely to be less satisfied with the school environment, relationships with teachers and their own identity. The author suggests that this is due to the preference for extrinsic motivation (high grades, praise, diplomas, pressure) in traditional pedagogical practices. On this basis, intrinsically motivated learners experience psychological discomfort in the context of traditional pedagogical approaches.

Grassinger and colleagues (2024), investigating the relationship between subjective well-being and learners' intrinsic motivation, note that these concepts directly influence each other. Thus, “intrinsically motivated learners feel good at school because of positive emotions and the desire to understand the content of learning, which is an integral part of intrinsic motivation”.

The results of a comparative study of teacher support for learners in the pre-professional development stage showed that teachers who provide care and support, giving learners opportunities for choice and independent decision making, promote autonomous learning motivation and positive emotions in the educational environment, which supports their psychological well-being (Egorenko, 2019).

Researcher Gordeeva (2014) and her colleagues also note a positive correlation between the level of psychological well-being of learners and their intrinsic motivation, based on interest and enjoyment of the learning process.

At the higher education level, authors investigate the relationship between psychological well-being and learners' self-organization and motivation, the relationship between learning

motivation, engagement, self-criticism and learners' compassion for themselves (Kotera et al., 2023).

Highly motivated learners actively participate in academic activities and demonstrate well-being. Reducing self-criticism and increasing self-compassion (positive attitude towards oneself as a factor of psychological well-being) contributes to the transition from extrinsic to intrinsic motivation.

The development of pedagogical strategies aimed at creating a psychologically healthy educational environment and supporting the learning motivation of learners of different ages is a broad area of research. Learners of different ages have peculiarities of perception of learning motivation, its types, namely the prevalence of external or internal motives, as well as groups of factors of dynamics of learning motivation.

Methods and organization of the study

The aim of the study was to analyze the relationship between motivation to learn and psychological well-being of learners, with the subsequent definition of key principles of pedagogical design of the educational environment, contributing to the maintenance of motivation to learn among learners as a condition and indicator of their psychological well-being.

The following methods were used in the study: theoretical analysis of scientific and psychological-pedagogical literature related to the research problem, in particular, analysis of existing theories of psychological well-being and personality development; analysis of modern publications related to the research subject; methods of qualitative data collection based on text analysis, interpretation of scientific sources; comparative analysis of concepts and approaches to the problem under study; as well as methods of generalization and systematization of data obtained as a result of empirical observations.

The results of the study and their discussion

The study examined and interpreted learning motivation within the following theories of psychological well-being and personality development in terms of different approaches to understanding personality, needs and learning processes.

1. Theory of self-determination (Deci & Ryan, 2000). The theory emphasizes the role of intrinsic motivation and needs for autonomy, competence, and social acceptance as key determinants of a person's behavior and psychological well-being. Motivation becomes more stable and effective when activities are perceived as voluntary and conscious choices consistent with personal interests and values.
2. Positive Psychology (Seligman, 2009) The theory focuses on the study of factors that promote human worthiness, happiness and psychological well-being. It explores aspects such as optimism, resilience to stress, gratitude, and a sense of meaning in life in order to identify strategies that help people realize their potential and achieve life satisfaction.
3. Theory of Attribution (Heider, 1958; Weiner, 1974) The theory explains how people interpret the reasons for their successes and failures, attributing them to internal (ability, effort) or external factors (task difficulty, luck). These explanations influence motivation, emotions, and subsequent behavior, determining a person's future efforts in similar situations.
4. Cognitive dissonance theory (Festinger, 1957) The theory describes the psychological discomfort that arises when there is a contradiction between an individual's beliefs, attitudes, and behavior. To reduce this dissonance, the individual seeks to change his or her behavior or cognitive attitudes, which promotes internal consistency and psychological balance.
5. Expectancy and Value Theory (Eccles & Wigfield, 2002). The theory posits that motivation to perform depends on two key factors: expectations about the likelihood of success

and the subjective value he or she places on the task at hand. High expectations for success with high goal value stimulate activity and persistence in the individual.

6. Flow Concept (Csikszentmihalyi, 1990). The concept of flow describes a state of total immersion in an activity when a person experiences high levels of concentration, satisfaction, and engagement. Flow occurs when there is an optimal balance between the complexity of the task and the level of personal skills, which promotes maximum productivity and intrinsic motivation.

7. Social cognitive theory of personality (Bandura, 1990) The theory emphasizes the mutual influence of personal factors, behavior, and environment (the principle of interdependence). A key role in motivation is played by self-efficacy as a belief in one's ability to successfully cope with tasks, which determines the level of effort and persistence in achieving goals.

The theories presented encompass learning motivation, emphasizing different aspects but with common overlaps. The unifying element of all the theories is the assertion of cognitive mechanisms at the core of learning motivation, where the learner analyses his/her abilities, assesses the complexity of learning tasks, and the influence of environmental factors on learning and goal attainment (Table 1).

Table 1

Learning motivation as conceptualized in modern theories of psychological well-being and personality development

Theory	Relation to learning motivation
Theory of self-determination (E.L. Deci & R.M. Ryan)	Learning motivation is the result of basic psychological needs being met: the learner is able to choose or influence the learning process (autonomy); positive outcomes and feedback increase the desire to continue learning (competence); and the learner feels part of a community (relatedness to others).
Positive Psychology (M. Seligman)	Learning motivation is enhanced when learning is seen as a way of achieving meaning, discovering strengths and enjoying the process.
Theory of Attribution (F. Heider, B. Weiner)	When a learner considers success to be the result of his or her own efforts (intrinsic factors), motivation to learn increases. When failure is explained by uncontrollable (external) factors, motivation to learn decreases.
Cognitive dissonance theory (L. Festinger)	Learning motivation can be caused by the desire to resolve the contradiction between the knowledge of the need for knowledge and the lack of skills. Cognitive dissonance motivates, leads to a change in attitude and later to a change in the learner's behavior.
Expectancy and Value Theory (J. Eccles & A. Wigfield)	A learner is motivated when he/she is success-orientated, believes he/she can succeed (expectation of individual success), is guided by positive values, considers the task useful and valuable (value of performing an action).
Flow Concept (M. Csikszentmihalyi)	Learning motivation occurs in a state of “flow”, characterized by maximum engagement and autonomous satisfaction with learning activities when tasks are neither too easy (boredom) nor too difficult (anxiety).
Social cognitive theory of personality (A. Bandura)	Learning motivation is determined by belief in self-efficacy and interaction with the environment. Confidence in one's own ability to complete tasks increases motivation to learn, observation of successful peers (modelling) motivates imitation and success, and environmental support increases motivation to learn.

Each of the theories reviewed reveals different aspects of the overall picture and provides a unique perspective on learning motivation as a condition and indicator of learners' psychological well-being. The theory of self-determination (Deci & Ryan, 2000) most emphasizes the role of intrinsic motivation, finds confirmation in empirical studies. However,

it may not take into account individual differences in needs, as well as the influence of cultural and social factors. Positive Psychology (Seligman, 2009) focuses on the development of sustainable motivation through positive emotions, and less on cognitive processes. Attribution theory explains the reasons for the formation of stable motivation, allows students to adjust attributions to increase their motivation, but does not take into account the emotional factors influencing the explanation of events (Heider, 1958; Weiner, 1974). Cognitive dissonance theory (Festinger, 1957) shows how motivation arises in a situation of knowledge conflict, but does not take into account individual differences in tolerance for dissonance between beliefs and actions. The theory of expectations and values explains individual differences in learning motivation, allows predicting behavior in learning activities, but also does not take into account emotional factors (Eccles & Wigfield, 2002). The flow concept (Csikszentmihalyi, 1990) describes optimal states of productivity, a balance of complexity and competence, but does not take into account the complexity of calling a "flow" in the traditional education system. Socio-cognitive theory of personality (Bandura, 1990) takes into account the social environment as a motivation factor, which is very important, but does not pay enough attention to the internal motives of learning, which makes it weaker against the background of other theories.

Involvement, activity and satisfaction, which are characteristic of high learning motivation, change the learning environment and turn it into a basis for learners' self-realization. In the case of passivity, uncertainty, insecurity, there is a tendency to avoid learning activities, the emergence of destructive forms of learning behavior.

As a condition of psychological well-being, learning motivation manifests itself as the presence of intrinsic motivation and contributes to the satisfaction of basic needs for autonomy, competence and relatedness to other people, which directly affects emotional stability in learning, reducing academic stress and anxiety during the study period. Developed and sustained learning motivation contributes to learners' awareness, content and subjective sense of life satisfaction.

A high level of motivation to learn should also be seen as an indicator of psychological well-being. Learners who experience positive emotions and feel supported in the educational environment are more likely to be curious, interested, engaged and active in learning. A sense of self-efficacy, as a belief in one's own abilities, increases learners' intrinsic learning motivation. Conversely, high levels of academic stress and anxiety reduce attention and learning ability, leading to amotivation. Low levels of learning motivation may indicate the presence of internal problems in learners, which may include anxiety and burnout.

Learning motivation is largely determined by the quality of the learner's interaction with the educational environment and its participants, which makes its study and the search for effective approaches to its pedagogical design a priority for educational science. Each of the considered theories emphasizes the possibility of creating certain conditions in the educational environment that support learners' motivation to learn. Understanding the implementation of the mechanisms of the considered theories in the pedagogical design of the educational environment will contribute to the psychological well-being of learners at different levels of education.

We believe that pedagogical design of the educational environment is a process of designing and organising learning spaces and technologies for achieving educational and psychological goals. This process includes not only the content of learning, but also the creation of conditions that promote learning motivation, engagement and maintenance of emotional and psychological health of learners (Gagne et al., 2005).

Among the existing approaches to the design of the educational environment within the framework of the research problem, we can highlight the ARCS theory of motivational design (Attention, Relevance, Confidence, Satisfaction), which focuses on maintaining learners'

motivation to learn by increasing their self-confidence and the relevance of the learning material (Keller, 2010).

The conducted analysis allows us to identify the principles of motivational design of the educational environment that contribute to the maintenance of learning motivation as a condition and indicator of psychological well-being (Table 2).

Table 2.

Principles of motivational design of the educational environment for psychological well-being

Principle	*Content*
Individualization and support for autonomy	*The ability to choose and control one's own learning, the possibility of self-testing, a differentiated approach.* *For example, when completing assignments, students can choose a written or oral format for completing them, as well as special conditions for completing them in the form of choosing a partner and deadline, which gives them a sense of control.*
Relevance of learning outcomes	*The applicability of acquired knowledge and skills, the understanding of their value and future applicability contributes to the development of intrinsic motivation and increases self-efficacy and competence, which reduces anxiety and increases self-confidence.* *For example, a more motivating learning outcome for future teachers will not be mastery of the theoretical principles of didactics and definitions, but rather the acquisition of skills in developing and conducting lessons and applying learning technologies in practice.*
Positive interaction	*Positive interaction, group work, opportunity to share knowledge and experience, support from teachers reduces academic stress, increase sense of belonging; feasibility of tasks provides opportunity for self-fulfillment.* *For example, when performing a difficult task, the teacher suggests performing it in groups in stages, which gives a sense of support and eliminates fear, self-doubt or aggressiveness against the background of feelings of incompetence.*
Integration of engagement technologies into learning	*The use of interactive elements (gamification) in teaching the digital generation of learners reduces learning overload, increases learning motivation and learning satisfaction.* *For example, using additional points for each added term in the glossary of a subject, provided that its meaning is understood, will relieve students from fatigue during a "boring" type of activity.*
Ethical evaluation and feedback	*An assessment system that focuses not only on results but also on learning progress reduces self-confidence, supportive feedback motivates changes in learning behavior, and creates a positive attitude towards the educational environment.* *For example, the "silent" awarding of points to an electronic journal without discussion and feedback causes students to doubt their abilities, anxiety and reduces learning motivation.*
Development of self-regulation skills and emotional stability	*Positive emotions develop cognitive and social resources that contribute to the correct response to failures, feedback; the ability to set goals and plan learning activities, to reflect on the process and the outcome contributes to the development of metacognition as pillars of learning motivation and the growth of psychological well-being in general.* *For example, analyzing mistakes through positive feedback from a teacher after students fail a test develops reflection skills, forms a healthy attitude towards failures as part of learning and opportunities for growth and planning of their further educational activities, which reduces academic stress.*

Based on the analysis of theories and research and design of ARCS, as well as the results of empirical observation of students in schools in Karaganda, a number of recommendations should be given for motivational design of educational environment. Two key aspects that have a complex influence on learners' motivation to learn: pedagogical and psychological.

Pedagogical includes a number of components directly related to the organization of the learning process. Clearly articulated learning outcomes play an important role. Their clarity and significance for the learners will show the practical value of the acquired skills and, accordingly, of the tasks performed in the course of the training (Theory of expectations and values). The applicability of the acquired knowledge and skills supports the learner's sense of competence and increases intrinsic motivation (Self-determination theory). Effective teaching methodology, selection of optimal pedagogical approaches, use of modern teaching technologies creates conditions for increasing learners' interest and involvement. Such conditions allow them to immerse themselves in the learning process with a high level of concentration and enjoyment in doing the tasks (Stream concept). The pedagogical side provides for a variety of forms and methods of learning that allow their individual educational needs and abilities to be taken into account and realized in interaction with others in a cooperative environment. As empirical observations show, the importance of behavioral modelling and mutual interaction between teacher and learners contributes to the formation of self-control and self-efficacy in learners (Social-cognitive theory of personality, Self-determination theory). When determining the impact of the assessment system on learning motivation, it is necessary to highlight its important components: transparent assessment criteria, fairness, objectivity, effective feedback create an adequate perception of the reasons for success or failure, confidence and control over one's own results (Attribution theory), a sense of competence (Self-determination theory). An important element is the organization of the learning environment, including the digital one. The availability of resources and supportive infrastructure contributes to the creation of a favorable learning environment, which increases the well-being and satisfaction of learners.

The psychological side of learning reflects the factors that influence the emotional state and internal motivation of learners. One of the most important elements is the quality of communication between the participants in the educational process. Supportive and open communication helps to create an atmosphere of trust, reduces the level of academic stress and creates a sense of belonging to the educational community (Social Cognitive Theory of Personality, Self-Determination Theory). A sense of achievement and a situation of self-fulfillment build sustainable motivation to learn. Regular opportunities for learners to demonstrate their achievements, self-assessment to monitor personal progress and development, and teacher recognition of learners' efforts build self-confidence. The observations also indicated a long-lasting sense of satisfaction from the learning process, which arises under the influence of positive reinforcement of students' achievements in the form of feedback (Flow concept). Self-actualization of the learner, combined with the possibility of choice and autonomy in learning, increases the learner's personal interest and responsibility for learning outcomes, which is an indicator of intrinsic motivation to learn (Self-determination theory). An equally important aspect of the psychological side of learning is the teacher's personality and style of interaction with learners. A teacher who is passionate about teaching and shows respect and attention to the individuality of the learners creates a motivating educational environment. Applying an empathy-based approach creates a positive learning environment that allows for the experience of positive emotions and supportive interpersonal relationships (Positive psychology).

Respecting the principles of pedagogical design makes it motivating and allows learners to achieve a higher level of psychological well-being.

The results obtained can be useful to the administration, teachers and the psychological service to develop measures aimed at increasing the learning motivation of learners.

Conclusions

The analysis of the relationship between educational motivation and psychological well-being of students allowed us to formulate a number of key conclusions.

A learner's psychological well-being is characterized by harmony of mental processes and functions, a sense of inner integrity and emotional balance. Learning motivation is recognized as a key factor in academic success and well-being in educational settings. Learning motivation in learners of different ages can be viewed multidimensionally in different theories of psychological well-being and personality development as a desire for self-realization, a result of the satisfaction of basic psychological needs, a way of achieving pleasure and meaning, a response to expectations and values, a desire to resolve cognitive conflicts, a result of engaging in meaningful activities, a balance of belief in success and the significance of the outcome of learning, a result of perceiving the causes of both success and failure, and a state of full engagement. Satisfaction with interpersonal relationships, the possibility of receiving positive emotions from communication and the learning process, the satisfaction of the need for emotional support contribute to the growth of learning motivation and the strengthening of the psychological well-being of the learner.

Learning motivation is not only a factor in the successful development of an educational program, but also a significant indicator of the psychological well-being of students. A high level of motivation to learn is associated with satisfaction with the educational process, positive self-esteem and emotional stability. Psychological well-being, in turn, affects the sustainability of learning motivation. A favorable educational environment, support from teachers and classmates, as well as the ability to independently choose learning strategies contribute to the formation of internal motivation and reduce learning stress. Decrease in learning motivation can occur in conditions of frustration, tension in relations in the educational environment, monotonous learning activities, inability to apply knowledge and skills for realization of life plans, inaccessibility of educational resources and conditions for learning, lack of clear learning goals and other negative circumstances violating psychological well-being of learners.

The formation of an educational environment that supports learning motivation requires compliance with a number of key principles of pedagogical design. It is important to consider the reciprocal relationship between learning motivation and learners' psychological well-being in the pedagogical design of educational environments. Pedagogical design of educational environments is an integrated approach that combines pedagogical, psychological, physical and technological solutions to create a motivating and supportive educational environment.

This study highlights the importance of learning motivation as a key factor in the psychological well-being of learners. The contribution of the research is to systematize existing theories and identify their relationship with the pedagogical design of the educational environment, expand the empirical base by analyzing modern research on the impact of learning motivation on the psychological well-being of learners, as well as propose principles of pedagogical design aimed at supporting internal learning motivation and psychological well-being of learners. Future research directions may include the development of an experimental model of the "Modern Learning Environment" educational environment, the testing of various pedagogical strategies for maintaining the psychological well-being of participants in the educational process, as well as the study of the influence of cultural characteristics on the perception of learning motivation and emotional comfort. The analyses carried out are limited to a few theories and can be extended in future research. The limitations of the study are related to the lack of longitudinal data, which makes it difficult to assess the long-term impact of the proposed pedagogical strategies. In the future, it is possible to conduct long-term studies

analyzing the dynamics of learning motivation and its impact on the psychological well-being of learners. The correlation indicator will be covered in more detail in future research on this topic.

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SYLLABUS DEVELOPMENT FOR TEACHER INPUT IN STUDENT-CENTERED LEARNING

Abstract: Modern didactic practice called Student-Centered Learning (SCL) promotes a learning process that is flexible, adaptable to individual student needs. This paper offers an examination of general education cycle discipline syllabi within the framework of SCL, focusing on the customization of syllabi to meet student needs and tracing their developmental trajectory. Employing both bibliographic and content analysis methodologies, this study illuminates the distinctive features and evolutionary patterns of SCL syllabi. Notably, it identifies a wide array of assignment formats and types evident in syllabi sourced from the Department of General Education Disciplines. The syllabi are a key document in discipline-based teaching, regarding instructions, course content, and student teaching and learning dynamics. The findings of the study help deepen our comprehension of syllabus evolution within the SCL paradigm and provide valuable insights for educational practitioners and curriculum developers.

Key words: student-centered learning, teacher input, a syllabus design, student engagement, meaningful learning, learning outcomes.

Introduction

Considering student-centered learning in syllabus development is essential, particularly in the era of Industry 4.0, where higher education is undergoing significant transformations through the integration of digital technologies. This shift is evident in the use of online resources, hybrid teaching approaches, assessment systems, and the incorporation of artificial intelligence and virtual reality. A key aspect of this transformation is syllabus development for teacher input in student-centered learning, which ensures how educators contribute to shaping the learning experience through a student-centered syllabus. The emphasis on student-centered education, where individualized programs and active student engagement in the learning process have become foundational to modern education.

Syllabi serve as essential tools that guide both instructors and students, outlining course policies, the achievement of learning outcomes, and competence development within a given course. At the end of each academic year, the Department of General Education Discipline cycle (hereinafter - GEDC) at Astana IT University (hereinafter - AITU) reviews the syllabi based on instructor feedback, student feedback, and students' performance, including failures and achievements. Despite these efforts, the development of syllabi remains a critical aspect that needs deeper examination, particularly in terms of how effectively it provides guidance for both instructors and students from the perspective of student-centered learning.

This paradigm shift in higher education towards student-centered learning prioritizes learner needs and experiences over teacher input in the educational process. This shift is closely examined in the syllabus design of GEDC at AITU. The development of course syllabi at AITU follows guidelines outlined in internal documents, educational program curriculums, national qualification frameworks, and other related official documents. The annual review of the GEDC syllabi is also necessary to address student needs and learning experiences, assess the

availability of educational resources, evaluate labor market demands, and consider time constraints for both students and teachers.

The syllabi for the GEDC, designed for future IT specialists, aim to delineate course content, learning activities, assignments, and grading policies in a manner that prioritizes student-centered learning experiences over traditional teacher-centered approaches. Still, of course, the reality is that student responses to these new approaches are not equal. Some students adapt to this style eagerly and show positive results in learning outcomes and evaluations; and other students struggle with time management and thus may do poorly, or even fail the course. These latter students find the shift in responsibility within the learning process to be a serious challenge. For instructors and administrators, it is essential to constructively align the various components of the course according to individual student needs, thereby offering all students the best opportunity to successfully navigate the program within this new educational paradigm. This approach aims to shift the focus of students from merely achieving grades to maintaining their stipend, towards prioritizing the learning experience and academic achievement. Considering the goals of higher education such as developing student skills and abilities, developing critical thinking, the ability to analyze and synthesize information, problem-solving skills, effective communication, and the capacity for independent learning and adaptability in changing circumstances, students always find their short-cut way to pass the course examinations.

Literature Review

In contemporary educational discourse, the concept of a "student-centered approach" or student-centered instruction has gained widespread currency, indicating a significant departure from the traditional teacher-centric model. Typically, conventional education focused on the teacher entails the dissemination of knowledge and delivery of information to meet syllabus requirements, often adhering strictly to the prescribed curriculum. Communication tends to be one-way, with limited efforts made to lead to meaningful interaction with students (Astana IT University, 2022).

In this context, students are portrayed as passive recipients of information, consistently instructed on what they must know and do. The possession of knowledge is attributed solely to teachers, leaving students with minimal involvement in its acquisition. This approach frequently impedes students' capacity to take charge of their own learning and engage in independent study (Degago, 2015).

In a student-centered approach, students take on a more active role in shaping their own learning trajectory by identifying promising skills and interests, thus contributing to their becoming sought-after professionals. Learners have diverse needs, interests, and levels of preparation. By considering individual student needs and preferences in curriculum development, it is possible to create a more engaging and stimulating academic environment, which enhances student motivation to learn (Tang, 2023). In this regard, developing syllabi and engaging learners in this process, as well as adjusting parameters based on criteria, is a relevant aspect of educational activities.

Student-centered learning in higher education is an approach aimed at overcoming some of the challenges associated with traditional forms of education. It entails achieving learning outcomes based on the needs of the learner, rather than solely relying on the input of the instructor. According to the European Higher Education Area (Lojdová, 2019), this approach significantly influences the design, flexibility, and interactivity of educational programs, course content, and the overall learning process. Today, this approach is widely used in universities worldwide.

This approach is designed to ensure inclusive learning, especially for those with fewer opportunities to acquire knowledge and skills. For example, students who are concurrently

employed, students of different age groups, etc. In a student-centered approach, the educational process integrates the knowledge, skills, and competencies that are in demand in the labor market. By considering the interests and goals of students, educational programs can be more closely aligned with the requirements of the modern job market, helping graduates to be more competitive.

Students learning through a student-centered approach often develop the ability to analyze their knowledge and skills, assess their professional needs, and set goals for future development. The role of mentoring by instructors in this context is a key factor, as the principle of reflection requires continuous analysis by the instructor of the dynamics and further progress of the learner and the group.

The student-centered approach allows for adapting educational programs and syllabi to the individual needs of each learner, ensuring more effective learning. Thus, the student-centered approach in education enables better preparation of students for the modern job market by providing them with the necessary knowledge, skills, and competencies for a successful professional career.

In 2020, the report Mapping and Analysis of SCLT practices: Usable knowledge to support more inclusive, high-quality higher education (Zerovnik, 2013) was published, examining the student-centered approach from various perspectives. The analysis demonstrated that for the successful implementation of a student-centered teaching and learning ecosystem in universities, the ecosystem must include 10 key elements:

1. Policies, rules, and regulations supporting learner-centered teaching and learning.
2. Learner-centered curriculum and pedagogy.
3. Assessment processes involving learners.
4. Flexible learning methods.
5. Student support.
6. Pedagogical support.
7. Active learning spaces and academic libraries.
8. Learning technology infrastructure.
9. Community learning connections and partnerships.
10. Quality assurance supporting learner-centered teaching and learning.

The report outlines the role of each item, with collective curriculum development playing a dominant role. Course and curriculum development involves processes where responsible instructors determine the expected learning outcomes within the course, how they align and contribute to the overall goals of the curriculum and the diversity of the proposed course, and how these learning outcomes can be achieved through pedagogy and assessment processes.

In efforts to enhance student engagement and empowerment in the learning process, the student-centered approach has gained prominence over the teacher-centered approach. Rooted in constructivism, the student-centered approach posits that learners actively construct meaning by connecting current information with prior knowledge. Unlike the teacher-centered model, which emphasizes knowledge transmission from teachers to students, student-centered learning shifts the focus of knowledge acquisition to the students themselves, thereby entrusting them with the responsibility of acquiring and interpreting information, while teachers serve as facilitators (Astana IT University, 2025). Ideally, students assume control of their learning, shaping the content and trajectory of their educational journey within the student-centered framework. However, in practice, teacher-centered and student-centered approaches are not mutually exclusive but rather represent opposite ends of a spectrum, with various activities existing along the continuum between them. Prior to fully implementing student-centered learning, teachers must progressively facilitate the transition, while also addressing students' preconceptions about learning. This is particularly relevant in regions where deference to authority figures, such as teachers, remains prevalent. Additionally, there exist intermediate

forms of knowledge transmission that go beyond mere adherence to syllabi, involving the presentation of coherent information to students before guiding them through the process of learning and applying and synthesizing knowledge (Tang, 2023).

Research by Richmond and colleagues (Richmond, 2018) indicates that student-centered curriculum plans contribute to improving students' perceptions of teacher effectiveness and strengthening the connection between them. The authors suggest making curriculum plans more student-centered by establishing commonality in the curriculum and providing opportunities for students to collaborate and discuss assignments. It is also necessary to balance power and control between students and teachers by involving students in the development of policies and procedures. Additionally, diverse assessment mechanisms should be developed, and students should be provided with opportunities to revise assignments to create a more dynamic and flexible learning environment.

Over four years, Vlasenko and his colleagues (Vlasenko, 2022) conducted an experiment involving two groups of mathematics graduate students. One group was offered a traditional content-focused curriculum plan for a training research seminar in mathematical analysis, while the second group was provided with a student-oriented curriculum plan developed in accordance with a personalized approach to teaching and learning. Analysis of this experiment's results confirmed the effectiveness of creating a learning environment defined by emotional aspects such as coherence, acceptance, and empathy.

They note that the development of a curriculum plan oriented towards students' needs and interests stimulates their motivation and active participation in the learning process. Such an approach to teaching contributes to the formation of a favorable educational environment in which students feel confident and interested in the course material. They also note that student-centered learning promotes the development of students' personal qualities such as responsibility, autonomy, and self-confidence.

In the development of syllabi and curricula, due consideration must be given to linguistic elements, as they serve as pivotal determinants for student motivation. According to Haiying Liang syllabuses written with a dominant sense of certainty and authority may create unequal power dynamics between teachers and students, potentially hindering participation and critical thinking (Haiying, 2023). To promote learner-centeredness, educators should reflect on syllabus design, fostering inclusive and participatory environments that empower students, enhance autonomy, and encourage critical engagement in their learning process.

For student-centered learning to be successful, it must:

- Be part of the university's academic goal.
- Contribute to changing the culture within the university (Adipat, 2021).

The student-centered approach, including active learning and flexibility, can also be organized only if students take responsibility and initiative and become active participants, and the our university is attempting to provide an environment conducive to SCL approach. To understand to what extend the university faculty is fulfilling SCL designed syllabi, we have the following aims for this study:

- To find out the usage of student-centered learning and its parallel or derivative phrases in scholarly papers related to syllabi design and to find out how the SLC has been evolving in scholarly articles
- How the GEDC syllabi are designed to provide course information
- If the GEDC syllabi reflect student commitment in learning

Research methods

In this study, we employed bibliometric analysis (Sugeng, 2018) of articles using the VOSviewer software and content analysis of syllabi from the general education department at AITU. For the bibliometric analysis we used "Student-oriented learning" ,"Student-centered

learning", "Student-centered approach" ,"Student-centered learning and teaching" in a query string (ALL ("student oriented learning") OR ALL ("student centered learning") OR ALL ("student centered approach") OR ALL ("student centered learning and teaching")) AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "PSYC")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE , "English")). The study results are represented in the visuals of the structure and classification based on the analysis (Gutiérrez-Salcedo et al. 2018). This helps us to see a systematic and comprehensive understanding of the SLC structure, its evolution in the filed of education, identifying the clusters that form divers aspects of this approach, to see trends (Aria and Cuccurullo, 2017; Mukherjee et al., 2022b). We chose the period 1954-2024 as the term first emerged in papers. And we limited our study on issues of article type in English. Our search dates to 16 April 2024.

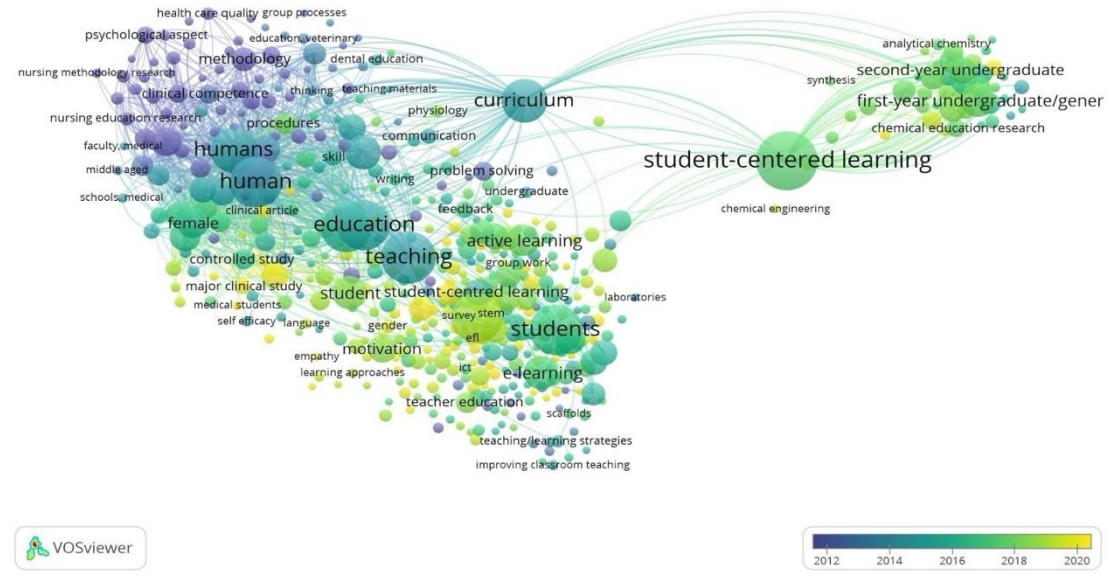
For the syllabus content analysis, we studied GEDC syllabi. We studied each syllabus separately. We excluded comparing or finding any weaknesses or mistakes. We focused on finding out components of the syllabi and the information that address SCL.

Setting

Bibliometric analysis was conducted using the VOSviewer software and this software enables cluster and network analysis of literature relevant to the research subject. To assess the frequency of the term "student-oriented learning" in scholarly works, a sample (n=7737) was collected from the Scopus database (www.scopus.com).

Figure 1

Bibliometric analysis with VosViewer (by year)



The main keywords for the search included "student-oriented learning", "student-centered learning", "student-centered approach", and "student-centered learning and teaching" (the following query was used for analysis: "student-oriented learning", "student-centered

learning", "student-centered approach", "student-centered learning and teaching", as these terms are interchangeable).

Figure 2.
Bibliometric analysis with VosViewer (by claster)

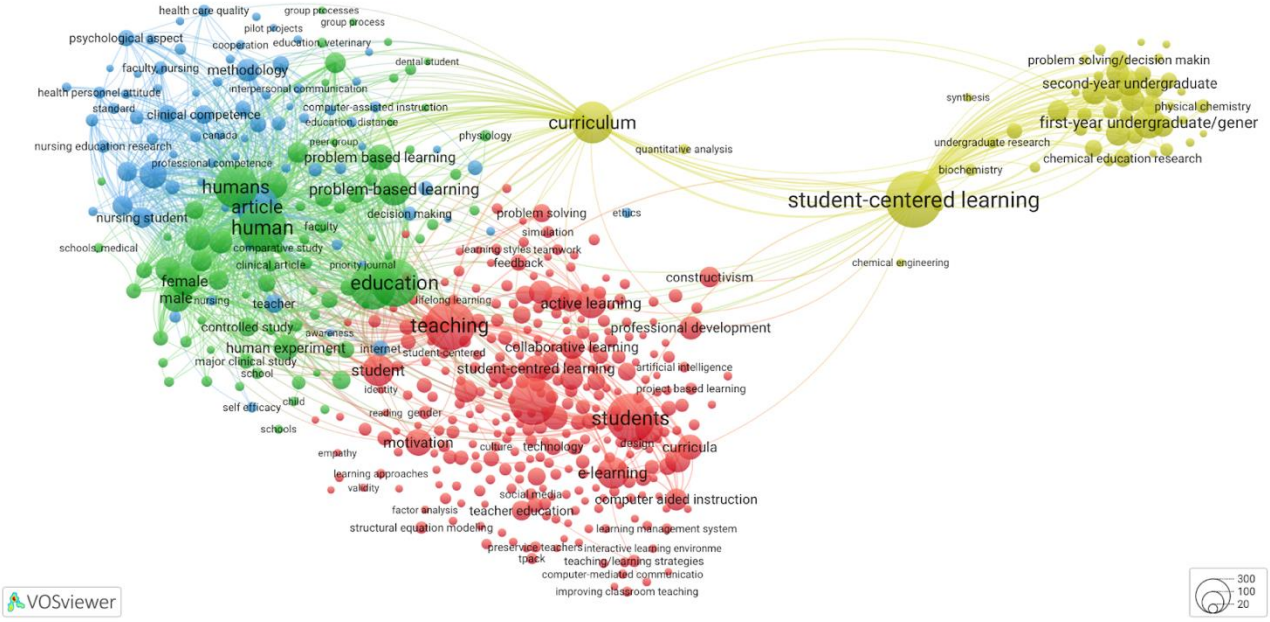
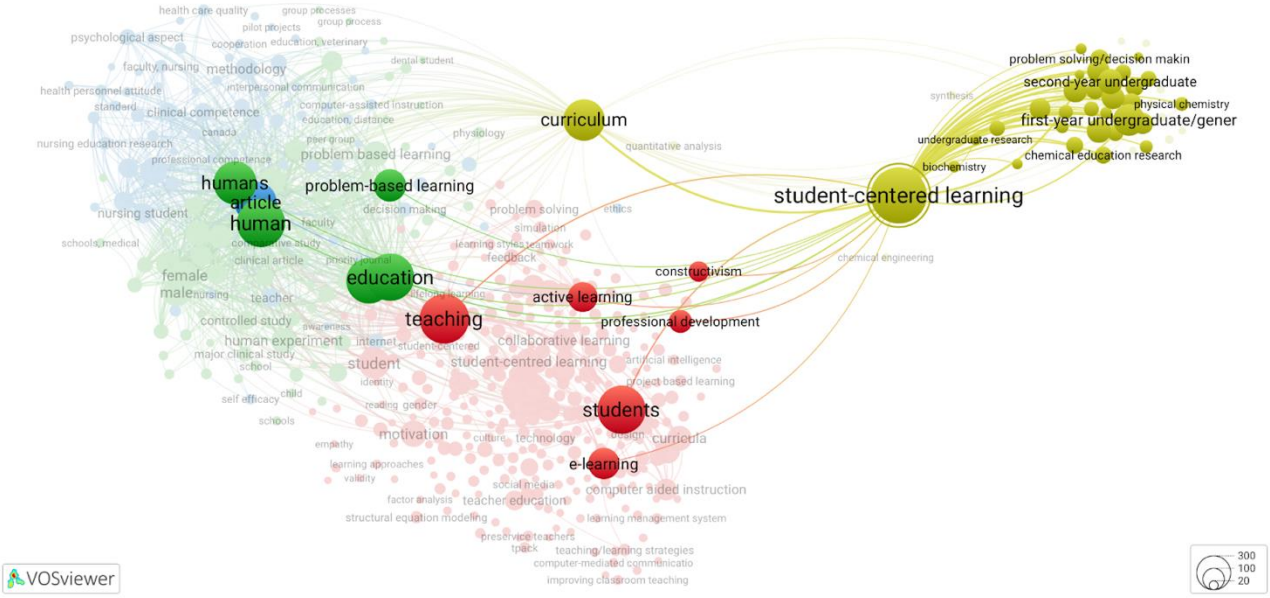


Figure 3.
Bibliometric analysis with VosViewer (by key word "student-centered learning")



During the analysis of this database, works related to this topic were identified. Research on this topic has become more active from 2012 to the present (see Figure 1). It is particularly notable that from 2016 to the present, the number of publications related to this topic has been increasing, reaching a peak in 2022-2023. This once again confirms the importance and relevance of this topic. Additionally, this topic is divided into four clusters (see Figure 2), with "student-centered learning" and "curriculum" being at the center of one of the clusters (see Figure 3).

The content study of syllabi was conducted at Astana IT University and was based on the general education programs at the undergraduate level, which include 10 courses: Philosophy, History of Kazakhstan, Sociology, Psychology, Cultural Studies, Political Science, Russian Language, Kazakh Language, English Language, and Academic Writing. While the university offers strong graduate and postgraduate programs, the majority of students—5,263—are enrolled at the undergraduate level.

Regardless of their chosen major, all students are required to complete 10 general education courses. The current view of general education is outlined in the *Educational Standards* for undergraduate students as follows:

The compulsory component courses of the general education cycle:

- Aim to shape the worldview, civic, and moral positions of future professionals, ensuring their competitiveness through proficiency in information and communication technologies, the ability to communicate effectively in Kazakh, Russian, and foreign languages, and a commitment to a healthy lifestyle, self-improvement, and professional success.
- Develop a set of key competencies that contribute to the social and cultural development of an individual based on their worldview, civic, and moral values.
- Enhance interpersonal, social, and professional communication skills in Kazakh, Russian, and foreign languages.
- Promote digital literacy by enabling students to master and apply modern information and communication technologies across various aspects of their life and career.
- Foster self-development skills and lifelong learning abilities.
- Shape individuals who are adaptable to the modern world, capable of critical thinking, and committed to physical self-improvement (Ministry of Education of the Republic of Kazakhstan, 2022).

Subject Matter for Analysis

The units of analysis were course syllabi (n = 10) from the 2023-2024 academic year, covering undergraduate first-, second-, and third-year courses.

A standardized syllabus was used across all sections of each course. Due to the descriptive nature of this study, there was no need to balance the number of syllabi analyzed for individual courses or general education areas. Ultimately, 100% of general education courses were included in the analysis.

Findings

A bibliometric analysis conducted using VOSviewer (Figure 1) identifies key trends in research on student-centered learning and situates the topic *Syllabus Development for Teacher Input in Student-Centered Learning* within the academic discourse. The concept map illustrates the evolution of scholarly interest, shifting from the dominance of traditional methodological approaches (2012–2015) to a growing emphasis on active learning, student engagement, and need-based curricula (2018–2020). The nodes *student-centered learning*, *curriculum*, *teaching*, *education*, and *active learning* occupy a central position within the research network,

underscoring the necessity of rethinking the role of the teacher—not only as a facilitator but also as an architect of the educational process.

A further analysis focused on *student-centered learning* (Figure 3) reinforces its central role in contemporary educational research, integrating themes such as *curriculum*, *problem-solving*, *constructivism*, *active learning*, and *professional development*. The visualization of network connections highlights the deep integration of SCL into curriculum development strategies aimed at enhancing student autonomy. Its associations with the terms *first-year undergraduate*, *second-year undergraduate*, and *chemical education research* indicate the widespread adoption of this paradigm in higher education, particularly in the natural sciences. The high density of connections among the nodes *students*, *e-learning*, and *motivation* further emphasizes the necessity of revising traditional pedagogical models and incorporating digital educational technologies. These findings underscore the significance of the present study, as they highlight the teacher's role as a pivotal agent in the transformation of educational practices, bridging the gap between conventional teaching methods and contemporary educational trends.

As a first step in our syllabus content study, we grouped the checklist characteristics into common themes that emerged as a result of our content analysis.

- The identified themes included:
- Acknowledgment of General Education Guidelines
- Basic Course Information
- Required Reading
- Course Content
- Use of Technology
- Topics Related to Personal Development
- Description of Assignment Completion Opportunities
- Instructor Contact Information

Basic Information in Syllabi

In the initial phase of the analysis, we identified the key information that instructors provided to students in the course syllabi.

Most syllabi included details about the instructor, such as:

- Office location
- Instructor’s email address
- Full name of the instructor

However, only a few syllabi specified the major or specialization for which the syllabus was designed.

A related finding was the limited emphasis on the use of technology in the educational process. While the descriptive sections of the syllabi mentioned opportunities to use new technologies, their actual application in assignments and coursework was not explicitly stated.

Table 1.
Syllabi components

Theme	Type	Percentage
Course Format	online lectures	90%
	field trips and demonstrations	10%
Assessment Practices	traditional assessment methods	40%
	non-traditional assessment methods	60%
Alignment with General Education Guidelines	course content	100%
	teaching methods	20%
Student Responsibility for Learning	academic policies	30%

Course Format

The data indicate that courses primarily relied on online lectures, which were recorded by instructors in the university's studio and updated one or, in some cases, two years ago (Table 1).

Field trips and demonstrations of subject-specific applications during practical sessions with students were rarely used.

Assessment Practices

Most syllabi included information about the grading system.

Non-traditional assessment methods were predominant, such as:

- Oral presentations
- Project-based activities
- Group-based practical work

These were included in the majority of syllabi.

Less than half of the syllabi incorporated written assignments or accounted for attendance and classroom participation in the grading criteria.

Formal multiple-choice (MC) exams were the most common form of assessment. Assignments requiring logical and analytical thinking were mainly found only in language course syllabi.

Testing was more frequently used in social science courses, though this does not necessarily mean that these exam formats are ineffective. Rather, they reflect the potential for students to rely on rote memorization or random guessing in their responses.

Alignment with General Education Guidelines

One of the primary objectives of this study was to determine the extent to which syllabi referenced the general education guidelines.

Each field category contained three core principles, some of which included multiple concepts. To facilitate analysis, we divided these principles into distinct elements to examine their presence in course syllabi more precisely.

The results showed that, across all syllabi, the most frequently mentioned principle was "course content".

The least frequently mentioned principles were "teaching methods".

However, this does not imply that students are not informed about the general education guidelines—rather, this information was simply absent from the syllabi.

Student Responsibility for Learning

Another significant aspect of our analysis focused on student responsibility for their learning process.

A surprising finding was that only a small portion of syllabi included information regarding academic conduct policies, despite the importance of this issue in university settings.

Discussion

The General Education Department at AITU delivers following disciplines: History of Kazakhstan, Philosophy, socio-political modules (Sociology, Psychology, Political science, Cultural studies), language disciplines (Kazakh, Russian, English, German and Chinese languages, Academic writing and Physical education. In our study we eliminated Physical education course as it aims training of students through physical activities.

The instructors of these disciplines in developing their syllabus are oriented towards a student-centered approach. The GEDC course syllabi primarily consists of lectures, practical sessions, student work with instructors and student self-study.

The lectures for the disciplines are organized on the e-learning platform - Digital Institute of Continuing Education, Astana IT University, which provides students with the opportunity to view lectures independently and revisit them as desired. The main goal of the creation of the Digital Institute of Continuing Education is the implementation of continuing education in the collaboration of formal and non–formal education at AITU. One of the key tools of the continuing education system will be mechanisms for recognizing the results of both non-formal education and skills and competencies of the previous level of education, as well as the procedure for confirming compliance and assigning qualifications. The creation of a Digital Institute of Continuing Education is aimed at implementing this idea in the IT field.

According to the academic policy of AITU, conducting a seminar (practice) session involves the consolidation of student skills in using theoretical knowledge in relation to the specifics of the discipline being studied. The topics of the seminars are problematic topics, allowing students to master the skills of conducting discussions and scientific polemics. An active seminar participant is a student who demonstrates a high understanding and comprehension of theoretical material.

According to the results of the content analysis, it was revealed that the syllabi of the Department of General Education disciplines include the following methods of conducting practical classes and forms of conducting independent work of students:

- Project-based learning;
- Presentation-based learning;
- Essay-based learning;
- Game-based learning;
- Problem-based discussions and debates.

One approach to fostering student-centred teaching and learning involves the adoption of project-based learning (PBL). Recently, there has been increased attention on PBL and other student-centred methodologies aimed at cultivating profound learning and the acquisition of skills essential for success in higher education, career paths, and civic engagement. While such approaches have faced criticism in the past, particularly from proponents of traditional subject-based content knowledge, project-based learning stands out as a meaningful instructional strategy. It facilitates students' mastery of content knowledge, academic skills, and the cultivation of competencies vital for thriving in the 21st century. The overarching objective of PBL is to enhance student engagement and foster a deeper comprehension of key concepts. By allowing students to learn through practical application, problem-solving, collaboration, and real-world simulations akin to those encountered by professionals in various fields, PBL offers a dynamic educational experience (Apperson, 2017).

During presentation-based activities, active learning unfolds from the preparatory phase through to the actual presentation before the class. In the preparatory phase, students engage in exploring relevant materials from various sources, consulting the internet, engaging in discussions with peers or seeking guidance from instructors, and crafting visually appealing and well-organized PowerPoint slides. According to Grimm (Grimm, 2015) and Brown (Brown, 2024), students demonstrate enhanced comprehension and deeper learning when they

engage in writing about concepts, a principle that extends to presenting topics or content using PowerPoint slides. The process of PowerPoint preparation necessitates students to thoroughly grasp and distill the key points of the content to be highlighted in their presentations. The integration of PowerPoint in the classroom addresses the limitations of traditional lectures by facilitating efficient structuring, organization, and emphasis of essential information. Sugahara & Boland (Sugahara, 2006) noted that the incorporation of PowerPoint media in learning enhances learners' attention, leading to higher retention rates and increased participation levels.

Game-based learning involves acquiring new concepts and skills through the utilization of digital and non-digital games. The integration of games into educational settings has been shown to yield significant enhancements in both learning and educational outcomes. As outlined by Boctor (Boctor, 2013), the mechanism through which game-based learning supports learning entails two main steps: Firstly, games serve as a motivator for students to integrate knowledge from diverse disciplines and apply it in decision-making processes; and secondly, students can experiment with how game outcomes are influenced by the choices and decisions they make. Additionally, game-based learning facilitates student interaction with peers to discuss game-related strategies, fostering improved coordination and enhancing social interaction skills. Enhancing problem-solving skills is crucial for adapting to society, and game-based learning has emerged as a highly effective method for enhancing such skills. For instance, Hwang (Hwang, 2016) discovered that interactive learning sessions enable students to grasp concepts more effectively and enhance their cognitive problem-solving abilities. Game-based learning, through its integration of multiple skills into the learning process, is also recognized for its capacity to boost student engagement. Additionally, research Boctor (Boctor, 2013) indicates that students who engage in educational games exhibit superior academic progress compared to those who do not, across various subjects, including proficiency in English language comprehension. Consequently, incorporating a game-based approach into learning can effectively align with both teachers and students preferences, contributing to increased engagement, coordination, and creativity among students.

The criteria-based assessment system addresses to the following objectives:

1) Contribute to the enhancement of educational quality through an objective and transparent assessment system.
2) Formulate a unified and higher-quality assessment mechanism that aligns with international standards.
3) Create conditions for the development of self-reliance and responsibility in acquiring knowledge and experience.
4) Provide the opportunity to evaluate academic achievements and compare them with expected outcomes.
5) Develop high-level skills such as analysis, synthesis, evaluation, and creativity.

Thus, review based analysis of syllabi GEDC, including characteristics of the assignments, grading criteria, practice session activities, and learning materials, has demonstrated that to enhance student motivation, it is essential to provide a clear understanding of how the learned material can be applied in real-world contexts. The humanities block of courses is primarily designed to shape a comprehensive worldview and support the socialization of students in IT sphere.

Engaging students in the learning process, while considering their individual factors such as needs, interests, dynamics of preparation, and motivation, allows teachers to achieve greater success in knowledge acquisition. This approach not only enhances students competencies but also helps minimize academic stress, ultimately leading to better educational outcomes.

Conclusion

Prioritizing individualized learning within modern educational frameworks, particularly through SCL, emphasizes active learner engagement and the cultivation of personal responsibility for education. In the context of syllabus development, teachers play a critical role in shaping the learning experience by integrating interactive, practice-based teaching methods that inspire student participation and enhance motivation. These methods not only help students retain information but also develop essential skills such as critical thinking, problem-solving, and creativity—competencies that are crucial for adapting to contemporary challenges.

A core feature of effective syllabus development in SCL is the integration of theoretical knowledge with practical, real-world applications. This approach ensures that the learning process is both relevant and meaningful to students in terms of their future professional. As a result, students not only gain a deeper theoretical understanding but also acquire the practical skills necessary for their future professional fields.

The core values of SCL are empowering students, ensuring the relevance of subject matter and active participation in acquiring the theoretical and practical knowledge that are clearly written in the course syllabus. Effective syllabus development should be designed to accommodate individual student needs, professional interests, and levels of preparedness. This syllabus tailoring allows for more effective and personalized learning, ultimately leading to a more engaging educational experience.

To enhance the effectiveness of SCL, we assume based on this study, course instructors and administration should consider how active learning methods such as group discussions, project-based learning, and case studies integrated into syllabus design considering student commitment in participating and their preparation to these types of class activities giving value to the preparation process. These collaborative and interactive methods require student engagement and responsibility for their own learning. It is important for syllabus developers to prioritize the inclusion of real-world applications of theoretical knowledge. By doing so, students can see the direct relevance of their studies to future careers, helping them understand the practical value of their education.

Diverse student needs, interests, and learning styles are important components to be reflected in the syllabi, while still adhering to essential learning objectives and standards. These must be considered by syllabus developers and instructors how to best integrate them in SCL syllabus. Including advantages of educational technologies that facilitate adaptive learning, allowing students to learn at their own pace and engage with content that is both relevant and personalized to their needs. This might ensure that teaching practices and course materials better align with the needs of students and achieve their academic and personal development goals.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Tleshova Zhibek – Supervision, Conceptualization, Methodology, Writing – Original Draft, Project administration. Belessova Nursulu - Formal analysis, Investigation, Writing – Original Draft. Nurkanat Anel – Validation, Writing – Original Draft. Issakhanova Assel - Writing – Original Draft, Visualization, Formal analysis. Zhanadilova Aigul – Validation, Formal analysis, Investigation, Visualization.

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THE STRUCTURE OF METHODOLOGICAL COMPETENCE OF UNIVERSITY TEACHERS AND THE LEVELS OF ITS DEVELOPMENT

Abstract: The development of methodological competence among university instructors is a key factor in improving the quality of higher education and adapting to modern educational challenges. This study explores the structure, components, and levels of methodological competence, emphasizing the need for continuous professional development. A mixed-methods approach was employed, combining theoretical analysis with a review of the best global practices. The findings suggest that methodological competence encompasses pedagogical knowledge, research skills, adaptability, and innovation. The study also proposes a five-level classification system to assess instructors' methodological competence. Enhancing this competence through targeted professional development and digital learning strategies is crucial for improving teaching effectiveness and student outcomes in higher education.

Keywords: methodological competence, university instructors, pedagogical knowledge, professional development, digital learning, higher education, assessment strategies, teaching innovation, blended learning, student-centered learning.

Introduction

The mission of education evolves in response to changes in the system of social values adopted by society. Along with the established notions of the patterns through which human development occurs via education, these changes have defined the content, forms, and methods of teaching and upbringing, pedagogical thinking, the position of educators and students, and the very structure of educational institutions—in other words, the essence of a given educational paradigm.

Kazakhstan’s higher education system is currently facing the challenge of implementing a new paradigm – “higher education as the formation and development of personality”. All necessary prerequisites for this transition have been established: the shift to a competency-based model of professional training, the introduction of a modular structure for educational programs, student-centered learning, teaching, and assessment, as well as a credit-based rating system for evaluating students' academic achievements.

The new paradigm of higher education is educationally oriented toward meeting the need for lifelong personal development in an ever-changing modern world. In reality, lifelong education (including self-education) is a continuous process of expanding an individual’s personal, cultural, and professional potential throughout life. Therefore, learning and teaching strategies must take this phenomenon into account.

In this regard, the teaching strategy in higher education is based on the principle that learning and teaching should be inclusive, aimed at upholding and promoting academic integrity and respect, and rooted in a rich research environment that fosters the principles of “research-based learning” and service to society. This approach enables students to conduct research, generate new knowledge, and develop critical thinking skills. At the same time, the learning context should shape students' perspectives on the importance of continuous professional development and skill enhancement, including those focused on personal growth.

Additionally, the teaching and learning strategy should be directed toward achieving excellence in education through evidence-based approaches that foster active, interactive, and innovative teaching and assessment methods, instructional design, and the development of partnerships.

The tools of this strategy include teaching methodology, learning and teaching methods, assessment systems, and evaluation techniques.

When shaping the academic environment, the learning strategy should be based on a comprehensive approach that considers the availability of appropriate educational laboratories, integrates aligned teaching and assessment technologies, and places special emphasis on the functional adaptability of the learning space to the goals and objectives of education.

Thus, the relevance of developing university instructors' methodological competence is determined by factors such as the advancement of educational technologies, the improvement of education quality, graduate preparedness for the labor market, and the modernization of educational and academic programs. It should encompass components and subcomponents that describe the presence of specific competencies.

Methods and organization of the study.

The research is based on a constructivist approach, as it is grounded in the understanding that the same phenomenon or process does not have a single objective interpretation. Overall, the study employs a mixed research methodology that combines both quantitative and qualitative research methods.

At the first stage, an analysis of scientific literature and regulatory legal acts was conducted (Kassenov et al., 2022).

For the literature review, filters were applied using key terms such as "methodological competence", "teaching methodology", "higher education teaching methodology", "didactic competencies of a teacher", and "personal competencies of a teacher" to search for articles and journals available in open-access sources within the fields of social sciences and education. Articles published in open-access scientific journals, including both theoretical and empirical studies, were selected. To ensure the effectiveness of the strategy, the largest multidisciplinary databases, such as Web of Science (WoS) and Scopus, were utilized. When analyzing domestic scientific experience, publications recommended by the Committee for Quality Assurance in Science and Higher Education were primarily used. To systematize the reviewed academic works, an annotated bibliography was compiled based on key terms.

The selected scientific works were studied according to the following hierarchy: review studies – theoretical and conceptual works – empirical studies.

As a result of this analysis, the level of research on the problem in academic literature was determined, and the components of teachers' methodological competence were standardized.

The next stage of the study involved an analysis of global best practices in developing teaching strategies in higher and postgraduate education. The first level of this stage consisted of a theoretical study of the concept of methodological competence. To achieve this, logical and dialectical analysis methods were applied, allowing for the systematization and structuring of the examined approaches. The second stage involved reviewing strategic documents from universities ranked in the top 50 of global university rankings. The outcome of this stage was the systematization of various approaches to understanding teachers' methodological competence and the development of its structure using synthesis and forecasting methods, simplifying its further application in the study.

Literature review

The concept of methodological competence among university teachers has gained increasing attention in educational research, particularly in the context of higher education reform and the demand for improved teaching methodologies. This review examines relevant literature on the structure, components, and development levels of methodological competence, drawing from contemporary pedagogical theories and empirical studies.

Methodological competence is broadly defined as a teacher's ability to apply pedagogical methods effectively to facilitate learning, conduct educational research, and integrate innovative teaching techniques. According to Shulman (1986), pedagogical content knowledge (PCK) is a critical element of a teacher's expertise, encompassing both subject knowledge and an understanding of how to teach it effectively. The studies (Darling-Hammond, 2017; Mukhatayev et al., 2024; Agnihotri, 2024) further emphasize the role of reflective practice in enhancing methodological competence, where educators continuously assess and refine their teaching strategies.

Methodological competence is a critical attribute for educators and researchers, encompassing a range of skills and knowledge areas that enhance teaching effectiveness and academic inquiry. This competence is built on several core components that collectively shape an educator's ability to design, implement, and evaluate teaching and learning processes effectively. Firstly, pedagogical knowledge refers to an educator's understanding of teaching principles, curriculum development, instructional design, and assessment strategies. It includes familiarity with various teaching models, learning theories, and student-centered approaches that enhance engagement and comprehension. Scholars such as Mishra & Koehler (2006) emphasize the integration of technological, pedagogical, and content knowledge as an essential framework for modern educators, ensuring effective teaching in digital and traditional classroom settings.

Methodological competence also requires proficiency in educational research, encompassing the ability to design studies, collect and analyze data, and apply research findings to practice. Research skills enable educators to:

- Develop research questions and select appropriate methodologies.
- Conduct qualitative and quantitative research to explore educational challenges.
- Interpret data to make evidence-based improvements in teaching.
- Publish findings and contribute to the academic discourse on educational best practices.

As noted by Creswell (1994), strong research skills empower educators to adopt a scientific approach to pedagogy, ensuring that their teaching methods are based on empirical evidence rather than intuition alone.

Innovation in education involves the integration of technology, active learning methodologies, and interdisciplinary approaches to enhance student engagement. Effective educators employ innovative teaching strategies such as: combining traditional face-to-face instruction with online resources and interactive tools; encouraging students to review learning materials before class, enabling more interactive discussions and problem-solving during lessons; using game-based learning techniques and real-world simulations to reinforce concepts; enabling teamwork and peer discussions to develop critical thinking and problem-solving skills. Williams J.K. (2008) highlight the importance of digital learning environments and adaptive technologies in enhancing methodological competence, ensuring that educators remain at the forefront of instructional innovation.

Continuous professional development and self-evaluation are key aspects of methodological competence. Educators who engage in reflective and adaptive practices:

1) Regularly assess their teaching effectiveness and make necessary adjustments.
2) Seek feedback from students and colleagues to identify areas for improvement.
3) Stay updated on the latest research and advancements in educational methodologies.

4) Engage in lifelong learning through workshops, conferences, and professional learning communities.

Brookfield (1996) underscores the significance of critical reflection in teaching, arguing that self-awareness and adaptability allow educators to refine their approaches and respond effectively to changing educational landscapes.

Effective communication and collaboration are essential for fostering knowledge exchange and improving pedagogical practices. Educators must be able to communicate complex concepts clearly to students and colleagues; work collaboratively with peers, researchers, and industry professionals to enhance learning outcomes; engage in interdisciplinary cooperation to develop comprehensive educational programs; participate in academic networks, conferences, and online communities to stay informed about emerging trends. Hargreaves & Fullan (2012) emphasize the role of professional learning communities in enhancing methodological competence, as collaboration among educators leads to shared knowledge and improved instructional strategies.

Methodological competence is a multifaceted skill set that requires a balance of pedagogical expertise, research proficiency, innovation, adaptability, and collaboration. By continuously developing these components, educators can enhance their teaching effectiveness, contribute to academic knowledge, and ultimately improve student learning outcomes. As the educational landscape evolves, methodological competence remains a foundational pillar for educators committed to excellence and lifelong learning.

Based on the components of the teacher's methodological competence, we further consider the levels of its development. The development of methodological competence among university teachers follows a structured progression, reflecting an educator's growing mastery of teaching methods, research integration, and pedagogical innovation. Scholars have proposed various models to assess this development, with one widely accepted framework classifying it into four levels: Basic, Intermediate, Advanced, and Expert (Korthagen, 2004; Gibbs, 1988; Tondeur et al., 2012; Lunenberg et al., 2006). Each level represents an increasing degree of proficiency, autonomy, and contribution to the academic community.

The increasing digitalization of education necessitates a reevaluation of methodological competence in higher education. Different studies highlight the importance of digital pedagogy, online learning platforms, and artificial intelligence-assisted teaching as emerging domains requiring methodological expertise (Selwyn, 2010; Caena & Redecker, 2019). The COVID-19 pandemic further accelerated the adoption of blended and online learning models, underscoring the need for university educators to develop digital competencies alongside traditional teaching skills (Hodges et al., 2024).

The development of methodological competence is a dynamic and lifelong process that progresses through distinct levels, from basic instructional skills to expert-level educational leadership. Each stage builds upon the previous one, encouraging educators to refine their teaching strategies, integrate research-based methods, and contribute to pedagogical advancements. By recognizing where they currently stand and identifying areas for growth, university teachers can take intentional steps to enhance their methodological competence, ultimately improving student learning outcomes and advancing the field of education.

The literature underscores that methodological competence is a multifaceted construct encompassing pedagogical knowledge, research skills, adaptability, and innovation. Its development follows progression from basic to expert levels, influenced by continuous professional learning and technological advancements. Future research should explore strategies for effectively enhancing methodological competence among university educators in an evolving educational landscape.

Results and discussion

In the context of student-centered learning, teaching, and assessment, the primary focus of a university's development strategy is the enhancement of the academic environment, including learning spaces and infrastructure, particularly digital infrastructure. A crucial factor in this strategy is ensuring the high quality of faculty performance.

In this regard, the teaching and learning framework should structurally reflect three fundamental principles:

1. The evolution of student-centered teaching and learning approaches;
2. The transformation of curricula and assessment systems based on inclusivity and integrity;
3. The development of students' professional skills and personal growth competencies.

In a student-centered learning environment, teaching approaches should be focused on meeting students' needs, interests, abilities, and opportunities, which is dictated by the inclusive nature of education. Higher education institutions should implement adaptive learning approaches, effectively combining face-to-face interactions between students and instructors with online learning. A blended learning approach adds flexibility to the teaching and learning process, allowing instructors to reconsider where and how they focus educational activities while enabling students to develop independent learning skills and digital literacy.

Blended learning necessitates that both instructors and students acquire IT competencies.

This restructuring of teaching modifies the learning process, encouraging students to engage more deeply with their subjects during face-to-face sessions by interacting with peers and refining their understanding of course materials. Teaching should leverage educational technologies to create blended learning approaches that enhance students' comprehension of course content in both face-to-face and online settings.

It is also essential to adopt an interdisciplinary approach—not only in designing curricula but also in forming teams where students collaborate on academic tasks, known as team-based learning.

This approach has several positive effects on personal development:

- Firstly, it enhances the diversity of contributions from different categories of students, faculty, and other staff members;
- Secondly, it provides students with opportunities to interact with their peers and build relationships essential for overall well-being;
- Thirdly, it fosters both personal responsibility for learning and teamwork skills necessary for group work and collaborative learning.

Additionally, summative and formative assessments should be redesigned to align with real-world challenges within the broader transformation of educational programs. Assessment strategies should address global social issues, uphold the values of inclusivity and integrity, draw on best practices in teaching and assessment, and integrate work-related, professionally recognized learning opportunities for students.

A key focus of the learning strategy is the development of two skill categories:

- Disciplinary knowledge and skills, with in-depth mastery leading to professional certification opportunities;
- Soft skills, including attributes, dispositions, and competencies that contribute to academic and career success.

Therefore, a core goal of the teaching and learning strategy is the development of instructors' methodological competencies necessary for effective teaching in their respective disciplines. Achieving this goal requires aligning faculty professional competencies with the educational needs of institutions and students while fostering motivation and engagement in continuous professional development.

By doing so, we will ensure the effective application of knowledge in educational program development, pedagogy, and best practices, enabling faculty to become highly effective educators. This includes demonstrating key teaching and learning skills such as lesson planning, assessment, addressing special needs and inclusion, designing high-quality instructional resources, and effectively using diverse evaluation strategies and tools to monitor student performance and progress based on planned learning outcomes.

The conducted research has allowed us to construct a framework for university faculty's methodological competence, identifying its components and subcomponents accordingly.

In the evolving landscape of higher education, particularly in technical and rapidly developing fields such as information technology, the methodological competence of university instructors plays a critical role in ensuring the quality of teaching and student learning outcomes. Methodological competence, in this context, refers to a complex, multi-component system of professional knowledge, skills, and attitudes that allow educators to design, deliver, and improve the learning process in alignment with modern pedagogical requirements and technological advancements. Based on the conducted research, this chapter presents a structured model that outlines the key components of methodological competence for IT discipline teachers.

The **knowledge component** serves as the foundation of methodological competence. It encompasses a thorough understanding of national and institutional curricula, educational standards, and the broader goals of instruction. Teachers must not only master their subject matter but also be proficient in a variety of teaching methods and strategies that accommodate diverse student needs and classroom dynamics. Moreover, this component includes awareness of cultural and social factors that affect education—an essential skill in multicultural and international learning environments. Continuous professional development and the ability to stay updated on new research, teaching trends, and interdisciplinary linkages are also integral to this dimension.

The **didactic component** relates to the practical aspects of teaching, including curriculum development, lesson planning, classroom management, and assessment. Instructors must be able to design coherent learning programs with well-defined objectives and logically sequenced content. Effective lesson planning requires the ability to adapt teaching methods to learner needs while maintaining a structured, goal-oriented approach. Furthermore, a supportive and stimulating learning environment—both physical and virtual—is essential to foster engagement and motivation. The ability to manage classrooms, whether in-person or online, and implement a range of assessment techniques is equally important in this component.

Closely tied to didactic practice is the **design component**, which focuses on the strategic planning and implementation of educational projects and programs. Teachers must be able to define clear goals, develop meaningful content, and structure educational activities in a way that maximizes learning outcomes. Flexibility is a key aspect here; instructors should adapt their plans to accommodate students with varying learning needs, preferences, and backgrounds. Collaboration is another essential element, as educational success often depends on effective teamwork with colleagues, administrators, and industry stakeholders.

The **informational component** reflects the teacher's capacity to interact with a constantly evolving knowledge environment. IT instructors must be adept at searching for, evaluating, and organizing educational content using a wide range of sources—from textbooks and scholarly articles to digital platforms and multimedia tools. In addition, they need to be capable of translating complex information into accessible, student-friendly formats. This includes supporting the development of students' information literacy, enabling them to navigate, analyze, and interpret data independently and critically.

Effective teaching also hinges on strong communication abilities, which form the **communicative component** of methodological competence. Instructors should possess skills

in active listening, oral and written expression, and non-verbal communication. The ability to understand students' perspectives, empathize with their experiences, and provide meaningful feedback is crucial for building trust and maintaining a productive learning atmosphere. Moreover, conflict resolution skills are essential for managing interpersonal challenges that may arise within academic settings.

The **reflexive component** involves the teacher's capacity for self-assessment and continuous improvement. This includes introspection, or the ability to critically evaluate one's own teaching practices, as well as openness to peer feedback and professional dialogue. Documenting reflections through journals or teaching portfolios allows instructors to monitor their progress and identify areas for development. Commitment to lifelong learning and a proactive approach to professional growth underscore the importance of this component.

Equally important is the **monitoring component**, which relates to the teacher's ability to define learning objectives, measure student progress, and adjust instruction accordingly. Competent instructors employ a variety of assessment tools to collect meaningful data on student performance. They analyze this data to identify trends, challenges, and areas for intervention. Importantly, they provide students with timely, constructive feedback and use the results to enhance instructional strategies and learning outcomes.

Finally, the **personal and motivational component** addresses the internal qualities that support effective teaching. These include pedagogical empathy—the ability to understand and respond to students' emotional and academic needs—as well as strategies for motivating learners through relevant, engaging tasks. Teachers must also demonstrate emotional resilience, ethical behavior, and a collaborative spirit in their interactions with colleagues and students alike. These traits contribute to a professional climate that fosters trust, innovation, and student-centered learning.

Together, these eight components form a holistic model of methodological competence that is essential for IT discipline instructors in higher education. The model underscores the integration of theoretical knowledge, practical skills, reflective practice, and interpersonal attributes. By developing and reinforcing these elements, educators can enhance their teaching effectiveness, respond to the dynamic demands of the digital age, and contribute meaningfully to the advancement of academic quality and student success.

Based on analysis and conducted research, we have identified the levels of methodological competence development among university faculty. The determination of the level of methodological competence skills can be made using five levels: advanced, high, medium, acceptable, and low. The assignment of a specific level to a percentage range will depend on the context and specific assessment criteria. Below is the proposed scheme for defining levels and their percentage distribution:

Expert Level (95-100%): At this level, the educator possesses a highly advanced level of methodological competence. They demonstrate a deep understanding of methodological principles and possess a wide range of skills across all components of methodological competence. The educator is capable of applying teaching methods and approaches innovatively and creatively, effectively using various methodological techniques and technologies, and adapting them to different learning contexts.

High Level (85-94%): An educator at this level demonstrates high methodological competence. They have in-depth knowledge and a broad range of skills in most components of methodological competence. The educator successfully applies various teaching methods, adapts instructional materials and resources to students' needs, effectively assesses learners, and analyzes learning outcomes.

Medium Level (75-84%): At this level, the educator possesses solid foundational knowledge and skills in methodological competence. They are capable of applying basic

teaching methods and techniques, selecting and creating instructional materials, adapting them to students' needs, and conducting fundamental learner assessments.

Acceptable Level (50-74%): At this level, the educator has limited knowledge and skills in some components of methodological competence. They can apply basic teaching methods and techniques but with limited flexibility and innovation. The educator requires further development of methodological skills and an increase in knowledge in the field of teaching methodology.

Low Level (1-49%): At this level, the educator has very limited or no knowledge and skills in many components of methodological competence. They struggle with applying teaching methods and techniques, selecting and adapting instructional materials, and assessing learners. The educator requires significant training and support to develop their methodological competence.

It is important to note that the percentage assignment for each level is relative and may be contextual. This scheme presents a general concept for assessing levels of methodological competence and can be adapted according to the specific criteria and expectations of an educational organization or system.

Conclusion

The development of methodological competence among IT discipline instructors plays a key role in ensuring high-quality education and preparing future specialists in the field of information technology. Given the rapid advancement of the IT sector, the demand for professionals with deep knowledge and skills, and the need to adapt educational programs to modern labor market requirements, the issue of improving instructors' methodological training has become particularly significant.

This section analyzes the factors influencing the need for methodological competence development, examines the key components of instructors' methodological training, and proposes a phased improvement concept. Special attention is given to the integration of advanced national and international experiences, as well as scientific-pedagogical approaches that can contribute to more effective teaching and learning of IT disciplines.

Key Research Findings:

- A structured ranking of methodological competence components for IT discipline instructors has been developed, with a detailed description of the required knowledge and skills corresponding to each component.

- Five levels of methodological competence development for IT instructors have been identified: expert, high, medium, acceptable, and low, along with a clear description of each level.

In the future, based on the proposed structure and levels of development, as well as the analysis of advanced domestic and international experience in the system of training and professional development for personnel in the pedagogical field, it will be possible to develop a concept for enhancing the methodological competence of university faculty. The goal is to further develop faculty members' methodological competencies necessary for the successful teaching of disciplines in their respective fields.

The concept will enable the targeted development of the following competencies:

- The ability to effectively apply knowledge in the design of educational programs and utilize appropriate pedagogical methods and practices for successful teaching;

- Advanced demonstration of key teaching and learning skills, including lesson planning, assessment, and consideration of special needs and inclusion;

- The capability to develop high-quality teaching and methodological materials for disciplines with the integration of information and communication technologies, as well as the effective use of diverse assessment strategies and tools to monitor students' academic

performance and progress in accordance with planned learning outcomes.

The limitations of the study include its theoretical nature, as well as the assessment of the development process within a narrow group of faculty (primarily IT discipline instructors). In the future, the practical application of the conceptual foundations for the development of university faculty's methodological competence is planned, along with its dissemination at the national level.

Conflict of Interest Statement

The authors declare no potential conflicts of interest regarding the research, authorship, or publication of this article.

Author Contributions

Aidos Mukhatayev: Conceptualization, Methodology. Serik Omirbayev: Data curation, Writing - Original draft preparation. Andrii Biloshchytskyi: Methodology, Writing - Original draft preparation. Khanat Kassenov: Visualization, Investigation. Sapar Toxanov: Supervision. Saulesh Mukanova: Software, Validation. Zhekibayeva Botakoz: Writing- Reviewing and Editing,

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