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Contents / Мазмуну / Содержание

G. Duishonbekova, T. Imanalieva, S. Bokolova Methods of applying case studies in teaching Russian at universities	9
Г. Дуйшонбекова, Т. Иманалиева, С. Боколова Жогорку окуу жайларда орус тилин окутууда кейстерди колдонуунун методикасы.....	9
Г. Дуйшонбекова, Т. Иманалиева, С. Боколова Методы применения кейс-стади в обучении русскому языку в вузе.....	9
S. Kulueva, A. Gudimova Diagnostic support for the development of logical thinking of primary school students.....	18
С. Кулуева, А. Гудимова Кенже мектеп окуучуларынын логикалык ой жүгүртүүсүн өнүктүрүүдө диагностикалык колдоо.....	18
С. Кулуева, А. Гудимова Диагностическое обеспечение развития логического мышления младших школьников.....	18
M. Samadiyeva, G. Karabalaeva, N. Asipova The influence of emotional intelligence on the adaptation of first-year students at a technical university	27
М. Самадиева, Г. Карабалаева, Н. Асипова Педагогикалык технологияларды колдонуу менен болочок мугалимдердин кесиптик компетенцияларын калыптандыруунун психологиялык-педагогикалык аспекттери	27
М. Самадиева, Г. Карабалаева, Н. Асипова Влияние эмоционального интеллекта на адаптацию первокурсников в техническом университете.....	27
A. Baitokova, G. Baitokova Technology for developing 4C competency in teacher training	42
А. Байтокова, Г. Байтокова Педагогикалык кадрларды даярдоодо “4К” компетенциясын калыптандыруу технологиясы.....	42
А. Байтокова, Г. Байтокова Технология формирования компетенции «4К» в подготовке педагогических кадров	42
R. Sulaimanova, A. Ukeleeva, S. Torobayeva Preparing future teachers for the formation of a healthy lifestyle for students.....	50
Р. Сулайманова, А. Укелеева, С. Торобаева Болочок мугалимдерди окуучулардын сергек жашоо мүнөзүн калыптандырууга даярдоо	50
Р. Сулайманова, А. Укелеева, С. Торобаева Подготовка будущих учителей к формированию здорового образа жизни учащихся.....	50
A. Bayaliev, M. Satybekova The impact of the academic environment on student success	58
А. Баялиев, М. Сатыбекова Академиялык чөйрөнүн студенттердин ийгилигине тийгизген таасири	58
А. Баялиев, М. Сатыбекова Влияние академической среды на успешность студентов.....	58
A. Shevelev Classification of problems that have manifested themselves in the training of students after opening up access to artificial intelligence services.....	67
А. Шевелев Студенттерге жасалма интеллект сервистерине мүмкүнчүлүк ачылгандан кийин пайда болгон көйгөйлөрдүн классификациясы	67
А. Шевелев Классификация проблем, которые проявились при обучении студентов после открытия доступа к сервисам искусственного интеллекта	67

Contents / Мазмуну / Содержание

D. Bolotbaev, M. Temirov

The use of artificial intelligence in teaching programming to students.....79

Д. Болотбаев, М. Темиров

Студенттерге программалоону окутууда жасалма интеллекттин колдонулушу79

Д. Болотбаев, М. Темиров

Использование искусственного интеллекта в обучении студентов программированию79

Y. Lai

A smart pen-based analysis of Chinese character stroke order errors
among beginning Central Asian students.....87

Ю. Лай

Борбор Азиялык башталгыч студенттердин кытай иероглифтеринин
черталар тартибиндеги каталарын акылдуу калем технологиясы менен талдоо.....87

Ю. Лай

Анализ ошибок порядка начертания китайских иероглифов
у начинающих студентов из Центральной Азии с использованием технологии умной ручки.....87

A. Samsaliev, Sh. Abydynova, I. Baigesekova, Ch. Aidarbekova

Formation of future doctors' readiness
for intercultural interaction in Kyrgyzstan98

А. Самсалиев, Ш. Абыдынова, И. Байгесекова, Ч. Айдарбекова

Кыргызстандагы болочоктогу дарыгерлердин маданияттар аралык
өз ара аракеттешүүгө карата даярдыгын калыптандыруу98

А. Самсалиев, Ш. Абыдынова, И. Байгесекова, Ч. Айдарбекова

Формирование готовности будущих врачей
к межкультурному взаимодействию в Кыргызстане.....98



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Methods of applying case studies in teaching Russian at universities

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Abstract. Modern education is undergoing extensive changes associated with the rapid development of interactive teaching methods. The purpose of this study was to investigate the practice of using the case method in Russian as a foreign language classes in higher education institutions. The study considered the key requirements for the application of the case method in teaching and developing critical thinking and supporting student independence. The study was aimed at investigating the effectiveness of the case method in improving student performance, language knowledge, critical thinking skills, and cultural understanding. The study examined modern tools that help improve the language skills of future specialists in various fields. The use of the case method in university classes is relevant for creating diverse educational formats that meet the requirements of modern society. The study found that the use of the case method in university classes is necessary for teaching students, as it prepares them for their future profession. The key findings of the study revealed that the case method creates a dynamic and interactive learning environment, promotes active student participation in learning, and a deeper understanding of the Russian language and culture. The case method helps to form a stable worldview and communicative competence. The findings of the study can be applied in the work of teachers in higher education and general education institutions. The study also discussed the significance of these findings for language teachers and suggested future research areas in the application of the case method in teaching

Keywords: interactive teaching methods; Russian as a foreign language; case method; effectiveness; modern technologies

■ INTRODUCTION

One reason for the increased interest in Russian is its status as an international language. Russian is one of the six official languages of the United Nations and is also the language of international communication in the former Soviet Union countries. This makes it a valuable tool for trade and cultural ties with Russian-speaking countries. In Kyrgyzstan, the key focus is on developing Russian not only as an official

language, but also as a language of interethnic and intercultural communication. The status of Russian as a language of interethnic communication is prescribed in Article 3 of the Constitutional Law of the Kyrgyz Republic No. 140 "On the State Language of the Kyrgyz Republic" (2023).

The case method contributes to the development of communicative competence. According to Y. Rozhkov (2023),

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the role of the case method in teaching is that it allows for objective assessment, identification of situations and problems, and consideration of the interests of learners. The case method is an effective method in education if its application is part of a system of practical exercises using the Russian language as an example. The use of the case method in Russian language classes as a second language in higher education institutions has proven to be an effective and interesting approach for language learners. S. Gruzko-va & A. Kamaleeva (2013) considered the emergence and problems of introducing the case study method into professional education: "Case studies are aimed at mastering not only specific knowledge and skills, but also at developing the general intellectual and communicative potential of the learner and the teacher". According to A. Bakhtina (2016), "case studies are a method that contributes to the development of communicative competence".

E. Aryukova *et al.* (2020) noted that "the case method can be viewed as a means of getting students more involved in learning, thereby helping them develop creative thinking and the ability to make decisions independently when faced with problems". The case method is a teaching method that involves analysing and discussing real situations or scenarios. This encourages students to take an active part in the learning process, apply their knowledge, and develop critical thinking skills that they can use in their future professional activities. T. Grishina (2018) noted that "the methodological and educational principles of the case study method can be effective in teaching social sciences and humanities".

O. Apanasenko (2020) pointed out that the case study method is a modern pedagogical technology, and therefore its mastery by teachers is relevant for improving the effectiveness of the educational process. The features and specifics of using interactive methods for teaching Russian to students from national groups in higher education institutions were discussed. The use of interactive forms of teaching in the educational process is one of the requirements for the implementation of basic educational programmes. Interactive teaching methods enable students to freely exchange knowledge, opinions, and ideas, and contribute to the creation of a study group team (Opanasenko & Chernenko, 2022). During creative work, a special atmosphere of cognitive activity is created, based on feedback, collective experience (representing the sum of the individual efforts of each participant in the educational process) and mutual evaluation of joint activities.

Notably, when case technologies are used in Russian language and literature classes, more time is allocated for group work and intergroup interaction, which allows for the development of communicative and social competences with a focus on mastering the skills of applying existing knowledge in specific situations to solve problems of practical significance. Language skills are an essential component of developmental education (Kalmatova *et al.*, 2024). The methodology of teaching Russian as a foreign language allows applied tasks to be solved when learning Russian in

higher education: first and foremost, to develop techniques and use methods of teaching Russian as a non-native language that can ensure the achievement and fulfilment of the relevant competences. Interactive teaching methods are increasingly being used in the teaching of Russian at universities, which substantially expand the possibilities of the educational process. However, conventional teaching methods also stay relevant and in demand.

The purpose of this study was to consider some aspects of case studies as a method of active problem-situational analysis in Russian language and literature classes using the example of case studies employed in Russian language classes as a non-native language in higher education. The study analysed the key problems faced by teachers of Russian language and literature, such as the diversity of the linguistic and cultural environment of students, different teaching and assessment methods, and the use of modern interactive technologies in the educational process. Particular attention was paid to the individualisation of teaching, interactive applications, and teaching programmes that allow for the effective adaptation of teaching materials to concrete professional tasks.

■ MATERIALS AND METHODS

This study was based on an analysis of the theoretical and practical aspects of using the case method in teaching Russian as a foreign language in higher education institutions. The study employed methods of analysis and synthesis of scientific literature devoted to the problems of teaching Russian as a foreign language, as well as methods of generalisation and systematisation of practical experience in applying the case method in the educational process. The study examined various approaches to the use of the case method, including the analysis of concrete case examples, role-playing games, and web quests used in Russian language classes. Particular attention was paid to analysing the effectiveness of the case method in developing students' communicative competence, critical thinking and understanding of the cultural characteristics of Russian-speaking society.

Furthermore, the study analysed modern interactive and innovative teaching methods applied in teaching Russian as a foreign language. Various recommendations and strategies aimed at improving the effectiveness of teaching Russian as a foreign language were also investigated, including the communicative approach, vocabulary building, and cultural immersion. The findings of the study were obtained based on the analysis and generalisation of experience in teaching Russian as a non-native language in higher education institutions, as well as on the analysis and synthesis of scientific literature on the subject. Overall, the study covered a wide range of studies on teaching Russian as a non-native language. These included studies by researchers such as M. Goncharova (2004), E. Barakhsanova *et al.* (2012), D. Abykenova & A. Asainova (2017) and others. A total of 23 literary sources were analysed in this study.

■ RESULTS AND DISCUSSION

Essence and role of the case method in the educational process

The case method is one of the most popular and effective teaching methods used in higher education. It involves active student engagement in the learning process, based on the analysis and discussion of situations called cases (Goncharova, 2004). Moreover, the case method allows for the integration of various language skills and areas of knowledge. Students can apply their grammar, vocabulary, and cultural knowledge to understand and solve cases. This interdisciplinary approach helps students see the interconnection between various language components and strengthens their overall knowledge of the language.

In the context of learning Russian as a second language, the case method offers many advantages (Shvedova, 2020). Firstly, it enables students to immerse themselves in authentic Russian language and culture. According to N. Tairova & N. Almatova (2021), by studying real-life situations such as job interviews, social interactions, or business negotiations, students gain a better understanding of the nuances of the language and cultural context. Secondly, the case method promotes active learning and student engagement. Instead of passively listening to lectures or memorising vocabulary, students take an active part in analysing and discussing cases. This active participation improves their language skills as they practise speaking, listening, reading, and writing in Russian. To effectively apply the case method in Russian as a second language classes, teachers need to carefully select and develop cases that are relevant, challenging, and aligned with the learning objectives. They should provide clear guidelines and facilitate discussion to ensure active student engagement. Furthermore, teachers can use multimedia resources, such as video or audio recordings, to increase the authenticity and realism of the cases (Barakhsanova et al., 2012).

The specifics of teaching Russian as a non-native language differ from those of teaching a native language for several reasons. The native language is the language of the homeland, which the learner acquires in early childhood by imitating the adults around them; it is learned first, used most often, and known long before the learner starts school (Imanalieva et al., 2023). The responsibilities of a teacher of Russian as a non-native language include determining the scope and content of the material to be learned; organising lessons and students in such a way as to achieve the best outcomes; motivating students to engage in activities; and monitoring the effectiveness of students' learning activities in terms of language acquisition (Goncharova, 2004).

The problem of teaching Russian as a non-native language requires a radical solution, because a second language plays an essential role in the everyday life of learners, just like their native language. Admittedly, it is easier to learn Russian at the same time as one's native language in early childhood, when a second language can be mastered without much effort. In this case, full bilingualism is achieved, when a person perfectly internalises and uses

both languages and both language systems equally (Afanasieva et al., 2019). Depending on the spoken language environment, such a person easily switches from one language to another because they think freely in either of them.

Problems of teaching Russian as a foreign language

The growing demand for learning Russian as a foreign language has necessitated a comprehensive understanding of the problems faced by both teachers and students. The authors of the present study identified some of the problems of teaching Russian as a foreign language:

1. Linguistic problems. The complex grammatical structure, rich vocabulary, and unique phonetics of the Russian language create serious problems for non-native speakers. These include, specifically, challenges with pronunciation. Non-native speakers may have difficulty pronouncing Russian sounds correctly, especially those that do not exist in their native language. For example, the pronouncing the letters 'Ы' and 'Щ' can be challenging. In addition, there are no words in Kyrgyz that begin with the letter 'Е', and therefore students pronounce the word 'ЕСЛИ' as 'ЭСЛИ'. Or the word 'ЦЕПЬ' is pronounced incorrectly. This also applies to grammatical problems. Russian grammar has its specific features, such as cases, declension, and verb forms, which can be confusing for non-native speakers. For example, the correct use of cases and the agreement of verbs with nouns can be a difficult task (Baranova et al., 2021). An error may be made in the use of the genitive case in the plural. The colloquial form 'полотенцев' is used instead of 'полотенец'. Or they may make speech errors: 'broke a mug', 'brown eyes', 'take measures', 'the hen is incubating eggs', etc. Furthermore, there is a problem with vocabulary. Russian has a rich lexicon, and non-native speakers may have difficulty memorising and using new words and expressions. For example, different meanings of the same word or synonyms can cause confusion. Or they have troubles remembering phraseological combinations. For instance, 'скоропостижное решение' (hasty decision), 'знаю это место как свои пальцы' (I know this place like the back of my hand), 'стадо лошадей' (herd of horses), etc.

2. Cultural problems. The Russian language is inextricably linked to Russian culture and traditions. Non-native speakers have difficulty understanding and using idioms, specific cultural expressions, or unwritten rules of communication. To learn the language effectively, it is essential to understand Russian culture, traditions, and social norms. To help students understand cultural nuances, the authors of the present study suggest including cultural immersion activities in the curriculum. Teachers should pay close attention to group work and communication-oriented activities. For example, cultural dialogue, which involves finding concrete ways to connect native and foreign literature, develops creative thinking, and enriches students' vocabulary (Goncharova, 2004). For instance, cultural elements should be integrated into lessons to ensure a holistic learning experience. It is worth teaching not only the language, but also the customs, traditions, and history of

Russian-speaking countries, and organising cultural events such as film screenings, cooking classes, or guest lectures to introduce students to the richness of Russian culture. It is also worth encouraging students to study Russian literature, music, and art to gain a deeper understanding and appreciation of the language.

3. Difficulties with understanding speech. Russian can be fluent and contain many slang terms and abbreviations that can be challenging for non-native speakers to understand. For example, different intonations or accents can cause confusion in understanding the meaning of a statement.

4. Pedagogical challenges. Teachers face challenges in developing appropriate teaching materials, selecting suitable teaching methods, and assessing student progress. The significance of adopting learner-centred approaches, such as task-based learning and communicative language teaching, is emphasised to address these challenges.

The authors of this study also offer several recommendations and strategies for effective teaching of Russian as a foreign language. The first is the use of a communicative approach. Written language also plays a key role in the development of communicative competence in Russian language classes based on the development of patriotic education. The culture of written speech is the ability to write correctly, to express one's thoughts on paper in a simple, accessible, and logical manner. These skills include the development of the necessary speech-thinking skills and the ability to form thoughts according to the written style. Written speech has always been a means of recording students' knowledge, which is a prominent part of the learning process. Writing down what one hears or summarising what one reads is a habitual way to remember what one learned. Since written language is the process of expressing thoughts in writing, it is linked to logical thinking and, as it develops, it has to rely on thinking and internal speech (Tolochina, 2013).

The second recommendation is to build vocabulary. When teaching Russian to students from national groups, role-playing games can be used to reinforce the curriculum on speech ethics, the principles of cooperative and polite communication, and pragmatism overall. The purpose and objectives of role-playing games vary depending on the field of activity and the profile of the students. The use of game elements in practical classes helps to stimulate the cognitive and creative activity of students in higher education, develops their thinking and memory, and fosters initiative in language learning.

Examples of case studies, role-playing games, and web quests

Group discussions can be used as role-playing games. Pair and group work develop students' cognitive abilities and oral speech. Group work can be focused on the use of so-called web quests. The teacher should pay special attention to the types of texts that students create. As an active problem-solving task embedded in a specific social context, web quests allow students to create various types of texts from different spheres of social activity. As a result, the following can be created: speeches for debates; speeches for radio and television broadcasts; speeches for the opening of an art exhibition; speeches for parliament. Web quests contribute greatly to the development of language learners' communicative competence and teach them to engage in the communication process considering the time, audience, situation, topic, and their own decisions.

The step-by-step description of the work process for solving problems in web quests disciplines participants quite well and clearly structures their activities. The teacher acts only as a tutor or consultant but does not direct the process itself. Participants in web quests carry out all their activities independently. Overall, web quests are considered to be quite problem-oriented, and such 'web quest' tasks develop the professional communicative and social competences of language learners, contribute to their search-based learning and the performance of certain professional roles, and strongly motivate them to create types of texts that are fitting to the situation, place, and time of communication.

In real life, there are often situations when there is a constant lack of a suitable language environment and no opportunity to communicate directly with native speakers of the language being studied on a regular basis. In such cases, motivation is greatly limited and influenced by the frequency and quality of rare language contacts. Therefore, high-quality language contact and good motivational support can only be provided by a Russian language teacher, who must pay attention to the methodological aspects of teaching Russian as a foreign language.

One example of a case study method for Russian can be as follows. Keys: use of incorrect cases in sentences. Description: in this key, students will give a series of sentences in which they must choose the correct cases. The task of the students is to determine which case to use in each sentence and explain their choice (Table 1).

Table 1. Examples of sentences for the case method in Russian

No.	Examples of sentences:
1	Я видела (красивый/красивую) цветок в саду. – I saw a beautiful flower in the garden.
2	Мама купила (новый/ новое) платье для меня. – Mom bought a new dress for me.
3	Он прочитал (интересный/интересное) роман за один вечер. – He read an interesting novel in one evening.
4	У нас есть (большой/ большая) собака по имени Рекс. – We have a big dog named Rex.
5	Она готовила (вкусный/вкусное) обед для гостей. – She cooked tasty dinner for the guests.

Note: the correct answer is highlighted in bold

Source: developed by the authors

After students choose the correct answer for each sentence, they should explain their choice based on the rules of Russian grammar. Then, a group discussion can be held to verify the correctness of the answers and analyse complex situations.

Contemporary approaches to teaching Russian as a foreign language

Teaching Russian as a foreign language at universities requires the use of both conventional and innovative methods, as well as consideration of students' cultural characteristics and individual needs (Basova & Skvortsova, 2019). However, as emphasised by G. Duishonbekova & T. Imanalieva (2023), for modern students in national groups to successfully learn Russian as a second language in a bilingual world, it is necessary to use interactive and innovative teaching methods. Teachers use interactive teaching methods, including case studies, in practical classes. The case study method is an effective teaching method if it is applied systematically. This method is not used systematically in Russian language classes at universities. Its use depends on the teacher's desire; therefore, it does not bring the desired result. It also contributes to the development of communicative competence: the ability to structure speeches; effectively present and convey the content of what was read; analyse and explain grammatical trends; understand and apply the rules of case usage in Russian in practice.

According to D. Abykenova & A. Asainova (2017), "the educational process in higher education should be aimed at equipping future specialists with the competencies that enable them to work effectively in their field of professional training at the level of international standards". Many researchers discuss the effectiveness of this technology in shaping the quasi-professional activities of university students. E. Barakhsanova *et al.* (2012) noted that this technology is implemented according to the basic provisions of situational, systemic, problem-based, personality-activity, and context-competence approaches.

Another area of development is the creation of cases focused on concrete professional fields. For example, cases related to medicine, business, or tourism allow students to apply their knowledge of Russian to a sufficient extent with the international community, enabling them to become experts in their future professional activities (Zhdanova *et al.*, 2012). This helps them develop specialised vocabulary and communication skills in a concrete field. The case study method makes classes more engaging and interactive and helps develop students' visual memory and language skills (Bagirova & Burykhin, 2012). The use of visual aids should be aligned with the objectives of the class and the abilities of the students to make the class more effective and interesting.

Based on the analysis, the authors of the present study developed a series of recommendations for Russian language teachers. These include the use of technology, particularly the case method. The case method of teaching

Russian language and literature has an interesting feature, which is that it allows combining different teaching methods and techniques. This combination of language teaching methods and techniques enables participants in small groups (microgroups) to acquire and consolidate new knowledge and new forms of cognition and to analyse reality, which ensures the effectiveness of the case method in language teaching (Akhmetova & Imanalieva, 2021). Furthermore, it is recommended to provide students with cultural immersion; application of skills in real life; personalised learning (individual feedback and support to help learners overcome their specific problems); collaborative learning (group work, pair work, and language exchange to promote active engagement and mutual learning); regular practice (homework or self-study assignments that reinforce topics covered in class); and support and motivation. Student motivation plays a valuable role in their success in learning Russian. Therefore, among all the factors influencing the learning of Russian, socio-psychological factors play a special role, and among them, motivation. Three main components can be identified: a motivational attitude towards the goal, which can be positive or negative in nature; a motivational desire to achieve the goal; and a motivational readiness on the part of the Russian language learner to make the desired efforts to carry out their plans and achieve the set goal. For professional development, teachers are encouraged to attend seminars, conferences, or webinars to improve their teaching skills and gain new knowledge. It is also worth constantly reflecting on one's teaching practice and getting feedback from students to improve effectiveness as a teacher.

CONCLUSIONS

The authors of the present study concluded that a process of subjective interaction between teachers and students has begun in modern Kyrgyz education. The rapid pace of modern life requires the search for and development of effective technologies. Notably, truly innovative pedagogical technologies are based on a competence-based approach and are aimed at achieving learning outcomes. As a result, progressive language teaching methods develop communicative skills and competences in students learning Russian, including linguistic (language), socio-cultural, pragmatic, general educational, and compensatory competences. In parallel, a culture of communication is formed, along with the ability to formulate thoughts, arguments, and conclusions in a concise and accessible manner, as well as the results of research, and the ability to evaluate the facts studied.

Another key area of development is creating group case studies that encourage students to work together and as a team. Instead of figuring things out independently, students can work in groups, discuss ideas, and develop their own solutions. This helps them develop teamwork and communication skills. By implementing the proposed recommendations and strategies, teachers can create a dynamic and effective learning environment that provides

students with the necessary skills to navigate the Russian language and culture in the modern interconnected world.

The authors also concluded that language skills are an essential component of developmental education, and that the methodology of teaching Russian as a non-native language enables the solution of applied problems in the process of learning Russian in higher education: first and foremost, to develop techniques and use methods of teaching Russian as a non-native language that can ensure the achievement and full implementation of the relevant competences. In a world of high demands on modern language skills, the methods of teaching Russian as a foreign language in higher education are becoming more complex. Russian language teachers make every effort to teach students not just the language as a system, but the language as a means of free communication: to develop productive communication skills in students learning Russian as a non-native language so that they can speak and listen in communication situations, adequately applying the knowledge they acquired and using the productive speech skills they developed.

For further research, a series of recommendations and strategies are proposed for the effective teaching of Russian

as a foreign language, including an individual approach to each student, the use of interactive teaching methods, the creation of authentic communication situations, and the active use of modern technologies. The use of modern interactive technologies should be aimed at supporting and enriching conventional methods, not replacing them entirely. Only in this case can marked results be achieved in the training of qualified specialists who are proficient in Russian at a professional level.

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Аннотация. Заманбап билим берүү интерактивдүү окутуу усулдарынын тез өнүгүшүнө байланыштуу олуттуу өзгөрүүлөргө дуушар болууда. Бул илимий макаланын максаты – жогорку окуу жайларында орус тили экинчи тил катары сабактарда кейс методун колдонуу практикасын изилдөө. Макалада критикалык ой жүгүртүүнү үйрөтүүдө жана өнүктүрүүдө кейс ыкмасын колдонуунун жана студенттердин өз алдынча иштөөсүн колдоонун негизги талаптары каралат. Изилдөө окуучулардын жетишкендиктерин, тилди билүүсүн, критикалык ой жүгүртүү жөндөмүн жана маданий түшүнүгүн жогорулатууда кейс методунун натыйжалуулугун текшерүүгө багытталган. Илимий иште келечектеги адистердин ар кыл багыттагы тилдик билимдерин өркүндөтүүгө көмөктөшүүчү заманбап инструменттер каралды. ЖОЖдун сабактарында кейс методун колдонуу заманбап коомдун талаптарына жооп берген ар түрдүү билим берүү форматтарын түзүү үчүн актуалдуу. Изилдөөнүн жүрүшүндө ЖОЖдо сабактарда кейс ыкмасын колдонуу студенттерди келечектеги кесибине даярдоого шарт түзгөндүктөн, студенттерди окутууда зарылчылык экендиги аныкталды. Иштин негизги жыйынтыктары кейс методу динамикалуу жана интерактивдүү окуу чөйрөсүн түзүп, студенттердин окууга активдүү катышуусуна жана орус тилин жана маданиятын тереңирээк түшүнүүгө көмөктөшөөрүн көрсөттү. Кейс методу идеялык туруктуулукту жана коммуникативдик компетенттүүлүктү өнүктүрүүгө жардам берет. Изилдөөнүн натыйжалары ЖОЖдордун жана жалпы билим берүү мекемелеринин мугалимдеринин ишинде колдонулушу мүмкүн. Макала ошондой эле тил мугалимдери үчүн бул жыйынтыктардын кесепеттерин талкуулоону жана окутууда кейс методдорун колдонуунун келечектеги изилдөө багыттары боюнча сунуштарды камтыйт.

Негизги сөздөр: интерактивдүү окутуу ыкмалары; орус тили экинчи тил катары; кейс ыкмасы; натыйжалуулугу; заманбап технологиялар

Методы применения кейс-стади в обучении русскому языку в вузе

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Аннотация. Современное образование претерпевает значительные изменения, связанные с бурным развитием интерактивных методов обучения. Цель данной научной статьи – исследовать практику использования кейс-метода на занятиях по русскому языку как неродному в высших учебных заведениях. В работе рассмотрены ключевые требования к применению кейс-метода в обучении и развитии критического мышления, к поддержке самостоятельности студентов. Исследование было направлено на изучение эффективности кейс-метода в повышении успеваемости студентов, знания языка, развитии навыков критического мышления и понимания культуры. В работе были исследованы современные инструменты, которые помогают улучшить языковые навыки у будущих специалистов различных областей. Использование кейс-метода на занятиях в вузе актуально для создания разнообразных образовательных форматов, соответствующих требованиям современного общества. В ходе исследования было установлено, что применение кейс-метода на занятиях в вузе является необходимостью в обучении студентов, поскольку он позволяет подготовить учащихся к будущей профессии. Основные результаты работы показали, что кейс-метод создает динамичную и интерактивную среду обучения, способствует активному участию учащихся в обучении и более глубокому пониманию русского языка и культуры. Кейс-метод помогает формированию мировоззренческой устойчивости и коммуникативной компетенции. Результаты исследования могут быть применены в работе педагогов в вузе и в общеобразовательных учреждениях. Статья также содержит обсуждение значения этих результатов для преподавателей языков и предложение будущих направлений исследований в применении кейс-метода в обучении

Ключевые слова: интерактивные методы преподавания; русский язык как неродной; кейс-метод; эффективность; современные технологии



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Diagnostic support for the development of logical thinking of primary school students

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Abstract. The current State Standard of General School Education of the Kyrgyz Republic establishes the main goal of primary school – the formation of educational universal actions, among which cognitive ones are of particular importance, including logical ones (analysis, synthesis, comparison, generalisation, abstraction). Increasing their level in students actualises the process of developing logical thinking, an integral part of which is diagnostics and diagnostic support for its implementation. The purpose of the article was to select and substantiate diagnostic support for the development of logical thinking in primary school students and to test it. The study involved methodological approaches (competence, activity) and methods of scientific knowledge, including theoretical (analysis of psychological and pedagogical literature), empirical (experiment, observation, measurement, comparison, description) and mathematical (statistical processing of experimental results). A pedagogical experiment was conducted to identify the advantages of diagnostic methods for individual logical operations and logical thinking in general during a fact-finding experiment using the example of determining the level of development of logical universal learning activities in primary school students of state-funded school No. 8 and the private school Bright in Bishkek. Based on the analysis of statistically processed results of the experiment, the following conclusions were made: the initial level of logical thinking is not the same among primary school students and for many of them it is insufficient for successfully achieving the final results required by the educational State Standard; the greatest advantages for implementing the ascertaining experiment were possessed by the method of F. Carter and K. Russell with the corresponding diagnostic tools; for the formative (developmental) experiment, diagnostic methods of individual logical operations were preferable, the features of the properties of which allow combining logical (training) five-minute sessions and monitoring elements in lessons

Keywords: logical operations; diagnostics; diagnostic tools; cognitive universal educational activities

■ INTRODUCTION

In the context of globalisation and the desire for a single educational space, society, rejecting “knowledgeable graduates”, needs “skillful, creative graduates” who are characterised by a high level of non-standard, logically thought-out solutions and self-development of cognitive processes. And in the current State Educational Standard of General School Education of the Kyrgyz Republic (2022), mental

education in primary school implies the formation and development of universal educational actions (UEA). They include cognitive, regulatory, personal, communicative actions. Each of them also has a complex structure. Thus, in the structure of cognitive UEA, the following are distinguished: general educational EA, problem setting and solution, logical EA. For successful completion of logical UEA,

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students must master the basics of logical thinking, learn to build conclusions based on the generalisation of the information received, independently draw conclusions, substantiate their judgments and independently seek a solution to the emerging problem (Soldatova & Lavrova, 2019; Shmeleva *et al.*, 2020).

It follows from the analysis of psychological and pedagogical literature that the development of logical and other cognitive skills and actions is most productively carried out in primary school age. It is at this age that the school student has the greatest reserves for the development of cognitive processes (Di Martino *et al.*, 2024). When entering school, the leading activity for children is learning. At the same time, they begin to participate in new types of interpersonal relationships, which is accompanied by the development of new psychological qualities, the formation of UEA.

Quite a large number of scientific studies have been devoted to the consideration of the essence of different types of UEA and their formation, among which are Zh. Charnetskaya (2019), E. Chirkova (2019) and others. The work of A. Gutsko (2020) reveals the results of studying the conditions, means and methods of forming logical UEA, which involve appropriate mental operations and logical thinking. The study by N. Usupova & Zh. Abdyraeva (2022) noted that pedagogical education plays a key role in the development of Kyrgyzstan, determining both the education of citizens and the success of various areas of the country's life. The authors examine the history of pedagogical education in the republic and emphasise the need for its deep modernisation in the context of globalisation. In the system of higher pedagogical education of the Kyrgyz Republic, the problem under study is currently given special attention, since the success of reforms in the educational sphere directly depends on the high-quality training of teaching staff and their activities aimed at the formation of UEA, including logical EA and logical thinking in students.

From the analysis of the above works, it follows, explicitly or implicitly, that the formation of any type of UEA largely depends on the high-quality methodological training of teaching staff, on the level of their proficiency in professional competencies that correspond to modern social values (Bida *et al.*, 2019; Tovkun & Lokhvytska, 2025). Despite the large body of research on the problem of the formation of all types of universal learning activities and logical ones in particular, many of its aspects still remain insufficiently studied. For example, little attention has been paid by scientists and practitioners to the issues of diagnostics and monitoring of UEA. This fact has been noted by many scientists, including L. Peterson *et al.* (2016) in a teaching aid that describes diagnostic procedures and keys for processing the obtained data, and contains materials for the practical implementation of a comprehensive diagnosis of the levels of development of UEA (regulatory, communicative, cognitive) of primary school students. The study by Sh. Pashayeva (2021) also proves the need to expand opportunities and improve diagnostic support for the learning process. The author argues that due to lack of time

in lessons, schools often neglect diagnostics of the level of UEA, and therefore suggests using “five-minute logical sessions” as a means of development and a tool for diagnosing logical UEA. The advantage of “five-minute logical sessions” is that they allow teachers to follow the curriculum, improve the level of students’ performance of individual logical operations and simultaneously track changes in the ability to perform them in the process of educational activities without creating overload.

Based on the above, the contradictions characteristic of modern education are highlighted between the needs of society for logically thinking and active individuals and the insufficient effectiveness of the educational process for their development in primary school, as well as the interest in diagnosing their level in the formation of logical thinking in primary schoolchildren and the insufficient elaboration of the possibilities of practical implementation of these issues in the UEA of state and private schools. The identified contradictions allowed for the formulation of the purpose of this study: to select and justify diagnostic methods with appropriate diagnostic support for determining the level of individual logical operations and logical thinking in younger schoolchildren and to conduct a comparative analysis of the possibilities and preferences of their diagnostic support based on the results of a pedagogical experiment.

■ MATERIALS AND METHODS

To achieve this goal, theoretical methods were used, including the analysis of scientific and theoretical literature on pedagogy and psychology, which made it possible to establish the expediency of choosing diagnostic methods and diagnostic support for the formation of logical thinking and its individual components necessary to perform logical UEA required by the State Standard of General School Education of the Kyrgyz Republic (2022). The study of diagnostic methods and their capabilities allowed them to be classified by purpose and place of application. It was found that some of them are aimed at determining the level of mastery of a single logical operation by a schoolchild, while others help to determine the level of development of several operations and logical thinking in general. The comparison method allowed for the establishment of the advantages of some of these methods and the preparation of the necessary diagnostic tools for their use in carrying out a particular stage of the experiment. At the same time, the functions of pedagogical diagnostics (controlling (evaluative), developing, informational, corrective, stimulating, predictive) were noted. From the standpoint of these diagnostic functions, the possibilities of logical five minutes were justified to identify the level of mastery of a logical operation by a student and simultaneously develop the skills to perform this operation, that is, to increase this level. Due to the fact that universal learning activities were based on the principles of the competence paradigm, competence-based and activity-based approaches were used in the study.

In addition, empirical (testing, questionnaires, pedagogical experiment) and mathematical methods (statistical

processing of results) were used, which made it possible to determine the level of development of skills to perform logical UEA in primary school students. Diagnostic support was developed for the experiment, including, among other things, diagnostic tools. It included: answer sheets, forms with questionnaires or tests (subtests), tables with assessment criteria and with the distribution of points by levels of mastery of each of the six logical operations, as well as a layout of a summary multifunctional table for entering the general results of testing (questionnaires). Experimental work was carried out in 2024 in class 4a of the state-funded Secondary School No. 8 with the participation of 25 students and in class 4a of the private school Bright with the participation of 22 students. In addition to the authors, teachers N. Mgoeva (Secondary School No. 8) and V. Eralieva (Bright School) participated in the assessment of the level of logical thinking and individual logical operations among students. The analysis of the statistically processed experimental results allowed for the statement that the use of diagnostic methods chosen by the authors with prepared didactic and diagnostic equipment is one of the ways to solve the problem of the formation of logical thinking and its components. The pedagogical expert was familiarised with the Code of Ethics of the American Sociological Association (2018) and the European Commission's guidance note on ethics and data Protection (2021).

■ RESULTS AND DISCUSSION

A great contribution to the solution of the problem under study was made by the author N. Menchinskaya (1989), who believes that the leading role in the development of logical thinking belongs to purposeful and systematic education and training in logical operations with a systematic approach to the pedagogical process. Despite the large layer of research in this area, there is still no unambiguous definition of this concept. Adhering to the vision of N. Menchinskaya (1989), R. Nemov (2018), and others, logical thinking is defined as the ability and skill of primary school students to independently perform simple logical operations. From this point of view, the structure of the concept of "logical thinking" includes: analysis, synthesis, comparison, classification, abstraction, generalisation.

Modern development of society and changes in the education system put forward new requirements for the process of personnel training. In the context of the implementation of educational standards of the Kyrgyz Republic, the main goal of primary school is the formation and development of universal educational actions (UEA). Among them, logical UEA are of particular importance, since they contribute to the development of school students' thinking abilities and their logical thinking. Table 1 provides brief ideas of scientists about the essence of the components that make up the concept of "logical thinking" and represent logical operations.

Table 1. Brief description of logical operations

No.	Logical operation	Definitions of logical operations
1	Comparison	Comparison of objects and phenomena with the aim of finding similarities and differences between them. "We know any object only by equating it with something and distinguishing it from something" (Ushinsky, 1974).
2	Analysis	The dismemberment of an object, mental or practical, into its constituent elements, followed by their comparison (Nemov, 2018).
3	Synthesis	Restores the whole dismembered by analysis, revealing more or less essential connections of the relationship of the elements identified by analysis. "Analysis and synthesis are the common denominators of the entire cognitive process" (Rubinstein, 1989).
4	Abstraction	Abstraction is the selection, isolation and extraction of one aspect, property, and moment of a phenomenon or object, essential in some respect, and its abstraction from the rest (Rubinstein, 1989).
5	Generalisation	"Generalisation is the rejection of individual features while preserving common ones with the disclosure of essential connections" (Blonsky, 1935).

Source: developed by the authors

It follows from the Table 1 that all logical thinking operations are closely interconnected, and their effective formation is possible only in a complex. For formation, as for any other process, appropriate conditions are necessary. One of the main pedagogical conditions for the implementation of the process of formation and development of logical thinking is the organisation of complex monitoring of school students' achievements using appropriate methods for diagnosing the level of mastery of logical operations. Diagnostics is an accurate definition of the results of the process, with the help of which it is possible to determine the achievement of the set goals. In this case, the results are considered taking into account the methods of their achievement, both the trends and the dynamics of the process are identified.

Currently, there are a significant number of diagnostic methods for determining the level of logical thinking and its constituent components. For example, the "Definition of Concepts" method establishes the level of mastery of the ability to abstract. The ability to generalise and concretise can be determined using the "Sequence of Events" method. The "Exclusion of Concepts" method allows for checking the ability to perform three operations (analysis, synthesis, and classification). With the help of L. Chuprov's (2009) "Inference by Analogy" method, the ability to compare is tested. Using the method of P. Carter & K. Russell (1998), it is possible to establish the level of development of six logical operations. The method A. Zak (1995) is able to assess the level of formation of the logical operation "comparison". From the above, it is clear that there are several

methods for assessing the level of each of the logical operations: some methods are aimed at checking the level of mastery of one logical operation, others – several.

The authors of this article tested the features and advantages of the last three of the above-mentioned diagnostic methods in a pedagogical experiment. They developed and tested diagnostic support for using each of them and demonstrated their importance in developing logical thinking and individual logical operations. In addition to a description of the diagnostic itself and a model of the protocol for its implementation, the diagnostic support included diagnostic tools, including a school student's answer sheet to

questions in a questionnaire or test, forms with test tasks, tables with evaluation criteria and distribution of points by levels of mastery of a logical operation, as well as a model of a summary multifunctional table for recording test results. Thus, Table 2 shows a fragment of a student's answer sheet to six test tasks by P. Carter & K. Russell (1998), used in the experimental work.

To carry out diagnostics in accordance with the methodology of P. Carter & K. Russell (1998), the diagnostic toolkit prepared by the authors of the article, in addition to the answer sheets (Table 2) intended for distribution to school students, includes Table 3 for assessors.

Table 2. Answer sheet for determining the level of logical thinking and each logical operation (fragment)

Full name of the school student _____ Class __ Secondary school _____		
Name of the subtest	The purpose of the subtest	The content of the subtest
First subtest	Identifying the level of development of the ability to conduct analysis. School students must find the original number based on the anagram data.	Task 1. Find an anagrammatic pair of numbers in parentheses. Underline this number: 1) 4792 (4748, 7492, 9265); 2) 3964 (1269, 3962, 4369); 3) 8614 (6841, 1452, 8154); 4) 3521 (3529, 2151, 1325); 7415 (7417, 4175, 4165).
Second subtest	Identifying the level of development of students' abilities to highlight the essential, the main thing, that is, the ability to abstract.	There is one word before the brackets and 5 words in the brackets. Find the 2 words written in parentheses that are most significant for the word in front of the parentheses. Underline these words: ■ division (class, dividend, pencil, divisor, paper); ■ cube (angles, wood, stone, drawing, side); ■ ring (diameter, sample, roundness, seal, door); ■ problem (condition, medal, doctor, question); ■ addition (sum, paper, victory, money, addend).

Source: developed by the authors based on the diagnostic methodology of P. Carter & K. Russell (1998)

Table 3. Distribution of points by levels, by subtest purpose, by criteria

No.	Purpose of the subtest	HL	AA	AL	BA
1	Theoretical analysis (anagram)	5	4	3	2
2	Highlighting the essential	5	4	3	2
3	Conducting a comparison	5	4	3	2
4	Carrying out classification	5	4	3	2
5	Carrying out a generalisation	5	4	3	2
6	Drawing an analogy	5	4	3	2
Overall test result for each level (assessment criteria)		25-30	19-24	13-18	7-12

Note: HL – high level, AA – above average, AL – average level, BA – below average

Source: developed by the authors based on the diagnostic methodology of P. Carter & K. Russell (1998)

Table 3 shows that the answers to the tasks of each subtest are assessed on a five-point scale in accordance with the methodology of P. Carter & K. Russell (1998). Each level corresponds to a range of six points, which generally determines the assessment criteria for checking the work completed by younger students. When checking and

assessing the work from the answer sheets for the entire test, the points were first calculated for the correct answers to each task from each subtest. The results of the checked work were entered into a summary Table 4 prepared according to the template, indicating the points scored and the corresponding level of mastery of the logical operation.

Table 4. Summary table of testing results of 4a grade students of Secondary School No. 8 in Bishkek (fragment)

School student's name	Subtest 1		Subtest 2		Subtest 3		Subtest 4		Subtest 5		Subtest 6		Overall result	
	Points	Level	Points	Level	Points	Level	Points	Level	Points	Level	Points	Level	Points	Level
1. Elnur	3	AL	3	AL	0	LL	3	AL	2	BA	3	AL	14	AL

Table 4. Continued

School student's name	Subtest 1		Subtest 2		Subtest 3		Subtest 4		Subtest 5		Subtest 6		Overall result	
	Points	Level	Points	Level	Points	Level	Points	Level	Points	Level	Points	Level	Points	Level
2. Adilet	5	HL	1	BA	0	LL	5	HL	2	BA	4	AA	17	AL
3. Bayel	2	BA	2	BA	0	LL	3	AL	3	AL	2	BA	12	BA
4. Marika	2	BA	2	BA	2	BA	3	AL	2	BA	0	LL	11	BA
5. Ademi	4	AA	1	LL	1	LL	3	AL	3	AL	5	HL	17	AL
6. Aibike	2	BA	2	BA	1	BA	3	AL	2	BA	0	LL	10	BA
7. Aelina	5	HL	4	AA	1	LL	2	BA	3	AL	4	AA	19	AA
8. Isa	2	BA	2	BA	1	BA	3	AL	2	BA	0	LL	10	BA
9. Islam	4	AA	3	AL	0	LL	4	AA	2	BA	2	BA	15	AL
10. Isabella	3	AL	1	LL	1	BA	2	BA	2	BA	1	LL	10	BA

Note: HH – high level, AA – above average, AL – average level, BA – below average, LL – low level

Source: developed by the authors based on the diagnostic methodology of P. Carter & K. Russell (1998)

The analysis of the contents of Table 4 highlights the broad possibilities of this method and the multifunctionality of the table. From the information on the horizontal lines, the level of proficiency in each of the 6 logical operations is determined for each school student, indicating the score, and the overall level of logical thinking is established based on the overall result (see the far-right column of Table 4). In addition, the analysis of the data in Table 4 by vertical columns allows for the determination of the degree of mastery of each of the six logical operations by all school students and distribute them into five subgroups with the corresponding level of logical thinking or a particular logical operation (high, above average, average, below average, low). For example, Elnur, according to the first, second, fourth, sixth subtests and logical thinking,

falls into the subgroup with the average level (Table 4). While, having gaps in mastering the logical operation of generalisation (fifth subtest), he ends up in the subgroup with a low level and needs additional support from the teacher. Based on the statistical processing of the data from Table 4, students of grade 4a of Secondary School No. 8 were distributed into 5 subgroups by the level of logical thinking (Table 5). Moreover, schoolchildren from the subgroups with a low and below average level clearly need additional help and support from the teacher.

Table 6 provides similar results for comparison of the diagnostics of logical thinking of school students from the private international school Bright using the diagnostic support described above according to the method of P. Carter & K. Russell (1998).

Table 5. Distribution of school students from grade 4a of Secondary School No. 8 into subgroups by level of logical thinking (ascertaining experiment)

The group number with the name of the level	Number of school students in subgroups	Percentage of school students in subgroups
1. High level (HL)	1	4%
2. Above average (AA)	3	12%
3. Average level (AL)	8	32%
4. Below average (BA)	9	36%
5. Low level (LL)	4	16%
Total	25	100%

Source: developed by the authors based on the diagnostic methodology of P. Carter & K. Russell (1998)

Table 6. Distribution of pupils of class 4a of the Bright school by levels of logical thinking during the ascertaining experiment

Group number with level name	Number of school students in subgroups	Percentage of school students in subgroups
1. High level (HL)	1	5%
2. Above average (AA)	4	18%
3. Average level (AL)	8	36%
4. Below average (BA)	6	27%
5. Low level (LL)	3	14%
Total	22	100%

Source: developed by the authors based on the diagnostic methodology of P. Carter & K. Russell (1998)

A comparative analysis of the data from Tables 5 and 6 shows that the level of logical thinking in private school students is higher, since the subgroups with a level above average and high in the class from the Bright school made up 23% in percentage terms, and in the class of Secondary School No. 8 – 16%. But still, the subgroups with a low and below average level make up 41% in the class of the Bright school. This indicates that private school teachers also need to look for ways to improve the level of logical thinking.

When using the diagnostic method of A. Zak (1995), which allows determining the level of mastery of the “comparison” operation by school students, a diagnostic

tool was also prepared. In this case, cards with his 22 exercise-tasks and memos with recommendations of A. Zak on the rational sequence of solving the exercises with an indication of their numbers, on the possibility of replacing artificial words with real ones in the exercises, as well as answer sheets were prepared and distributed to the school students. For those checking the students’ answers, the diagnostic tool contained cards with evaluation criteria and table layouts for recording the results of the check. After statistical processing of the data of the summary table with the results of checking the answer sheets, the school student were divided into subgroups in accordance with the level of formation of the ability to compare (Table 7).

Table 7. Distribution of students by levels of mastery of the logical operation “comparison” in the ascertaining experiment

Number of school students			
	High	Average	Low
In class 4a of Secondary School No. 8	5 (20%)	9 (36%)	11 (44%)
In the 4 th class of the private school Bright	5 (23%)	7 (23%)	10 (45%)

Source: developed by the authors based on the diagnostic method of A. Zak (1995)

In addition, in the above classes, diagnostics were carried out using the L. Chuprov method (2009), which also allows for determining the level of comparison skills. After statistical processing of the results, it was found that the subgroups with low and below average levels in percentage terms amounted to 56% in class 4a of Secondary School No. 8, and 45% in class 4a of the Bright school. From a comparative analysis of these results and the data from the contents of Tables 5, 6, 7 it follows that the results of diagnosing the level of mastery of the logical operation “comparison” using the three methods differ insignificantly (within 10%). Therefore, there are grounds for using one of them in the control experiment.

The conducted research confirms the key role of diagnostic support in the process of development of logical thinking of primary school students in the context of formation of universal educational actions regulated by the State Educational Standard of the Kyrgyz Republic. The obtained results of the ascertaining experiment clearly demonstrate heterogeneity of the initial level of formation of logical operations in primary school students, which emphasises the need for targeted and systematic work on development of this sphere of cognitive activity. The revealed advantage of the P. Carter & K. Russell (1998) methodology in the framework of ascertaining diagnostics is due to its complex nature, allowing assessing the level of proficiency in all basic logical operations and logical thinking in general.

At the same time, an analysis of the diagnostic capabilities of techniques focused on evaluating individual logical operations indicates their potential value for the implementation of the formative stage of learning. In particular, as S. Vorovshchikov (2010) notes, the use of “logical five minutes” based on the diagnosis of proficiency in a particular logical operation seems to be an effective tool for integrating developmental exercises into the learning process without additional workload and with the ability to

quickly monitor student progress. This approach allows for a combination of learning and assessment, contributing to a more informed assimilation of logical thinking techniques (Sundeeva & Sorokina, 2017). A comparative analysis of the results obtained in public and private schools revealed certain differences in the initial level of logical thinking, which may be due to different educational approaches and socio-cultural factors. This aspect requires further study to identify the most effective strategies for developing logical thinking in various educational contexts. The findings open up prospects for developing scientifically based methodological recommendations for the introduction of effective diagnostic support into the practice of primary education in the Kyrgyz Republic.

CONCLUSIONS

The study aimed at the scientific and theoretical substantiation and practical implementation of diagnostic support for the formation of logical thinking of primary school students from the standpoint of the requirements of the current State Standard of School General Education of the Kyrgyz Republic allows for a number of conclusions to be drawn. When determining the theoretical foundations of the study, it was established that the State Standard of School General Education of the Kyrgyz Republic designated the formation of UEA as the main goal of primary education. Among the different types of UEA, cognitive EA are of greater importance, which include logical EA that require the successful formation of logical thinking and the ability to perform logical operations. An integral part of the formation of logical thinking and the logical operations included in it is pedagogical diagnostics, which performs, along with the control, developing and stimulating functions. To use diagnostic methods in the educational process, the development of diagnostic support is justified, an integral part of which is a diagnostic tool.

The advantage of the diagnostic method of P. Carter & K. Russell and the diagnostic support developed for its implementation, consisting in the ability to determine the level of mastery of each logical operation and logical thinking in general by school students, and in its use at the ascertaining stage of the experiment, has been experimentally proven. Among the advantages of the diagnostic support of diagnostic methods aimed at determining the level of one logical operation, a more detailed study of the mastery of each of its components by school students is noted. From the analysis of the results of the ascertaining experiment conducted in Secondary School No. 8 and the private international school Bright it follows that the initial level of development of logical thinking in school students is heterogeneous and in many of them is insufficient for the effective formation of UEA. Moreover, it is noted that the level of logical thinking in students in grade 4a of the Bright school students is higher, despite the presence of school students with a low level of its formation. The revealed facts confirm the necessity of conducting a

formative experiment, the main purpose of which is to increase the level of logical thinking of students, using diagnostic support for determining the level of individual logical operations and “logical five-minute exercises”. Further research can be aimed at studying the influence of the developed diagnostic support and the system of “logical five-minute exercises” on the dynamics of the development of logical thinking of primary school students in the long term, as well as identifying optimal forms of integrating diagnostic procedures into the educational process, taking into account the specifics of various subject areas.

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None.

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Кенже мектеп окуучуларынын логикалык ой жүгүртүүсүн өнүктүрүүдө диагностикалык колдоо

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Аннотация. Кыргыз Республикасынын Мамлекеттик жалпы билим берүү стандарты башталгыч мектептин негизги максатын – билим берүүчү универсалдуу аракеттерди калыптандырууну белгилейт, алардын ичинен логиканы (анализ, синтез, салыштыруу, жалпылоо, абстракциялоо). камтыган таанып-билүү иш-аракеттери өзгөчө мааниге ээ. Окуучулардын таанып-билүү деңгээлин жогорулатуу, логикалык ой жүгүртүүнү өнүктүрүү процессин ишке ашырууда анын ажырагыс бөлүгү болгон диагностика жана диагностикалык колдоо болуп саналат. Макаланын максаты – башталгыч класстардын окуучуларынын логикалык ой жүгүртүүсүн өнүктүрүү үчүн диагностикалык колдоону тандоо жана негиздөө жана аны текшерүү. Изилдөөгө методологиялык ыкмалар (компетенттүүлүккө негизделген, ишмердүүлүккө негизделген) жана илимий билимдин ыкмалары, анын ичинде теориялык (психологиялык-педагогикалык адабияттарды талдоо), эмпирикалык (эксперимент, байкоо, өлчөө, салыштыруу, сыпаттоо) жана математикалык (эксперименттик натыйжаларды статистикалык иштетүү) камтылган. Аныктоочу эксперименттин жүрүшүндө Бишкек шаарынын №8 мамлекеттик бюджеттик мектебинин жана «Жаркын» жеке менчик мектебинин башталгыч класстарынын окуучуларынын мисалында логикалык универсалдуу окуу иш-аракеттеринин өнүгүү деңгээлин жеке логикалык операцияларды жана жалпы эле логикалык ой жүгүртүүнү диагностикалык методдордун артыкчылыктарын аныктоо максатында педагогикалык эксперимент өткөрүлдү. Эксперименттин статистикалык жактан иштелиген жыйынтыктарын талдоонун негизинде төмөнкүдөй корутундулар чыгарылды: башталгыч класстын окуучуларынын логикалык ой жүгүртүүсүнүн баштапкы деңгээли бирдей эмес жана алардын көбү үчүн билим берүүнүн Мамлекеттик стандартында талап кылынган акыркы натыйжаларга ийгиликтүү жетишүү үчүн жетишсиз; Тактоо экспериментин жүргүзүү үчүн эң чоң артыкчылыктарга Ф.Картердин жана К.Расселдин тиешелүү диагностикалык куралдары менен методдору ээ; Формативдик (өнүктүрүү) эксперимент үчүн жеке логикалык операциялардын диагностикалык ыкмалары артыкчылыктуу, алардын өзгөчө касиеттери логикалык (тренингдик) беш мүнөттүк сессияларды жана сабактардагы мониторинг элементтерин айкалыштырууга мүмкүндүк берет

Негизги сөздөр: логикалык операциялар; диагностика; диагностикалык каражаттар; таанып-билүү универсалдуу окуу иш-аракеттери

Диагностическое обеспечение развития логического мышления младших школьников

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Аннотация. Действующим Госстандартом школьного общего образования Кыргызской Республики установлена главная цель начальной школы – формирование учебных универсальных действий, среди которых особую значимость имеют познавательные, включающие в том числе логические (анализ, синтез, сравнение, обобщение, абстракция). Повышение их уровня у учащихся актуализирует процесс развития логического мышления, неотъемлемой частью которого является диагностика и диагностическое обеспечение для ее осуществления. Целью статьи был выбор и обоснование диагностического обеспечения развития логического мышления младших школьников и его апробация. В ходе исследования были задействованы методологические подходы (компетентностный, деятельностный) и методы научного познания, включая теоретические (анализ психолого-педагогической литературы), эмпирические (эксперимент, наблюдение, измерение, сравнение, описание) и математические (статистическая обработка результатов эксперимента). Проведен педагогический эксперимент по выявлению преимуществ методик диагностики отдельных логических операций и логического мышления в целом при констатирующем эксперименте на примере определения уровня сформированности логических универсальных учебных действий у учеников начальных классов госбюджетной школы №8 и частной школы «Брайт» в городе Бишкек. На основе анализа статистически обработанных результатов проведенного эксперимента сделаны выводы: исходный уровень логического мышления не одинаков у младших школьников и у многих из них недостаточен для успешного достижения конечных результатов, требуемых образовательным Госстандартом; наибольшими преимуществами для осуществления констатирующего эксперимента обладает методика Ф. Картера и К. Рассела с соответствующим диагностическим инструментарием; для формирующего (развивающего) эксперимента предпочтительны методики диагностики отдельных логических операций, особенности свойств которых позволяют совмещать на уроках логические (тренинговые) пятиминутки и элементы мониторинга

Ключевые слова: логические операции; диагностика; диагностический инструментарий; познавательные универсальные учебные действия



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The influence of emotional intelligence on the adaptation of first-year students at a technical university

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Abstract. The article presented the results of the study of the influence of emotional intelligence on the adaptation of first-year students in the educational environment of a technical university. The relevance of the study is that emotional intelligence, as one of the unique phenomena of modern psychological science, has not been sufficiently studied. Such problems as the manifestation of emotional intelligence in different categories of people; how much emotional intelligence is developed in young people, how objectively they realise it, how emotional intelligence affects students' relationships in the educational environment and students' academic achievements, etc., remain unexplored. The purpose of the article was to reveal the scientific and theoretical foundations of emotional intelligence, to identify the most established scientific views on the nature of the phenomenon in question, to determine how this property is developed in students of a technical university, what is its influence on the adaptation of first-year students at the university, how students can manage their emotional intelligence, who helps them with this, etc. An analysis of the current state of the scientific and theoretical foundations of emotional intelligence showed that the most established view is that of emotional intelligence as a manifestation of the internal emotional attitude of the individual, accompanied by intellectual awareness of social behaviour, attitudes toward different types of activities and interactions in the environment. The article, based on modern research methods – tests of Hall and “Emin” (D. Lyusin), as well as on the results of a special ascertaining experiment, revealed the ways in which emotional intelligence influences students' academic achievements, the adaptation of pre-university students in the educational environment, the development of self-motivation, empathy in students, the recognition of other people's emotional attitudes, and the management of their emotional intelligence, which are a consequence of the purposeful supportive pedagogical activities of teachers. The practical significance of the research results lies in the fact that they can be used in the development of various adaptation programs for students, including those aimed at developing emotional intelligence as a psychological factor that ensures effective sociopsychological adaptation to the educational environment of a higher educational institution

Keywords: internal emotional attitude; academic achievements; attitude to learning; self-motivation; recognition; emotion management; adaptation programs

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■ INTRODUCTION

The social function and distinctive feature of higher education consisted in its responsibility to provide advanced professional training of socially and emotionally competent specialists demanded by the labour market, which, in turn, depended on the quality of education. Consequently, the quality of professional training of specialists remained one of the important tasks of the social and economic development of society (Shafait *et al.*, 2021). The implementation of new innovative educational technologies accompanied by the emotional intelligence (EI) of students into the university education system was expected to improve the quality of professional education at the university, thereby ensuring the formation of competitive personnel possessing professional competencies (Varyvoda & Gordenko, 2024). Preliminary studies of ways to increase the effectiveness of higher professional education showed that learning outcomes at universities largely depended on the emotional intelligence of students during the educational process, with future young specialists required to be psychologically resilient, socially flexible, and endowed with high emotional intelligence. D. Goleman (2021) demonstrated that emotions played a much greater role in relationships and success at work.

As noted by M. Reva (2022), emotional intelligence represented, on the one hand, the ability to recognise, analyse, and control one's own feelings and emotions, and on the other hand, the skill to sense and understand the moods of others. The higher and more productive the implementation of higher education based on the consideration of students' EI, the more highly qualified the specialist would be, along with their contribution to societal development and their own emotional well-being. One of the important ways to achieve such a result was reliance on students' EI in the university educational process. This implied that within the higher education system, significant importance was placed on the formation of professionalism combined with high emotional intelligence, which were essential conditions for improving learning outcomes. Consequently, there arose a need to enhance learning results through the systematic implementation and application of EI strategies. If this was the case, university students had to be professionals capable of responding to societal demands through EI, thereby achieving success in the learning process (Zhoc *et al.*, 2018).

Each university, depending on its mission, internal institutional structure, quantitative and qualitative composition of faculty members, characteristics of the educational environment, students' value orientations, and learning strategies, could encounter different stressful, emotional situations, shocks, and difficulties requiring resolution. These difficulties were primarily connected to the level of development of students' social and emotional intelligence, which manifested differently depending on a person's ability to perceive and understand their own and others' emotions, regulate, and control their own and others' emotional states. EI and learning outcomes ensured the achievement

of many successes in various fields beyond formal education, such as in professional activities. Therefore, the study of problems related to students' EI in order to ensure adaptation to the educational process and improve academic achievement became one of the urgent tasks of university pedagogy (Mamina, 2021).

The transition from school life to studying at a technical university represented a significant challenge for first-year students. Besides academic adaptation to increased workload, difficulties of technical disciplines, and new teaching methods, students faced the necessity to integrate into a new social environment, build relationships with peers and instructors, as well as independently resolve numerous everyday and organisational issues. In conditions of high competition and often abstract nature of technical specialties, stress, self-doubt, and difficulties in interpersonal interaction could become serious obstacles to successful adaptation and academic performance. In this context, the role of emotional intelligence became especially significant (Tsybulskaya *et al.*, 2024). The ability to recognise and manage one's own emotions, understand the feelings of others, build empathetic relationships, and effectively cope with stress could substantially facilitate the adaptation process, help students overcome academic difficulties, find support within the social environment, and maintain the necessary level of motivation and well-being throughout the entire period of study. The aim of this article consisted in investigating the relationship between the level of emotional intelligence development in first-year technical university students and their success in the adaptation process to the conditions of higher education institutions.

■ LITERATURE REVIEW

A preliminary excursion into the history of research on emotional intelligence (EI) problems showed that the concepts of emotion and intelligence (important manifestations of a rational person) were quite complex and contradictory. At the same time, the interdependence of these concepts and phenomena was universally acknowledged. Life demonstrated that every person was subject to these two important mental phenomena. A person was especially sensitive when something concerned their close ones – children, loved ones, etc. – and exhibited critical thinking and reason when analysing others' actions. Reason and empathy were two important aspects of personality that, to some extent, opposed and competed with each other. However, interaction between them could lead to the emergence of empathy with rational approaches, which helped to better understand others and make informed decisions. It was assumed that emotion, as sensitivity, was closer to and an earlier manifestation of human traits. However, human actions based predominantly on emotions (whether positive or negative) could provoke similar emotions in those to whom they were directed; hence, a rational effect was required. At the same time, as noted by N. Kozlov (2014),

“a person ‘living by the head alone’ did not always understand others, often losing out to them in spontaneity, brightness, and the forcefulness of emotions. On the other hand, a person living solely by emotions and feelings too often found themselves in problematic situations that could have been avoided...” At the same time, “we overestimate the significance of purely cognitive abilities... but intelligence is powerless when emotions take over.” The authors adhered to the view that harmony arose as a result of a balance between reason and human emotions. As noted above, harmony between mind and feelings was possible and necessary, consisting not in equality but in hierarchy: reason made responsible decisions, while subordinated feelings assisted in this.

Analysis of the study by P. van der Zanden *et al.* (2019) showed that successful people coloured their lives with emotions, but in situations requiring responsible decisions, emotions were sidelined in favour of reason. From this arose the necessity to form emotion and intelligence as a symbiosis of sensitivity and reason in human life activity, especially at a young age when feelings overflowed and were not always subject to analysis. EI in this case was understood as the ability to recognise one’s own and others’ emotions and manage them. This implied that educators, in the learning process, needed to pay attention not only to learning outcomes but also to monitoring the acquisition of intellectual, social, personal, and emotional skills necessary for students to achieve success in social life.

Theoretical analysis showed that despite numerous characteristics attributed to the concept of emotional intelligence, the absence of a unified definition and the vagueness of the term persisted. The research by M. Brackett *et al.* (2004) indicated the scientific relevance and practical significance of studying this psychological phenomenon, through which human behaviour could be predicted. Researchers adhered to the opinion on the importance of EI in human life, while also noting the difficulty of creating a unified concept based on the conclusions of various studies. The authors distinguished between interpersonal and intrapersonal types of emotional intelligence. According to scientific studies, people with a high level of EI could properly regulate states of emotional instability; a high level of interpersonal EI formed communicative competence, on the basis of which predisposition in the field of interpersonal relations was established; a high level of intrapersonal EI provided convincing evidence that persistence in achieving goals, persistence in decision-making and implementation – in other words, in the field of professional activity and personal achievements – was enhanced.

E. Erickson (1993) noted that “conditions ensuring the emotional well-being of an individual included a sense of individuality, sociability, and the ability to build close relationships, as well as the ability to demonstrate activity.” D. Goleman (2021) revised the definition of emotional intelligence, equating it largely with “proper” social behaviour. He emphasised four components included in the structure of emotional intelligence: self-awareness, self-control,

social sensitivity, and relationship management. According to R. Bar-On (2012), emotional intelligence was “a set of non-cognitive abilities and skills that influenced the ability to successfully cope with environmental demands and pressures.” From this, it followed that a key point in improving academic achievements and learning outcomes of students was ensuring their socio-psychological adaptation, conditioned by the peculiarities of students’ EI.

In the study by S. Derevyanko (2007), emotional intelligence was characterised as influencing students’ adaptability indicators. In the realm of emotional experiences, EI played a predominantly regulatory role, whereas in subject-subject relations, it played a stimulating role. Research results by E. Belonosova (2016) showed that activation of personal resources and communicative abilities of students was possible during adaptation to the process of obtaining higher professional education. An important condition for successful adaptation was the presence of constructive communicative strategies, manifested as the ability to understand and be aware of one’s own emotional states and the emotions of others, to control one’s own emotions and evoke desirable emotions in others, and to establish relationships based on mutual goodwill with peers, instructors, and staff members.

A. Kuteynikov & D. Shandlarenko (2015) believed that the most academically successful students were also the most adaptive. The development of emotional intelligence through specialised techniques implemented in the framework of training programs would contribute to improving first-year students’ adaptation to university education. EI could be considered a criterion of successful adaptation to the educational process. Studies by A. Rean *et al.* (2022) and A. Voskovskaya (2022) emphasised that student adaptation, especially of freshmen, was an important condition for learning success. Attention to the peculiarities of foreign education systems in recent years showed that, in most cases, the focus was on social and emotional aspects of learning. The global SEL (social-emotional learning) program could be considered a foundation for this. The increased focus on models for developing social and emotional learning aspects was explained by the integration of components of self-awareness, self-control, and relationship skills in the learning process. In a number of studies, EI was considered a component of critical thinking, complex problem-solving, and creativity – emotional intelligence. In particular, J. Durlak *et al.* (2015) in their experimental studies investigated “student self-awareness” as an expression of emotional intelligence. Self-awareness as a measure diagnosed learners’ recognition of their own thoughts and emotions and their influence on their own behaviour. In doing so, learners demonstrated the ability to independently manage learning by effectively controlling their thoughts, emotions, and behaviour. On this basis, the possibility of achieving academic success was demonstrated.

The formation of a more adapted personality, and subsequently the development of personality as a whole,

depended on knowledge of mechanisms and patterns of development of these qualities. For this reason, much attention was devoted to the problem of adaptation in general, and the development of personal adaptive potential of EI in particular, in the works of A. Maklakov (2001) and D. Leontiev (2016). Coping was one of the main aspects of adaptation actively studied by psychologists. In their models, R. Bar-On (2000) and D. Goleman (2021) considered adaptive capacity as a separate element of emotional intelligence. R. Bar-On (2000) linked emotional intelligence and coping strategies aimed at solving problems and defined them as adaptive. If a person avoided problems, such coping strategies indicated a low level of emotional intelligence.

Research by K. Zhoc *et al.* (2018) showed that a considerable amount of work addressed the influence of EI on students' academic outcomes. Analysing some of these, Chinese universities attached great importance to considering students' academic performance and learning outcomes as crucial indicators of life. EI stimulated learners' attention to the learning process and maintained their interest in education during learning. The study by R. King & J. Chen (2019) reflected the importance of EI manifestations by instructors, affecting students' academic performance. How well a teacher understood the importance of emotions and was able to work with emotions influenced not only how they themselves learned but also significantly affected learners' behavioural characteristics and the overall educational situation. The authors regarded emotions as the main catalyst of learning.

E. Belonosova (2016), in the experimental study noted that the implementation of the program influenced the development of emotional intelligence, especially its interpersonal component, positively affecting student adaptation. To ensure a more successful adaptation process, it was necessary to conduct various training sessions aimed at developing skills for understanding others' feelings and emotions, as well as activities focused on performing special tasks in which students learned to work in teams, support, and understand each other.

Thus, many studies demonstrated that freshmen's success in studies directly depended on the level of development of their emotional intelligence. Therefore, the need arose to consider opportunities for improving the quality of education by making additions to some conclusions within the university education system. A natural question arose: was it possible to teach emotional intelligence? Experimental studies of university students employing "behaviour modification" methods demonstrated that specially organised training exerted a positive and significant impact on the level of emotional intelligence.

■ MATERIALS AND METHODS

To explore the theoretical foundations of emotional intelligence (EI) and its impact on the adaptation of first-year university students, academic achievement, and the ability to recognise and regulate their own EI within the

educational environment, modern methodologies and a comprehensive set of scientific methods were employed. Based on the research objectives and selected EI criteria, appropriate diagnostic tools were chosen. The theoretical phase involved methods of analysis, systematisation, generalisation, and comparative study of national and international psychological literature.

For diagnosing the state of EI and its influence on first-year students' adaptation, the Hall Emotional Intelligence Test (n.d.) and the Emotional Intelligence Test "Emin" by D. Lyusin (n.d.) were utilised. Among the empirical methods, a natural experiment was conducted to organise an educational environment aimed at developing EI and enhancing students' academic performance. The total sample consisted of 119 students (52 urban and 67 rural), aged 18-19 years, from the first and second years at the East Kazakhstan Technical University named after D. Serikbayev. The study took place in early October of the 2024/2025 academic year. Given the assumption that EI predominantly concerns students' social and interpersonal relationships, sociometric methods were applied to diagnose interpersonal relations within groups and assess the moral and psychological climate of faculties. In using sociometric techniques to study the influence of EI on academic achievement, attention was paid to both formal and informal social structures within the educational process. The research was conducted anonymously and with the informed consent of all participants.

The Hall Questionnaire measured levels of emotional awareness, emotion regulation, the ability to influence others' emotions, empathy, and self-motivation. Separate versions of the questionnaire were developed for urban and rural students (Hall Test for Urban Students, 2024; Hall Test for Rural Students, 2024). The "Emin" test assessed participants' abilities to understand and manage their own and others' emotions (Test "Emin" for Urban Students, 2024; Test "Emin" for Rural Students, 2024). To evaluate the impact of EI development on first-year students' adaptation, a formative experiment was conducted involving an experimental group (24 students) and a control group (28 students). The effectiveness of an 18-hour training program was assessed using non-parametric statistical methods, specifically the Mann-Whitney U test and the Wilcoxon signed-rank test. The study adhered to ethical standards outlined in the Code of Ethics of the American Sociological Association (2018) and the Guidance Note of the European Commission on Ethics and Data Protection (2021).

■ RESULTS AND DISCUSSION

Results of the Hall Test

(17 urban students participated in the study)

Emotional Awareness. As shown in Table 1, high scores on items related to recognising true emotions (30.37% fully agree and 33.33% mostly agree) indicate well-developed emotional awareness. This enables students to be conscious of their feelings and better navigate life situations.

Table 1. Interpretation of the “Emotional Awareness” scale, % of total students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
1	29.4	23.5	35.3	0	5.9	5.9
2	17.6	41.2	23.5	0	0	17.6
4	17.6	47.1	17.6	0	5.9	11.8
17	17.6	35.3	23.5	0	17.6	17.6
19	35.3	35.3	23.5	0	0	5.9
25	64.7	17.6	11.8	0	5.9	0
Med.	30.37	33.33	22.53	0	5.9	9.8

Source: developed by the authors based on Hall's questionnaire

Management of One's Own Emotions (Emotional Resilience, Non-Rigidity). As shown in Table 2, respondents demonstrated a moderately good ability to manage negative emotions, including overcoming them after distress and discarding negative feelings when necessary (9.8%

fully agreed, 16.67% mostly agreed, and 34.3% somewhat agreed). However, 31.2% of participants reported difficulties in completely letting go of unpleasant experiences, which may indicate the need for further development of emotional flexibility.

Table 2. Interpretation of the “Management of One's Own Emotions” scale, % of total students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
3	0	5.9	47.1	17.6	11.8	17.6
7	11.8	35.3	41.2	0	5.9	5.9
8	0	17.6	35.3	0	17.6	29.4
10	17.6	5.9	47.1	0	0	29.4
18	17.6	29.4	11.8	11.8	5.9	23.5
30	11.8	5.9	23.5	11.8	5.9	41.2
Med.	9.8	16.67	34.33	0	6.7	24.5

Source: developed by the authors based on Hall's questionnaire

Self-Motivation (Voluntary Emotion Regulation). Participants demonstrated confidence in their ability to concentrate and attain calmness, when necessary, as evidenced by responses to the question regarding the ability to enter

a state of readiness and focus (16.67% fully agree, 30.4% mostly agree, and 32.37% partially agree). This indicates a good level of self-motivation and the capability to mobilise oneself when required to achieve goals.

Table 3. Interpretation of the “Self-Motivation” scale, % of the total number of students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
5	35.3	11.8	47.1	0	0	5.9
6	29.4	47.1	5.9	0	5.9	11.8
13	23.5	23.5	41.2	0	5.9	5.9
14	0	23.5	29.4	0	17.6	29.4
16	0	41.2	35.3	0	5.9	11.8
22	11.8	35.3	35.3	0	11.8	5.9
Med.	16.67	30.4	32.37	0	7.85	11.8

Source: developed by the authors based on Hall's questionnaire

Empathy. As shown in Table 4, 84.34% of respondents demonstrated strong empathy and the ability to recognise the emotional needs of others, as evidenced by high scores on questions related to understanding the emotional

needs of those around them (22.6% fully agree, 30.4% mostly agree, and 31.34% partially agree). This enables effective interaction with others and provides support in difficult situations.

Table 4. Interpretation of the “Empathy” scale, % of the total number of students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
9	35.3	47.1	11.8	0	0	5.9
11	11.8	11.8	47.1	5.9	11.8	11.8

Table 4. Continued

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
20	11.8	35.3	41.2	5.9	0	5.9
21	35.3	23.5	35.3	0	0	5.9
23	35.3	23.5	29.4	0	0	11.8
28	5.9	41.2	23.5	5.9	11.8	11.8
Med.	22.6	30.4	31.34	2.95	3.9	8.85

Source: developed by the authors based on Hall's questionnaire

Recognition of Others' Emotions and Influence on Their State. As shown in Table 5, 76.43% of participants rated their abilities to influence others as fairly high (36.23% mostly agree and 40.2% partially agree). The ability to affect the emotional

state of others and provide support demonstrates that the respondents have developed not only skills in recognising others' emotions but also possess the capacity to positively influence the mood and emotional condition of those around them.

Table 5. Interpretation of the scale "Recognition of Others' Emotions and Influence on Their State", % of the total number of students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
12	11.8	29.4	47.1	5.9	5.9	0
15	0	52.9	47.1	0	0	0
24	0	41.2	35.3	0	5.9	17.6
26	17.6	35.3	35.3	0	0	11.8
27	17.6	35.3	35.3	0	5.9	5.9
29	0	23.5	41.2	11.8	5.9	17.6
Med.	7.8	36.23	40.2	2.95	3.93	8.82

Source: developed by the authors based on Hall's questionnaire

Overall, across these five aspects, it can be noted that the test participants demonstrated a good level of emotional intelligence; however, certain aspects, particularly the management of negative emotions, may require further development to achieve greater emotional flexibility and resilience.

Results of the Hall Test

(the study involved 43 rural students)

Emotional awareness was measured through the participants' ability to recognise their emotions and use them as a source of information. As shown in Table 6, 81.76% of respondents agreed with statements reflecting the value of emotions as a source of knowledge about life and the importance of understanding their true feelings (18.61% fully agreed, 32.55% mostly agreed, and 30.6% somewhat agreed). This indicates that the test participants possessed

good emotional awareness, understanding the significance of both positive and negative emotions for decision-making.

Emotion Regulation (Emotional Resilience, Non-Rigidity). Emotion regulation reflects the respondents' ability to cope with negative feelings, restore calm, and avoid fixation on negative experiences. As shown in Table 7, 67.06% of participants positively assessed their ability to calm down and manage negative emotions, with a high percentage of moderate (+1 scale, 35.65%) and neutral responses as well. This is particularly evident in questions related to the ability to "easily manage feelings" after distress and "not dwell on negative emotions" (15.11% fully agree, 16.3% mostly agree, and 35.65% partly agree). Thus, participants generally demonstrated good emotional resilience skills; however, some may require further development of flexibility in managing emotions under stressful conditions.

Table 6. Interpretation on the "Emotional Awareness" scale, % of the total number of students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
1	16.3	34.9	37.2	2.3	7	2.3
2	16.3	37.2	30.2	2.3	4.7	9.3
4	16.3	30.2	41.9	0	0	11.6
17	11.6	37.2	20.9	4.7	11.6	14
19	16.3	27.9	27.9	2.3	2.3	23.3
25	34.9	27.9	25.6	0	0	11.6
Med.	18.61	32.55	30.6	1.93	4.26	12.01

Source: developed by the authors based on Hall's questionnaire

Table 7. Interpretation of the “Emotion Regulation” scale, % of total students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
3	11.6	14	23.3	14	20.9	16.3
7	23.3	20.9	37.2	0	4.7	14
8	9.3	14	37.2	7	9.3	23.3
10	14	18.6	37.2	0	2.3	27.9
18	20.9	16.3	39.5	2.3	9.3	11.6
30	11.6	14	39.5	7	7	20.9
Med.	15.11	16.3	35.65	5.05	8.9	19

Source: developed by the authors based on Hall's questionnaire

Self-Motivation (voluntary emotion regulation). Self-motivation is characterised by the ability to evoke positive emotions and maintain calmness to complete tasks. As shown in Table 8, a high percentage (78.27% positive responses: 23.65% strongly agree, 27.5% mostly agree, and 27.12% somewhat agree) to questions regarding the ability to “evoke

positive emotions” and “be calm and focused” indicates that respondents generally demonstrated confidence in their capacity to sustain a positive attitude despite external circumstances. The conclusion: respondents possessed a strong ability for self-motivation, utilising their internal resources to maintain the emotional state necessary for goal achievement.

Table 8. Interpretation of the “Self-Motivation” scale, % of the total number of students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
5	37.2	34.9	18.6	2.3	0	7
6	23.3	41.9	20.9	2.3	4.7	7
13	18.6	16.3	30.2	2.3	9.3	23.3
14	18.6	18.6	30.2	0	9.3	23.3
16	23.3	23.3	39.5	0	4.7	9.3
22	20.9	30.2	23.3	2.3	4.7	18.6
Med.	23.65	27.5	27.12	1.53	5.45	14.75

Source: developed by the authors based on Hall's questionnaire

Empathy is associated with sensitivity to the emotional needs of others and the ability to respond adequately. The results showed that 78.33% of respondents gave positive answers regarding their ability to “listen to others” and “respond to the emotions of those around them” (21.33% fully agreed, 24.8% mostly agreed, and 32.2% somewhat

agreed), indicating a high level of empathy. Some participants selected neutral or slightly negative responses, which may indicate a need to further develop this skill for certain individuals. Therefore, the respondents demonstrated a high level of empathy, allowing them to understand and provide emotional support to others.

Table 9. Interpretation of the “Empathy” scale, % of the total number of students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
9	41.9	30.2	14	0	2.3	11.6
11	7	16.3	34.9	9.3	18.6	14
20	30.2	20.9	34.9	4.7	0	9.3
21	20.9	25.6	37.2	0	2.3	14
23	4.7	27.9	44.2	0	4.7	18.6
28	23.3	27.9	27.9	4.7	2.3	14
Med.	21.33	24.8	32.2	3.12	5.03	13.6

Source: developed by the authors based on Hall's questionnaire

Recognition of others' emotions and the ability to influence their emotional state reflect the social competence of the participants. As shown in Table 10, 78.35% of respondents demonstrated high scores on items related to “tuning into others' emotions”, “improving mood”, and “picking up cues in communication”, indicating the

respondents' confidence in their ability to positively affect the emotional state of others. Thus, the participants demonstrated strong skills in recognising and positively influencing the emotions of others, which is essential for establishing and maintaining harmonious interpersonal relationships.

Table 10. Interpretation of the “Recognition of Others’ Emotions” scale, % of total students

Questions	Strongly agree (+3)	Mostly agree (+2)	Partly agree (+1)	Strongly disagree (-3)	Mostly disagree (-2)	Partly disagree (-1)
12	16.3	30.2	34.9	0	4.7	14
15	23.3	32.6	34.9	0	2.3	7
24	14	20.9	32.6	2.3	2.3	27.9
26	23.3	34.9	27.9	0	2.3	11.6
27	20.9	18.6	44.2	0	4.7	11.6
29	16.3	16.3	27.9	4.7	9.3	25.6
Med.	19.02	25.6	33.73	0.78	4.3	16.3

Source: developed by the authors based on Hall’s questionnaire

Overall, the results from the Hall questionnaire indicated that the respondents demonstrated a well-developed emotional intelligence across all five scales. They exhibited strong skills in emotional awareness and management, self-motivation, empathy, and the ability to influence others’ emotions.

Results from the “Emin” test (35 urban students participated)

Analysis by Main Scales. Regarding interpersonal emotional intelligence (IEI), respondents demonstrated a relatively high ability to notice others’ emotions. For items 1, 3, 20, and 27, 34, 28, 22, and 24 students respectively selected “strongly agree” (22.85%) or “somewhat agree” (54.25%), indicating a high sensitivity to others’ emotions. The average score on this scale can be considered high.

Intrapersonal Emotional Intelligence (IAI). Questions aimed at understanding one’s own emotions showed that respondents generally had good awareness of their feelings. For items 7, 14, and 26, 30, 28, and 27 students respectively chose “somewhat agree” (47.63%) or “strongly agree” (33.3%), suggesting a moderate to high level of intrapersonal EI.

Understanding Emotions (UE). Responses related to comprehension of emotional states, both personal and others’, indicated that respondents possessed good emotion perception skills. For items 1, 20, and 32, 34, 22, and 19 students respectively selected “somewhat agree” (53.33%) or “strongly agree” (18.1%). The level of emotional understanding can be characterised as high.

The “Emotion Management” (EM) scale included items related to managing both own and others’ emotions. Responses showed that respondents did not always successfully regulate their emotions, especially under stress. For items 6, 12, and 37, only 12, 7, and 15 students respectively chose “somewhat agree” (19.03%) or “strongly agree” (13.33%). Conversely, for the same items, 23, 28, and 5 students selected “strongly disagree” (16.13%) or “somewhat disagree” (37.13%).

Subscale Analysis. Understanding Others’ Emotions (UEO). For items 1, 3, and 11, 34, 28, and 25 students respectively selected “somewhat agree” (54.27%) or “strongly agree” (28.6%). Responses to questions focused on perceiving and understanding others’ emotions indicated confidence in the ability to notice others’ emotional states. This subscale reflects a high level.

The subscale “Managing Others’ Emotions” (MEO) included questions about influencing others’ emotional states. Responses indicated that some respondents were

able to successfully support others’ moods, though not consistently. For items 9 and 15, 23 and 21 students respectively chose “somewhat agree” (52.85%) or “strongly agree” (10%), indicating a moderate level of managing others’ emotions.

Understanding Own Emotions (UOE). For items 14 and 26, 28 students each selected “somewhat agree” (47.15%) or “strongly agree” (31.4%), suggesting respondents were fairly confident in their feelings. This subscale is at a moderate to high level.

Managing Own Emotions (MOE). For items 6 and 28, 12 and 28 students respectively selected “somewhat agree” (41.4%) or “strongly agree” (15.75%). Responses to questions related to emotion regulation and self-control indicated that respondents sometimes experienced difficulties controlling emotional outbursts, reflecting a moderate level on this subscale.

Expression Control (EC). For items 21 and 39, 23 and 16 students selected “somewhat agree” (44.25%) or “strongly agree” (11.45%). Responses concerning control over emotional expression showed that respondents were moderately capable of regulating their emotions. This aspect can also be characterised as moderate.

In general, respondents demonstrated good skills in understanding emotions – both others’ and their own – reflected in high interpersonal and intrapersonal EI scores. However, skills in managing emotions, both personal and others’, require further development. This result suggests that respondents could better control and influence the emotional climate by improving their abilities in self-regulation and expression management.

Results of the “Emin” test (study included 24 rural students)

Analysis by Main Scales. Interpersonal Emotional Intelligence (IEI). For question 1 – 21, question 3 – 18, question 27 – 16 students selected “somewhat agree” (61.45%) or “fully agree” (15.65%). Respondents are mostly confident in their ability to notice the emotional states of others. This indicates a high level of interpersonal emotional intelligence.

Intrapersonal Emotional Intelligence (IIEI). For question 7 – 20, question 14 – 16, and question 26 – 17 students selected “somewhat agree” (45.83%) or “fully agree” (27.77%). Respondents are aware of their emotions and understand their causes. This suggests a medium or high level of intrapersonal emotional intelligence, as respondents can track and recognise their emotions.

Understanding Emotions (UE). Questions related to recognising emotional states show that respondents have high emotional sensitivity. For question 3 – 18, question 11 – 16, and question 20 – 19 students selected “somewhat agree” (61.1%) or “fully agree” (12.5%). The level of emotion understanding in the group can be considered high.

Emotion Management (EM). For question 6 – 8, question 12 – 1, and question 37 – 17 students selected “somewhat agree” (23.63%) or “fully agree” (9.7%). Respondents indicated that they do not always control their emotions in stressful situations, which indicates a medium level of emotion management. They may try to manage their reactions but do not always do so effectively.

Subscale Analysis. Understanding Others’ Emotions (UOE). For question 1 – 21, question 3 – 18, and question 3 – 16 students selected “somewhat agree” (51.37%) or “fully agree” (25%). The high level of this subscale is confirmed by the fact that 76.37% of respondents are confident in their ability to notice and understand others’ emotions.

Managing Others’ Emotions (MOE). For question 5 – 10, question 9 – 19 students selected “somewhat agree” (47.95%) or “fully agree” (14.6%). 37.55% of respondents report that they cannot always influence others’ emotional states. The level of managing others’ emotions is assessed as medium, as the ability to influence others is moderately developed.

Understanding Own Emotions (UOE). For question 14 – 16, question 26 – 17 students selected “somewhat agree” (43.75%) or “fully agree” (25%). These results show that respondents generally understand their emotions. This indicates a high level in this subscale.

Managing Own Emotions (MOE). For question 6 – 8, question 28 – 19 students selected “somewhat agree” (39.6%) or “fully agree” (16.7%). Responses related to self-control indicate that respondents sometimes experience difficulties managing their emotions. This points to a medium level on this subscale.

Expression Control (EC). For question 21 – 15, question 23 – 15 students selected “somewhat agree” (60.4%) or “fully agree” (2.1%). Respondents mostly control the expression of their emotions, indicating a moderate capacity for expression control. This subscale is also at a medium level.

Results of the study on emotional intelligence level and evaluation of the development program

Overall, the study results indicated that the participants demonstrated a good level of emotional intelligence, but certain aspects, particularly managing negative emotions in relation to others, might require additional development to achieve greater emotional flexibility and resilience. However, a considerable number of respondents experienced difficulties in recognising and managing emotions, both their own and those of others. Some respondents might face challenges in emotion recognition and management for various reasons, such as insufficient sensitivity to the emotions of others. Respondents could misinterpret others’ emotional states, struggle to maintain emotional contact, and fail to respond effectively to emotional signals from interlocutors. Individuals with a low level of emotional

awareness found it difficult to recognise their needs and were poorly informed about their internal state.

Regarding individual personality traits, factors such as anxiety, which causes avoidance of triggering situations, or self-centeredness, which leads to an inability to notice and understand others’ emotional states, were observed. The level of emotional intelligence development was important for emotional self-regulation and social interaction, as a low level of this component could increase risks associated with social isolation.

As demonstrated in Figures 1, 2, and 3, difficulties in recognising and managing emotions could impede the formation of deep and meaningful relationships. In Figure 1, among 24 rural students, 9 students selected the options “strongly disagree” – 16.7%, and “somewhat disagree” – 20.8%.

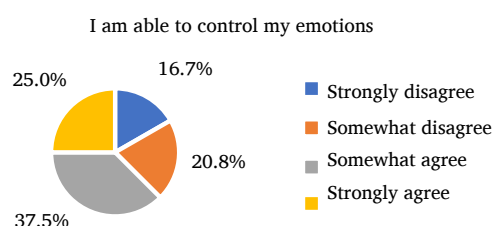


Figure 1. Ability to control one’s own emotions

Source: developed by the authors based on the “Emin” questionnaire

As shown in Figure 2, out of 24 rural students, 8 students selected the options “somewhat agree” – 29.2% and “strongly agree” – 4.1%.

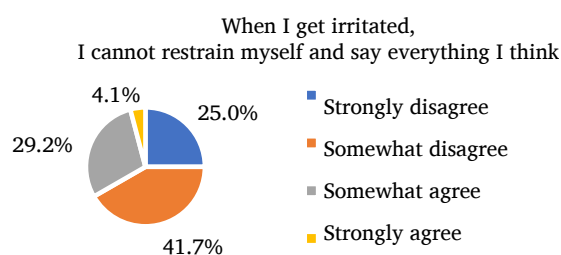


Figure 2. Student behaviour when irritated

Source: developed by the authors based on the “Emin” questionnaire

As shown in Figure 3, out of 35 urban students, 16 urban students selected the options “somewhat agree” (40%) and “strongly agree” (5.7%).

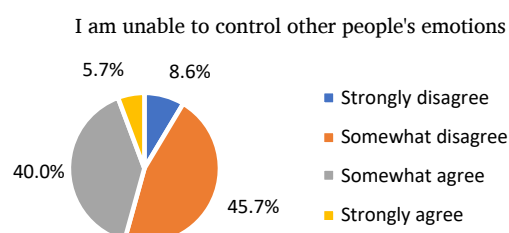


Figure 3. Ability to manage the emotions of others

Source: developed by the authors based on the “Emin” questionnaire

As shown in Figure 4, improving skills in emotional control and influencing the emotions of others can help respondents cope more effectively with emotional situations. "Somewhat disagree" – 37.5%, "strongly disagree" – 16.7%.

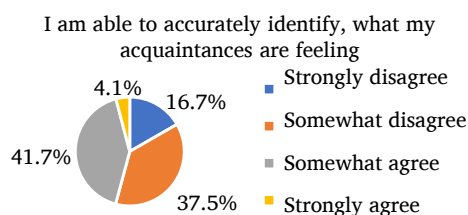


Figure 4. Ability to perceive what others are feeling
Source: developed by the authors based on the "Emin" questionnaire

As shown in Figure 5, out of 24 rural students, 11 students chose the options "somewhat disagree" (37.5%) and "strongly disagree" (8.3%).

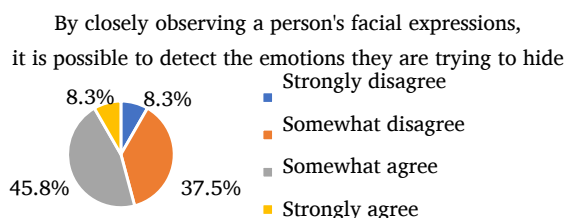


Figure 5. Ability to recognise the emotions others are hiding
Source: developed by the authors based on the "Emin" questionnaire

Figures 6-9 show that 11 out of 24 rural students and 12 out of 35 urban students demonstrated poor ability to manage mood. Additionally, 22 rural students out of 43 struggled to cope with pressure, which may indicate a low level of stress resilience. In response to the question, "I can easily detach from distressing experiences", 10 out of 17 urban students reported that they were unable to do so. Individuals with low stress resilience typically exhibit high sensitivity, where emotions dominate over rational thinking; they have low attention span and increased anxiety; they respond sharply to unexpected events (unable to control their reactions, possibly displaying aggression, shouting, or crying); they appear nervous, physically and mentally tense, and restless; they are unable to think clearly and respond adequately, struggle to manage emotions, and quickly fall into panic; they frequently suffer from insomnia and psychosomatic disorders.

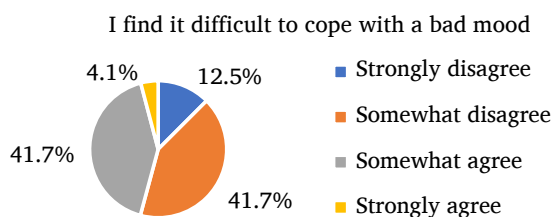


Figure 6. Ability to cope with bad mood (rural students)
Source: developed by the authors based on the "Emin" questionnaire

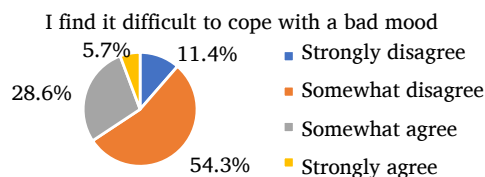


Figure 7. Ability to cope with bad mood (urban students)
Source: developed by the authors based on the "Emin" questionnaire

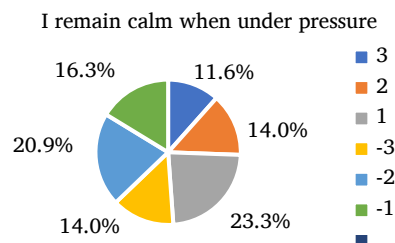


Figure 8. Ability to remain calm when under pressure
Source: developed by the authors based on the Hall's questionnaire

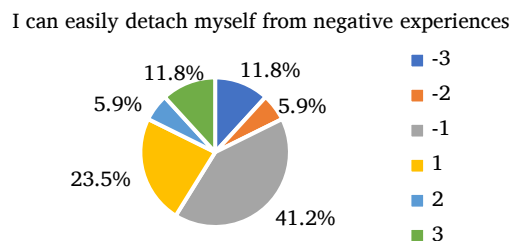


Figure 9. Ability to detach from negative experiences
Source: developed by the authors based on the Hall's questionnaire

Based on the research results, several conclusions were drawn. Overall, emotional intelligence plays a crucial role in the ability to adapt to various conditions. It represents the capacity to identify, recognise, and differentiate emotions (both one's own and those arising in others), as well as the ability to use the understanding of emotions to manage one's behaviour and relationships with others. Researchers note that the better developed emotional intelligence is, the higher the adaptive capabilities (Rean & Wang, 2024). Individuals with a high level of emotional intelligence adapt more easily to any situations and conditions without a decrease in performance or experiencing negative emotions (Palamarchuk & Korotsinska, 2020).

The results of the conducted study indicated the need for targeted work on developing emotional intelligence, aimed at improving the adaptation of first-year university students to academic life. To address this task, among participants with low adaptability and interpersonal emotional intelligence scores, an experimental group of 24 individuals and a control group of 28 individuals were formed. An 18-hour training program titled "Interpersonal Understanding in a Group" was implemented with the experimental group, aiming to create comfortable psychological conditions for developing interpersonal understanding among first-year students. The training program plan included:

1. Introductory part. The goal was to increase interest in the sessions and create a positive emotional atmosphere. A specific ritual was introduced, and a warm-up activity was conducted to activate group participants. The thematic focus related to psychological sciences.

2. Main part. This included a set of psychotechnical exercises and methods aimed at achieving the program's objectives. Special attention was given to developing emotional awareness, as previous research has shown that this is a key element of emotional intelligence that responds well to training (Ivanova, 2011).

3. Final part. This involved summarising the sessions, reflection, and a farewell ritual. Reflection entailed retrospective analysis in two directions: emotional (whether the session was liked or not) and meaningful (the significance and purpose of the session).

After the program completion, a reassessment of its effectiveness was conducted in both the experimental and control groups. Analysis using the Mann-Whitney test demonstrated a significant improvement in adaptation and interpersonal emotional intelligence scores among the experimental group participants, with mean values increasing from 30 to 34.3. To determine the direction of changes, calculations using the Wilcoxon signed-rank test were performed, showing an increase from 18.3 to 20.3, with statistically significant results. These findings indicate that the implementation of the program contributed to the development of emotional intelligence, particularly its interpersonal aspect, which positively affected student adaptation. The improvement in scores suggests that through mastering interpersonal interaction skills and techniques, students became better equipped to adjust to new environments and academic conditions. Therefore, emotional intelligence can be considered a criterion for successful adaptation to various spheres, including the educational process.

■ CONCLUSIONS

The modern educational system represents a complex multi-agent environment that requires not only the transfer and assimilation of knowledge, skills, and abilities but also the creation of an educational environment that facilitates the rapid adaptation and transformation of the established social relationships of recent high school graduates to the relatively free academic environment of the university and to the independent organisation of the learning process. Therefore, alongside the formation of academic skills, an important aspect of university education is the development of emotional intelligence (EI), which is defined as the ability to understand, recognise, and manage one's own emotions, as well as to interact taking into account the emotional states of others. This means that EI is a key aspect of social personality development and academic success of students in a modern university.

The study conducted, considering scientific-theoretical concepts of EI, as well as the results of original research related to the study of EI's influence on student adaptation and improvement of their academic achievements,

allowed the following conclusions to be made. Despite the fact that most psychological and pedagogical studies emphasise the importance and necessity of EI as a means of cognitive activity and stress its role in forming practical skills and abilities, and despite studies demonstrating the connection between EI and teachers' instructional activities in the educational process, issues related to the impact of emotional intelligence on students' self-organisation and adaptation in the educational process of technical universities remain insufficiently explored. A specialised study carried out considering the aforementioned circumstances and aiming to investigate students' self-regulation and their ability to control their EI showed that many students are well aware of the significance of EI in human life, have good self-motivation regarding EI, and show empathy towards participants in the educational process. At the same time, many of them struggle to manage their emotions, fail to direct their EI towards priority tasks in the cognitive process, have difficulty recognising the EI of others, suffer from an inability to regulate their mood, etc. The research confirmed the hypothesis about the necessity of psychological and pedagogical support of students' EI by identifying their attitudes and levels of EI development.

Therefore, one of the important tasks for improving the quality of education at universities remains the problem of psychological and pedagogical support for students' emotional intelligence at the initial stage of university education, which requires teaching them EI management through the introduction of specialised courses and EI regulation training. In their study, the authors demonstrated the relationship between student adaptation in higher education institutions by determining their levels of emotional intelligence development, which, besides university academic achievements, also influence other accomplishments. All this is determined by the possibility of implementation based on emotional intelligence and student adaptation.

Thus, the development of emotional intelligence plays a significant role in the successful adaptation of students to studying in a new educational institution and contributes to the formation of positive relationships with others. To help first-year students cope more easily with the transition to a new academic environment and community, it is necessary to take their individual characteristics into account and organise orientation programs – a series of practical sessions. These sessions should help students understand the challenges of the adaptation period, learn to effectively cope with emerging difficulties, and develop the ability to interact constructively with others. Special attention should be given to conducting trainings aimed at developing the ability to understand the emotions and feelings of others, as well as performing group tasks that will help students learn to work in teams, support each other, and show mutual understanding.

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Аннотация. Макалада техникалык университеттин билим берүү чөйрөсүндө эмоционалдык интеллекттин биринчи курстун адаптациясына тийгизген таасири боюнча изилдөөнүн жыйынтыктары келтирилген. Изилдөөнүн актуалдуулугу эмоционалдык интеллект заманбап психология илиминин уникалдуу кубулуштарынын бири катары жакшы изилденбегендигинде. Адамдардын ар кандай категорияларында эмоционалдык интеллектти көрсөтүү сыяктуу маселелер дагы эле изилдене элек; жаштардын эмоционалдык интеллектти канчалык өнүккөн, алар аны канчалык объективдүү билишет; макаланын максаты эмоционалдык интеллекттин илимий-теориялык негиздерин ачуу, каралып жаткан кубулуштун табияты жөнүндө эң туруктуу илимий көз караштарды аныктоо, техникалык жогорку окуу жайынын студенттеринде бул касиет канчалык өнүккөнүн, ЖОЖдогу биринчи курстун студенттеринин адаптациясына анын таасири кандай экендигин, студенттер өздөрүнүн эмоционалдык интеллекттин кантип башкарууну билишет, аларга ким жардам берет ж. б. Эмоционалдык интеллекттин илимий-теориялык негиздеринин азыркы абалын талдоо, социалдык жүрүм-турумдун интеллектуалдык аң-сезими менен коштолгон инсандын ички эмоционалдык мамилесинин көрүнүшү катары эмоционалдык интеллектке болгон көз караш, айлана-чөйрөдөгү ар кандай иш-аракеттерге жана өз ара аракеттенүүгө болгон мамиле эң жакшы жолго коюлганын көрсөттү. Макалада, заманбап изилдөө методдоруна таянуу-холл жана «Эмин» тесттери (Д. Лусин), ошондой эле атайын негиздөөчү эксперименттин натыйжалары боюнча, студенттердин академиялык жетишкендиктерине эмоционалдык интеллекттин таасири, билим берүү чөйрөсүндө биринчи курстун студенттеринин адаптациясы, студенттердин өзүн-өзү мотивациясын, эмпатиясын өнүктүрүү, башка адамдардын эмоционалдык мамилесин таануу жана алардын эмоционалдык интеллектин башкаруу, бул мугалимдердин максаттуу колдоочу педагогикалык иш-аракеттеринин натыйжасы. Изилдөөнүн жыйынтыктарынын практикалык мааниси, алар жогорку окуу жайынын билим берүү чөйрөсүнө натыйжалуу социалдык-психологиялык адаптациялоону камсыз кылган психологиялык фактор катары эмоционалдык интеллектти өнүктүрүүгө багытталган студенттер үчүн ар кандай адаптациялык программаларды иштеп чыгууда колдонулушу мүмкүн.

Негизги сөздөр: ички эмоционалдык мамиле; окуудагы жетишкендиктер; окууга болгон мамиле; өзүн-өзү түрткү берүү; таануу; эмоцияны башкаруу; адаптация программалары

Влияние эмоционального интеллекта на адаптацию первокурсников в техническом университете

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Аннотация. В статье представлены результаты исследования влияния эмоционального интеллекта на адаптацию первокурсников в образовательной среде технического университета. Актуальность исследования состоит в том, что эмоциональный интеллект как один из наиболее уникальных феноменов современной психологической науки недостаточно изучен. До сих пор не исследованными остаются такие проблемы, как проявление эмоционального интеллекта у разных категорий людей; насколько у молодых людей развит эмоциональный интеллект, насколько они объективно осознают его; как эмоциональный интеллект влияет на взаимоотношения студентов в образовательной среде и на академические достижения студентов и т.д. Цель статьи состояла в раскрытии научно-теоретических основ эмоционального интеллекта, выявлении наиболее устоявшихся научных взглядов о природе рассматриваемого явления, в определении, насколько данное свойство развито у студентов технического вуза, каково его влияние на адаптацию первокурсников в вузе, насколько студенты умеют управлять своим эмоциональным интеллектом, кто им в этом помогает и др. Анализ современного состояния научно-теоретических основ эмоционального интеллекта показал, что наиболее устоявшимся является взгляд на эмоциональный интеллект как на проявление внутреннего эмоционального отношения личности, сопровождаемого интеллектуальным осознанием социального поведения, отношение к разным видам деятельности и взаимодействия в окружающей среде. В статье, опираясь на современные методы исследования – тесты Холла и «Эмин» (Д. Люсин), а также на результаты специального констатирующего эксперимента, раскрыты пути влияния эмоционального интеллекта на академические достижения студентов, на адаптацию первокурсников в образовательной среде, на развитие самомотивации, эмпатии у студентов, на распознавание эмоционального отношения других людей и управления своим эмоциональным интеллектом, которые являются следствием целенаправленной поддерживающей педагогической деятельности преподавателей. Практическая значимость результатов исследования заключается в том, что они могут быть использованы при разработке различных адаптационных программ для студентов, в том числе направленных на развитие эмоционального интеллекта как психологического фактора, обеспечивающего эффективную социально-психологическую адаптацию к образовательной среде высшего учебного заведения

Ключевые слова: внутреннее эмоциональное отношение; академические достижения; отношение к обучению; самомотивация; распознавание; управление эмоциями; адаптационные программы



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Technology for developing 4C competency in teacher training

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Abstract. Modern society imposes new demands on the training of teaching personnel, especially in the context of digitalisation and global transformations in the field of education. Consequently, the integration of technologies aimed at developing key 21st-century competencies in future teachers has become highly relevant. The purpose of this study was to determine the effectiveness of integrating the 4C method into the training students majoring in education as a means of developing essential professional and universal competencies. The research employed methods of theoretical analysis of scientific literature, quantitative analysis with statistical data processing, a comparative approach to evaluating the results obtained through traditional and innovative teaching technologies, as well as student surveys conducted via the digital platform Kahoot. The study analysed the features of applying the 4C method (Creativity, Critical Thinking, Communication, Collaboration) in the educational process, compared the academic achievements of students from two experimental groups, and examined the impact of modern educational approaches on students' motivation and engagement. The results demonstrated that the application of this method significantly enhanced learning motivation, contributed to the development of sustainable professional skills, improved teamwork abilities, and fostered independent analytical thinking. Analysis of the findings showed a positive trend: the experimental groups exhibited higher levels of student engagement and improved overall learning outcomes. Additionally, it was established that the implementation of such technologies requires appropriate methodological support, digital resources, and teacher training for effective application. The practical value of this study lies in the fact that its results can be utilised by pedagogy instructors and educational methodologists when designing educational programmes aimed at developing 21st-century competencies among future education professionals

Keywords: 21st century; competence; digitalisation; educational standards

■ INTRODUCTION

The ongoing advancement of scientific and technological progress, the globalisation processes taking place around the world, and changes in society are also influencing the education system. The third-generation education standard for higher education institutions in the Kyrgyz Republic has raised the issue of reforming education within vocational training (Baitokova, 2017). Graduates of modern higher and secondary vocational-pedagogical institutions are

actively entering the teaching profession. In shaping behaviour, personal development, and communication – which play a vital role in the growth and formation of younger generations – alongside subject-based competencies, significant attention must also be paid to key competencies (informational, social-communicative, self-organisation, and problem-solving) (Grytsenko & Liashenko, 2023). The relevance of this research lies in the need to prioritise the

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development of key and subject competencies in teacher training, particularly through the use of modern technologies in shaping these competencies.

The concept of “competence” first emerged in the 1960s in the United States within the context of activity-based education. Its aim was to prepare specialists capable of successfully competing in the labour market. As for the terms “competence” and “competency”: competence, derived from the Latin *competere*, meaning to match or correspond, refers to the ability of a specialist to resolve various types of issues and to appropriately apply knowledge in relevant situations. Competency, according to N. Asipova (2019), is defined as an integrative ability to independently apply knowledge, skills, and abilities in different conditions. Thus, competence is a set of knowledge, abilities, skills, and personal qualities necessary to perform a specific task, while competency is the degree to which a specialist has mastered certain competences to perform effectively.

Competency-based education aims to guide future professionals toward becoming versatile specialists who can withstand internal and external competition and act competitively in any field by acquiring the necessary competencies. This approach is gradually taking shape. The development of these competencies in younger generations is greatly supported by the 4C model of competence. In elaborating the theoretical basis of this research, various educators have shared their perspectives, and some scholars have explored the historical development of the four skills. In the United States, these four skills began developing alongside other professional skills within the framework of military training programmes. “Hard” skills reflect one’s competency, domain-specific knowledge, and professionalism, while “soft” skills relate to communication, analytical ability, and general critical thinking (Gladneva, 2022). Some researchers, however, have noted various obstacles in forming these four skills. For instance, O. Ovsyannikova (2023) highlights that social, linguistic, interpersonal, and temperamental characteristics may hinder the development of communicative competence.

In studying pre-school children’s development based on the four skills, scholars have particularly focused on the competency of critical thinking. They have shared their views on using Edward de Bono’s “Six Thinking Hats” technique for developing this skill, suggesting its application during the reflection stage at the end of a lesson (Hamzina & Abykenova, 2022). Furthermore, several recent studies underscore the importance of integrating 21st-century skills into the educational process (Tsymbal, 2020). For example, a study published in 2024 analysed how teachers integrated 21st-century skills into their curricula and assessment practices. The research revealed that incorporating these skills into the learning process positively impacted students’ academic quality (Herlinawati *et al.*, 2024). Additionally, another 2024 study examined the potential of developing students’ 4C skills through gamified interactive assessment materials. The findings indicated that such methods help enhance students’ creativity, critical

thinking, communication, and collaboration skills (Ekaputra *et al.*, 2024). I. Listiqowati *et al.* (2025) analysed integrated teaching models such as the Project-Based Flipped Classroom, aimed at developing 4C skills in education. These models have been shown to increase student engagement and foster both creative and analytical (critical) thinking. The results demonstrated that this form of teaching is effective in developing students’ skills and their ability to apply knowledge in practice.

Drawing on the above academic sources, the relevance, effectiveness, and practical application of the 4C method in teacher training becomes evident. Effectively developing these competencies is seen as one of the key pathways to modernising the education system and aligning students with labour market demands. The objective of the study was to identify ways of developing professional competencies in pedagogy students based on the 4C method – namely, Creativity, Critical thinking, Communication, and Collaboration – and to evaluate the effectiveness of applying these skills in pedagogical practice.

■ MATERIALS AND METHODS

The methodological foundation of the research was based on the use of a set of interrelated, complementary approaches. At the theoretical stage, contemporary trends in education, 21st-century skills, and the 4C method were thoroughly examined through the study of scientific and methodological literature (Klarin, 2010). In addition, academic sources exploring the use of digital education platforms – particularly tools such as Kahoot – were also taken into account (Dillenbourg, 1999). The works of B. Trilling & C. Fadel (2009), which highlight the importance of teaching aimed at fostering creativity and collaboration, as well as the TPACK model, which demonstrates the need to integrate technology into the educational process (Mishra & Koehler, 2006), served as key components of the analysis.

The empirical part of the research involved a pedagogical experiment, which was used as the primary method of collecting empirical data (Slattenin *et al.*, 2013). The experimental work was conducted face-to-face with students enrolled in the Pedagogy programme at the Kyrgyz National University named after Jusup Balasagyn, within the framework of the course “Pedagogical Mastery”. The study was carried out during the winter semester of the 2024-2025 academic year. Two academic groups participated in the study: 20 students from group DO-23-11 and 25 students from group DO-22-9. The experiment consisted of two main cycles. In the first stage, traditional teaching methods were applied – such as delivering lectures, working with texts, and completing model-based assignments. In the second stage, active teaching methods based on the 4C concept were employed – these included group work, solving practical case tasks, collaborative presentations, and team discussions. The differences in teaching approaches made it possible to compare their impact on the quality of the educational process and student engagement. After each cycle, anonymous feedback was collected from

students through a questionnaire. The Kahoot digital platform was used to ensure a unified and accessible format for the survey. The collected data were processed using mathematical and statistical methods, including frequency distribution and intergroup comparison. This approach enabled the identification of differences in how students perceived learning materials and evaluated the teaching process.

All stages of the research were conducted in full accordance with the ethical principles of pedagogical research. All participants were informed in advance about the aims and conditions of the study. Participation was voluntary and completely anonymous. The research was carried out in accordance with the British Educational Research Association (BERA, 2024) Ethical Guidelines for Educational Research. Scientific articles, methodological manuals, modern digital education platforms, and academic publications dedicated to 21st-century skills and innovative teaching methodologies were used as sources of information for the research.

■ RESULTS AND DISCUSSION

The impact of the 4C competency on education

According to the requirements of standards in the higher and secondary vocational education system, all competencies within a given speciality are considered and implemented in the teaching of relevant subjects (Skornyakova, 2022). These include universal competencies: general scientific (GC), instrumental (IC), social-personal, and general cultural (SC). General scientific competence enables students to apply acquired knowledge broadly in their daily lives. They develop the ability to orient themselves within their chosen profession, to express their thoughts clearly and effectively, to master communication skills, and to engage in independent inquiry. The skills gained in class help them to satisfy their future needs in the teaching profession. Instrumental competence (organisational and problem-solving ability) leads students to deeply understand the essence of the teaching profession. As a result, they reach a level where they can independently resolve issues in both their professional careers and personal lives. Social-personal and general cultural competence shapes students' interpersonal communication and teamwork abilities, gradually forming social interaction skills. It equips them with the ability to engage in respectful dialogue, honour elders, respect peers, practise etiquette in communication, and confidently defend and justify their opinions. This, in turn, lays the foundation for a sustainable teaching career. Professional competence refers to possessing the necessary knowledge, skills, and experience for one's professional activity, as well as being prepared to address a variety of challenges in professional practice (Klarin, 2010).

When it comes to developing these competencies in students, it particularly requires pedagogical mastery, innovative approaches, and a strong emphasis on inquiry. The application of modern methods, new technologies, and educational innovations in developing competencies is yielding improved learning outcomes and reshaping how

competency development is approached. Currently, within the framework of the new educational standards in Kyrgyzstan, there is a growing need to explore the experiences of other countries that prepare teachers based on integrative and competence-based approaches, in line with the demands of modern reforms in higher professional education (Concept for the Development of Education in the Kyrgyz Republic, 2021). According to various authors, the pedagogical education system must be redirected to better align with the competencies required in the 21st-century. This redirection should be guided by international best practices. The global trend shows that in training future educators, it is essential not only to provide knowledge but also to ensure comprehensive professional readiness. In this context, one of the competencies adapted to modern requirements – the 4C competency developed in the United States – can serve as an effective framework for shaping relevant skills.

The history of the emergence of the 4C method

Looking into the history of the emergence of the 4C method: the 4Cs – Critical thinking, Creativity, Collaboration, and Communication – are four key skills that help individuals work successfully in all fields. These skills originated in the United States during the 1950s, when specialists developed them for training personnel in the armed forces. Over time, these four skills have come to be recognised as essential for the 21st century, and the 4C system has begun to be applied across various scientific and practical disciplines. Integrating these skills into the educational process, particularly in the training of pedagogical staff, demands swift and deliberate action (Mishra & Koehler, 2006). This is because the current information society urgently requires the formation of individuals who can think critically, argue their points with reason, collaborate in teams, and communicate effectively. In this context, B. Trilling & C. Fadel (2009) highlight creativity, communication, collaboration, and critical thinking as the most vital skills for success in the 21st century. Creative thinking, critical reflection on information, and the ability to communicate are not only essential at school or work but are also crucial for life in general. These skills help in forming strategies for achieving goals and in solving various challenges and tasks. A study by the OECD (2018) also notes that the education of the future should focus on developing “flexibility and responsible decision-making in challenging situations”. Modern employers report that beyond professional skills directly linked to job functions, they greatly value well-developed soft skills. To better understand the pedagogical value of this approach, it is important to examine the specific competencies encompassed by the 4C model.

According to the definition by American scholar, educator, and psychologist D. Klooster, critical thinking is, first and foremost, independent thinking; secondly, it begins and ends with questioning; thirdly, it relies on information as a foundation; fourthly, it is reasoned thinking; and fifthly, it is social thinking. The author states that critical thinking encompasses these five characteristics. By

developing critical thinking, today's students can achieve several outcomes: they come to understand its importance for professional growth and success in modern society; it helps them analyse and comprehend complex issues; it supports self-awareness and personal development; it enables them to distinguish facts from opinions in information sources; and it fosters observational skills (such as quickly identifying problems and determining their causes), analytical abilities (such as evaluating information and verifying facts), and the capacity to draw conclusions (such as processing and synthesising gathered data). P. Facione (2015) characterises critical thinking as "the process of evaluating and justifying evidence for decision-making".

Creative thinking involves approaching problems with originality and the ability to generate unconventional solutions. Creativity is the ability to view situations from a unique perspective, propose new and original ideas and solutions, think broadly and globally, and make non-standard decisions. R. Sawyer (2012) defines creativity as "a social process involving the generation, development, and sharing of ideas". Creativity reflects a person's ability to think innovatively in response to new conditions, as creative individuals are capable of producing fundamentally new and valuable outcomes and finding effective solutions that are highly relevant in today's world. Since creativity is a distinctive way of thinking that involves seeing the world from an unusual perspective, it should be nurtured from early childhood. Therefore, educators must pay special attention to fostering creativity in children.

Communication skills – such as the ability to connect with others and express oneself clearly – are essential. Through social interaction, individuals experience personal growth and self-discovery, gaining new knowledge and ideas about themselves and the world. Effective communication also involves adapting to the goals and context of the interaction, meaning the ability to choose appropriate methods and strategies depending on the situation. Persuasive communication, which involves selecting and applying suitable techniques and tools to achieve a specific goal, is also crucial. Communication is not merely the transmission of information; it is a process that fosters mutual understanding, builds relationships, and establishes trust (Hargie, 2011). Furthermore, A. Burns (2016) describes communication as a "vital social skill" necessary for successful education, encompassing not only the ability to express oneself but also to listen, understand, and respond appropriately.

Collaboration is the process by which two or more individuals or organisations work together in a shared environment to achieve common goals, involving knowledge exchange, learning, negotiation, and consensus-building. In today's world, this skill is in high demand, as nearly every profession involves some degree of teamwork. Therefore, future teachers must not only impart knowledge but also prepare students to interact with diverse individuals, resolve conflicts, and communicate harmoniously within a group. D. Johnson & R. Johnson (2009) describe collaboration as "interdependence and responsible interaction aimed at

achieving a goal", emphasising that mutual respect and support are key to successful teamwork. P. Dillenbourg (1999) also notes that collaboration involves the co-construction and reworking of knowledge, distinguishing it from individual learning. To develop these competencies, various technologies and methods can be applied in the learning process. Learner engagement is one of the most important issues in pedagogical science (Slastenin *et al.*, 2013). Active learning involves engaging with material thoughtfully and intuitively, applying one's full potential, and reaching a new, higher level of learning activity. Key methods include case analysis, discussion, round tables, brainstorming, problem-based learning, and role-playing games.

Using information derived from analytical discussions encourages independent decision-making and collective reflection. In the discussion phase, a controversial issue is openly debated from multiple perspectives, with participants presenting and justifying their viewpoints. This process helps students learn to support their answers with evidence and understand the value of different suggestions. The main goal is to generate innovative and unique solutions through collective thinking (Mambetkunov & Siyayev, 2002). Project-based learning, which focuses on outcomes, planning, evaluation, and practical application of knowledge, also plays a key role. Communication tasks such as "station rotation" and "flipped classroom" approaches allow for personalised learning experiences. Information construction involves organising, systematising, summarising, and transforming data. Thus, the use of pedagogical technologies in competency development plays a vital and indispensable role, as demonstrated through the practical application of the methods mentioned above.

Practical application and analysis of the 4C competency model

The main objective of the study was to examine how the use of the 4C method in modern education affects students' learning quality and engagement. This method is aimed at developing students' creativity, critical thinking, communication skills, and collaboration abilities. The experimental research was conducted with third-year students from two groups of the Pedagogical College at Jusup Balasagyn Kyrgyz National University: DO-23-11 and DO-22-9. Each group underwent two stages: the first involved traditional teaching methods, while the second employed modern methods incorporating elements of the 4C model.

The lessons were conducted within the framework of the pedagogy course, with identical content and topics across both stages. The difference lay in the teaching approach: in the traditional stage, lectures and Q&A sessions were used, whereas in the 4C stage, students worked in groups, solved problem-based scenarios, prepared presentations, engaged in discussions, and completed creative tasks. At the end of the experiment, students' academic performance was assessed anonymously via the Kahoot platform, and additional surveys were used to gather their feedback and evaluations. As shown in Table 1, both

groups demonstrated improved results after being taught using the modern 4C method. In group DO-23-11, 85% of students rated the 4C methodology as effective, while in

group DO-22-9, this figure was 72%. These results indicate that students were more actively engaged in the learning process and better absorbed the material.

Table 1. The results summary

Group	Traditional method	4C-based method
DO-23-11	65% (13 out of 20)	85% (17 out of 20)
DO-22-9	48% (12 out of 25)	72% (18 out of 25)

Source: compiled by the authors

These findings confirm that a teaching system based on the 4C competencies is significantly more effective than traditional methods. Improvements were observed in class participation, student interaction, depth of thinking, and engagement in creative tasks. According to instructors' observations, students became more willing to express their ideas openly and learned to resolve disagreements constructively. At the same time, several challenges were encountered in implementing this method. Firstly, not all instructors were adequately prepared to apply these methods. Secondly, some students were initially unaccustomed to working in teams, which led to lower engagement at the beginning. However, they gradually adapted during the learning process. Additionally, limited access to technical equipment and digital tools in classrooms posed another challenge.

The results of the study allow for concluding that education based on the 4C competencies is a method that meets the demands of the 21st-century. It not only improves the quality of students' knowledge but also enhances their social competencies. This method plays a particularly important role in the training of pedagogical personnel and offers the potential to elevate the education system to a new level. The 4C method significantly transforms traditional forms of education, prompting a re-evaluation of the roles of both students and teachers. In the world, shaped by technology and globalisation, these competencies have become essential requirements for the future workforce and for social integration. Moreover, by incorporating digital technologies and modern teaching tools, the 4C method makes the learning process more engaging. However, its successful implementation is accompanied by several challenges. Notably, many education systems lack the modern resources and qualified teachers necessary to develop 4C skills effectively. Thus, the 4C method has proven its relevance for advancing education in the 21st-century. Its implementation can play a key role in ensuring the future success of individuals in both professional and personal spheres. This competency model should aim not only to transform students but also to reshape the entire education system.

■ CONCLUSIONS

The findings of the study demonstrated that the 4C method holds significant importance and relevance in the preparation of pedagogical personnel. Through this approach, students effectively develop skills that are in high demand in modern society – namely creativity, critical thinking, effective communication, and collaboration. The data obtained

by comparing traditional and modern teaching methods during the experiment confirmed that the 4C method increases student engagement and interest in the learning process, while also significantly improving their communication and teamwork skills. For instance, in group DO-23-11, 65% of students showed positive results under traditional instruction, whereas this figure rose to 85% when the 4C method was applied. A similar trend was observed in group DO-22-9, where the percentage increased from 48% to 72%. These results indicate, firstly, that the 4C approach contributes to enhancing the effectiveness of teaching, and secondly, that it positively influences students' social and personal development alongside the educational process. The use of digital platforms in lessons – such as interactive assessment tools like Kahoot – helped to increase student interest and encouraged more active participation. This, in turn, transformed the teacher-student relationship into a more reciprocal, dialogue-based interaction, rather than a one-sided transmission of knowledge.

Each component of the 4C model plays a distinct and important role in the educational process. Creativity helps students unlock their potential and increases their interest in learning. Critical thinking enables them to analyse information, solve problems, and make reasoned decisions. Communication skills allow students to express their ideas clearly, engage in effective dialogue, and navigate social environments with confidence. Through collaboration, students learn to listen to one another and share responsibility when working in teams. All of these skills directly influence students' future professional activities and contribute to their development as successful specialists. Based on the study, it was concluded that the 4C method not only improves the quality of education but also serves as a key factor in modernising the education system and preparing professionals who meet global standards. This approach supports the development of future teachers not only in terms of knowledge but also in essential social skills. Furthermore, it creates the conditions for raising the quality of the educational process by fostering students' creativity, analytical thinking, and ability to interact with society. Looking ahead, promising directions for further research include examining each of the 4C components individually, developing effective teaching strategies, fully leveraging the potential of digital platforms, and exploring the impact of this method on students' academic performance and professional readiness. In addition, it is necessary to systematically integrate the 4C elements into teacher

training programmes and to develop methodological recommendations aimed at enhancing teachers' ability to apply this method effectively. In conclusion, the 4C method has fully demonstrated its scientific and practical value in the modernisation of education and the preparation of future professionals. It is expected to become an integral part of the education system in the future, with its effectiveness aligning closely with the demands of 21st-century education.

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Аннотация. Билим берүү тармагындагы глобалдык өзгөрүүлөрдүн жана өзгөчө санариптештирүүнүн шартындагы заманбап коом, педагогикалык кадрларды даярдоого жаңы талаптарды коюп жатат. Ушуга байланыштуу келечектеги мугалимдердин XXI кылымдагы негизги компетенцияларын өнүктүрүүгө багытталган технологияларды билим берүү процессине киргизүү актуалдуу болуп жатат. Бул иштин негизги максаты – педагогикалык кесипке ээ болуучу студенттерди даярдоодо кесиптик жана универсалдуу компетенцияларды өнүктүрүүнүн каражаты катары “4К” ыкмасын интеграциялоонун натыйжалуулугун аныктоо болуп саналат. Изилдөөдө илимий адабияттарды, теориялык талдоо методдорун, натыйжаларды жыйынтыгын чыгарууда математикалык-статистикалык методдорду колдонуу менен сандык талдоо, окутуунун салттуу жана инновациялык технологияларын колдонуу менен алынган натыйжаларды баалоодо салыштыруу, ошондой эле Kahoot санариптик платформасын колдонуу менен студенттерди сурамжылоо колдонулган. Иштин жүрүшүндө “4К” ыкмасын (креативдүүлүк, критикалык ой жүгүртүү, коммуникативдүүлүк, кызматташуу) окуу процессинде колдонуунун өзгөчөлүктөрү талдоого алынып, эки эксперименталдык топтун студенттеринин билим алуудагы жетишкендиктери салыштырылып, заманбап билим берүү ыкмалары менен өтүлгөн сабактар студенттерге таасирин тийгизе алды жана алардын кызыгуусун жаратты. Натыйжалар көрсөткөндөй, бул технологияны колдонуу окуу мотивациясын олуттуу жогорулатууга мүмкүндүк берет, туруктуу кесиптик көндүмдөрдү калыптандырууга өбөлгө түзөт, командада иштөө жөндөмүн өркүндөтөт жана өз алдынча аналитикалык ой жүгүртүүнү өрчүтөт. Натыйжаларды талдоодо оң динамиканы көрсөттү: эксперименталдык топтордо студенттердин активдүүлүгү жана окуу материалын өздөштүрүүнүн жалпы деңгээли жогорулаган. Мындан тышкары, мындай технологияларды ишке киргизүү үчүн тиешелүү усулдук колдоо жана санариптик ресурстар, ошондой эле мугалимдерди аларды колдонууга үйрөтүү зарыл экендиги аныкталган. Изилдөөнүн практикалык баалуулугу анын натыйжаларын XXI кылымдын компетенцияларын өнүктүрүүгө багытталган билим берүү программаларын иштеп чыгууда келечектеги билим берүү чөйрөсүндөгү адистер, педагогика тармагындагы мугалимдер жана методисттер колдоно ала турганында

Негизги сөздөр: XXI кылым; компетенттүүлүк; стандарт; санарип

Технология формирования компетенции «4К» в подготовке педагогических кадров

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Аннотация. Современное общество предъявляет новые требования к подготовке педагогических кадров, особенно в условиях цифровизации и глобальных преобразований в сфере образования. В связи с этим актуальным становится внедрение в образовательный процесс технологий, направленных на формирование у будущих учителей ключевых компетенций XXI века. Целью данной работы было определение эффективности интеграции метода «4К» в подготовку студентов педагогического направления как средства развития ключевых профессиональных и универсальных компетенций. В исследовании применялись методы теоретического анализа научной литературы, количественного анализа с применением статистической обработки результатов, сравнительный подход к оценке результатов, полученных при использовании традиционных и инновационных технологий обучения, а также анкетирование студентов с использованием цифровой платформы Kahoot. В процессе работы были проанализированы особенности применения метода «4К» (креативность, критическое мышление, коммуникация, кооперация) в учебном процессе, сопоставлены учебные достижения студентов двух экспериментальных групп, а также выявлено влияние современных образовательных подходов на мотивацию и вовлеченность студентов. Результаты показали, что применение данной технологии позволяет значительно активизировать учебную мотивацию, способствует формированию устойчивых профессиональных навыков, улучшает способность к работе в команде и развитию самостоятельного аналитического мышления. Анализ результатов показал положительную динамику: в экспериментальных группах наблюдалось повышение вовлеченности студентов и общего уровня усвоения учебного материала. Кроме того, установлено, что внедрение таких технологий требует соответствующего методического обеспечения и цифровых ресурсов, а также подготовки педагогов к их применению. Практическая ценность исследования заключается в том, что его результаты могут быть использованы преподавателями педагогики и методистами при разработке образовательных программ, направленных на развитие компетенций XXI века у будущих специалистов в сфере образования

Ключевые слова: XXI век; компетентность; цифровизация; стандарт обучения



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Preparing future teachers for the formation of a healthy lifestyle for students

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Abstract. Relevance of forming the foundations of a healthy lifestyle (HLS) among schoolchildren is due to the growing public attention to the issues of strengthening the health of the younger generation and the need to prevent diseases among children and adolescents. A modern school must not only provide education but also promote the development of a value-based attitude among students toward their own health. Informing students about the importance of health promotion, healthy eating, physical activity, and psychological well-being through school education is an essential part of the educational system. Teachers, in turn, must play a key role in fostering students' understanding of a healthy lifestyle as part of effective education. In this regard, the preparation of future educators to implement tasks related to the formation of a health culture becomes especially important. The purpose of this study was to identify the role of future teachers in shaping the foundations of a healthy lifestyle among schoolchildren, as well as to substantiate directions for improving their professional training. The study used methods such as theoretical analysis of scientific and pedagogical literature, generalisation, and interpretation of data. The study identified the main components of a healthy lifestyle that should be formed in students during their education: rational nutrition, physical activity, adherence to hygiene standards, and psycho-emotional well-being. The study analysed future teachers' understanding of HLS and their readiness to transmit this knowledge and these values to students. It was found that targeted training of pedagogical students in HLS foundations contributes to the development of personal responsibility for children's health and an awareness of their role in raising a healthy generation. The practical significance of the research lies in the possibility of using its results to develop teacher training programs in universities, as well as in organising professional development courses for current educators

Keywords: physical education; proper nutrition; hygiene; health; safe environment

■ INTRODUCTION

In the current socio-economic and cultural conditions of society, the issue of forming a culture of health is of particular importance. The Decree of the President of the Kyrgyz Republic S. Zhaparov (2021) states: "The family,

parents are obliged to ensure a healthy lifestyle and quality education for the younger generation, to form strong spiritual, moral and ethical foundations and work skills." This social challenge requires special training of modern

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teachers, especially students of pedagogical specialities, to teach healthy lifestyles and form a culture of health in school students. The current educational reforms have led to a revision not only of the content of school programmes, but also of the professional competencies of teachers. Research by A. Alimbekov (2016) shows that a healthy lifestyle directly affects students' academic achievement, social adaptation, and future professional success. Therefore, health education should be considered a key area in the training of educators (Palienko, 2022). Each person's life is unique and special, and health is considered a complex phenomenon that includes the physical, mental, social, and spiritual components of a person, as noted by A. Suprun & S. Salnik (2020).

A number of studies conducted in this direction in recent years show that future teachers lack the level of understanding of a healthy lifestyle and the skills to apply it in practice. For example, E. Dekina & T. Kulikova (2020) concluded in their work that most students of pedagogical specialisation associate the concept of a healthy lifestyle exclusively with physical activity, without taking into account its psychological and moral aspects. Also, the study conducted by N. Hodun (2022) revealed that although the theoretical level of disciplines aimed at the development of health culture in universities is relatively high, its effective formation in practice is insufficient.

Russian scientists D. Voikina & M. Nalimova (2019) emphasise that the role of the teacher in the formation of healthy lifestyle culture goes beyond the role of a "mentor" and becomes a key figure in the formation of life values. B. Barchi & M. Barchiy (2018) emphasise that the development of empathic skills and communication skills of future teachers is important for the proper transfer of the concept of healthy lifestyle to students. Also, globally, countries like Finland, Japan, and Singapore consider teacher training in health culture foundational for successful changes in their school education systems. Especially on the basis of the above scientific sources, it becomes clear that it is necessary to increase the readiness of future teachers to form a healthy lifestyle. In this regard, higher education institutions should use comprehensive, effective methods of healthy lifestyle formation when updating educational programmes.

In the process of training future teachers, the formation of their professional competence, adaptive mobility, ability to withstand competition, as well as a purposeful outlook on life and professional activity is one of the priority areas (Kozhevnikova & Kozhevnykov, 2024). Teacher training in the formation of healthy lifestyle of schoolchildren requires not only high theoretical knowledge, but also the ability to implement them in practice. In this direction, there is a need to make changes to the content, methods and pedagogical conditions of training future teachers. Integration of theory and practice, combining courses on health culture with practical and personal experience, introducing models aimed at using elements of a healthy lifestyle in pedagogical practice – this is the basis for a qual-

itative process. Along with the above considerations, the new generation of teachers should be a person who puts the formation of a healthy lifestyle in children as a priority. In this direction, it is necessary to make changes in the content, methods and pedagogical conditions of training future teachers. Integration of theory and practice, combination of courses on health culture with practical and personal experience, introduction of models aimed at using elements of a healthy lifestyle in pedagogical practice – these are the basis of a quality process. Along with the above considerations, the new generation of teachers should be individuals who make the formation of healthy lifestyles in children a priority. Because only by forming a correct lifestyle can conditions for the proper development of the growing generation be created. In this regard, this article aimed to reveal the meaning of a healthy lifestyle, to consider the issue of preparing future teachers and students for this process. The purpose of the study was to analyse the level of readiness of students of pedagogical specialties to form a healthy lifestyle and to substantiate the pedagogical conditions for its improvement.

■ MATERIALS AND METHODS

This study employed a qualitative, theoretical approach to explore the role of future teachers in fostering a healthy lifestyle (HLS) among schoolchildren and to propose directions for enhancing their professional training. The research design was grounded in a systematic analysis of existing scientific and pedagogical literature, ensuring a robust foundation for the investigation. The primary methods included theoretical analysis, synthesis, generalisation, and interpretation of data derived from scholarly sources. These methods were selected to comprehensively examine the multifaceted nature of HLS and its integration into teacher education programs.

The literature review encompassed peer-reviewed articles, books, and policy documents from 2013 to 2025, focusing on HLS components (e.g., physical activity, nutrition, hygiene, psychological well-being) and teacher preparedness. Sources were identified through academic databases and manual searches, prioritising works relevant to pedagogical training and health education. Key texts, such as A. Alimbekov (2016), E. Dekina & T. Kulikova (2020), and A. González Moreno *et al.* (2023), were analysed to extract insights on teacher competencies and student health outcomes. The analysis involved categorising findings into thematic clusters, such as HLS components and pedagogical strategies, to identify gaps and opportunities in teacher training.

Generalisation was used to synthesise findings into a cohesive framework, as presented in Table 1, which outlines HLS components and corresponding teacher preparation methods. Interpretation of the data focused on aligning theoretical insights with practical implications for university curricula. No primary data collection or experimental research was conducted, ensuring the study remained within a theoretical scope. This approach allowed

for a comprehensive exploration of the research objectives while maintaining methodological rigor suitable for informing educational policy and practice.

■ RESULTS AND DISCUSSION

The teacher's pivotal role in health promotion

A healthy lifestyle is a system of personal behaviour that provides a person with physical, mental, and social well-being in a real environment (natural, man-made, and social) and an active, long life. A healthy lifestyle creates the best conditions for normal life activity, the course of psychological and mental processes, thereby preventing diseases and prolonging a person's life. There are three types of health: physical, mental, and moral (social). Physical health is a natural state of the body, conditioned by the normal functioning of all its organs and systems. If all organs and systems work well, then the entire human organism (self-regulating system) functions and develops correctly. Mental health depends on the state of the brain, which is the level and quality of thinking, the development of attention and the degree of stability, the development of volitional qualities. Moral health is determined by those moral principles that are the basis of human social life, i.e., life that determines human society. The distinctive features of maintaining human moral health are, first of all, a conscious attitude to work, the assimilation of cultural treasures.

The harmony of the body's psychophysical forces increases health reserves, creating conditions for creative self-expression in various areas of life. An active and healthy person retains youth for a long time, continues creative activity. A healthy lifestyle empowers individuals to achieve their goals and objectives, successfully implement their plans, and effectively manage difficulties and colossal loads. Health, an intrinsic part of the individual, supports and strengthens, enabling a long and joyful life. Health is the priceless wealth of each person, both an individual and society as a whole. One of the main goals of the modern education system is to raise a generation that adheres to a healthy, active lifestyle. Teachers play a huge role in achieving this goal.

A healthy lifestyle is considered a way of life aimed at increasing the potential of human health through everyday activities. As noted in scientific sources, health care begins even before the birth of a child, and its basic qualities are formed in childhood. Therefore, the development of society is closely linked to the health of citizens, their responsible attitude to work and the Motherland. This process is influenced by natural, social and pedagogical factors. The

works of M. Lomonosov had pedagogical significance in the formation of pedagogical foundations of health. In his opinion, medicine is "the most useful science for humanity", caring about people's health, hygiene, nutrition and proving that physical exercises play an important role in strengthening health and development (Zhusueva *et al.*, 2014). In the introduction to D. Locke's book "On the Education of Children", N. Popovsky notes the health of the younger generation, recommends the systematic use of water procedures. Of particular value and interest for this problem is the treatise "A Brief Guide to Children from Birth to Adolescence, with Some Factual Observations Selected from the Best Authors" (1766), based on the pedagogical views of I. Betsky. D. Locke, J.-J. Rousseau show the importance of physical education of children and outline ways to maintain and strengthen health from childhood (Trineva & Repina, 2013).

The relevance of training future teachers is that there are many factors that negatively affect the health of students. Such problems as excessive use of computer technology, poor nutrition, insufficient physical education make it difficult to lead a healthy lifestyle. Therefore, teachers must be prepared to teach students the basics of a healthy lifestyle and to form healthy habits in them (Elaeva & Kryuchkov, 2015). The problem of forming the basics of a healthy lifestyle in students of all ages is one of the most important problems of education. The most favourable period for the formation of a child's personality is school age. School should and can become the most important component of the socialisation of the younger generation. At school, subjects of social transformations can gain spiritual and physical strength, find their own ways to solve the problems of personality formation.

Effective strategies for health lifestyle education and teacher preparedness

Four main areas occupy a special place in the formation of a healthy lifestyle: physical activity, proper nutrition, hygiene skills and psychological stability. These areas play an important role in strengthening the health of students and teaching them to avoid negative habits. In this process, the school teacher acts not only as a provider of information, but also as an educator who directly influences the behavior of children. Therefore, when training future teachers, it is necessary to have knowledge of the basics of a healthy lifestyle, as well as the ability to practically implement these skills. These components and teaching methods can be summarised in Table 1.

Table 1. Main components of a healthy lifestyle and ways of training teachers

No.	Components of a healthy lifestyle	Methods of teacher training
1	Physical education and sports	Include special courses on healthy lifestyle in the curriculum
2	Proper nutrition	Organisation of practical classes and school practices
3	Personal hygiene and health protection	Thematic seminars, trainings
4	Psychological health	Activities to develop students' emotional stability
5	Giving up bad habits	Learning by example of teachers

Source: developed by the authors

Preparing future teachers to form a healthy lifestyle for students is one of the priority issues in the field of education. These activities contribute to improving the health of students, their long and high-quality life (Kuatbekov & Kargapoltseva, 2018). Therefore, pedagogical universities and schools, working together, contribute to the upbringing of a healthy generation. In 2021, “class hours on a healthy lifestyle for students in grades 6-11” were developed (Gorkina *et al.*, 2021).

A healthy lifestyle has a specific structure. These include: a person's awareness of himself and his environment; striving to observe hygiene and relevant rules; personal and sufficient physical activity; strengthening the body with sunlight, cold water and fresh air; correct and rational nutrition; psychohygienic measures aimed at creating a positive emotional microclimate; observance of moral and positive behaviour established in society; rejection of bad habits; observance of safety rules in everyday life; striving to independently acquire a healthy lifestyle. The formation of a healthy lifestyle is influenced by external and internal factors. External factors include the social environment accompanying the life process, material, natural and living conditions, culture formed in society, as well as the microenvironment. Internal factors include a person's desires related to personal needs, values underlying life, personal attitudes, features of worldview, self-esteem (Savochkina *et al.*, 2019).

When understanding the theoretical foundations of organising a healthy lifestyle, it is important to understand the four levels separately. At the first level, it is important to create material and social conditions that ensure the quality of human life. These are basic conditions such as housing, income, safe environment. The second level is the creation of conditions for personal development of each person. This is related to the possibility of education, participation in social activities, health promotion, and sports. The third level considers the quality of social ties and interpersonal relations (friendly, family, professional relations). The fourth level is associated with the possibility of restoring energy: it is provided by proper nutrition, hygienic habits, observance of a rest regime. With these components in mind, effective ways of preparing future teachers are also clearly defined. Combining theory and practice, students should be given the opportunity to work with students in a school setting. For example, it is useful to organise activities to promote students' healthy lifestyles during practice. Also, seminars and trainings on the topic help students to learn different techniques, deepen their knowledge and develop skills of their practical application. These activities contribute to mastering pedagogical strategies that can influence students' health and well-being (Mamytov, 2021).

Analysing the effectiveness of test-based methods: Experimental tests can clearly identify which teaching methods are effective in promoting healthy lifestyles among students. For example, these could be tests that test knowledge of nutrition, physical activity, mental health and

other aspects of healthy lifestyles. Taking age and social factors into account: Test results can show how different age groups respond to health programs and how students' social status affects their perceptions of health. This is important for designing programs adapted to different groups of learners. Design of educational materials: Experimental data can help determine which forms of information delivery (e.g., games, videos, hands-on activities) are most effective for developing healthy habits (Quvondiqov, 2025). Psychological aspect: Test results can help students understand the psychological barriers that may prevent them from adopting healthy lifestyles. Teachers can use this data to develop strategies to improve motivation and overcome such barriers as key components of a healthy lifestyle.

A healthy lifestyle plays an important role in shaping not only students' health, but also their psychological state. Modern research shows that habits formed at a young age have a significant impact on a person's future life (Bruck, 2025). For example, A. González Moreno *et al.* (2023) found that adolescents who adopt a healthy lifestyle are less stressed, have higher self-esteem, and are less likely to be bullied at school. Digital technologies also have a positive impact on improving healthy eating habits and physical activity among youth (Benítez-Andrades, 2020; Benavides *et al.*, 2021). Health education programmes in higher education institutions have improved students' health perceptions and reduced risky behaviours (Çol *et al.*, 2024). At the same time, global scientific analyses have revealed worrying trends in adolescent health: with the rise in mental disorders and overweight, health education at school age is becoming increasingly important (Baird, 2025). Therefore, prevention and health promotion activities should be systematically integrated into the school environment through educational, digital and social initiatives.

In order to increase the competence of future teachers in the field of healthy lifestyle formation, it is necessary to introduce a number of special elements into the educational process. Firstly, it is recommended to organise courses on health and healthy lifestyle in higher education institutions. These courses would cover such important topics as proper nutrition, physical activity, stress management and psychological health. To consolidate students' theoretical knowledge in practice, practical lessons will be held on organising sports events, conducting games and physical education classes. It is also necessary to organise meetings with medical workers, nutritionists and fitness trainers in order to increase students' interest in the topic of healthy lifestyle. These events can be held in the form of master classes or webinars. Also of a particular importance is the development of motivational programmes for students to effectively implement healthy lifestyles in their lives. For example, as part of school projects “Healthy Lifestyle – My Choice!” students develop and learn to implement small projects on proper nutrition, sports and health. Organising special sport and health festivals within the school is also an effective way of getting student active. Such festivals may include activities such as marathons, races, yoga

classes. In addition, recognising students who have chosen a healthy lifestyle and are consistently implementing it in their lives with certificates and awards will undoubtedly motivate other students.

It is recommended to use new methods to make the learning process modern and interesting. Gamification takes a special place among them. Using of interactive games and quizzes on healthy lifestyles helps to keep students' attention. Also, organising practical activities – for example, holding master classes on healthy cooking in kitchens – will encourage the application of knowledge in life. Organising small physical exercises or breaks during lessons will also improve physical and psychological well-being and help to absorb knowledge effectively. All these actions will stimulate future teachers to systematic and effective work in their professional activity on forming healthy lifestyle habits in students. Only a teacher who has gained experience in promoting healthy lifestyles in everyday life can have a long-term positive impact on the behaviour and habits of students. Thus, mastering the significance, methods and basic principles of preparing future teachers to form a healthy lifestyle among students will undoubtedly bring great success to the younger generation in the future. “The single main driving force behind the socio-economic and digital development of the country is the education system. It depends on increasing students' interest in learning and their activity in learning” (Decree of the President of the Kyrgyz Republic, 2021). In conclusion, preparing future teachers for these activities builds sustainable skills that will accompany future teachers throughout their lives and improve their overall health.

■ CONCLUSIONS

The results of the study revealed that professional training of future teachers in the field of healthy lifestyle formation is an important direction of the modern education system. This direction requires comprehensive development of teachers' knowledge, skills, attitudes and views on health, psychological stability, social activity and culture of life. Based on the study, a multifaceted structure of healthy lifestyle formation was identified, which consisted of such basic components as physical training and sports, proper nutrition, hygiene, psychological stability and avoidance of bad habits. In addition, various levels of healthy lifestyle were comprehensively considered – from material and social conditions to the restoration of internal human resources.

In practical terms, it is recommended to use special courses, practical classes, interactive lessons and gamification

elements in higher education institutions on the topic of a healthy lifestyle. These methods, in addition to expanding the personal experience of students, provide them with a set of competencies necessary for the formation of healthy lifestyle skills in students. Obvious changes in student motivation are noted: attitudes towards health change, social activity increases, and responsibility for the profession increases. This is a factor that directly affects the quality of life of schoolchildren in the future. The practical value of the study lies in the possibility of systematic and effective integration of healthy lifestyle training into the curriculum of educational institutions.

It plays an important role not only in the work of teachers, but also in improving the health of society as a whole. Also, the introduction of healthy lifestyle culture into the educational process contributes to improving the quality of education and strengthening the psychological state of students. Further scientific research should focus on regional peculiarities of healthy lifestyle formation, factors affecting students of different ages, and the influence of teachers' personal experience of healthy lifestyle on pedagogical activity. Also, important promising directions are the development of innovative programs aimed at the formation of healthy lifestyle culture in educational institutions and the evaluation of their effectiveness.

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Болочок мугалимдерди окуучулардын сергек жашоо мүнөзүн калыптандырууга даярдоо

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Аннотация. Окуучулардын сергек жашоо образын калыптандыруунун актуалдуулугу коомдо өсүп келе жаткан муундун ден соолугун чыңдоо жана балдар менен өспүрүмдөр арасында оорулардын алдын алуу маселелерине өзгөчө көңүл бурулуп жаткандыгына байланыштуу. Заманбап мектеп билим берүүдөн тышкары, окуучулардын ден соолугуна болгон баалуулук мамилесин да калыптандырышы керек. Ден соолукту чыңдоонун, туура тамактануунун, кыймыл активдүүлүгүнүн жана психологиялык абалды чыңдоонун маанилүүлүгү тууралуу маалымдоо билим берүү тутумунун маанилүү бөлүгү болуп саналат. Мугалимдер, өз кезегинде, окуучуларга сергек жашоонун маңызын жеткиликтүү үйрөтүүдө негизги ролду ойношу керек. Ушуга байланыштуу болочок педагогдорду ден соолук маданиятын калыптандырууга багытталган милдеттерди ишке ашырууга даярдоо өзгөчө мааниге ээ. Изилдөөнүн максаты – мектеп окуучуларынын арасында сергек жашоонун негиздерин калыптандырууда келечектеги мугалимдердин ролун аныктоо жана алардын кесиптик даярдыгын өркүндөтүү багыттарын негиздөө. Изилдөөдө илимий жана педагогикалык адабияттарды теориялык талдоо, педагогикалык адистиктеги, алынган маалыматтарды жалпылоо жана интерпретациялоо колдонулду. Изилдөө учурунда мектепте калыптандырылышы керек болгон сергек жашоонун негизги компоненттери аныкталды: рационалдуу тамактануу, кыймыл активдүүлүгү, гигиеналык эрежелерди сактоо жана психоэмоционалдык жыргалчылык. Болочок мугалимдердин сергек жашоо тууралуу түшүнүктөрү жана аларды окуучуларга жеткирүүгө даярдыгы талданды. Педагогикалык багыттагы студенттерге сергек жашоонун негиздерин максаттуу үйрөтүү алардын балдардын ден соолугу үчүн жеке жоопкерчилигин калыптандырууга жана дени сак муунду тарбиялоодогу ролун аңдоого өбөлгө түзөөрү аныкталды. Изилдөөнүн практикалык мааниси жогорку окуу жайларындагы мугалимдерди даярдоо программаларын иштеп чыгууда жана мугалимдердин квалификациясын жогорулатуу курстарын уюштурууда колдонууга болот.

Негизги сөздөр: дене тарбия; туура тамактануу; гигиена; ден-соолук; коопсуз чөйрө

Подготовка будущих учителей к формированию здорового образа жизни учащихся

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Аннотация. Актуальность формирования основ здорового образа жизни (ЗОЖ) у школьников обусловлена повышенным вниманием общества к вопросам укрепления здоровья подрастающего поколения и необходимости профилактики заболеваний среди детей и подростков. Современная школа должна не только обучать, но и способствовать формированию у учащихся ценностного отношения к собственному здоровью. Информирование о важности укрепления здоровья, здорового питания, физической активности и психологического состояния посредством школьного образования является важной частью системы образования. Учителя, в свою очередь, должны играть ключевую роль в формировании понимания здорового образа жизни в эффективном обучении учащихся. В этой связи особую значимость приобретает подготовка будущих педагогов к реализации задач, связанных с формированием культуры здоровья. Целью исследования было выявление роли будущих учителей в формировании основ ЗОЖ у школьников, а также обоснование направлений совершенствования их профессиональной подготовки. В работе использовались методы теоретического анализа научной и педагогической литературы, обобщение и интерпретация данных. В ходе исследования были выявлены основные компоненты здорового образа жизни, которые должны формироваться у школьников в процессе обучения: рациональное питание, физическая активность, соблюдение гигиенических норм, психоэмоциональное благополучие. Проанализированы представления будущих учителей о ЗОЖ и их готовность транслировать эти знания и установки учащимся. Установлено, что целенаправленное обучение студентов педагогических специальностей основам ЗОЖ способствует формированию у них личной ответственности за здоровье детей и осознанию своей роли в воспитании здорового поколения. Практическая значимость исследования заключается в возможности использования его результатов при разработке программ подготовки будущих педагогов в вузах, а также в организации курсов повышения квалификации учителей.

Ключевые слова: физическое воспитание; правильное питание; гигиена; здоровье; безопасная среда



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The impact of the academic environment on student success

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Abstract. The academic success or failure of students in higher education institutions necessitates an in-depth investigation of the content of education and the factors influencing it. This article provided a scientific analysis of the key factors affecting students' academic performance and examined the interrelation between these factors and the academic environment. The scientific and practical relevance of the study is grounded in the increasing demand for quality education and the growing influence of the educational environment on students' academic outcomes. The purpose of the research was to identify the main factors influencing academic success among university students and to provide a comprehensive understanding of their interaction with the academic environment. The study employed systematic analysis, comparative method, survey, interview, and correlation analysis. The research involved students from higher education institutions in Kyrgyzstan. The findings revealed that internal motivation, pedagogical competence of instructors, the psychological climate of the educational environment, academic support, and collaboration among students significantly impacted academic success. The academic environment was conceptualised through three core components: infrastructural, axiological, and communicative-organisational. The analysis showed that academic failure was often linked to insufficient learning and living conditions, instructors' attitudes toward students, and discrepancies between institutional corporate culture and its ideal model. The scientific novelty lies in the fact that, for the first time, the interrelationship between the factors shaping students' academic success and the academic environment has been examined in a comprehensive manner. The practical value of the study is that its results can support higher education administrators, faculty, and policymakers in making effective decisions aimed at improving the academic environment. Consequently, this contributes directly to enhancing students' educational achievements

Keywords: academic success; educational environment; higher education institution; motivation; student achievement; academic support; corporate culture

■ INTRODUCTION

In the modern world, the quality of education is a key factor in the socio-economic development of a country. International comparative studies, including PISA, are of great importance for objective assessment of the state of education systems of different countries and determination of their competitiveness at the world level. The Kyrgyz Republic has twice participated in the PISA study – in 2003 and 2006 (PISA, 2023). The results of these studies revealed

serious problems in education in the country. Kyrgyzstan, occupying the last places in the world rankings (43rd and 57th places), proved that pupils of 7-9 grades have not reached the required level in basic educational competences.

In 2025, Kyrgyzstan will again participate in the PISA study. This will be the first cycle for the country to take place in a digital format, which will create new requirements and challenges. The study will assess the level of

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education of students in seven key competences: (1) reading and writing skills; (2) mathematical literacy; (3) scientific literacy; (4) information and communication technology literacy; (5) financial literacy; (6) cultural and civic literacy; (7) global competence. Kyrgyzstan's participation in the PISA-2025 study will make it possible to assess the current state of the education system at the international level. It will also contribute to analysing the effectiveness of the reforms, identifying strengths and weaknesses, and improving educational policy in accordance with global trends. Therefore, the relevance of this study is conditioned by the need to improve the modern education system. Such students have much better chances to continue their studies in secondary school and then in secondary and higher vocational institutions, but it can be said that their further success (failure) depends on the environment in which they study. This situation emphasises the need to study the factors of academic environment that influence students' success in education. Such strategies help students and teachers to develop experience and knowledge of working in different cultural and social environments, and encourage respect, exchange and understanding of ethnic and cultural diversity in society.

Success and unsuccessfulness in education are qualitative indicators of teachers' and students' achievements. In the article, the authors considered it as a situation reflecting the inconsistency of their educational activities with social expectations. The review of scientific publications also showed that the main focus of the study by T. Lebedeva *et al.* (2016) was on the study of factors affecting academic achievement as one of the elements of educational success. In it, analysing the statistical factors affecting the academic performance of university students, the authors concluded that such factors as the content of education, sources of income, use of free time have a significant impact on the high or low level of academic performance. However, the meaningful interpretation of the results obtained by the authors is not given in the article.

Researcher S. Lazarev (2016), studying the factors influencing learning outcomes, identified two sectors of their localisation: the first is the student's personal qualities and the second is the quality of the educational environment in which the student is located. A. Shaporov *et al.* (2019), studying the academic achievements of medical students, found that such personality traits as organisation and conscientiousness, as well as motivation to study, are associated with them. The study on academic giftedness in PRC universities by H. Tiwen (2023a) highlighted that student success encompasses not only high intelligence but also motivation, creativity, emotional intelligence, and leadership qualities. It emphasised that a tailored academic environment, utilising innovative teaching methods and modern technologies, is crucial for nurturing these diverse aspects of student potential. Analysing the historical development of academic giftedness abroad, the article by H. Tiwen (2023b) reveals that standard educational systems often fail to meet the needs of gifted students,

necessitating specialised programs and teacher training. The study underscored how responsive and differentiated academic environments, employing methods like accelerated learning and enrichment, are vital for maximising student potential. The research by A. Alekseeva (2022) demonstrated how socio-communicative competence and value-semantic priorities influence career self-realisation differently for men and women. The findings suggested that academic environments should account for these diverse motivational and value-driven predispositions to optimise professional development programs. S. Kostyu (2015) examined the psychological and pedagogical foundations of a student's worldview formation, defining academic success through an analysis of its psychological factors and the student's role as an active participant in their learning. The study underscored that a holistic academic environment must consider students' internal psychological aspects to effectively foster success.

L. Sibanda *et al.* (2015) analysed the factors influencing the academic success of students – regularity of classes, attendance and quality of assignments, the result of hard work, and determination. N. Isaeva (2014) noted that the influence of the educational environment of the school on the success of the student's personal and professional development depends on his perception and experience of the environment. According to S. Lazarev (2016), considering the general set of factors that determine learning outcomes as a complex phenomenon, 32% of them directly correspond to the educational environment. Although the impact of the educational environment on student performance is not of primary importance, its potential has not been studied in depth and is not assessed at the current level. The authors of the current study aimed to define the academic environment and its elements, as well as to consider in more detail the relationships that influence student learning.

■ MATERIALS AND METHODS

This study employed a comprehensive approach, integrating both theoretical and empirical methods. The theoretical foundation was established through a systematic analysis of academic literature spanning pedagogy, psychology, and the sociology of education. This rigorous review facilitated a conceptual analysis of “educational environment” and “academic environment”, enabling to delineate their interconnections and identify their core components. Furthermore, methods of synthesis, classification, and comparative analysis were utilised to structure existing theoretical frameworks and approaches. To ascertain the influence of the academic environment on student success and to determine the interrelationships between the identified factors, an empirical study was conducted. The study involved 5,132 students from the 1st to 5th courses of the J. Balasagyn Kyrgyz National University. These students represented 21 faculties and various fields of study. The sample was formed using a total enumeration method, drawing from students participating

in an online survey as part of the project “Assessing the quality of services provided by the J. Balasagyn State University” (2023). This approach ensured representativeness across different courses and faculties.

Empirical data collection was carried out via anonymous online questionnaires using the Google Forms platform. The questionnaire was designed to assess several key areas: students’ satisfaction with infrastructural conditions for learning and living (including lecture theatres, libraries, canteens, dormitories, and sports facilities); the psychological climate within the educational environment and their interactions with lecturers and peers; their subjective perception of the academic environment’s impact on their personal and professional development and overall academic performance; and their perception of the university’s corporate culture. Certain questions within the questionnaire were developed based on previously validated surveys for assessing the educational environment, adapted specifically to the context of higher education in the Kyrgyz Republic. The questionnaire comprised both closed-ended questions utilising Likert scales (a 5-point scale for satisfaction assessment) and open-ended questions to gather qualitative data on suggestions and perceived issues.

The online survey was conducted throughout the 2022-2023 academic year. Students were invited to complete the questionnaire voluntarily, and access was disseminated via the university’s information channels. Anonymity of participation was strictly guaranteed, which significantly contributed to eliciting candid responses. The survey adhered to the ethical guidelines for scientific research outlined in The Guidance Note of the European Commission on Ethics and Data Protection (2021). The collected quantitative data were processed using correlation analysis methods to identify relationships between various aspects of the academic environment and indicators of student academic success. The Excel statistical software package was utilised for this purpose. Qualitative data derived from the open-ended questions underwent content analysis to uncover key themes and patterns in students’ perceptions of the academic environment. Finally, the findings from the empirical investigation were correlated with the theoretical tenets to formulate comprehensive conclusions.

■ RESULTS AND DISCUSSION

Understanding the academic environment conceptual framework

In scientific literature, the concept of environment is closely related to such categories as space, environment, conditions. O. Netsenko (2015) comprehensively considers methodological principles and theoretical concepts of the phenomena of space and environment. Modern methods of understanding and studying the environment in philosophy, psychology and pedagogical sciences are based on the subject-subjective approach to socialisation, as they are aimed at identifying the subjective function of the environment. Approaches to the definition of

environment from a sociological point of view Sh. Hannanov (2011) defines the most general interpretation of the concept of “social environment” as a set of conditions that promote or hinder the transition of the subject’s activity to a certain state in the environment. This state of affairs emphasises the need to analyse the results of empirical studies of students’ satisfaction with learning conditions. Sh. Khannanov (2011), analysing the anthropocentric and exocentric concepts of the social environment, comes to the conclusion that the first is “What should the environment be like for a person to effectively develop in accordance with his life choices,” and the second is “How should a person manage the environment in order to effectively realise his personal goals and the goals of the group to which he belongs?” This conclusion is of fundamental importance in the authors’ study, since it is very important that a successful educational environment contributes to increasing the student’s potential.

The analysis of scientific publications showed that the concept of “educational environment” is developed more deeply by the authors than the category of “academic environment”. The concept of “educational environment” is presented in detail in the works of V. Belovolov & T. Sultanbekov (2014). S. Tarasov (2011) considers that “the educational environment is characterised as a set of social, cultural, as well as psychological and pedagogical conditions specially organised in an educational institution, as a result of which a person is formed in interaction with society.” According to N. Isaeva & L. Borisova (2013), the educational environment of a university is defined as a process that objectively includes resources for the development and formation of the personal and professional experience of all participants in the educational process, involving students in general activities. S. Tarasov (2011) believes that the elements of the educational institution environment include spatial-semantic, content-methodological, communication-organisational components. S. Lazarev (2016) notes that “the educational environment of a university is traditionally assessed by the information technology component (an indicator of information availability, the degree of use of innovative, information and telecommunication teaching aids in the educational process of a university); the intellectual component (a qualitative indicator of the teaching staff); the material component (the level of development of the material and technical base that ensures the educational process).”

According to the results of anonymous online survey of students of 1-5 years using Google Forms “Assessing the quality of services provided by the J. Balasagyn State University” (2023), the majority of students (70.8%) perceived the educational environment of the university as adaptive. They were satisfied with the conditions for their personal and professional development, but at the same time they believed that psychologically comfortable and generally favourable conditions for the successful implementation of educational and professional activities do not allow them to fully disclose and implement all their abilities.

Components of academic environment and student success

When comparing the educational and academic spheres in terms of ideology and content, academic circles as a sphere of activity are often found in scientific publications. E. Sivak & M. Yudkevich (2008) interpret the academic sphere as a set of norms and rules of educational and scientific activities characteristic of a certain community, as well as a set of resource, expert and status networks based on these norms. A. Oganyan & D. Khloptsov (2018) emphasised the multifaceted nature of the academic sphere and focus on its specific characteristics. They showed the interconnection and dependence of educational, research and expert-analytical

activities of faculty, students and community, as well as the incompleteness of formal agreements between the participants of the academic sphere and the lack of clearly defined criteria for evaluating academic activities.

Pedagogical science studies the content and mechanisms of educational processes aimed at developing and shaping the student's personality through scientific research conducted at all levels of education. The academic sphere is relevant only for the level of higher education and reflects the inseparable unity and interrelation of educational activities and scientific research. In this study, at the level of higher education the academic sphere is understood as a set of components (Table 1).

Table 1. Components of the academic environment

Infrastructure component	Axiological component	Communication and organisational component
The infrastructure of an organisation, which includes buildings, premises, etc., the material space for educational and scientific activities, material and technical equipment, scientific centres and laboratories, information infrastructure and resources).	The values of academic culture, the university's mission, its position, rules and patterns of behaviour, etc.	The subject of the integrity of the academic environment; a unified set of students, faculty and administration in education; relationships between them, style and nature of interaction, etc.

Source: compiled by the authors

Infrastructural component. Undoubtedly, the infrastructure of the university, the design and ergonomics of the building, spatial features of the campus have a significant impact on students, faculty and staff of the university. The architecture and design of buildings can influence the choice of place of study and work, the desire to study at the university, the formation of personality, as well as the efficiency of work. Researchers L. Sibanda *et al.* (2015) noted that "if universities are organised to accommodate the interests and needs of different groups, they will motivate students to engage in active learning and researchers and teachers to generate and transmit knowledge and scholarship." Buildings (spaces) can have a positive impact on efficiency, productivity (educational achievement). Learning is not limited to classrooms but continues outside the classroom through independent, group project work, which attracts students to alternative "open" spaces on campus, and their design, in turn, influences learning outcomes.

In the study entitled "Assessing the quality of services provided by the J. Balasagyn State University" (2023), an anonymous online survey was conducted using Google Forms among students studying in the 1st-5th years of the 2022-2023 academic year, with a total of 5,132 respondents from among students studying in each direction of 21 faculties of the university. Of the 100% students who were able to be assessed, 41% gave the following rating: comfortable and safe study and living environment including auditorium, library, canteen, hostel, sports facilities, etc. As the provided data show, the infrastructural component by its individual indicators can contribute to the development of students' potential and become one of the environmental factors of students' academic performance.

Axiological component. Self-determination based on values is an important stage in the development of a

student's personal axiological potential. Academic maturity is the final stage in the development of a student's personal axiological potential. The more developed the axiological potential of a student studying at a university, the higher the quality of his or her professional life and professional activity. The development of students' axiological potential in the educational process is ensured as a result of a number of interrelated conditions and actions, which are: actualisation of values in the content of education; creation of conditions for value self-determination of a future specialist in the educational environment of a university; implementation of the axiological component in industrial practice; introduction of a model reflecting the logic of development of axiological potential, which links such stages as adaptation, orientation and personalisation in the learning process; Only when students' mastery of fundamental knowledge and modern information technologies is based on the integration of intellectual, communicative and creative skills, this process will be sustainable and effective.

In the study of the axiological foundations of higher education, the substantiation of issues of developing the corporate culture of the university, integrating traditional research and innovation areas, as well as finding the optimal balance between classical academic values and post-academic values is of particular importance. This process varies depending on the practice of modernising the university and the macro-regional context of each national education system focused on social and market values. To develop the axiological potential of the student's personality, it is necessary to take into account the following value aspects for a qualitative change in his value attitude to his educational activities, to himself and to his future professional activities (Table 2).

Table 2. Aspects of development of personal axiological potential of a student

Academic values	Values for personal growth and wellbeing of students	Values of civil society	Organisational values
■ Institutional independence; ■ Fundamentalism; ■ Academic freedom; ■ Academic solidarity (collegiality); ■ Fostering innovation; ■ Professional competence; ■ New paradigms of teaching and research; ■ Academic responsibility; ■ Unity of the educational and research process; ■ Academic mobility; ■ Critical thinking; ■ Mentoring model of teacher-student relationships (involvement in the scientific community); ■ Interdisciplinary research; ■ International cooperation of teachers; ■ Elitist nature of university education.	■ Self-determination; ■ Self-realisation; ■ Individuality; ■ Subject-subject relations; ■ Continuous learning; ■ Adaptation of the individual to the environment and situation; ■ Professional mobility; ■ Health; ■ Corporatism; ■ Competitiveness.	■ Freedom, democracy; ■ Transparency; ■ Social justice; ■ Tolerance; ■ Ethical behaviour; ■ Cultural diversity; ■ Social responsibility; ■ Inclusiveness.	■ Decision-making through the coordination of opinions and interests; ■ Freedom in conducting scientific research; ■ Status hierarchy based on scientific authority; ■ Technologisation of educational activities; ■ Standardisation of the quality of education (educational programs); ■ Creation of material values and creation of knowledge; ■ Competitiveness of the university; ■ Availability of educational programs for foreign students; ■ Strategic partnership of the university with business structures.

Source: compiled by the authors

The concept of axiologisation defines the theoretical and methodological basis for the development of student's axiological potential in the educational process. Within its framework, the first basic provision is the law of increasing needs. It characterises the internal aspirations and tendencies of the student's development aimed at values as a driving force. The second position notes that the process of formation of students' value orientations is based on the coordinated action of special mechanisms. These mechanisms are search, evaluation, selection and design. These mechanisms allow each student to consciously comprehend the world of values and determine their personal orientation. The third position considers students' cognitive independence as the initial stage of axiological potential of personality, and this indicator indicates their internal readiness for cognition, self-development and responsible choice. All these provisions emphasise the essence of value formation on the basis of student's personal development.

Communicative and organisational component. Within this component, the authors focus on the relationship between students and teachers as the two main subjects of the academic environment. S. Jafari & A. Asgari (2020) found in their study that there is a significant positive relationship between the academic achievements of the study group, teacher-student interaction and academic motivation. Students' success in learning depends on their interaction with teachers. The nature of the relationship with teachers in the educational process can significantly affect the personal and professional development of students. According to the researchers, the effectiveness of the educational process depends on how well the teacher matches the image of the ideal teacher in the minds of students. Authors M. Ulug *et al.* (2011) noted that a positive teacher attitude improves student performance and success: 91.2% of students believed that a positive teacher attitude improves performance, only 0.9% believed that it reduces success,

and 7.9% believed that it does not affect performance. Researchers V. Labunskaya & A. Bzezyan (2018) noted that the influence of a teacher's appearance on students' academic achievement is one of the elements of success in education. According to them, students are more likely to participate in lessons with teachers who have a pleasant appearance and believe that such teachers contribute to the effective implementation of educational goals. In addition, L. Makarova & M. Startsev (2017) highlighted "areas of disharmony that reflect possible reasons for dissatisfaction with the relationship between teachers and students." The researchers also highlighted the main problematic aspects of their current interaction as "inconsistency of value orientations and lack of motivation for reflective thinking in their activities." I. Cheremiskina & V. Rashchupkina (2018) in their study identified the authoritarian style of interaction between teachers and students as one of the problem areas, defining the discrepancy between the real and desired image of the teacher.

Therefore, warm relationships with teachers and emotional support from classmates can contribute to students' academic success. A favourable climate in a group improves students' mood, promotes cooperation with classmates and teachers, and reveals personal and creative potential. Creating a favourable climate in a group of students improves students' emotional state, promotes constructive cooperation with classmates and teachers, and reveals personal and creative potential. The distinctive features of such a climate are: maintaining a positive attitude, a life-loving optimistic outlook, the prevalence of mutual support and approval in relationships; building social ties based on cooperation, mutual assistance and warm, trusting relationships; a positive attitude of group members to joint activities and leisure; developing a fair, respectful attitude towards each member of the group (including support for the weak and assistance to new students); special attention to such personal qualities as responsibility, honesty, hard

work, kindness and politeness; sincere interest and empathy for the successes or failures of each student in the group.

In addition, students' academic success largely depends on their interaction with teachers. Relationships with teachers in the educational process can affect the personal and professional development of students. Also, T. Ryabova (2020) emphasised that social and psychological factors are becoming important risk factors for students' academic success. During the study, the authors managed to identify "lack of relationship with the teacher" as one of the social and psychological factors affecting students' academic failure. Thus, the educational environment of modern universities is a complex socio-cultural and multicultural area where global and ethnocultural interests are skilfully combined. Therefore, the strategy for managing the educational process of universities should include issues of forming moral and spiritual values and functional and pedagogical qualities of managers. This is one of the important conditions for effective professional activity in a multicultural society.

■ CONCLUSIONS

In the modern world, the quality of education is considered a key factor in the socio-economic development of the country. The results of Kyrgyzstan's participation in the international PISA study revealed serious problems in the education system and the importance of external environmental factors. In order to meet modern educational challenges, it was necessary to conduct an in-depth study of the characteristics of the educational environment and the academic environment that affect the academic success of students. The results of the study revealed that the academic achievements of students are significantly influenced by the learning conditions, the quality of the educational environment, the personal qualities and motivation of the student. The academic environment, in turn, reflects the inextricable link between education and scientific activity and acts as a factor creating conditions for the personal and professional development of students.

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The results of the empirical study showed a positive perception of the educational environment by students, but it was also noted that the full potential of the environment is not fully utilised. Infrastructure, axiological, communication and organisational components were identified as the main components that directly affect the success of students. Thus, to ensure the academic success of students, it is necessary to develop the educational environment, improve its infrastructural, methodological and social aspects. Scientific research conducted in this direction and the findings contribute to the effective planning of activities aimed at bringing the education system of Kyrgyzstan closer to world standards, developing the potential of students and strengthening the intellectual resources of society.

One of the main findings of this study was that educational programs should be aimed at strengthening interpersonal relationships and connections between students and teachers, as well as developing a sense of belonging to the academic environment. These factors are considered important components for improving students' academic performance. Future research should evaluate models developed in different learning environments and among multilingual students. It is necessary to provide students with an educational environment that creates optimal conditions for strengthening students' sense of belonging to the academic environment and increasing their academic achievement. This issue should be a subject for further scientific research.

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Академиялык чөйрөнүн студенттердин ийгилигине тийгизген таасири

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Аннотация. Студенттердин жогорку окуу жайларындагы ийгилиги же ийгиликсиздиги билим берүүнүн мазмунун жана академиялык жетишкендиктерге таасир этүүчү факторлорду терең талдоо зарылдыгына басым жасайт. Бул макалада студенттердин академиялык ийгилигин аныктоочу негизги факторлор, ошондой эле алардын калыптанышында академиялык чөйрөнүн ролу каралат. Изилдөөнүн илимий жана практикалык актуалдуулугу билим берүүнүн сапатына болгон талаптардын өсүшү жана студенттердин билим алуусунун натыйжаларына билим берүү чөйрөсүнүн таасиринин күчөшү менен шартталган. Изилдөөнүн максаты студенттердин академиялык ийгилигине таасир этүүчү негизги факторлорду аныктоо жана бул факторлордун академиялык чөйрө менен байланышын аныктоо болуп саналат. Иш системалык анализ, салыштырма метод, анкета, интервью жана корреляциялык анализ ыкмаларын колдонгон. Эмпирикалык маалыматтар Кыргызстандын жогорку окуу жайларында окуган студенттерди сурамжылоонун негизинде чогултулган. Натыйжада, академиялык ийгиликтин деңгээлине ички мотивация, мугалимдердин педагогикалык чеберчилиги, билим берүү чөйрөсүндөгү психологиялык климат, академиялык колдоо жана студенттердин кызматташтыгы олуттуу таасир этет. Академиялык чөйрө үч компоненттин жыйындысы катары каралат: инфраструктуралык, аксиологиялык жана коммуникативдик-уюштуруучулук. Илимий талдоо көрсөткөндөй, студенттердин ийгиликсиздигинин себептери катары – окуу жана жашоо үчүн жетишсиз шарттар, мугалимдердин студенттерге болгон мамилеси жана жогорку окуу жайынын корпоративдик маданиятынын идеалдуу моделге шайкеш келбестиги белгиленди. Илимий жаңылыгы – студенттердин академиялык ийгилигин шарттаган факторлор менен академиялык чөйрөнүн өз ара байланыштары биринчи ирет комплекстүү түрдө изилденип жатканында. Практикалык баалуулугу – алынган жыйынтыктар жогорку окуу жайлардын жетекчилигине, окутуучуларына жана билим берүү саясатын жүргүзүүчү адистерге академиялык чөйрөнү өркүндөтүү боюнча эффективдүү чечимдерди кабыл алууга негиз берет. Бул өз кезегинде студенттердин билим алуудагы жетишкендиктерин жогорулатууга түздөн-түз өбөлгө түзөт.

Негизги сөздөр: академиялык ийгилик; билим берүү чөйрөсү; жогорку окуу жайы; мотивация; студенттердин жетишкендиги; академиялык колдоо; корпоративдик маданият

Влияние академической среды на успешность студентов

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Аннотация. Успешность или неуспешность студентов в процессе обучения в высших учебных заведениях акцентирует внимание на необходимости глубокого анализа содержания образования и факторов, влияющих на академическую успеваемость. В настоящей статье рассмотрены ключевые факторы, определяющие академический успех студентов, а также роль академической среды в их формировании. Научная и практическая актуальность исследования обусловлена ростом требований к качеству образования и усиливающимся влиянием образовательной среды на результаты обучения студентов. Целью исследования было выявление основных факторов, влияющих на академическую успешность студентов вузов, и определение взаимосвязи этих факторов с академической средой. В работе применялись методы системного анализа, сравнительный метод, анкетирование, интервью и корреляционный анализ. Эмпирические данные были собраны на основе опроса студентов, обучающихся в вузах Кыргызской Республики. Результаты показали, что на уровень академической успешности значительное влияние оказывали внутренняя мотивация, педагогическое мастерство преподавателей, психологический климат в образовательной среде, академическая поддержка и сотрудничество между студентами. Академическая среда рассмотрена как совокупность трех компонентов: инфраструктурного, аксиологического и коммуникативно-организационного. Среди проанализированных индикаторов авторы выделили в качестве причины академических неудач недостаточную комфортность условий для обучения и проживания, в качестве объекта воздействия – отношение преподавателей к студентам, а также несоответствие фактической корпоративной культуры вуза желаемому эталонному уровню. Научная новизна исследования заключается в комплексном анализе взаимосвязи между факторами академической успешности студентов и академической средой, что ранее не рассматривалось столь системно. Практическая значимость результатов заключается в возможности их применения администрацией вузов, преподавателями и разработчиками образовательной политики для принятия эффективных решений, направленных на совершенствование академической среды и повышение учебных достижений студентов в системе высшего образования

Ключевые слова: академическая успеваемость; образовательная среда; высшее учебное заведение; мотивация; достижения студентов; академическая поддержка; корпоративная культура



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Classification of problems that have manifested themselves in the training of students after opening up access to artificial intelligence services

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Abstract. The relevance of the study arises from the rapid proliferation of artificial intelligence (AI) services in education, which creates new challenges for pedagogical practice. The use of AI by students leads to decreased motivation for independent learning, problems with academic integrity, deformation of critical thinking and the need to adapt teaching methods. The objective of this paper was to categorise the key problems arising from the use of AI in education and to propose solutions, including the author's pedagogical model for teaching programming. The research methods included analysis of scientific publications, experiment with control and experimental groups of students, quantitative and qualitative analysis of the results, questionnaire survey, content analysis of code and comparative analysis of traditional and AI-integrated approaches. As a result of the study, a classification of problems including decreased motivation, lack of AI skills, violations of academic integrity, deformation of critical thinking, the need to adapt teaching methods, changes in knowledge assessment and digital inequality was performed. A pedagogical model for teaching Java programming based on individualisation, project structure and AI integration was proposed. The model included setting up personal projects, step-by-step mastering of the material, code performance control and formative assessment. The experiment showed that the application of the model increased the amount of code executed by 216%, the average score by 18.3%, and the students' motivation by 36%. At the same time, the level of independence decreased slightly (–1.35%). It was found that the use of AI in teaching requires a revision of control methods, including oral defences, portfolios and cross-checking of work. The practical value of the paper lies in the development of an adaptive teaching methodology that minimises the negative impact of AI and promotes programming skills. The model can be scaled to other disciplines that require practical application of AI. The results of the study are useful for teachers, methodologists and developers of educational programmes

Keywords: education; programming; pedagogical model; academic integrity; critical thinking; student motivation; digital divide

■ INTRODUCTION

The spread of publicly available artificial intelligence (AI) services to students, schoolchildren and teachers has become one of the most prominent trends in modern education. AI offers unprecedented opportunities to optimise the learning process, automate routine tasks and personalise learning. However, along with the obvious advantages, the widespread implementation of AI gives rise to a number of complex issues and problems that require in-depth analysis

and development of adequate solutions. In particular, as V. Pogrebnoi (2023), AI capabilities can not only positively but also negatively affect the learning process and the quality of learning. This aspect deserves special attention, because ignoring potential risks may lead to undesirable consequences for the educational system as a whole.

The relevance of this topic is confirmed by many studies on the impact of AI on various aspects of educational

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activities. For example, the study by B. Ogunleye *et al.* (2024) focuses on the experience of using ChatGPT by undergraduate engineering students to debug, generate and explain code. The authors observe a decline in code quality and interaction in pair programming, highlighting the need to reconsider learning objectives and collaborative working models with AI in mind. This study clearly demonstrates that without proper adaptation of teaching methodologies, the introduction of AI can lead to negative effects. On the other hand, A. Park & T. Kim (2025) in their study showed that students who used ChatGPT performed significantly better in practical big data analysis tasks compared to groups using StackOverflow or a control group. This result, however, comes with an important observation about the need for a balanced approach and maintaining academic integrity. Thus, the success of using AI in teaching depends largely on how well it is integrated into the educational process and how aware students are of the ethical aspects of its use.

The problem of students' adaptation to working with AI is also central. H. Güner & E. Er (2025) analysed student interaction profiles with ChatGPT and found that after prompting training, the majority of students switched to AI collaboration, which was associated with improved academic performance. This indicates that preparing students to effectively interact with AI tools is critical to the successful implementation of technology in the classroom. Without targeted training, AI skills can be used ineffectively or even detrimentally. Particular attention should be paid to ethical and methodological challenges. The UN News (2025) article emphasises the need to maintain human control over technology, the importance of ethical considerations and investment in teacher and student learning. This global vision confirms that the introduction of AI in education is not just a technological issue, but also a social, ethical and pedagogical issue (Dodonova & Dodonov, 2022). Specific methodological aspects are equally important, for example, C. Sengul *et al.* (2024) in their review of the impact of chatbots on software engineering education point out that basic skills (such as declarative thinking) are important to teach prior to AI uptake, given the complexities of formulating tasks for AI tools. This indicates the need to build a strong foundational knowledge base in students before they can effectively apply AI in their academic endeavours.

Thus, against the background of the rapid development and widespread introduction of AI into the educational sphere, the need for a deep understanding of the emerging problems and challenges becomes obvious. From issues of declining quality of learning and deteriorating interaction to ethical dilemmas and the need to revise pedagogical approaches, all this requires systematisation and the search for effective solutions. Based on the analysis of the reviewed publications, synthesis of the information received and the author's three-year experience, the aim of the paper was formulated: to determine the classification of problems that seem to be the most important for pedagogical practice, and within the framework of this

classification to outline general ways to overcome them, and in particular, for some problems to propose the author's approach to their solution.

LITERATURE REVIEW

In addition to the studies already mentioned, there is a vast literature that delves into various aspects of the impact of AI on the educational process. Analysing these sources allows for formation a more complete picture of the challenges and opportunities associated with the integration of AI in learning. One of the significant challenges arising from the use of AI is the risk of superficial understanding and decreased creativity in students. W. Takerngsaksiri *et al.* (2024) looked at student audiences' perceptions of autocompletes (e.g., GitHub Copilot). Their study showed increased productivity and help with syntax, but simultaneously revealed decreased creativity and superficial understanding of the subject matter. This emphasises the need to introduce explanations and practices that encourage deeper understanding of the material, rather than simply getting ready-made solutions.

The readiness of AI to solve complex problems and adequately assess student work is also under active debate. N. Dunder *et al.* (2024) tested ChatGPT on 127 Kattis tasks, where successful solutions were obtained only in 19 cases. Their finding that AI copes with simple tasks but is not ready for complex tasks indicates the need to refine approaches to assessing student work in AI environments. In the context of active learning methodologies, D. Córdova-Esparza *et al.* (2024) reviewed 15 papers on approaches such as PBL, flipped classrooms and gamification. They concluded that these methodologies stimulate motivation, participation and the development of cognitive and socio-emotional skills. This is particularly important in the context of AI, as active methods can help compensate for potential disadvantages associated with passive information consumption. Algorithmic bias is also a serious problem. A study by S. Chinta *et al.* (2024) points to sources of algorithmic bias such as training materials, model training, and cultural context. The authors suggest techniques for assessing and mitigating bias, such as auditing and participation of diverse groups, are critical to ensure fairness and inclusivity in AI-enabled educational systems.

In the broader context of the application of AI tools, W. Holmes *et al.* (2019) in their extensive report consider the applicability of adaptive learning, assessment and chatbots in real educational contexts. They focus on ethical concerns, privacy and the need for digital literacy, which emphasises the multifaceted nature of AI adoption in education. For educators, the development of AI also brings its own challenges. P. Shah (2023) notes that there is widespread rumour, confusion and fear among educators about the development of AI. Understanding what AI is, how it works, and how it can be used to improve education can help overcome these fears and use AI for administrative tasks, lesson design, and professional development.

In the work of S. Kramarov *et al.* (2025) reviewed the basic concepts and methods of using AI technologies in educational activities, with the goal of providing educators with practical guidelines for integrating these technologies. A. Mills (2023), in a selection of articles, suggests how education must change to meet today's AI systems and what role teachers and researchers should play in shaping the future of generative AI. Her papers also explain AI concepts, describe possible applications of AI in education, and describe negative consequences such as loss of knowledge and increased inequality.

The issues and challenges faced by teachers and educational institutions following the widespread adoption of generative AI models such as ChatGPT and GPT-3 are discussed in detail by J. Rudolph *et al.* (2023). They suggest temporary solutions, such as developing writing assignments that AI cannot yet cope with and incorporating elements of personal experience into assignments. The authors emphasise the need not to ban but to intelligently integrate AI tools into educational practice, as well as training students in the critical use of AI, updating academic honesty policies and developing clear guidelines. A. Vieriu & G. Petrea (2025) discuss the impact of AI on students' academic development, emphasising the need for a balanced approach so that AI complements rather than replaces human interaction and the development of critical thinking. This is in line with the study by Q. Ju (2023), which showed that complete reliance on AI for writing assignments resulted in decreased accuracy.

A survey of 262 university students in Florida and Pennsylvania conducted by G. Pitts *et al.* (2025) found that while the benefits of AI (feedback and learning support) are recognised, there are concerns about academic honesty, accuracy of information and loss of critical thinking skills. These concerns are supported by the analysis of J. Weeks *et al.* (2024) which showed that students using generative AI scored lower on average in examinations. A study at universities in Bahrain conducted by A. Ateeq *et al.* (2024) also showed that the adoption of AI affects academic integrity and requires a shift to more comprehensive assessment methods.

In the context of the need to redesign the learning process, W. Holmes *et al.* (2019) propose a model that utilises different types of technology exposure, from simply replacing a tool to performing new previously unimaginable tasks. G. Davydova & N. Shlykova (2024) analyse the future of higher education and outline a number of expected challenges, including issues of monopolisation of AI algorithms. Finally, Sberbank Corporate University (2024) discusses the main risks and practical ways to minimise them for a more effective and safer implementation of AI in pedagogical practice. Thus, a vast body of research confirms that the introduction of AI in education is a multifaceted process that requires not only technical solutions, but also a deep rethinking of pedagogical approaches, ethical standards and academic integrity to ensure an optimal balance between innovation and quality of learning.

■ MATERIALS AND METHODS

The methodological basis of the research was the aim to systematise the key problems arising in the process of student learning when using artificial intelligence services, as well as to develop and test a pedagogical model aimed at minimising the negative consequences of their use. To achieve the goal, a set of complementary methods was used. First of all, a review and analysis of publications concerning the impact of AI on the educational environment, academic integrity, digital inequality and transformation of pedagogical strategies was carried out. On the basis of theoretical analysis, problem areas were identified that require piloting in a practical teaching context.

The main empirical method was a pedagogical experiment organised with the participation of students of the specialties "Information Technology" and "Business Informatics". For the purity of the experiment, the control group (training without the use of AI) and the experimental group (training with the integration of AI) were formed. Training modules on the discipline "Programming in Java" were used as an experimental base. The control group included students of 2021 year of entry, the experimental group – 2024. The total sample coverage was 152 students, of which 65 – in the control group and 87 – in the experimental group. The following methods were used to evaluate the effectiveness of the developed pedagogical model: quantitative measurement of the amount of programme code performed by students; analysis of the dynamics of academic performance; questionnaire survey to identify the level of motivation and autonomy; content analysis of handed in assignments for code correctness, application of key language constructs and style integrity. Observation of learning activities was also used, which allowed for recording behavioural changes during the course and the degree of students' involvement in the learning process. Comparative analysis was carried out according to the following indicators: the average amount of programme code per semester, the percentage of those who successfully completed the course, the level of motivation and self-assessment of independent work on a Likert scale. As a result of the analysis, objective data demonstrating the impact of the introduction of AI tools on educational outcomes and features of learning dynamics were obtained. The experiment was conducted in accordance with the ethical principles outlined in The Guidance Note of the European Commission on Ethics and Data Protection (2021).

■ RESULTS AND DISCUSSION

Analysis of identified problems and their negative impact

The classification of problems in the use of AI and the author's approach to overcoming them are presented in Table 1. It should be noted that not all the named problems have been worked out by the author. It is intended to continue methodological research to cover all the missing problems. The following is a breakdown of each problem from the classifier.

Table 1. Classifier of AI problems and approaches to their solution

No.	Name of the problem	Author's approach
1	Reduced motivation for independent learning	+
2	Lack of AI skills	
3	Academic honesty	
4	Deformation of the critical thinking process	
5	Adaptations of teaching methods	+
6	Changing the assessment of knowledge	+
7	Digital competence gap	

Source: developed by the author

Reduced motivation for independent learning is usually due to the fact that AI services, such as ChatGPT, can independently solve problems, programme, write essays and perform other learning tasks that were previously performed by students. Students are able to get instant answers to complex questions, which makes the process of information retrieval and reflection unnecessary, resulting in students being less likely to engage in independent analysis, a reduced need to memorise and comprehend material, and a dependence on automated solutions. When a student receives a ready answer from an AI, he or she may think that he or she has understood the topic. However, superficial familiarity with information does not mean deep learning. It reduces the need to study the subject more thoroughly. If complex problems can be solved with the push of a button, students may lose interest in learning. The challenge that used to motivate them to find solutions on their own disappears. If knowledge can be obtained at any time with the help of AI, the question arises, "Why study when a machine can do everything for me?" This is especially true in disciplines where it is important not just to know the facts, but to understand the principles and be able to apply them in practice.

The lack of AI skills stems from the fact that not all students know how to effectively use AI for learning (Shevchuk & Hunaza, 2025). Some rely on it completely without validating information, while others do not understand how to use AI to improve their learning. Many educational institutions have yet to integrate AI courses, leaving students without the necessary knowledge. Teachers themselves often lack sufficient training to teach students how to use AI effectively. Students may not realise that AI does not always give reliable answers, have no knowledge of how AI learns and what data it is based on, leading to uncritical perception of information. Many students use AI only to get ready-made solutions, ignoring its potential as a learning tool. They don't know how to formulate queries properly to get more accurate and useful results. Some students do not realise the risks of plagiarism when using AI. Ignoring copyright and academic integrity can lead to serious consequences.

Problems with academic integrity are often associated with copying answers from AI without thinking about the material, which leads to violations of academic integrity. There is an increased risk of cheating, plagiarism and substitution of real knowledge with automated solutions. Students' actions with copying text without citing sources, recycling other people's ideas without critical thinking,

automatic writing of essays, abstracts, and theses – also leads to violations of academic integrity. Many traditional plagiarism checking systems are not yet fully adapted to recognise AI-generated texts, which creates difficulties for teachers. Students may use AI to get answers during online exams, violating fair grading rules.

Deformation of the critical thinking process is manifested in the fact that students may accept AI answers as truth without fact-checking and logical analysis. This reduces the level of critical thinking and the ability to work with different sources of information. Critical thinking is the ability to: analyse information, find cause and effect relationships, compare different points of view, and formulate reasoned conclusions (Matviienko, 2022). When AI is overused without thinking, these skills can degenerate. Instead of analysing a text independently, a student enters a task into ChatGPT and receives a ready paraphrase, losing the skill of working with information. When writing an essay, the student uses data from AI without checking its validity and as a result refers to false facts. When preparing for an exam, the student does not learn how to solve problems, but simply copies ready-made solutions from the AI. When studying philosophy, the student receives brief definitions of concepts from the AI, but does not analyse them from different perspectives. In a discussion, the student may refer to the AI's opinion, but cannot explain why it is correct.

The need to adapt teaching methods is a very important issue that all educational institutions must address. Teachers have to change their approach to teaching, develop new formats of assignments that require thinking about the material rather than simply reproducing information. With the development of artificial intelligence, especially generative models such as ChatGPT, learners are able to quickly get ready-made answers, generate texts, perform calculations and even program without deep understanding of the subject. This calls into question the effectiveness of traditional learning methods that focus on memorisation, reproduction and routine tasks. There is a need to rethink pedagogical goals: instead of focusing on information assimilation, the importance of critical thinking, the ability to analyse, synthesise and make decisions independently is increasing. Teachers need to adapt their methods in order to: integrate AI as a tool in the learning process rather than perceive it as a threat, motivate students to think independently despite the availability of ready-made solutions, move from testing knowledge to as-

sessing skills, including the ability to work with AI, interpret its answers and critically evaluate them, update forms of control and assignments, making them less vulnerable to automatic generation. Thus, the problem of adapting teaching methods lies not only in technological changes, but also in the need to revise pedagogical philosophy, goals and approaches to teaching in the era of artificial intelligence (Onyshchenko & Serdiuk, 2025).

Changing knowledge assessment as a problem echoes to some extent the previous one, but the author singles it out as a separate item because of its importance, as classical forms of knowledge testing (tests, essays, homework) are losing their effectiveness. New methods of assessment are required – oral examinations, work with cases, practical tasks that require personal participation of the student. Thus, it is necessary to evaluate the process, not just the result. For example, instead of just handing in a finished software assignment, a student records a video explanation of his code. It is also important to introduce oral exams and interviews (for example, instead of a test on the subject, students participate in debates, defending different points of view), project and practice-oriented assessment – when instead of a test paper a student develops a mobile application or application solution and explains its functionality. Instead of one-off test papers it is possible to assess the whole learning process, to create a collection of the best works of a student during the course. Analysis of learning progress – the teacher sees the growth of skills. In a design course, a student does not submit one final project, but builds a portfolio of several works, showing the development of their skills. It is also possible to use AI detectors to check the originality of texts.

The digital competence gap means that not all students have the same AI skills, creating a digital divide. Those who know how to use AI effectively gain an advantage, while others may fall behind. The digital divide is the difference in digital proficiency between different groups of people. In education, it is expressed in the following ways: the difference between students – some students easily use

AI for learning, while others do not even understand how to use it; the difference between teachers – some teachers actively implement technologies, while others prefer traditional methods; the difference between educational institutions – some universities are equipped with modern digital platforms, while others lag behind in technical development; differences in access to technology – not all students have powerful devices, stable internet and paid access to educational services.

The consequences for education without solving the above problems can be very unpleasant: without independent study of the material, students remember less information, analyse data worse; AI does not always give correct or relevant answers, and without analysis skills a student may accept any information uncritically; lack of in-depth knowledge and practical skills may lead to problems in the future, especially in professions that require analytical thinking and creativity.

Author's approach to teaching programming

Based on more than three years of experience in using AI and “fighting” its consequences, the author has developed some practical techniques to solve individual ones (Table 1). Adaptation to the problem of declining motivation for independent learning and adjustment of teaching methods was required immediately after the emergence of open access to AI. All teaching materials and manuals were previously built on solving local examples, such as, for example, to sort a two-dimensional numerical array, of dimension 10 by 20, in ascending order, using the bubble method. This task can be solved with the help of AI, by entering the text of this task into a query and immediately get the code of the solution in any programming language. The learning process in this case is reduced to a formal recording of task completion and zero learning outcome. In this study, the author proposes a pedagogical model for teaching programming using AI (Fig. 1). The model was tested on the academic discipline “Programming in Java”.

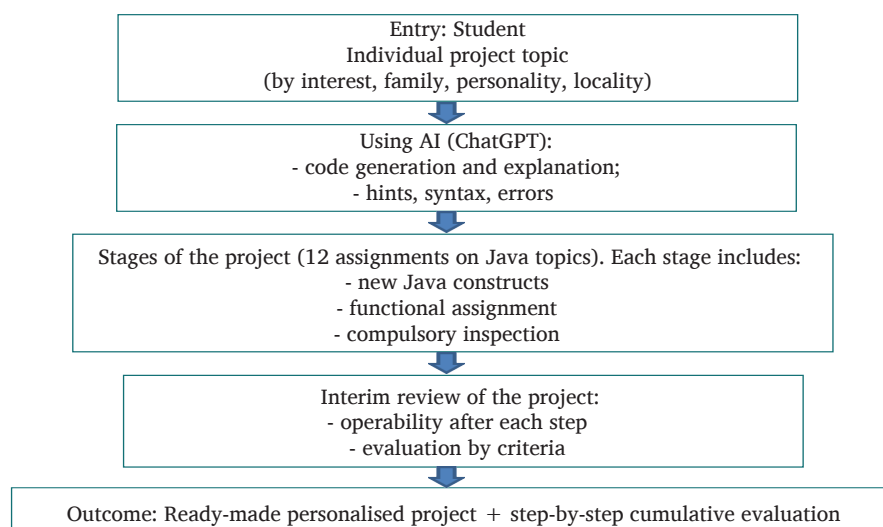


Figure 1. Block diagram of the pedagogical model

Source: developed by the author

The purpose of the pedagogical model of teaching the discipline “Programming in Java” with the use of AI was to develop practical programming skills, logical thinking and digital literacy in students, taking into account personal motivation, interests and active application of AI in learning activities. The principles of the model include:

- individualisation of learning: each student works on a unique topic related to their personal context;
- project structure: all learning activities are organised as a single project divided into linked tasks;
- AI integration: the use of ChatGPT and other AI tools is encouraged as part of practice, with an emphasis on code reflection;
- step-by-step mastery of the Java language: each step includes new language constructs;
- self-sufficiency of tasks: after each step, the project must compile and work correctly;

■ continuity and obligation: skipping classes is not possible due to the dependence between stages;

■ formative assessment: each task is assessed separately, the points are summarised;

■ structure of the training process (Table 2).

The proposed pedagogical model in teaching the discipline “Programming in Java” is based on a number of key approaches. Among the pedagogical technologies used are project-based learning, competency-based approach and activity-based approach, which are complemented by formative assessment and digital didactics with artificial intelligence (AI) elements. In this model, the role of AI in learning is to provide support for creating code, generating examples and templates, explaining syntax and logic, and automating repetitive tasks. Importantly, AI is not a substitute for thinking, and students are required to modify and make sense of the generated code.

Table 2. Structure of the training process

Stage	Table of contents
1. Project setting	Assignment of the topic, formation of the assignment taking into account the student's interests
2. Planning	Division of the project into 10-12 phases/sessions
3. Classes	Each is a new Java construct + project functionality
4. Use of AI	Searching for solutions, explanations, testing with the help of AI
5. Control	Checking the result (whether the project works), analysing code correctness
6. Evaluation	Points for each assignment; final defence – summative assessment
7. Completion of the project	The project must be complete, workable and logically coherent

Source: developed by the author

The teacher's role includes methodological support, problem setting, individual counselling, formative assessment and control over the correct application of AI. The forms of control and evaluation provide for separate assessment of each task. The main evaluation criteria include absence of compilation errors, application of new language constructs, correctness of functionality, code quality (its structure and readability), and adequate use of AI. An important aspect of the model is ethical and legal standards. Project topics are developed taking into account the Law of the Kyrgyz Republic No. 58 “On Personal Information” (2008), students do not use personal data without consent, and AI is used exclusively for educational purposes.

As a result of implementing this model, it is expected that the student will develop a deep understanding of the Java language, valuable project development experience, a critical attitude towards AI-generated code, and the skill of incremental programme construction. This pedagogical model is scalable, allowing it to be applied to other disciplines such as Python, C++, Android development, databases and others due to its versatility.

Effectiveness of the developed pedagogical model

The developed model allows combining individual and competence-based approach with modern digital tools, including AI. It increases students' interest in programming, makes the process more visible and controllable. The model can be adapted to other languages and disciplines

of technical profile. Further the mentioned techniques are considered in more detail.

For each student was asked to realise the project with a different option. Each option is related to data that are personal or local in nature, for example: “My hobbies”; “My street”; “Family history”; “Sports in Kyrgyzstan”; “Books in Kyrgyzstan”; “Films of Kyrgyzstan”; “Travelling in Kyrgyzstan”; “Banks in Kyrgyzstan”; “Famous people in Kyrgyzstan”; “Computers in Kyrgyzstan”; “Favourite music”; “Food in Bishkek”; “My studies”; “Health in Bishkek”; “Nature in Kyrgyzstan”; “My school”; “My hometown”; “Issyk-Kul”; “Animals of Kyrgyzstan”. All variants were offered taking into account the Law of the Kyrgyz Republic No. 58 “On Personal Information” (2008).

The project was divided into sessions, for example, 12 sessions. Each lesson is a new programming material. For example, in the first lesson the topic was: “Main programme”. Here the student learnt how to create new classes and objects, as well as how to organise input-output with control. The programme should give a list of modes. Some modes are mandatory: data entry, view and delete. To implement the main programme, a new class must be created, and for each mode also separate classes, initially “blanks”. The student was required to come up with additional modes for their topic. The number of modes is at least four. For example, “Give out books for the specified year”, “Give out tours of Kyrgyzstan in 2025” and so on. Each mode is a separate Java class. All classes should have names

according to their theme. Then, in accordance with his variant, the student realised his project. And the work was built in such a way that after each class, the project should fully work without errors. At each lesson students had to add one or more programming techniques as instructed by the instructor, but the project must remain functional. Dependency of classes is very important. It is impossible to skip classes because they are dependent on each other.

The author accepted the work in parts, according to the class number. This was possible because, according to the condition, the project must remain workable. Often, the programme code was not checked, but only the result of execution was viewed and the correctness of using the required programming technique, for example, the use of exceptions, was checked. This simplified the checking of assignments, which is also important, because with a large number of students and, consequently, topics, the load on the instructor increased significantly. If all criteria are met, the assignment is evaluated according to the rules adopted by the educational institution. For example, in 2024 the total number of points for the module was accepted 30. Therefore, the price of one completed assignment was $30:12 = 2.5$ points. If an assignment did not fulfil the criteria, it was valued at zero points, but it was allowed to be handed in at one of the subsequent classes, with no possibility of starting the next assignment, due to interdependence. The final grade depended on the number of completed and defended assignments. A fully completed project gave the maximum grade, which in 2024-2025 was 30 points per module and 60 points per semester. In the final session, the project had to be completed in its entirety, in which case the student received the maximum number of points. Otherwise, the number of points depended on the number of defended classes.

To confirm the effectiveness of the outlined methodology, measurements and surveys were conducted: measurement of the complexity of the tasks performed by the number of programme code and student surveys to determine the level of independence and motivation. The general population for the experiment was represented by students in the speciality "Information Technologies" and "Business Informatics". For the sample population were selected first year, second semester students for whom the author conducted classes on Java programming. The age of the students: 18-19 years old. Gender composition was approximately equal. The sample consisted of two groups of students: control group – students of 2021 year of enrolment and experimental group of 2024 year of enrolment. This was possible because the author kept the data on academic disciplines from 2007 to 2025, as well as the results of academic practical assignments for 2020 to 2025. The 2021 sample covered 65 students and the 2024 sample covered 87 students. Students in 2021 completed 12 practical assignments, of which 3 assignments were 12 academic hours and 9 assignments were 24 hours, totalling 36 hours. Students by the second semester had already acquired skills in the basics of programming, so the emphasis was on the features

of the Java language, e.g., use of classes, various controls in data entry, I/O operations, exceptions, interfaces, etc.

At that time AI services were unknown to students, so the tasks were a separate standard variant for each participant, for example, to develop a class for entering the book title, author, year of release, price. The class should have a constructor, getter and setter. It was necessary to create an object of this class and perform the input. The second activity was to equip the input with control and re-entry. Such an assignment was designed for 4 academic hours. Other assignments were designed in a similar way and were not very dependent on each other, although even then there was an aspiration to unite all the assignments into one project. The complexity of the assignments for the academic years 2021 to 2022, when the AI services were unknown to the students, the amount of programming code, averaged about 250 statements per semester. The number of students in the control group that were counted was 65. The students who completed all the tasks were – 35 students. This category was considered successful by the author. Thus, the successful students were 54%. The category of "Successful" students was considered and analysed in the experiment. The average number of points for all students for the spring term, including successful students, of the control sample was 35 points.

Students in the 2024 entry year also completed 12 practical assignments, of which 3 assignments were 12 academic hours and 9 assignments were 24 hours, totalling 36 hours. Students by the second semester were also gaining skills in basic programming, so the emphasis was on the features of the Java language. AI services, in particular ChatGPT, were already well known to the students, so the assignments, in accordance with the principles outlined above, were an individual project, according to the model discussed above, which took into account the requirements of the curriculum and the personal or local characteristics of the student. For the experimental group (2024), the amount of programme code was 540 operators per semester. The number of students in the sample that were counted was 87. The students who completed all the tasks were – 59. This category was also considered successful by the author. Hence, the successful students were 59%. Thus, the complexity of the developed programme code increased by 2.16 times. The number of successful students increased by 5% (54 and 59), i.e., it changed but not significantly. The average score for all students for the spring term, including successful students, of the experimental sample was 46 points.

As an illustration of the proposed approach, a brief description of task No. 1 for option No. 12 "Health in Bishkek" is given. Students were required to develop a new class for data mode input, corresponding to the selected variant. The name of the class had to be in Latin or English, for example, WriteNumModeHealth. Inside the class, a list of modes was to be output, including the mandatory ones: "data entry", "view entered data", "delete" and "exit". The total number of modes was to be at least eight,

and the missing modes were to be invented by the students themselves. The data storage structure included the name of the organisation (string), type (string with a choice from a list, e.g. “fitness” or “trade”), address (string), specialisation (string with a choice from a list, e.g. “volleyball” or “football”) and telephone (format string). It was important to name all the elements of the programme in Latin letters, avoiding uninformative names like name1 or str2; names like PrintOpenChopCentre were recommended. The result of this task was displaying the name of the variant (“Health in Bishkek”) in the Main class, displaying the list of numbered modes and entering one mode (WriteNumModeHealth class). Erroneous entry of the mode number was accompanied by a corresponding message and re-entry, and the “Exit” mode terminated the programme execution.

In order to assess the indicators of the level of independence and motivation, a survey was conducted. Students from the control group (2021 year of entry), numbering 62, and the experimental group (2024 year of entry), numbering 84, in the second semester of study

took part in it. Students in the control group (2021 entry year), prior to the availability of publicly available AI services, were asked the following questions to assess programming assignments: 1. Rate the level of independent mastery of the material on a scale of 0 to 10. 2. Evaluate the level of interest in performing laboratory works on a scale from 0 to 10. Students in the experimental group (2024), who already had access to AI services, were asked similar questions, but taking into account the availability of AI: 1. Rate the level of independent mastery of the material on a scale from 0 to 10, taking into account the availability of AI services. 2. Rate the level of interest in laboratory works on a scale from 0 to 10.

The results of the survey showed that independence before the AI was 7.4 points on average, and interest (motivation) was 6.1 points. After the introduction of AI in the educational process, independence slightly decreased to 7.3 points, while interest (motivation) increased significantly to 8.3 points. All the obtained results of the author's experiment are presented in more detail in Tables 3 and 4.

Table 3. Measurement results of the experiment by complexity (code volume)

Category	2021 (control)	2024 (experimental)	%
	Number of operators	Number of operators	
Code scope	250	540	216

Source: developed by the author

Table 4. Measurement results of the experiment (quality)

Category	2021 (control)		2024 (experimental)		+/- %
	people	%, points	people	%, points	
Total students	65		87		+ 33
Successful students (60 points)	35	54%	51	59%	+ 5
Average number of points per semester (max = 60)	62	35 points	84	46 points	+ 18.3
Level of independence according to the survey on a 10-point scale	62	7.4 points	84	7.3 points	-1.35
Level of motivation according to the survey on a 10-point scale	62	6.1 points	84	8.3 points	+ 36

Source: developed by the author

The presented results clearly demonstrate that the integration of artificial intelligence in the educational process, especially in disciplines requiring practical application of skills, such as programming, is possible and even desirable, which is also confirmed in the works of G. Fan *et al.* (2025), A. Gaitantzi & I. Kazanidis (2025). Despite the potential challenges of decreased motivation and changes in knowledge assessment, the tested pedagogical model shows how the purposeful use of AI within individualised projects can significantly increase the complexity of students' tasks and increase their interest in learning (Ali *et al.*, 2024). This confirms the need for further research and methodological developments to fully overcome all the identified challenges and ensure the most effective and harmonious implementation of AI in modern education.

CONCLUSIONS

AI is a powerful tool that can both facilitate and complicate the learning process. To minimise the negative effects, it is important to develop students' critical thinking, digital

literacy and self-control skills, as well as to modernise educational programmes, adapting them to the realities of the AI era. The paper analysed the problems caused by AI in education and, based on this analysis, defined a classification of these problems. For each problem there are generally accepted ways of their solution and, separately, to overcome the problem of decreasing motivation for independent learning, as well as to adjust teaching methods, the author has given the author's methods of preparation for programming classes, formalised as a pedagogical model.

The results of the experiment indicate the practical value of the considered pedagogical teaching model, and allow for drawing the following conclusion: students are forced to refine the project on their own, as the AI is not able to know personal or local data, so it can only develop general programme code that needs to be refined. Using class, subroutine, and data names according to variant also makes it difficult to use the AI directly; dividing the project into coherent, mutually related activities that do not allow “jumping” through an activity makes it difficult to use the

AI directly. These techniques stand on the side of prohibitions against unfair use of AI.

On the other hand, the use of topics related to personality, family, interests and place of residence stimulates interest in independent work. According to the results of the measurements, students began to perform more complex tasks, which was expressed in the amount of programme code. This was an increase of 216%. The number of successful students per semester increased by 5% and the semester grade point average increased by 18.3%. Student surveys were administered using two criteria: independence assessment and interest (motivation) assessment. The results of the survey showed a decrease in the level of autonomy from 7.4 to 7.3 points, which was -1.35%, and interest increased from 6.1 to 8.3 points, which was 36%. The results of the survey showed the expected result. AI services had a negative effect on autonomy but increased students' motivation

as students' ability to develop software code increased significantly. Based on this research, the author considers the proposed methods of class preparation satisfactory and, in order to increase the level of autonomy, in the future, it is expected to provide a more rigorous and diverse approach to the evaluation of each assignment. One of the ways of such control could be cross-checking of the application by the students themselves, under the supervision of the instructor.

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None.

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Студенттерге жасалма интеллект сервистерине мүмкүнчүлүк ачылгандан кийин пайда болгон көйгөйлөрдүн классификациясы

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Аннотация. Изилдөөнүн өзгөчөлүгү искусственный интеллект (ИИ) технологияларынын билим берүү тармагында тез таралышы менен байланыштуу. Студенттердин ИИди колдонуусу өз алдынча окууга мотивацияны төмөндөтүү, академиялык адалдыктын бузулушу, сын ой жүгүртүүнүн начарлашы жана окутуу ыкмаларын өзгөртүү зарылчылыгын келип чыгарат. Изилдөөнүн максаты – билим берүүдө ИИди колдонуунун келип чыгарган негизги көйгөйлөрдү классификациялоо жана аларды чечүү жолдорун, анын ичинде программалоо үйрөтүү үчүн автордук педагогикалык моделди сунуш кылуу. Изилдөө ыкмаларына илимий адабияттарды талдоо, контрольдук жана эксперименттик студенттер топтору менен сыноо, натыйжаларды сандык жана сапаттык талдоо, сурамжылоо өткөрүү, программалык кодду анализдөө жана салттуу жана ИИди колдонгон ыкмаларды салыштыруу кирет. ИИ менен байланышкан көйгөйлөр классификациясы иштелип чыкты: мотивациянын төмөндөшү, ИИди колдонуу боюнча жетишсиздиктер, академиялык адалсыздык, сын ой жүгүртүүнүн начарлашы, окутуу ыкмаларын өзгөртүү зарылчылыгы, билимди баалоо стратегияларынын өзгөрүшү жана цифралык теңсиздик. Java программалоо тилин үйрөтүү үчүн персоналдаштырылган долбоорлорго негизделген педагогикалык модель сунушталды. Модель жеке долбоор тапшырмаларын, программалоо көндүмдөрүнүн этаптуу өнүгүүсүн, иштөөчү кодду текшерүүнү жана формативдик баалоону камтыйт. Сыноо натыйжасында модель программалык коддун көлөмүн 216 %, орточо бааны 18,3 %, студенттердин мотивациясын 36 % көбөйткөнү, ал эми өз алдынча окуу деңгээли бир аз гана төмөндөгөнү (–1,35 %) аныкталды. ИИди колдонгон окууда билимди баалоонун жаңы ыкмалары (ауызекүү корголуу, портфолиолор жана өз ара код текшерүү) зарылдыгы далилденди. Изилдөөнүн практикалык мааниси ИИдин терс таасирин азайтуучу жана программалоо көндүмдөрүн жогорулатуучу ылайыкталган окутуу методикасын иштеп чыгууда. Моделди ИИди колдонууну талап кылган башка дисциплиналарга да колдонсо болот. Натыйжалар окутуучуларга, окуу программаларын иштеп чыгуучуларга жана билим берүү саясатын иштеп чыгуучуларга пайдалуу

Негизги сөздөр: билим берүү; программалоо; педагогикалык модель; академиялык ак ниеттүүлүк; критикалык ой жүгүртүү; студенттерди шыктандыруу; санариптик теңсиздик

Классификация проблем, которые проявились при обучении студентов после открытия доступа к сервисам искусственного интеллекта

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Аннотация. Актуальность исследования обусловлена стремительным распространением сервисов искусственного интеллекта (ИИ) в образовании, что создает новые вызовы для педагогической практики. Использование ИИ студентами приводит к снижению мотивации к самостоятельному обучению, проблемам с академической честностью, деформации критического мышления и необходимости адаптации методов преподавания. Цель работы – классифицировать ключевые проблемы, возникающие при использовании ИИ в образовании, и предложить пути их решения, включая авторскую педагогическую модель для обучения программированию. Методы исследования включали анализ научных публикаций, эксперимент с контрольной и экспериментальной группами студентов, количественный и качественный анализ результатов, анкетирование, контент-анализ кода и сравнительный анализ традиционных и ИИ-интегрированных подходов. В результате исследования выполнена классификация проблем, включающая снижение мотивации, недостаток навыков работы с ИИ, нарушения академической честности, деформацию критического мышления, необходимость адаптации методов преподавания, изменение оценки знаний и цифровое неравенство. Предложена педагогическая модель обучения программированию на Java, основанная на индивидуализации, проектной структуре и интеграции ИИ. Модель включает постановку персональных проектов, поэтапное освоение материала, контроль работоспособности кода и формирующее оценивание. Эксперимент показал, что применение модели увеличило объем выполняемого кода на 216 %, средний балл – на 18,3 %, а мотивацию студентов – на 36 %. При этом уровень самостоятельности снизился незначительно (–1,35 %). Установлено, что использование ИИ в обучении требует пересмотра методов контроля, включая устные защиты, портфолио и перекрестную проверку работ. Практическая ценность работы заключается в разработке адаптивной методики преподавания, которая минимизирует негативное влияние ИИ и способствует развитию навыков программирования. Модель может быть масштабирована на другие дисциплины, требующие практического применения ИИ. Результаты исследования полезны для преподавателей, методистов и разработчиков образовательных программ.

Ключевые слова: образование; программирование; педагогическая модель; академическая честность; критическое мышление; мотивация студентов; цифровое неравенство



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The use of artificial intelligence in teaching programming to students

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Abstract. In the context of rapid integration of artificial intelligence (AI) into all spheres, including education, understanding its impact on the learning process, especially in the field of programming, is of paramount importance. The aim of this paper was to identify and evaluate the impact of AI on the formation of students' programming competences and to develop recommendations for optimising its application in the academic environment. The study was conducted using empirical methods, including anonymous questionnaire survey of second-year students of two leading universities. The study found that 100% of surveyed students actively used AI in the learning process, with a significant majority (78.5%) regularly interacting with AI applications, indicating a high degree of dependence, exacerbated by insufficient fundamental training and limited access to paid resources. It was found that students often perceive AI outputs uncritically and tend to focus on getting ready-made code without delving into understanding the algorithms, potentially leading to a loss of autonomy and errors. Despite these challenges, AI is showing significant benefits such as personalising learning, increasing efficiency and engagement, positioning itself as a powerful support tool for educators. The data obtained also indicate insufficient differentiation of the concepts of "AI" and "neural networks" among the respondents, which emphasises the need for deeper theoretical training and development of analytical skills. The results of the study provided valuable information for teachers and educational programme developers, allowing them to adjust approaches to teaching programming, to strengthen the emphasis on critical thinking and independence, and to develop methods for effective integration of AI into the educational process, taking into account its advantages and limitations

Keywords: educational process; automation; platforms; ChatGPT; Gemini; DeepSeek; GitHub Copilot

INTRODUCTION

The educational process cannot be imagined without the active introduction of artificial intelligence (AI), especially in the field of programming. The rapid development of technologies and the growing demand for qualified specialists in the field of information technology, the use of AI in teaching programming opens new horizons for students and teachers. For faculty, the impact of AI on student learning is of great interest (Shevchuk & Hunaza, 2025). Research on the application of AI to facilitate programming instruction is actively developing. A. Tseplyaev (2023)

noted that there are more and more ways to simplify the process of learning programming through the emergence of AI-based code generation models that can be used in the implementation of low-level tasks. This can allow students to focus on higher level algorithms.

A. Sazonov (2024) noted that the use of AI in software development opens unique opportunities for programmers to improve creation processes, optimise code, automate tasks, and even create innovative solutions. K. Kurbanova (2025) in her article noted that the use of

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artificial intelligence in the organisation of self-study of “Fundamentals of Programming” opens new opportunities for effective, flexible and personalised learning. In turn, S. Bevzenko (2024) emphasised that the study of automatic programming methods with the use of artificial intelligence is a promising direction that has the potential to change the ways in which program code is created. Automatic programming in natural language makes the process of creating software code more accessible for people without specialised IT education, which expands the potential audience of developers. M. Kaleem *et al.* (2024) noted that solving a typical programming problem involves algorithmic thinking, pattern recognition, decomposition and abstraction skills. These skills are the foundation of computational thinking (CT) and are essential for a programmer. Therefore, the programming instructor needs to consider these skills when assessing students. Universities are gradually adjusting the curriculum of undergraduate students to include more computer-oriented courses such as data mining, Python programming, and database applications, argued S. Zhang *et al.* (2023).

The new phase is related to the introduction of generative AI based on Large Language Models (LLM) such as GPT (OpenAI), Gemini (Google), Llama (Meta) and Claude3 (Anthropic). O. Herden (2024) wrote that generative artificial intelligence (GIA) has caused a big stir recently. These systems have the ability to generate text, images, or other data using generative models. They will have an impact on all kinds of knowledge work, especially writing computer programmes. For software developers, the way of working will change using these systems. Therefore, it is necessary to show students the use, possibilities and limitations of these techniques.

Embedding generative AI into specialised platforms is considered to be a more effective approach. K. Kuramitsu *et al.* (2023) observed that coding assistance with deep learning is an emerging problem that has attracted a lot of attention in the software development community. To compactly integrate coding assistance with deep learning, the authors focused on neural machine translation (NMT), which allows users to translate natural language descriptions into expressions in a programming language such as Python. In turn, M. Abolnejadian *et al.* (2024) believe that it is possible to teach students an introduction to Python programming through a dedicated learning platform that uses ChatGPT to create personalised learning materials based on each student's educational experience. P. Menon (2023) suggested using GitHub Copilot, which can provide coding suggestions and generate correct and readable code in common programming languages. The use of Copilot in programming courses encourages teachers to learn about Copilot's capabilities and how they could adapt their teaching by incorporating an AI assistant capable of generating code. S. George & P. Dewan (2024) noted that the success of GPT in coding tasks made it important to consider the impact of GPT and similar models on the teaching of programming.

Students' use of GPT to solve programming problems can hinder their learning. However, they can also gain significant benefits such as quality feedback on programming style, explanations of how a given piece of code works, help in debugging the code, and the ability to see valuable alternatives to their code solutions. The aim of this paper was to comprehensively analyse the impact of AI on students' programming skills and to identify optimal strategies for its use in the learning process.

■ MATERIALS AND METHODS

An empirical study in the form of an anonymous questionnaire was conducted to investigate students' general awareness of, and attitudes towards, the use of artificial intelligence in education, as well as the extent to which they depend on AI when studying programming. This method was chosen as it was considered the most suitable for collecting data on the opinions, knowledge, and behavioural patterns of a large group of respondents while ensuring confidentiality and minimising response bias. The study took place in the 2024/25 academic year and involved 65 second-year students from two higher education institutions: J. Balasagyn Kyrgyz National University (25 students from the IVT-23 group) and Al-Farabi Kazakh National University (branch in Bishkek) (40 students from the KI-23 group). All respondents were enrolled on the “Programming” course, ensuring the relevance of the sample for the purposes of this study.

Traditional paper questionnaires were used for data collection. The questionnaires were self-administered, allowing students to answer at their own pace and without direct influence from the researchers. The form of the survey was mixed, including both closed-ended questions with suggested answers and open-ended questions requiring extended comments. The questionnaire consisted of eight key questions aimed at gathering information about different aspects of students' interactions with AI:

1. What do you know about AI? (Answer options: (a) nothing; (b) a little; (c) know enough; (d) have full knowledge).
2. Is there a difference between the concepts of AI and neural networks? (Answer options: (a) yes; (b) no; (c) these concepts are interrelated).
3. What AI-related resources are you aware of? (Answer options: (a) list if you know; (b) don't know).
4. Are you aware of any neural network resources and if so, which ones? (With an open field for listing).
5. Have you had to work with AI-related applications, and if so, which ones? (With an open field for enumeration).
6. Does AI help you in your studies or, on the contrary, does it prevent you from thinking independently and solving problems? (Answer options: (a) helps; (b) hinders; (c) both; (d) do not use AI).
7. How often have you had to use AI in your studies and which application would you favour? (With an open field to indicate frequency and preference).

8. Would you like to associate your activity with AI in the future? (Answer options: (a) yes; (b) no; (c) maybe).

The questionnaire procedure was conducted in classrooms in the presence of researchers, who ensured the distribution and collection of questionnaires, as well as answered students' clarifying questions on the wording. Anonymity of participation was strictly observed to ensure the validity of the responses. The survey was conducted in accordance with the ethical principles specified in the Guidance Note of the European Commission on Ethics and Data Protection (2021). The data obtained were subjected to quantitative and qualitative analyses. Quantitative analysis involved calculating the percentage of responses to closed questions. Qualitative content analysis was applied to the open-ended questions to identify recurring themes, usage patterns, and students' overall perceptions of AI. The results were

presented in the form of tables and infographics for clarity. Particular attention was paid to identifying correlations between the level of knowledge about AI, frequency of its use and perceived usefulness/harm to the learning process.

RESULTS AND DISCUSSION

Analysing the results of the student questionnaire

In order to analyse and systematise the data obtained from the students' questionnaire results regarding their knowledge and use of artificial intelligence in the learning process, the responses were collected and summarised in Table 1.

Table 1 refers to the use of AI in the learning process not in relation to a specific discipline, but in general. The infographic on the results of this survey is presented in Figure 1. The responses to questions 2 and 7 were 100%, so they are not shown in the diagrams.

Table 1. Results of students' questionnaires about knowledge and use of artificial intelligence in teaching

No.	Question	Answer 1	Answer 2	Answer 3
1	What do you know about AI?	Know a little – 67.7% (44 students)	Know enough – 32.3% (21 students)	
2	Is there a distinction between AI and neural networks?	Concepts are interrelated – 100% (65 students)		
3	What AI-related resources are you aware of?	ChatGPT – 100% (65 students)	Gemini – 44.6% (29 students)	Copilot, DeepSeek – 10.8% each (7 students each)
4	Are you aware of any neural network resources and if so, which ones?	Positive – 32.3% (21 students)	Negative – 67.7% (44 students)	
5	Have you worked with AI applications?	Affirmative – 78.5% (51 students)	Negative – 21.5% (14 students)	
6	Does AI help you in your studies?	Yes – 66.15% (43 students)	No – 33.85% (22 students)	
7	How often have you had to use AI in your studies and which application would you favour?	Used – 100% (65 students)	ChatGPT – 100% (65 students)	
8	Would you like to get involved with AI?	Yes – 80% (52 students)	No – 20% (13 students)	

Source: compiled by the authors

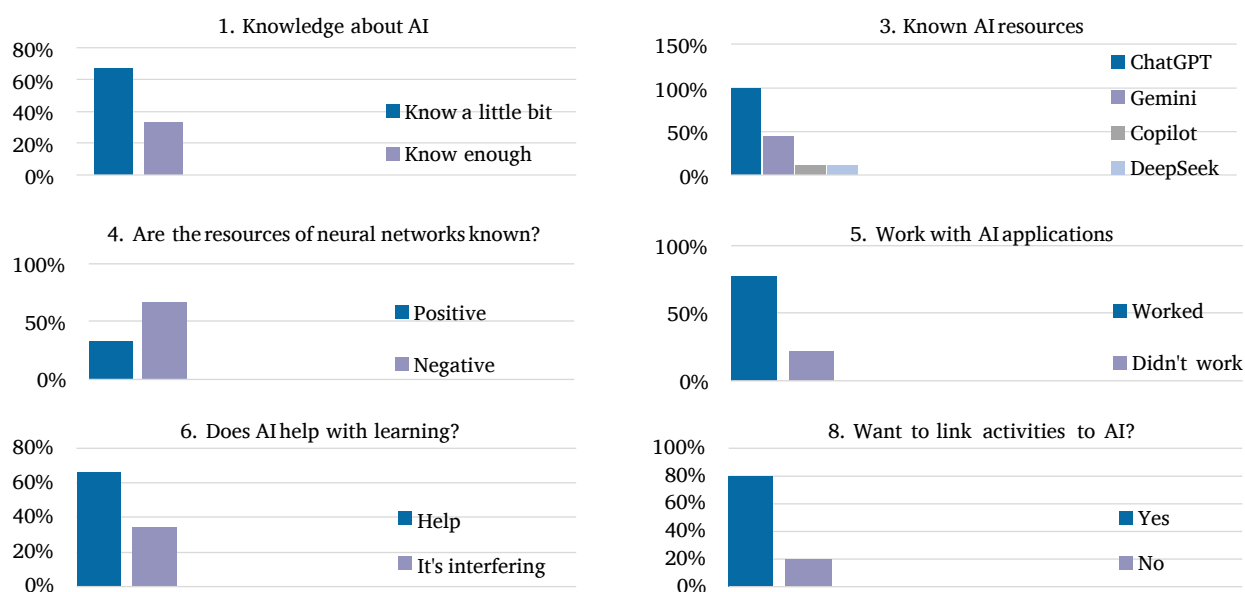


Figure 1. Results of students' questionnaires on the application of AI

Source: compiled by the authors

The analysis of answers to the first question of the questionnaire confirmed the expected results corresponding to the level of training of second-year students who demonstrated a basic understanding of AI concepts. At the same time, the answers to the second question revealed a significant need for clarification of terminology: 100% of respondents indicated the relationship between AI and neural networks, but in an academic context it is necessary to clearly distinguish these concepts, as neural networks are only a subset or one of the approaches within the broad field of AI. Responses to the third question regarding known AI resources were generally acceptable given the students' active use of neural networks. However, it was noted that respondents use only a limited range of available educational resources designed to optimise the learning process.

Of particular interest were the answers to the fourth question, which confirmed the previously identified tendency for the majority of students not to distinguish between AI and neural networks. According to the results of the fifth question, 78.5% of students actively interact with AI applications; while 21.5% do not use them for objective reasons, for example, due to the lack of regular access to the Internet. In response to question six, 66.15% of respondents gave a positive answer regarding the usefulness of AI in learning, although they recognised a limitation in critically thinking about the results obtained from AI. The remaining 33.85% expressed a preference for independent problem solving, motivated by a desire to understand the logic behind decisions. Finally, 80% of students expressed their willingness to link their future professional activity with AI, which is an expected result, given the dynamic development of the IT sphere, but does not exclude the presence of students with other career orientations.

There is a discussion regarding the potential impact of AI on the programming profession. D. Amodei, CEO and Co-founder of Anthropic, predicts that AI will generate up to 90% of code in the next 3-6 months, and then almost all code within a year (Pangambam, 2025). However, not all experts share this pessimistic scenario. Current automatic code generation capabilities demonstrated by tools such as Copilot and ChatGPT show that the generated code often contains errors, which precludes full trust in it. The statistics of GitHub (2023) showed that users accept only about 30% of the code offered by Copilot, although the acceptance rate increases with increasing experience with the tool. However, a Stanford University study showed that the use of AI can lead to an increase in the number of errors in code written by programmers, suggesting that the impact of AI is ambiguous (Prather *et al.*, 2024).

The results of the survey, which showed 100% use of AI by students in the learning process, indicated the formation of a high degree of dependence on artificial intelligence. It is important to note that students tend to uncritically perceive the answers generated by AI, believing them to be optimal and not allowing for the possibility of errors. When asked to explain the algorithmic basis of the generated code, students often find it difficult to give explanations,

which indicates the priority of obtaining a ready result over understanding the essence of the solution. Consequently, in the process of teaching programming it is necessary to emphasise students' attention to their responsibility for the final result and to develop the skills of critical evaluation of solutions offered by AI.

Advantages and disadvantages of using AI in education

The use of AI in the educational process has a number of positive aspects. Generative AI systems capable of generating code (GenAI code generators) can automate routine tasks of writing low-level code, allowing students to focus on developing high-level algorithms, as M. Dolinsky (2024) noted. A study by M. Liffiton *et al.* (2023) showed that the CodeHelp system effectively answers students' questions without generating ready-made code, facilitating independent search for solutions. The work of D. Cambaz & X. Zhang (2024) demonstrated the potential of LLM-based code generators in the role of teaching assistants and virtual tutors to enhance teaching and learning. An approach based on data and principles from educational psychology as well as computational pedagogy indicates a significant increase in student engagement and mastery in learning to code in AI-based virtual environments, according to F. Sarshartehrani *et al.* (2024).

AI TA developers note that models such as ChatGPT, LLaMA, and Gemini demonstrate outstanding abilities to understand, generate, and explain code in a programming context, making them promising tools for teaching assistants (Lee *et al.*, 2023). Moreover, research suggests that some LLMs may rival or even surpass the abilities of some students. N. Humble (2024) argued that ChatGPT is capable of providing correct or partially correct explanations and solutions in software testing and programming that can be improved through operational development. Similar results were obtained for Copilot, where up to half of the programming tasks could be solved using the original description and the remainder using operational engineering techniques.

However, along with the benefits, there is a downside to using AI. Generative models can produce erroneous code and produce different answers to the same query. In this regard, AI TA supports the concept of "Subgoal learning", an effective learning strategy that helps students decompose complex tasks into subtasks (Lee *et al.*, 2023). Despite the ability of large language models to answer questions, write essays, and solve programming tasks, the generated prompts may contain misleading information or be insufficiently detailed, especially in the final stages of the tasks (Roest *et al.*, 2024).

Generative AI (GAI) often exhibits weaknesses in more complex tasks such as identifying vulnerabilities in software, working with object-oriented approaches in programming, and tasks that require both conceptual understanding and directly writing code (Denny *et al.*, 2023). It is important to note that these challenging tasks for GAI are often similar to those that cause difficulties for the

students themselves. Modern software development, especially in large-scale projects, requires from future specialists not only the ability to write code (which GAI tools can perform), but also teamwork skills, effective communication and constant human interaction with colleagues and users, which GAI at the current stage of development are not able to reproduce at the human level. The problems of GAI accuracy are compounded by the fact that systems are not aware of their own inaccuracies, which can mislead students. Moreover, effective use of GAI presupposes strong foundational knowledge, which is a challenge in the context of modern education, where there is a tendency to reduce the hours of study of basic disciplines. Therefore, it is recommended that instructor supervision is exercised when integrating GAI into the educational process to ensure that students' use and conclusions of the system are consistent with the course content. Effective implementation of AI in education also requires revision of curricula and assessment methods to take into account the development of students' skills required to work in a pervasive automation environment.

■ CONCLUSIONS

The results of this study strongly suggest that there is a significant problem with the nature of students' use of AI, which is particularly critical given their future specialisation in information technology. There is a clear and growing dependence of students on AI, which appears to be due to several factors. First of all, it is insufficient fundamental training in core disciplines, exacerbated by the reduction of teaching hours. In addition, limited technical background or access to advanced AI tools plays a role, forcing students to rely on commonly available but not always optimal solutions. Despite the undeniable benefits of AI in teaching programming, there are significant challenges to its integration. A key issue is the financial inaccessibility of many professional AI platforms, which limits students' ability to learn advanced tools. Moreover, excessive and uncritical use of AI leads to a loss of autonomy in problem solving. Students often fully trust the results generated by AI without critically evaluating them, which can lead to the implementation of incorrect or inefficient solutions. This, in turn, hinders the development of a deep understanding of

algorithms and programming logic. Another problem is the need for high-quality, relevant data for training AI systems, which is a prerequisite for their correct and effective operation in an educational context.

Nevertheless, the use of AI in programming education opens new and promising opportunities for both students and teachers. AI can significantly increase the personalisation of learning by adapting materials and tasks to the individual needs of each student, making the process more effective and engaging. However, it is fundamentally important to recognise that AI should be seen as a supportive tool designed to complement, not replace, traditional teaching methods. The role of the instructor remains central to the learning process, encompassing student motivation, support and critical thinking. AI can effectively facilitate this by automating routine tasks, providing immediate feedback and generating valuable data for continuous improvement of the learning process and adaptation of educational programmes.

In the light of the results obtained, further research on this topic seems to be extremely relevant and necessary. It is planned to continue studying this topic in more detail, taking into account the specifics of each discipline within IT education and specific generative AI models used by students. Special attention will be paid to quantitative and qualitative assessment of the phenomenon of using AI in the learning process based on an extended sample of respondents. This will allow for a deeper identification of both advantages and disadvantages inherent in the application of AI in the educational environment and the development of sound recommendations to optimise its integration.

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■ CONFLICT OF INTEREST

No conflict of interest exists at this time.

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Аннотация. Жасалма интеллекттин бардык тармактарга, анын ичинде билим берүүгө жана окуу процессине интеграция болушу, өзгөчө программалоо тармагына тийгизген таасирин түшүнүү өзгөчө мааниге ээ. Бул иштин максаты студенттердин программалоо компетенциясынын калыптанышына жасалма интеллекттин таасирин баалоо жана аны академиялык чөйрөдө оптималдуу колдонуу боюнча сунуштарды иштеп чыгуу болуп эсептелет. Изилдөө эмпирикалык методдорду жана анын ичинде эки алдыңкы университеттин экинчи курсунун студенттеринин анонимдүү сурамжылоосун колдонуу менен жүргүзүлгөн. Изилдөө көрсөткөндөй, сурамжылоого алынган студенттердин 100 % окуу процессинде жасалма интеллектти жигердүү колдонушат, ал эми олуттуу көпчүлүгү (78,5 %) жасалма интеллект тиркемелери менен үзгүлтүксүз иштешет. Бул көз карандылыктын жогорку деңгээлин көрсөтүп турат. Ошондой эле, фундаменталдык даярдыктын жетишсиздиги жана акы төлөнүүчү ресурстарга жетүүнүн чектелгендиги да бул маселени курчутат. Студенттер көбүнчө жасалма интеллекттин ишинин натыйжаларына терең маани бербестен эле кабыл алып, алгоритмдерди түшүнбөй туруп, даяр кодду алууга басым жасашат. Бул өз алдынча аракеттенүүнү жоготууга жана каталардын пайда болушуна алып келет. Бул көйгөйлөргө карабастан, жасалма интеллект окутууну жекелештирүү, эффективдүүлүктү жогорулатуу жана мугалимдер үчүн күчтүү жардамчы курал катары олуттуу артыкчылыктарды көрсөтөт. Сурамжылоонун жыйынтыгында алынган маалыматтарга караганда респонденттердин арасында “Жасалма интеллект” менен “Нейрондук тармактар” түшүнүктөрүнүн ортосундагы айырмачылыктарды так түшүнүүнүн жоктугу көрүнүп, тереңирээк теориялык окутуунун жана аналитикалык ой жүгүртүүнүн өнүктүрүүнүн зарылдыгы көрүнүп турат. Изилдөөнүн натыйжалары, мугалимдер жана окуу пландарын иштеп чыгуучулар үчүн баалуу маалыматтарды берип, аларга программалоону окутууга болгон мамилени оңдоого, критикалык ой жүгүртүүгө жана өз алдынча өркүндөөгө басым жасоого, анын артыкчылыктарын жана кемчиликтерин эске алуу менен жасалма интеллектти билим берүү процессине эффективдүү интеграциялоо ыкмаларын иштеп чыгууга мүмкүндүк берет

Негизги сөздөр: билим берүү процесси; автоматташтыруу; платформалар; ChatGPT; Gemini; DeepSeek; GitHub Copilot

Использование искусственного интеллекта в обучении студентов программированию

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Аннотация. В условиях стремительной интеграции искусственного интеллекта (ИИ) во все сферы, включая образование, понимание его влияния на процесс обучения, особенно в области программирования, приобретает первостепенное значение. Целью данной работы были выявление и оценка влияния ИИ на формирование компетенций студентов в области программирования и разработка рекомендаций по оптимизации его применения в академической среде. Исследование проводилось с использованием эмпирических методов, включая анонимное анкетирование студентов вторых курсов двух ведущих университетов. В ходе исследования было установлено, что 100 % опрошенных студентов активно используют ИИ в учебном процессе, при этом значительное большинство (78,5 %) регулярно взаимодействует с ИИ-приложениями, что свидетельствует о высокой степени зависимости, усугубляемой недостаточной фундаментальной подготовкой и ограниченным доступом к платным ресурсам. Выявлено, что студенты часто некритически воспринимают результаты работы ИИ и склонны фокусироваться на получении готового кода, не углубляясь в понимание алгоритмов, что потенциально приводит к утрате самостоятельности и появлению ошибок. Несмотря на эти вызовы, ИИ демонстрирует значительные преимущества, такие как персонализация обучения, повышение эффективности и вовлеченности, позиционируясь как мощный вспомогательный инструмент для преподавателей. Полученные данные также указывают на недостаточную дифференциацию понятий «ИИ» и «нейронные сети» среди респондентов, что подчеркивает необходимость более глубокой теоретической подготовки и развития аналитических способностей. Результаты исследования предоставляют ценную информацию для преподавателей и разработчиков образовательных программ, позволяя им скорректировать подходы к обучению программированию, усилить акцент на критическом мышлении и самостоятельности, а также разработать методики эффективной интеграции ИИ в учебный процесс с учетом его преимуществ и ограничений.

Ключевые слова: образовательный процесс; автоматизация; платформы; ChatGPT; Gemini; DeepSeek; GitHub Copilot



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A smart pen-based analysis of Chinese character stroke order errors among beginning Central Asian students

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Abstract. The ability to master Chinese orthography is of increasing importance in global education, yet learners from non-logographic backgrounds encounter persistent and distinctive obstacles. Addressing the specific challenges experienced by Central Asian students is crucial for informing targeted teaching strategies. The present study sought to elucidate the procedural difficulties and cognitive factors underlying stroke order errors in Chinese character writing among five beginning-level international students from Kyrgyzstan and Uzbekistan, all native Dungan speakers fluent in Russian. Utilising smart pen technology to record and analyse the writing process, the author of this study collected data on stroke order errors during textbook-based copying exercises. Analysis of 605 error instances across 1,800 characters revealed an average error rate of 33.6% per student for characters containing errors. The most prevalent error types were stroke sequence errors (78.5%), stroke direction errors (19.3%), and stroke reversal phenomena (2.2%). Common sequence errors included horizontal-vertical order reversal (31.4%) and component order reversal (28.6%), while frequent direction errors involved confusion between ‘ti’ (提) and ‘pie’ (撇) strokes (52.1%). The findings indicated that, although a Dungan language background may offer certain phonological advantages, it does not inherently support correct stroke order execution, which is significantly influenced by prior Cyrillic/Russian script habits. This research advances understanding of the specific procedural barriers faced by Central Asian learners and proposes evidence-based interventions for more effective Chinese character instruction

Keywords: Chinese character acquisition; stroke sequence; Dungan language; error analysis; smart pen technology; Cyrillic interference

■ INTRODUCTION

The acquisition of Chinese characters poses a formidable challenge for international students learning Chinese as a second language, particularly for those whose native writing systems differ fundamentally from the logographic nature of Chinese script. Mastery of correct stroke order is widely recognised as essential – not only for the aesthetic presentation of characters but also for facilitating character recognition, writing fluency, and long-term retention (Sun *et al.*, 2024; Yang & Tian, 2024). Empirical research has shown that adherence to standard stroke order principles enhances motor memory, accelerates character recognition, and increases the efficiency of character production (Hou & Jiang, 2022). Central Asia offers a unique sociolinguistic context for Chinese language

acquisition. Many students from countries such as Kyrgyzstan and Uzbekistan speak Dungan as their first language – a Sinitic language historically derived from north-western Chinese dialects, but which has been written exclusively in Cyrillic script since the Soviet era (Honkasalo, 2024). This creates an intriguing scenario: while these learners possess phonological familiarity with many Chinese morphemes, they lack exposure to Chinese orthographic conventions. As mentioned by X. Duan & Z. Cai (2024), the phonological proximity between Dungan and Mandarin may facilitate vocabulary acquisition and pronunciation; however, the stark orthographic divergence between Cyrillic and Chinese scripts introduces unique challenges in character production.

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Recent advancements in digital technology have opened new avenues for investigating the dynamic process of character writing. According to N. Ismail & D. Ghani (2021), smart pen technology, capable of recording real-time stroke sequence, direction, and timing, has emerged as a powerful tool for analysing the specific difficulties encountered by different learner populations. Unlike traditional error analysis, which focuses solely on the final written product, smart pen data capture the temporal and spatial dimensions of writing, offering valuable insights into the cognitive processes underlying character formation.

Although prior studies have explored stroke order acquisition among learners from alphabetic, syllabic, and other logographic backgrounds, research specifically targeting Central Asian learners with Dungan backgrounds remains notably limited (Hong *et al.*, 2021; Liang & Ng, 2024). Given the increasing number of students from this region pursuing Chinese language studies, this population presents a compelling case for examining the interplay between phonological advantage and orthographic disadvantage in character acquisition. To address this gap, the present study investigated stroke order errors among five beginning-level international students from Central Asia with Dungan as their native language during the initial stages of Chinese character acquisition. By leveraging smart pen technology to analyse their writing processes, this research aimed to identify error patterns, explore their underlying causes, and propose targeted pedagogical interventions. The findings have significant implications for curriculum design, instructional practices, and the development of specialised learning materials tailored to this unique student population. Specifically, this study sought to answer three primary research questions: what types and patterns of stroke order errors are most prevalent among Central Asian students with Dungan language backgrounds; how do these error patterns relate to the students' prior experience with the Cyrillic script; what pedagogical recommendations can be derived from these findings to enhance character instruction for Central Asian learners.

LITERATURE REVIEW

Research on Chinese character acquisition among second language learners has expanded considerably in recent years, with increasing emphasis on the role of stroke order in successful character mastery. H. Hsiung *et al.* (2017) demonstrated that correct stroke order significantly improves character recognition, writing accuracy, and long-term retention among learners. This was further corroborated by J. Xu & X. Jiang (2022), who found a strong correlation between adherence to standard stroke order and enhanced character recall and production in beginning learners.

The cognitive mechanisms underlying character acquisition have been explored through neuroimaging studies. For example, J. Zhang *et al.* (2022), utilising functional magnetic resonance imaging (fMRI), revealed that learners' neural pathways for processing new writing systems are profoundly influenced by their first language script

experiences. Their findings suggest that pre-existing neural networks, shaped by prior writing experiences, may either facilitate or impede the acquisition of Chinese characters. Extending this neurocognitive perspective, K. Lui *et al.* (2023) employed event-related potential (ERP) techniques to investigate children's neural responses to stroke order violations. Their results showed that both anterior N2 and posterior P3 ERP components were heightened in response to incorrect stroke order, indicating the brain's sensitivity to stroke sequence even at an early age. Notably, poor spellers exhibited a reduced right lateralised N2 response, which was closely linked to weaker spelling and reading performance. This suggests the right lateralised N2 as a potential neural marker for Chinese literacy development and highlights the foundational importance of stroke order knowledge in both reading and spelling acquisition.

The distinctive linguistic background of Central Asian students with Dungan heritage has attracted scholarly attention. E. Allès (2005) offered a comprehensive historical account of the Dungan language, tracing its evolution from north-western Chinese dialects and its subsequent adoption of Cyrillic script during the Soviet era. P. Kokaisl (2025) found that while Dungan speakers exhibit superior phonological skills in Chinese learning, they do not demonstrate a significant advantage in character writing compared to learners from unrelated language backgrounds, underscoring the dissociation between phonological familiarity and orthographic competence.

Technological innovation has transformed research methodologies in character acquisition. Y. Lai & X. Zhang (2021) developed quantitative methods for assessing key aspects of handwritten Chinese characters produced by CFL (Chinese as a Foreign Language) learners, including stability, symmetry, and inclination. Their comprehensive analytical framework allows for the objective evaluation of character writing quality based on calligraphic principles, providing a solid foundation for further empirical research in this area. On this basis, they employed digital ink technology to analyse the dynamic process of Chinese character writing among beginning-level Chinese language learners, capturing temporal and spatial dimensions of handwriting behaviours that are not observable in static written products (Lai & Zhang, 2024). Their research further explored the factors influencing dynamic stroke writing behaviours, revealing that variables such as character complexity, stroke type familiarity, and learner background serve as significant predictors of stroke writing quality. These findings contribute to a deeper understanding of the dynamic and multifaceted nature of Chinese character acquisition.

Recent advancements in educational technology have also shown promise in supporting character writing development. L. Wong *et al.* (2023) introduced AI-Strokes, a machine learning-powered Chinese handwriting learning tool that provides real-time, personalised feedback to students. In a controlled trial, students who used AI-Strokes demonstrated significantly greater improvements in handwriting accuracy, particularly in stroke order, stroke direction, and the

avoidance of extra or missing strokes, compared to those receiving conventional instruction. The study suggests that personalised digital feedback and multimodal task design can foster orthographic awareness and enhance the psycholinguistic processes underlying Chinese handwriting acquisition.

The pedagogical value of error pattern analysis has been emphasised by Y. Hao *et al.* (2021), who demonstrated that instructional interventions tailored to identified error patterns significantly improve character writing accuracy among beginners. The relationship between character complexity and error frequency has been established by C. Chan (2020), who observed that error rates increase proportionally with stroke count and structural intricacy. In summary, the literature reveals substantial gaps in the understanding of Chinese character acquisition among Central Asian learners with Dungan language backgrounds. The author of the present study sought to address these gaps by providing empirical insights into the specific challenges faced by this population, thereby informing more effective and culturally responsive pedagogical strategies.

■ MATERIALS AND METHODS

This study recruited five international students (four males, one female) from Central Asia, all of whom were enrolled in an elementary Chinese language programme at a university in Gansu Province, China. The participants ranged in age from 19 to 23 years ($M = 20.8$, $SD = 1.48$) and had been studying Chinese for an average of 4.2 months ($SD = 0.84$) at the time of data collection. Three participants were from Kyrgyzstan and two from Uzbekistan. All reported Dungan as their first language and demonstrated native-like fluency in Russian as their second language, reflecting the unique multilingual context common among Central Asian populations. Importantly, none of the participants had prior experience with Chinese character writing before commencing their formal studies. While Dungan is a Sinitic language historically linked to Mandarin, it is written exclusively in Cyrillic script in contemporary contexts, meaning these learners approached Chinese character writing as a novel orthographic system. All participants were recruited via voluntary participation following an information session about the research project during their Chinese language class. The study was conducted from October to December 2023. Informed consent was obtained from all participants. The study protocol was reviewed and approved by the university's Institutional Review Board, ensuring compliance with ethical standards for research involving human subjects (ASA, 2018).

Character selection. A total of 120 Chinese characters were selected for the writing task. These characters were drawn from the textbook *Developmental Chinese* (Jihua, 2011), which is currently used by the learners, and represent the vocabulary introduced during the first eight weeks of instruction. The selection aimed to encompass a range of structural complexities, with characters varying from 2 to 12 strokes, and to include diverse structural types such as left-right, top-down, and enclitic forms. All selected

characters adhere to the standard stroke order prescribed by the Stroke Order Specification for Common Characters in Modern Chinese issued by the State Language Commission of China (2020). This careful selection ensured ecological validity, as the characters closely reflect the actual learning content and challenges faced by beginners in the classroom. Furthermore, the inclusion of both characters that strictly follow stroke order norms and those that deviate from them enables a nuanced analysis of error patterns related to both standard conventions and exceptional cases.

Smart pen technology. To accurately capture the writing process, this study utilised the Evernote Smart Pen system. This digital pen records handwriting in real time, transmitting detailed stroke sequence and direction data to the Evernote application. Used in conjunction with specialised notebooks, the system enables precise tracking of pen movements, including the timing, order, and direction of each stroke. By leveraging this technology, researchers are able to analyse not only the final written product but also the dynamic process of character formation. This approach yields a rich dataset for identifying stroke order errors, hesitations, and self-correction attempts. The digital recording of the entire writing process offers significant methodological advantages over traditional paper-and-pencil tasks. It enables fine-grained temporal analysis and allows for the detection of overt errors as well as near-misses or corrections that may not be apparent in the final written form.

Procedure. Data collection was conducted through individual sessions held in a quiet classroom environment to minimise distractions. Each participant completed three sessions, each lasting approximately 60 minutes, with sessions scheduled one week apart to mitigate fatigue and practice effects. During each session, participants were instructed to copy 40 characters from their textbook using the smart pen and specialised notebook. Characters were presented individually on a computer screen, and participants were asked to write each character as they would during regular coursework. To ensure that writing behaviour reflected participants' natural strategies and habits, no explicit instruction regarding stroke order was provided, and no time limit was imposed. Prior to the first session, participants completed a detailed background questionnaire, which gathered information on their language learning history, educational background, and any prior exposure to Chinese characters. After completing all writing tasks, each participant participated in a semi-structured interview designed to elicit qualitative data on their character learning strategies, perceived difficulties, and any cross-linguistic influences affecting their writing process.

Error classification. Stroke order errors were classified using a modified taxonomy based on L. Ch'ng *et al.* (2018), with additional subcategories developed to account for patterns specific to this learner population. The primary error categories included stroke sequence errors, stroke direction errors, and stroke reversal phenomena. These categories, along with their definitions, specific manifestations, and examples, are summarised in Table 1.

Table 1. Classification and examples of stroke errors in Chinese character writing

Error category	Definition	Specific manifestation	Examples
Stroke sequence errors	Deviations from the prescribed order of strokes, while maintaining correct stroke direction and form	1. Horizontal-vertical order reversal 2. Component order reversal 3. Outside-inside order reversal 4. Other sequence deviations	1. Writing the vertical stroke before the horizontal in “十” 2. Writing the right component before the left in “好” 3. Writing the inner part before the enclosure in “回”
Stroke direction errors	Incorrect execution of the direction of individual strokes	1. Confusion between <i>tí</i> (提) and <i>piě</i> (撇) strokes 2. Confusion between <i>nà</i> (捺) and <i>piě</i> (撇) strokes 3. Horizontal strokes written right-to-left 4. Vertical strokes written bottom-to-top	1. Writing 提 as 撇 or vice versa 2. Writing 捺 as 撇 or vice versa 3. Horizontal strokes in reverse direction 4. Vertical strokes in reverse direction
Stroke reversal phenomena	Violations of principles governing the general directional flow of character construction	1. Bottom-to-top construction 2. Right-to-left construction 3. Other global reversal patterns	1. Assembling the character from the bottom up 2. Assembling from right to left 3. Other systematic directional reversals

Source: developed by the author

To ensure the accuracy and consistency of error identification, two trained raters independently coded the video recordings and digital pen data. Inter-rater reliability was calculated using Cohen's kappa coefficient. Any discrepancies encountered during the coding process were resolved through discussion and consensus with a third rater, an expert in Chinese orthography and second language (L2) writing research. This rigorous, multi-rater approach served to establish the reliability and validity of the error classification process.

Statistical analysis. Descriptive statistics were computed to summarise the frequencies of different error types, as well as to examine distributions across various character features and participant characteristics. Chi-square tests were conducted to assess the relationship between character structural features (such as configuration type) and the occurrence of specific error types. Additionally, correlation analyses were performed to explore the association between character complexity – operationalised as stroke count – and error frequency. All statistical analyses were

carried out using SPSS version 28.0, with the significance threshold set at $p < 0.05$, unless otherwise specified.

RESULTS AND DISCUSSION

Overall patterns and structural influences on stroke order errors

Analysis of the 1,800 characters produced by the five participants (360 characters per participant) revealed a total of 605 characters containing at least one stroke order error. This corresponds to an overall error rate of 33.6%. Notably, error rates exhibited considerable individual variation, ranging from 26.4% to 41.7% (Mean = 33.6%, Standard Deviation = 5.8%), despite the participants sharing similar linguistic backgrounds and instructional exposure. The distribution of identified error types is summarised in Table 2. Stroke sequence errors emerged as the most prevalent category, accounting for 78.5% of all observed errors. Stroke direction errors constituted 19.3% of the total, while instances of stroke reversal phenomena were relatively infrequent, representing only 2.2% of all errors.

Table 2. Distribution of stroke order error types

Error type	Number of occurrences	Percentage
Stroke sequence errors	475	78.5%
Stroke direction errors	117	19.3%
Stroke reversal	13	2.2%
Total	605	100%

Source: developed by the author

Further analysis within the category of stroke sequence errors indicated that horizontal-vertical order reversal was the most common subtype, contributing to 31.4% of these errors. This was followed by component order reversal (28.6%), outside-inside order reversal (22.3%), and other sequence errors (17.7%). Among stroke direction errors, confusion between *tí* (提) and *piě* (撇) strokes was the most frequently observed subtype, accounting for 52.1%

of direction-related errors. Other notable direction errors included incorrect horizontal stroke direction (28.2%), incorrect vertical stroke direction (12.8%), and confusion between *nà* (捺) and *piě* (撇) strokes (6.9%).

Chi-square analysis revealed a statistically significant association between the structural configuration of characters and the type of stroke order errors observed ($\chi^2 = 18.74$, < 0.01). Specifically, characters with a

left-right structure were disproportionately associated with component order reversal errors. Conversely, characters featuring an enclosed structure demonstrated higher rates of outside-inside order reversal errors. These findings suggest that particular structural configurations present distinct challenges for Central Asian learners, likely stemming from the cognitive demands associated with segmenting and correctly sequencing complex visual forms.

Furthermore, a moderate positive correlation was identified between character complexity, as measured by stroke count, and overall error frequency ($r(N-2) = 0.42$, $p < 0.01$). This indicates that, generally, characters with a higher number of strokes were more prone to stroke order errors. However, this relationship was not strictly linear. Notably, some visually simple characters that possess irregular stroke order conventions (e.g., “九”, “乙”) exhibited disproportionately high error rates. This observation underscores that visual complexity alone is not the sole determinant of stroke order difficulty, and suggests that the interplay of structural regularity and idiosyncratic exceptions significantly influences error patterns among L2 learners.

In summary, the overall error patterns and their structural underpinnings highlight the necessity for a nuanced approach to character instruction, one that takes into account not only general complexity but also the specific configuration and conventionality of each character. This provides a foundation for understanding how learners' errors are shaped by the visual and cognitive demands of Chinese script, which is further complicated by cross-linguistic influences discussed below.

Cross-linguistic influence and orthographic learning challenges

Analysis of error patterns in relation to participants' established writing habits revealed distinctive influences stemming from their prior experience with the Cyrillic script. The predominance of horizontal-vertical order reversal errors (e.g., executing vertical strokes before horizontal strokes) appears to reflect the prevalent top-to-bottom writing orientation characteristic of many Cyrillic letters. Similarly, the observed tendency to write horizontal strokes from right to left, deviating from the standard left-to-right direction in Chinese, aligns with certain Cyrillic handwriting conventions.

Qualitative data gathered from post-task interviews corroborated these quantitative findings. Several participants explicitly acknowledged transferring writing habits acquired from Russian to their Chinese character writing. For instance, one participant remarked, “When I write in Russian, I often start from the top and work my way down. I think I'm doing the same thing with Chinese characters without realising it.” Another participant noted, “Some strokes in Chinese characters remind me of parts of Russian letters, so I write them the same way.” These self-reported observations suggest that deeply ingrained motor routines, developed over years of writing in Cyrillic, create significant interference in the acquisition of correct

Chinese character stroke order. This phenomenon indicates that cross-script interference is not confined to abstract orthographic knowledge but also manifests substantively in the procedural and motor domains of writing. The persistent confusion between *tí* (提) and *piě* (撇) strokes, in particular, highlights the considerable challenge learners face when acquiring new stroke types that lack direct analogues or similar motor execution patterns in the Cyrillic script.

Despite the participants' Dungan linguistic background affording a degree of phonological familiarity with numerous Chinese morphemes, no discernible advantage was observed in their stroke order execution when compared to typical error patterns documented for learners from non-Sinitic language backgrounds. This observation suggests that phonological proximity does not inherently translate into orthographic proficiency, particularly when the learner's first language (L1) employs a fundamentally different writing system.

Participants themselves acknowledged this apparent disconnect. As one individual articulated, “I can understand many Chinese words because they sound similar to Dungan, but writing the characters is completely new to me because we only use Russian letters for writing Dungan.” This distinction highlights the critical need to differentiate between the potential for lexical and phonological transfer and the distinct challenges associated with acquiring orthographic and procedural knowledge in second language writing. In conclusion, the cross-linguistic influence of Cyrillic script experience is pervasive and multifaceted, affecting not only the sequencing and directionality of strokes but also the very motor routines learners bring to character writing. This underscores the importance of addressing both cognitive and procedural aspects of writing in the instructional design for this learner group.

Pedagogical implications and instructional recommendations

The distinct error patterns identified in this study carry significant implications for the design and implementation of Chinese character instruction tailored for Central Asian learners. The predominance of stroke sequence errors, particularly horizontal-vertical order reversals, underscores the necessity for explicit instruction in the fundamental principles governing Chinese character stroke order. This instruction should place a particular emphasis on contrasting these principles with established Cyrillic writing habits. Instructional materials should be systematically organised to address structural configurations known to present specific challenges, such as enclosed characters and left-right structures. Furthermore, these materials should incorporate targeted practice designed to help learners internalise crucial sequencing rules, such as ‘outside-before-inside’ and ‘left-before-right’. In addition, it is important for instructors to recognise that learners' previous literacy experiences may shape their approach to Chinese character writing in subtle ways. For example, the tendency to apply Cyrillic-based sequencing or directionality rules can

persist even after initial instruction. Therefore, repeated and varied practice opportunities – such as copying, dictation, and guided writing tasks – should be integrated into the curriculum to reinforce correct stroke order and direction. Teachers might also consider the use of error analysis as a regular classroom activity, encouraging students to identify and correct common mistakes both individually and collaboratively.

Considering the pronounced influence of Cyrillic writing habits on stroke direction errors, instructors should explicitly highlight and address differences in writing directionality, especially concerning horizontal and diagonal strokes. The observed disconnect between phonological familiarity and orthographic accuracy strongly suggests that educators should not presume that Dungan speakers' linguistic background automatically confers an advantage in the domain of character writing. On the contrary, systematic and explicit character writing instruction remains essential, employing approaches comparable to those utilised for learners from alphabetic or other non-character-based linguistic backgrounds.

Furthermore, the integration of technology, such as smart pen systems, can significantly enhance the provision of immediate and detailed feedback and facilitate a more granular analysis of the writing process. This technological support can thereby assist both educators and learners in identifying and remediating persistent error patterns. Additionally, incorporating kinaesthetic and visual learning strategies – including techniques like air-writing, finger tracing, and the use of color-coded stroke order diagrams – may prove beneficial in helping learners establish new motor routines distinct from those habituated through Cyrillic script. It is also advisable to create a supportive classroom environment that encourages risk-taking and values the process of learning from errors. Peer support networks, collaborative group work, and scaffolded practice can all contribute to building learner confidence and resilience when grappling with the complexities of Chinese character formation.

Instructional interventions should also include opportunities for learners to reflect on their own writing habits, perhaps through video analysis or peer feedback sessions, to increase awareness of cross-script interference. This metacognitive component can empower learners to consciously monitor and adjust their writing behaviours, fostering greater autonomy in mastering Chinese character stroke order. In summary, effective pedagogy for Central Asian learners must combine explicit contrastive analysis, targeted practice, technological support, and metacognitive strategies to address the complex interplay of structural, cognitive, and procedural challenges in Chinese character writing.

Comparative analysis of research on character writing acquisition

The findings of this study both align with and diverge from previous research on Chinese character writing

acquisition among diverse learner populations. For instance, M. Kong (2020) found that stroke sequence and character configuration errors were most common among Hong Kong children, closely linked to visual discrimination and spatial memory, and decreased with age and schooling. This highlights the developmental trajectory of orthographic knowledge in native learners. For learners of Chinese as a foreign language, similarities and cross-linguistic differences emerge. S. Deng & W. Hu (2022) identified stroke order errors as most prevalent but noted that error types and frequencies varied with learners' first language and writing experience. C. Looi-Chin *et al.* (2018) reported that business students frequently made stroke omissions, additions, and misplacements, particularly with complex or unfamiliar characters, and that interference from alphabetic scripts led to systematic errors in stroke direction and order.

Y. Han & N. Pankitwanitjalearn (2021) observed that Thai university students showed frequent stroke order errors in complex characters, attributing this to the influence of Thai script writing habits. This aligns with the present study's finding that cross-script interference, such as from Cyrillic or other alphabetic systems, shapes the types and frequencies of stroke errors, including horizontal-vertical order reversals. C. Chen & L. Feng (2016) found that Italian beginners struggled with universal stroke order rules, but errors were more pronounced when learners' native scripts differed greatly from Chinese in structure and direction, supporting the idea that L1-L2 script similarity influences error patterns. J. Xing & M. Yang (2021) analysed Korean intermediate learners, noting a tendency to process characters holistically by breaking them into components and radicals. While these learners could analyse structure and integrate form, sound, and meaning, they often made errors like stroke deletion, substitution, and dislocation – especially with visually or phonetically similar characters. The study emphasised the need to consider the relationship between Chinese characters and language when analysing acquisition and errors.

Overall, this study extends prior research by clarifying how cross-script interference from alphabetic systems manifests in stroke order and character structure errors. While stroke sequence errors are common across native and non-native learners, the specific patterns and causes – such as L1 script influence, character similarity, and holistic versus componential processing – underscore the need for tailored instructional approaches. These insights deepen the understanding of the procedural and cognitive aspects of Chinese character acquisition among second language learners.

CONCLUSIONS

This study provided a systematic investigation of stroke order errors in Chinese character writing among five beginning-level Central Asian students, all native Dungan speakers, within a university-level Chinese programme in Gansu. Despite their inherent linguistic closeness to Chinese via their Dungan native tongue, participants demonstrated a significant frequency of stroke order inaccuracies, with an

average error rate of 33.6%. The predominant error category was stroke sequence errors (78.5%), followed by stroke direction errors (19.3%), and instances of stroke reversal (2.2%). The most common sequence errors included horizontal-vertical order reversals and component order misplacements, whereas direction errors frequently involved confusion between *ti* (提) and *pie* (撇) strokes.

These results yield crucial insights into the acquisition of Chinese orthography by this learner demographic. Notably, the anticipated orthographic benefits from Dungan-Chinese phonological and lexical similarities did not materialise in the procedural domain of stroke order. Conversely, the learners' profound familiarity with Cyrillic script – characterised by distinct stroke directionality and sequencing conventions – proved to be a considerable influencing factor, leading to discernible patterns of interference. These patterns were particularly evident in errors related to stroke direction and the ordering of complex or enclosed character components, highlighting the cognitive and motoric hurdles involved in adapting to a fundamentally different writing system. Furthermore, the investigation uncovered substantial individual differences in error rates and patterns, emphasising the importance of personalised instructional strategies. Individuals exhibiting fewer errors generally approached writing with greater deliberation and metacognitive awareness, often pausing for planning prior to execution. This observation implies that cultivating metacognitive strategies and encouraging learners to consciously reflect on stroke order principles may bolster accuracy and aid the internalisation of standard writing conventions.

Theoretically, this research enriches the broader literature on cross-linguistic influence and second language orthographic acquisition. The emergent patterns lend support to a multi-faceted model of language transfer, which differentiates between lexical/phonological knowledge and procedural/motor skills. Although Dungan's phonological congruence with Chinese might facilitate oral comprehension and vocabulary learning, the procedural acumen essential for accurate character composition appears more profoundly influenced by the learners' established literacy experiences in Cyrillic. This emphasises the imperative to account for the intricate interplay of linguistic, cognitive, and motor factors within models of second language writing development.

In terms of methodology, the application of smart pen technology was exceptionally valuable for capturing the dynamic process of character production. The detailed temporal data on stroke sequencing, hesitations, and writing rhythm offered visibility not merely into manifest errors but also into the underlying cognitive processes and self-correction mechanisms learners employed. Such technologically augmented methods present encouraging pathways for future research and pedagogical practices, facilitating

more precise diagnostics of learning challenges and the creation of targeted feedback systems. Pedagogically, these outcomes directly inform Chinese language instruction for Central Asian learners. The study concludes that effective teaching must conscientiously address the interference from Cyrillic script by emphasising comparative analysis of writing systems and providing targeted training on Chinese character-specific rules and structures. Furthermore, the development of metacognitive skills and deliberate practice is pivotal for learners to supersede ingrained Cyrillic habits and assimilate new orthographic procedures.

Prospectively, subsequent research endeavours should explore the longitudinal trajectory of stroke order acquisition among Central Asian learners, assessing whether the identified error patterns diminish with augmented proficiency and exposure. Studies evaluating the effectiveness of targeted instructional strategies – such as explicit contrastive analysis, kinaesthetic training, and real-time digital feedback – would refine best practices in Chinese character pedagogy. Additionally, comparative studies with learners from varied linguistic origins could elucidate the relative impacts of Dungan language background versus Cyrillic literacy on character learning achievements. Ultimately, with the intensification of China's educational and economic ties with Central Asian nations, particularly through initiatives like the Belt and Road, the imperative for culturally attuned and linguistically sensitive Chinese language pedagogy grows more pressing. This research offers empirically substantiated perspectives for educators, curriculum developers, and policymakers alike, underscoring the necessity of customised instructional methods that cater to the specific difficulties encountered by these learners in mastering Chinese orthography. Through enhancing comprehension of cross-linguistic and cross-script dynamics, this work establishes a foundation for more efficacious and inclusive Chinese language education within an ever-more interconnected global landscape.

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■ CONFLICT OF INTEREST

None.

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Борбор Азиялык башталгыч студенттердин кытай иероглифтеринин черталар тартибиндеги каталарын акылдуу калем технологиясы менен талдоо

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Аннотация. Кытай орфографиясын өздөштүрүү дүйнөлүк билим берүүдө барган сайын маанилүү болуп баратат, бирок логографикалык эмес тилдик чөйрөдөн келген окуучулар туруктуу жана өзгөчө кыйынчылыктарга туш болушат. Борбор Азиялык студенттердин өзгөчө кыйынчылыктарын изилдөө максаттуу окутуу стратегияларын иштеп чыгуу үчүн маанилүү. Бул изилдөө Кыргызстан жана Өзбекстандан келген, дунган тилинде сүйлөгөн жана орус тилин эркин билген беш башталгыч деңгээлдеги студенттин кытай иероглифтерин жазуудагы черталар тартибиндеги каталардын процедуралык кыйынчылыктарын жана когнитивдик факторлорун аныктоого багытталган. Жазуу процессин жазып алуу жана талдоо үчүн акылдуу калем технологиясын колдонуп, изилдөөнүн авторлору окуу китебиндеги көчүрүү көнүгүүлөрү учурунда черталар тартибиндеги каталар боюнча маалыматтарды чогулткан. 1800 иероглиф боюнча 605 ката учурунун анализи ар бир студент үчүн катасы бар иероглифтердин орточо ката деңгээли 33,6 % экенин көрсөттү. Эң көп кездешкен ката түрлөрү: черталардын ырааттуулугу боюнча каталар (78,5 %), черталардын багыты боюнча каталар (19,3 %) жана черталардын инверсиясы феномени (2,2 %). Ырааттуулук каталарынын ичинен горизонталдык-вертикалдык тартиптин инверсиясы (31,4 %) жана компоненттердин тартибинин инверсиясы (28,6 %) көп кездешсе, багыт каталарынын арасында “ти” (提) жана “пье” (撇) черталарынын аралашып кетиши (52,1 %) басымдуу болгон. Жыйынтыктар дунган тилинин фонологиялык артыкчылыктары болгону менен, бул тил черталар тартибин туура аткарууга өбөлгө түзбөй турганын, бул процесс кириллица/орус жазуусунун адаттарынан олуттуу таасирленерин көрсөттү. Бул изилдөө Борбор Азиялык окуучулар туш болгон өзгөчө процедуралык тоскоолдуктарды түшүнүүнү тереңдетип, кытай иероглифтерин окутуунун натыйжалуулугун жогорулатуу үчүн далилдерге негизделген чараларды сунуштайт.

Негизги сөздөр: кытай иероглифтерин өздөштүрүү; черталар ырааттуулугу; дунган тили; каталарды талдоо; акылдуу калем технологиясы; кириллицанын таасири

Анализ ошибок порядка начертания китайских иероглифов у начинающих студентов из Центральной Азии с использованием технологии умной ручки

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Аннотация. Овладение китайской орфографией приобретает все большее значение в глобальном образовании, однако учащиеся из нелогографических языковых сред сталкиваются со специфическими трудностями. Изучение конкретных проблем, с которыми сталкиваются студенты из Центральной Азии, имеет ключевое значение для разработки целенаправленных стратегий обучения. Настоящее исследование было направлено на выявление процедурных трудностей и когнитивных факторов, лежащих в основе ошибок в порядке черт при написании китайских иероглифов у пяти студентов начального уровня из Кыргызстана и Узбекистана, являющихся носителями дунганского языка и свободно владеющих русским. Используя технологию умной ручки для записи и анализа процесса письма, автор исследования собрал данные об ошибках в порядке черт во время выполнения упражнений по копированию из учебника. Анализ 605 случаев ошибок в 1800 иероглифах показал среднюю частоту ошибок 33,6 % на одного студента для иероглифов, содержащих ошибки. Наиболее распространенными типами ошибок были ошибки в последовательности черт (78,5 %), ошибки в направлении черт (19,3 %) и феномен инверсии черт (2,2 %). Среди ошибок последовательности чаще всего встречались инверсия порядка горизонтальных и вертикальных черт (31,4 %) и инверсия порядка компонентов (28,6 %), в то время как среди ошибок направления преобладала путаница между чертами «ти» (提) и «пье» (撇) (52,1 %). Результаты показали, что, несмотря на определенные фонологические преимущества дунганского языка, он не способствует правильному выполнению порядка черт, который значительно зависит от привычек, сформированных кириллическим/русским письмом. Исследование углубляет понимание специфических процедурных барьеров, с которыми сталкиваются учащиеся из Центральной Азии, и предлагает научно обоснованные меры для более эффективного обучения написанию китайских иероглифов.

Ключевые слова: освоение китайских иероглифов; последовательность черт; дунганский язык; анализ ошибок; технология умной ручки; влияние кириллицы



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Formation of future doctors' readiness for intercultural interaction in Kyrgyzstan

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Abstract. This article addressed the pressing issue of developing future doctors' readiness for effective intercultural interaction within the multicultural society of Kyrgyzstan. The aim of the study was to analyse contemporary approaches to fostering intercultural competence among medical students and to develop recommendations for integrating these approaches into the educational process. To achieve this objective, both qualitative and quantitative methods were employed, including content analysis of medical university curricula and a survey of senior students from the I.K. Akhunbaev Kyrgyz State Medical University and Osh State University (N = 347). The study revealed that the cultural, linguistic, and religious diversity of Kyrgyzstan's population has a direct impact on the quality of healthcare delivery. According to the survey results, 68% of respondents reported frequent difficulties in communicating with patients due to language barriers, while 57% had encountered conflicts arising from differing perceptions of illness and traditional treatment methods. Furthermore, 92% of the participants indicated a lack of systematic courses on intercultural communication within their academic programmes. This is supported by the content analysis, which showed that less than 1% of subjects include modules on ethnopsychology or medical anthropology. The authors propose specific measures for modernising medical education, including the introduction of a compulsory module titled "Intercultural Aspects of Medicine", training academic staff in cross-cultural teaching methodologies, and fostering a multicultural environment in universities through exchange programmes and the establishment of "Ethno-Clubs". It was found that students with practical experience in multinational clinics demonstrated intercultural sensitivity levels 34% higher than those without such experience. The findings of this study have practical value for medical universities, the Ministry of Health, and international organisations, contributing to improved quality in medical education and enhanced interethnic interaction within Kyrgyzstan's healthcare system

Keywords: professional readiness; multicultural environment; pedagogical challenge; cultural competence; medical education; tolerance

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■ INTRODUCTION

Modern society is evolving in the context of globalisation, which contributes to the active expansion of intercultural contact across all areas of life, including healthcare. For Kyrgyzstan, as a multi-ethnic state, this creates specific conditions in which medical professionals regularly interact with representatives of diverse cultures. As a result, the need to prepare future doctors for professional activity in a culturally diverse environment is increasing. The development of intercultural competence among medical students is becoming a crucial task for the medical education system and represents a significant pedagogical challenge (Kozubovska *et al.*, 2022). A review of the literature suggests that addressing this challenge requires the implementation of modern educational approaches, such as active learning methods, the integration of intercultural components into academic curricula, and the development of practical experience. Successfully addressing this issue will enhance the quality of medical care in culturally diverse contexts and strengthen interethnic harmony in society.

In recent years, medical education in Kyrgyzstan has been actively evolving with a focus on training professionals capable of working effectively in multinational and multicultural environments. A key aspect of this process is the development of intercultural competence among future doctors. A group of researchers, O. Heller *et al.* (2023), conducted a mixed-methods study exploring the attitudes of medical students in Kyrgyzstan towards family medicine. The findings revealed that while future doctors generally recognise its significance within the healthcare system, they also note existing gaps in their educational training, particularly in the area of intercultural communication, which hinders effective interaction with patients from various ethnic and cultural backgrounds in Kyrgyzstan's multi-ethnic society. A. Samigullina *et al.* (2024), in their research on the digital transformation of adaptation processes for international students in Kyrgyz medical universities, explored the development of an expert system aimed at improving student integration into the educational environment, taking into account cultural characteristics and needs. This, in turn, supports the development of intercultural competence. In a study by U. Kadyrkulova & G. Abylasynova (2020), dedicated to reforms in Kyrgyzstan's medical education system, the authors emphasised the need to include intercultural training in academic programmes so that future doctors can work effectively in culturally diverse settings.

The article by D. Kozhogulova (2016) addressed the challenges and prospects of diversity-oriented education in Kyrgyzstan, highlighting the importance of equipping students with intercultural communication skills for successful professional activity in a multi-ethnic society. The author stresses the value of implementing the "Multilingual and Multicultural Education" programme in public educational institutions, aimed at fostering tolerance and strengthening interethnic relations. Although the study by K. Nagymzhanova *et al.* (2024) focused on the development of intercultural communication among international

medical students in Kazakhstan, its findings are also relevant for Kyrgyzstan, as the research confirmed that developing such skills promotes a better understanding of cultural differences and improves communication with patients.

The article by G. Orozalieva *et al.* (2021) explored the formation of intercultural competence in future teachers. While the study targets pedagogical education, its conclusions about the importance of intercultural training are also applicable to medical education, as future doctors likewise require intercultural communication skills. As noted by J. Betancourt *et al.* (2002), cultural competence in healthcare comprises a set of knowledge, skills, and attitudes that enable the delivery of appropriate and high-quality care to patients from diverse cultural backgrounds. Similarly, R. Thackrah & S. Thompson (2013) stressed that the concept of cultural competence continues to evolve and that it is necessary to acknowledge its dynamic nature, aiming for intercultural sensitivity and critical reflection on healthcare workers' own cultural positions.

Kyrgyzstan, as a country with rich ethnic and cultural diversity, faces an important task – preparing medical professionals capable of effectively engaging with patients of different nationalities, religious beliefs, and cultural traditions. In the context of globalisation and increasing migration, the issue of cultural adaptation in healthcare is becoming increasingly relevant. Medical professionals in Kyrgyzstan provide daily care to patients from various ethnic and cultural communities – Kyrgyz, Uzbeks, Russians, Tajiks, and others (Abramzon, 1946). Each of these groups possesses unique perceptions of health, illness, and treatment methods, requiring doctors to have not only professional qualifications but also the ability to consider cultural nuances in order to build trustful relationships with patients. However, research shows that the current medical education system in the country does not sufficiently equip future doctors with intercultural communication skills.

This issue is particularly pronounced during the educational process in medical universities. Future doctors must not only be able to provide competent medical care but also find common ground with representatives of different cultural groups (Karpenko, 2022). At the same time, the current curriculum does not always address the necessity of cultivating intercultural sensitivity and tolerance among students. As a result, many graduates are not fully prepared for practice in culturally diverse settings. This highlights the urgent need to reform approaches to medical education. It is essential to integrate disciplines and methods into academic programmes that promote the development of intercultural competence. This involves not only introducing specialised courses but also rethinking pedagogical methods to foster students' respect for cultural differences, empathy, and readiness for open and respectful dialogue with patients from various ethnic and religious backgrounds. The aim of this study was to analyse existing approaches and methods for developing intercultural competence among future doctors in Kyrgyzstan and to propose

recommendations for integrating these approaches into the educational process of the country's medical universities.

■ MATERIALS AND METHODS

This study employed a comprehensive research design, incorporating both qualitative and quantitative methods for data collection and analysis. The empirical and informational basis of the research was formed through: content analysis of academic curricula from medical higher education institutions in Kyrgyzstan (specifically, the I.K. Akhunbaev Kyrgyz State Medical University and Osh State University); a review of relevant scientific publications concerning the development of intercultural competence in medical education; international reports and recommendations from the World Health Organization (WHO, n.d.) and UNESCO (2006) related to intercultural communication in healthcare; and primary empirical data obtained through a student survey.

Content analysis was conducted to systematise and examine the curricula of medical universities in the Kyrgyz Republic with the aim of identifying the presence and extent of disciplines or modules dedicated to developing intercultural competence. In particular, the study analysed the academic plans and syllabi of the I.K. Akhunbaev Kyrgyz State Medical University and Osh State University. Additionally, 28 scholarly publications on intercultural competence in medicine were analysed to identify essential components of training, such as culture-specific knowledge (e.g. understanding traditional health beliefs among Kyrgyzstan's ethnic groups, the role of religious practices) and communication skills (e.g. techniques for overcoming language barriers, non-verbal communication strategies).

A survey was conducted among fourth- to sixth-year students at the I.K. Akhunbaev Kyrgyz State Medical University and Osh State University between October and December 2024 using a questionnaire hosted on the Google Forms platform. The total sample included 347 respondents (KSMU: $n = 215$; OSU: $n = 132$). These institutions were selected due to their leading role in training medical professionals in the country. A purposive (non-random) sampling method was employed. Inclusion criteria were: (1) current enrolment in the 4th-6th year of study; and (2) clinical practice experience (i.e. having interacted with patients). The survey link was distributed through university dean's offices and academic advisors and subsequently shared in student chat groups. The response rate was approximately 68% of those invited who met the inclusion criteria.

The questionnaire consisted of four blocks:

■ Block A: Socio-demographic data (e.g. year of study, university, and optionally, ethnic self-identification);

■ Block B: Questions on experience with intercultural interaction during clinical practice, self-assessed readiness, and common challenges when interacting with patients from different cultural, linguistic, and religious backgrounds (e.g. "How often do you encounter patients whose culture/language differs from yours?" with options: "Very often", "Often", "Sometimes", "Rarely", "Never");

■ Block C: Open-ended questions designed to elicit qualitative data on specific difficulties in intercultural communication and student suggestions for improving training (e.g. "Describe a memorable case of intercultural misunderstanding with a patient. How did you resolve it, if at all?");

■ Block D: An adapted intercultural sensitivity scale based on the MILKS model (Model of Intercultural Learning, Knowledge, and Skill) by A. Fantini & A. Tirmizi (2006). The adaptation process included cultural and contextual validation by three experts in intercultural communication and medical pedagogy, pilot testing ($n = 30$), and modifications to ensure contextual relevance for Kyrgyzstan. The reliability of the adapted scale was confirmed with a Cronbach's alpha coefficient > 0.8 , indicating strong internal consistency. Respondents rated their agreement with statements (e.g. "I feel confident when communicating with patients from other cultures") using a 5-point Likert scale ("Strongly disagree" to "Strongly agree").

Quantitative data from the survey were processed using IBM SPSS Statistics 28. Descriptive statistical methods (frequency analysis and percentage calculations) were applied to characterise the challenges students faced. For the analysis of qualitative data collected via open-ended questions (Block C), thematic analysis was used to identify key issues and suggestions raised by respondents. Responses were coded, recurring themes and patterns were identified, and general categories were formed.

The study was conducted in strict accordance with the ethical principles of the WMA Declaration of Helsinki (1964). The research protocol was approved by the Ethics Committee of the I.K. Akhunbaev Kyrgyz State Medical University (Protocol No. 3, dated 15 September 2024). Student participation was voluntary and anonymous, with informed consent obtained in advance.

■ RESULTS

Kyrgyzstan, a multi-ethnic state with more than 80 ethnic groups, provides unique conditions for medical practice. This study confirmed that the cultural, linguistic, and religious diversity of the population directly affects the quality of healthcare delivery. A survey of students ($N = 347$) revealed the following key challenges:

■ Language barriers: 68% of respondents reported frequent difficulties communicating with patients who did not speak Kyrgyz or Russian, leading to errors in medical history taking;

■ Cultural discrepancies: 57% experienced conflicts due to differences in perceptions of illness, traditional treatment methods (especially among Uzbek and Tajik communities), and the role of the family in decision-making;

■ Educational resource gap: 92% noted the absence of systematic intercultural communication courses in the curricula of KSMU and OSU.

A comparative analysis of the curricula at KSMU and OSU showed that fewer than 1% of courses include modules on ethnopsychology or medical anthropology, and there

are no standardised practical sessions for developing skills in multicultural simulations. These findings align with the conclusions of U. Kadyrkulova & G. Abylasynova (2020) and O. Heller *et al.* (2023), confirming a systemic gap in training. As emphasised by L. Kuvaeva (2025), cultural competence is not an add-on but a fundamental element of medical professionalism in multi-ethnic societies. Without its incorporation, healthcare effectiveness in ethnically mixed regions (such as Osh and Batken Regions) remains low.

Based on a thorough content analysis of medical curricula and relevant academic literature, as well as qualitative data collected through the open-ended questions of the survey (Block B), the essential components required for preparing future doctors for effective intercultural interaction were identified. These elements comprise three key components. Firstly, culture-specific knowledge, which involves an in-depth understanding of traditional health beliefs among the main ethnic groups in the Kyrgyz Republic, such as Kyrgyz, Uzbeks, and Dungans. Particular attention should be paid to the influence of religious practices – such as namaz (ritual prayer) and fasting – on adherence to treatment regimens, as well as to sensitive aspects like the prohibition of autopsies in Islam, which, according to data, result in conflicts in forensic medical practice in 75% of cases. Secondly, the development of communication skills, including techniques for effectively overcoming language barriers. This includes the use of professional interpreters and the acquisition of basic medical vocabulary in Uzbek and Tajik – skills that are especially relevant in the southern regions of the country. This component also involves mastering non-verbal communication, with sensitivity to cultural taboos, such as the prohibition of handshakes with women in conservative families (Shcherban & Dolynay, 2024). Thirdly, the implementation of practice-oriented learning methods. These include the analysis of clinical case studies based on real-life intercultural conflict situations (e.g., refusal of blood transfusion on religious grounds), and role-playing exercises involving cultural representatives. A pilot implementation of these methods at Osh State University showed that 89% of students reported a significant increase in confidence in their intercultural communication skills.

The critical importance of internships in multi-ethnic healthcare institutions was emphasised: although only 12% of students had such experience, 98% considered it highly valuable. Further analysis using the adapted MILKS intercultural sensitivity scale ($\alpha > 0.8$) revealed that students ($n = 41$) with practical experience in multinational clinics demonstrated 34% higher levels of intercultural sensitivity than those without such exposure. This finding supports E. Baikina's (2024) argument that competency develops through immersive experience, not solely theoretical instruction.

To address the identified shortcomings in the training of future doctors and to enhance the effectiveness of intercultural interaction in medical practice, specific and comprehensive measures have been proposed across several key areas. Modernisation of the academic curriculum

includes the introduction of a mandatory module entitled “Intercultural Aspects of Medicine”, totalling 72 academic hours. The main focus of this module should be on studying ethnomedical traditions and the culturally conditioned behaviours of patients in the Kyrgyz Republic, as well as on examining the legal aspects of informed consent, taking into account local cultural norms and values. As part of this initiative, the development of open educational resources (OER) in both Kyrgyz and Russian is planned. These resources will include clinical case studies with local specificity and are part of a project supported by the World Health Organization (WHO, n.d.).

Alongside curricular updates, the training of academic staff is of critical importance. Specialised training sessions must be provided for 100% of teaching personnel from clinical departments on cross-cultural education methodologies. This professional development will be carried out in partnership with international programmes such as Erasmus+ (n.d.), allowing for the integration of global best practices into the teaching process. Significant attention should also be devoted to creating a multicultural educational environment in universities. This will be realised through exchange programmes for students and faculty between regions of Kyrgyzstan with pronounced ethnic diversity (e.g. Batken and Osh regions), as well as with other Central Asian countries (such as Kazakhstan and Uzbekistan). A particularly important initiative involves the creation of “Ethno-Clubs” as platforms for constructive dialogue and experience-sharing between local and international students. According to experience from the Kyrgyz State Medical University, such clubs contributed to a 40% reduction in stereotyping within the student community.

The implementation of these measures is not only educationally, but also economically justified. The pilot launch of these initiatives at KSMU, planned for 2025, will require an investment of 28 million Kyrgyz soms. These funds will be allocated for equipping a simulation centre and compensating experts involved. However, as calculations by A. Samigullina *et al.* (2024) show, every som invested in the development of intercultural training for medical personnel has the potential to reduce costs related to conflict resolution and misunderstandings in healthcare institutions by 3.7 soms.

Systematically integrating these strategies will substantially improve the quality of care in multi-ethnic communities and strengthen the physician's role as a mediator of cultural dialogue. This aligns with the Sustainable Development Goals (2015) – SDG 3 (Good Health and Wellbeing) and SDG 10 (Reduced Inequalities) – underscoring the global significance of the issue. It should be noted that the primary barriers in intercultural healthcare communication remain language gaps, cultural differences in health beliefs and treatment practices, the family's role in therapy, stereotypes, and unconscious biases – all exacerbated by a lack of cultural competence and awareness among students and staff. Therefore, preparing future doctors for intercultural engagement is not only a vital pedagogical requirement

but a key step toward building a more tolerant, equitable, and effective healthcare community in Kyrgyzstan.

■ DISCUSSION

The present study clearly demonstrated that in today's globalised world – characterised by increasing migration and cultural diversity – the development of intercultural competence among future medical professionals is not merely desirable but an essential component of professional training (UNESCO, 2006). In the context of multi-ethnic Kyrgyzstan, where healthcare professionals interact daily with patients from diverse ethnic, linguistic, and religious backgrounds, the ability to communicate effectively across cultural boundaries directly impacts the quality and safety of medical care (Iskakov, 2016; Choyubekova & Sadamkulova, 2019). The absence of adequate intercultural training leads to significant challenges, ranging from language barriers and miscommunication to conflicts rooted in differing perceptions of health, illness, and treatment practices (Batyrov, 2024). The empirical data from this study, gathered through a student survey, corroborates these concerns, revealing substantial gaps in current curricula and highlighting the urgent need for systemic reform.

As noted by N. Sirota *et al.* (2015), effective intercultural communication in medicine is not only a matter of ethics and patient respect but also a practical necessity for achieving better clinical outcomes. Research shows that culturally competent physicians are more likely to build trust with their patients, which results in better treatment adherence and a reduction in medical errors (Paez *et al.*, 2009; Raza *et al.*, 2024). Moreover, investment in the development of these skills has proven economic benefits, helping to reduce costs associated with conflict resolution and repeat visits due to misunderstandings or distrust in the healthcare system (O'Byrne *et al.*, 2008; Spînu, 2024).

The measures proposed in this study – modernisation of curricula, targeted teacher training, and the creation of a multicultural educational environment – offer a comprehensive approach to addressing the identified issues. The introduction of specialised modules and the use of practice-oriented methods, such as clinical case studies and role-playing exercises, provide students not only with theoretical knowledge but also the opportunity to engage with realistic interaction scenarios, as discussed by Yu. Logvinov *et al.* (2018) and J. Divakaran (2025). Establishing an intercultural environment in universities, including exchange programmes and informal student clubs, contributes to the development of empathy and reduction of stereotyping at an interpersonal level, which is fundamental for fostering true cultural sensitivity (Ratzmann, 2019; Yogeewaran *et al.*, 2020; Nasie, 2023).

Thus, preparing future doctors for intercultural interaction is not merely an educational objective but a strategic priority for improving the national healthcare system and promoting social well-being. It is a process that demands sustained efforts from the academic community, government bodies, and international partners. Nevertheless, its

outcomes will contribute to the creation of a more effective, humane, and tolerant healthcare community – one that is capable of responding with dignity and competence to the challenges of a multicultural society.

■ CONCLUSIONS

The findings of this study convincingly underscored the critical importance of developing intercultural competence among future physicians within Kyrgyzstan's multi-ethnic and multicultural society. It has been shown that successful and ethical medical practice in such a context requires not only strong clinical knowledge, but also the vital ability to account for the cultural, ethnic, and religious differences of patients. Survey results revealed that 68% of respondents face significant communication difficulties due to language barriers, while 57% regularly encounter conflict situations arising from differing cultural perceptions of health, illness, and traditional healing practices. These figures highlight a clear deficiency in training related to intercultural interaction.

One of the key conclusions is the urgent need for the systematic integration of intercultural education into the medical higher education curriculum. Content analysis demonstrated that fewer than 1% of courses include modules on ethnopsychology or medical anthropology, and 92% of students report a complete lack of formal intercultural communication courses. The incorporation of such training would enable healthcare professionals to communicate effectively with patients from diverse ethnic backgrounds and prevent conflicts stemming from cultural misunderstandings. The practical value of this research lies in the provision of specific recommendations for improving medical education. These include the introduction of specialised courses and workshops in intercultural communication, the active use of role-playing exercises, and practice-based sessions grounded in real clinical case studies. The effectiveness of these methods is supported by evidence from the pilot implementation of role-play at Osh State University, where 89% of students reported a significant increase in confidence in their intercultural communication skills. Moreover, while only 12% of surveyed students had undertaken internships in multi-ethnic healthcare institutions, 98% of them considered the experience to be critically important. This is further supported by findings showing that students with such experience demonstrated 34% higher levels of intercultural sensitivity than their peers without this exposure. These measures will help future physicians to develop not only theoretical knowledge of cultural diversity, but also essential practical skills for applying that knowledge in everyday clinical settings. A key indicator of the success of such training is not only a reduction in stereotyping – evidenced by a 40% decrease in such tendencies through the “Ethno-Clubs” initiative at KSMU – but also increased patient satisfaction with culturally respectful and responsive care.

Furthermore, the study identified the need to establish an effective system for assessing and monitoring the level of intercultural competence among medical professionals.

This will allow for progress to be tracked and educational approaches to be adjusted accordingly. It is also essential to regularly update teaching materials and methodologies to reflect the evolving social, cultural, and technological landscape of modern society. Future research should focus on a deeper analysis of how intercultural training impacts the quality of healthcare across various regions of Kyrgyzstan, taking into account their specific ethnic and cultural composition. Additionally, exploring and adapting best practices from international medical education institutions will contribute to developing the most effective and

sustainable approaches to training future doctors in the context of Central Asia.

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■ CONFLICT OF INTEREST

None.

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Аннотация. Бул макалада Кыргызстандагы көп маданияттуу коом шарттарында болочоктогу дарыгерлердин натыйжалуу маданияттар аралык өз ара аракеттенүүгө даярдыгын калыптандыруу маселеси каралган. Изилдөөнүн максаты – медициналык студенттердин маданияттар аралык компетенттүүлүгүн калыптандыруунун заманбап ыкмаларын талдоо жана аларды билим берүү процессине интеграциялоо боюнча сунуштарды иштеп чыгуу болгон. Максатка жетүү үчүн сапаттуу жана сандык методдор колдонулган, анын ичинде медициналык ЖОЖдордун окуу программаларына контент-аналитикалык талдоо жана И.К. Ахунбаев атындагы Кыргыз мамлекеттик медициналык университетинин жана Ош мамлекеттик университетинин жогорку курсунун студенттерин (N = 347) сурамжылоо жүргүзүлгөн. Изилдөөнүн жыйынтыгында, Кыргызстандагы калктын маданий, тилдик жана диний ар түрдүүлүгү медициналык жардам көрсөтүүнүн сапатына түздөн-түз таасир этери аныкталды. Сурамжылоонун жыйынтыгы боюнча, респонденттердин 68 %ы тил тоскоолдуктарынан улам бейтаптар менен баарлашууда кыйынчылыктарга көп учурашарын, ал эми 57 %ы оорунун кабылдоосундагы жана салттуу дарылоо ыкмаларына болгон мамиленин айырмачылыгынан келип чыккан жаңжалдарга туш болгонун билдиришти. Мындан тышкары, респонденттердин 92 %ы окуу программаларында маданияттар аралык коммуникация боюнча системалуу курстар жок экенин айтышкан. Бул контент-аналитикалык изилдөө менен да ырасталып, дисциплиналардын 1 %тен азы гана этнопсихология же медициналык антропология боюнча модулдарды камтый турганы аныкталган. Макаланын авторлору медициналык билим берүүнү модернизациялоо боюнча так сунуштарды беришти. Аларга “Медицинанын маданияттар аралык аспектери” аттуу милдеттүү модулду киргизүү, мугалимдерди кросс-маданий окутуу ыкмалары боюнча даярдоо жана ЖОЖдордо студенттердин маданияттар аралык тажрыйбасын кеңейтүү үчүн алмашуу программалары менен “Этноклубдарды” уюштуруу кирет. Изилдөөнүн жүрүшүндө улуттар аралык клиникаларда практика өткөн студенттердин маданияттар аралык сезимталдуулугу 34 %га жогору болору аныкталган. Бул изилдөөнүн жыйынтыктары медициналык ЖОЖдор, Саламаттык сактоо министрлиги жана эл аралык уюмдар үчүн практикалык мааниге ээ болуп, Кыргызстанда дарыгерлерди даярдоонун сапатын жогорулатууга жана саламаттык сактоо системасындагы этностор аралык өз ара түшүнүшүүнү жакшыртууга өбөлгө түзөт.

Негизги сөздөр: кесиптик ишмердүүлүккө даярдык; көп маданияттуу чөйрө; педагогикалык маселелер; маданий компетенттүүлүк; медициналык билим берүү; толерантуулук

Формирование готовности будущих врачей к межкультурному взаимодействию в Кыргызстане

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Аннотация. В данной статье рассмотрена актуальная проблема формирования готовности будущих врачей к эффективному межкультурному взаимодействию в условиях поликультурного общества Кыргызстана. Целью исследования был анализ современных подходов к формированию межкультурной компетентности у студентов-медиков и разработка рекомендаций по их интеграции в образовательный процесс. Для достижения поставленной цели использовались качественные и количественные методы, включая контент-анализ учебных программ медицинских вузов и анкетирование студентов старших курсов Кыргызского государственного медицинского университета им. И.К. Ахунбаева и Ошского государственного университета (N = 347). Исследование выявило, что культурное, языковое и религиозное разнообразие населения Кыргызстана напрямую влияет на качество оказания медицинской помощи. По результатам анкетирования, 68 % респондентов отметили частые сложности в общении с пациентами из-за языковых барьеров, а 57 % сталкивались с конфликтами, вызванными различиями в восприятии болезни и традиционных методах лечения. Более того, 92 % опрошенных указали на отсутствие систематических курсов по межкультурной коммуникации в учебных программах, что подтверждается контент-анализом, показавшим, что менее 1 % дисциплин содержат модули по этнопсихологии или медицинской антропологии. Авторами предложены конкретные меры по модернизации медицинского образования, включая введение обязательного модуля «Межкультурные аспекты медицины», подготовку преподавателей по методикам кросс-культурного обучения и создание поликультурной среды в вузах через программы обмена и «Этноклубы». Установлено, что студенты с опытом практики в многонациональных клиниках демонстрируют уровень межкультурной чувствительности на 34 % выше. Результаты исследования имеют практическую ценность для медицинских вузов, Министерства здравоохранения и международных организаций, способствуя повышению качества подготовки врачей и улучшению межнационального взаимодействия в системе здравоохранения Кыргызстана.

Ключевые слова: готовность к профессиональной деятельности; поликультурная среда; педагогический вызов; культурная компетентность; медицинское образование; толерантность

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