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STUDY OF FUTURE TEACHERS' READINESS TO INTERACT WITH CHILDREN EXHIBITING DEVIANT BEHAVIOUR

Abstract

This study investigates the professional readiness of future teachers enrolled in different teacher education programmes to interact with children exhibiting deviant behaviour. The study addresses the important role of teachers in preventing deviant behaviour, identifying early signs of psychological maladjustment, and recognising risks associated with problem behaviour among learners. The aim of the study was to examine and compare self-reported indicators of the cognitive and operational-activity components of professional readiness among future teachers from different fields of teacher education for working with children exhibiting deviant behaviour. Data were collected using an author-developed self-report questionnaire assessing professional knowledge and skills. Statistical analyses were performed using Jamovi (version 2.6). Between-group differences were examined using the Mann-Whitney U test, and the rank-biserial correlation coefficient was additionally calculated to estimate effect size. The results revealed statistically significant between-group differences in several overall and specific self-reported measures. Students enrolled in psychological and pedagogical support programmes reported higher levels of professional knowledge and skills, as well as higher scores on the overall measure. Among the specific skills assessed, the largest between-group difference was observed in instructional design skills ($r = 0.44$). However, statistically significant differences were not observed across all measures, indicating that the differences between the groups were selective and providing only partial support for the study hypothesis. These findings suggest that strengthening the operational-activity component of teacher education may represent a promising avenue for enhancing the professional preparation of future teachers. The self-report nature of the instrument should be considered when interpreting the findings: the observed differences reflect participants' perceptions of their own professional readiness and should not be interpreted as objective differences in their actual level of professional competence.

Keywords: professional readiness, future teachers, self-assessment, psychological and pedagogical support, children exhibiting deviant behaviour, prevention of deviant behaviour, deviantological competence.

Introduction. Many global challenges facing society today are widely discussed in academic research. One of the most important is the education and upbringing of the younger generation. The significance of this issue for Kazakhstan has been emphasised by the Head of State, K.-J. Tokayev, who identified quality education and proper upbringing as key priorities of Kazakhstani society. In this context, teachers have an important role in preventing inappropriate and harmful behaviour among adolescents and young people [1]. Education and upbringing provide young people with important values and guidelines for personal and social development. They help prepare responsible citizens, employees and family members. However, negative behavioural changes are increasingly observed among adolescents and young people. Such changes may affect their thinking, emotions and ability to control their behaviour.

Deviant behaviour among children and young people has become a global concern. This issue affects teachers, psychologists, sociologists, parents and the international community. The authors' study of international approaches to the prevention of deviant behaviour, conducted during research visits to Poland, Slovakia and the United States, as well as an analysis of academic literature, shows that schools in many countries face various forms of problematic behaviour.

Common problems among adolescents include aggression, suicidal behaviour, bullying, violence, vandalism and different forms of addiction, such as drug, alcohol, and internet addiction.

The rapid spread of digital technologies has also created new risks related to dangerous forms of online behaviour and digital deviance. Under these conditions, teachers and trainee teachers need to understand their role in preventing deviant behaviour among children and adolescents. They must also be prepared to respond to the challenges created by a changing social and digital environment. Teachers are in a particularly critical position because they interact with children regularly and may notice early signs of psychological distress or risky behaviour. To identify and prevent such problems effectively, teachers need relevant knowledge, practical skills, and professional competence. The development of this competence should begin during teacher training at university.

The aim of the study is to examine and compare self-assessment indicators of the cognitive and operational-activity components of future teachers' professional readiness to interact with children demonstrating deviant behaviour across different fields of teacher education. The need for this study is driven by the necessity to improve teacher education programs in preparing future teachers to work with children exhibiting deviant behaviour in school.

In the present study, professional readiness is conceptualised in terms of professional knowledge and skills, operationalised through the cognitive and operational-activity blocks of the author-developed questionnaire, designed on the basis of a structural model of teachers' deviantological competence.

The research hypothesis was based on the assumption that there are intergroup differences in self-assessed indicators of professional knowledge and skills among future teachers from different fields of teacher education. It was hypothesised that students enrolled in educational programmes focused on psychological and pedagogical support may demonstrate higher levels of certain indicators of the cognitive and operational-activity components of professional readiness than students enrolled in general teacher education programmes.

The research question was formulated as follows: "What are the characteristics of future teachers' self-assessment of the cognitive and operational-activity components of professional readiness to interact with children demonstrating deviant behaviour, and are there differences in the corresponding indicators among students from different fields of teacher education?"

Literature review and key theoretical aspects of the research problem

In this study, deviant behaviour in children is examined through both psychological and educational lenses. It refers to behaviour by minors that differs from socially accepted norms and is expressed in their relationships, attitudes, values, and patterns of social interaction. Such behaviour may also indicate difficulties in the child's socialisation and personal development.

A review of the academic literature shows that researchers in education and psychology mainly focus on the causes of deviant behaviour among children and adolescents, as well as on humanistic approaches to addressing it. These issues have been examined by E.V. Zmanovskaya, Yu.A. Kleiberg, A.A. Rean and other scholars [2, 3, 4]. Researchers and practitioners have also developed various methods for preventing and correcting deviant behaviour among children and adolescents. Important contributions in this area have been made by A.T. Akazhanova, A.N. Teslenko, Z.M. Sadvakasova, Zh.B. Baiseitova and others [5, 6, 7, 8]. In the context of global digitalisation, increasing attention is focused on integrating artificial intelligence into teacher professional development, particularly in preparing educators to manage child deviant behavior [9].

In international research, behaviours that deviate from socially accepted norms – including defiance of adults, impulsivity, aggression, and conflict with peers and teachers – are commonly examined within the broader frameworks of disruptive and externalising behaviour, verbal aggression, and other forms of maladaptive or non-normative behaviour. Although the terminology and conceptual frameworks differ, these behavioural manifestations broadly correspond to what is referred to as "deviant behaviour" in Kazakhstani scholarship, particularly in the fields of deviantology, pedagogy, and psychology.

International researchers examine this issue from several perspectives. Extensive literature addresses bullying among young people, as well as to adolescents' attitudes, self-stereotypes and social-emotional intelligence [10]. Other studies investigate anxiety and depression among African children and adolescents [11]. The relationship between physical activity and deviant behaviour

among Chinese adolescents has also attracted research interest [12]. International research is valuable because it presents a wide range of approaches to the study of deviant behaviour and offers strategies for its prevention and early intervention. However, despite the growing interest in this topic, the professional readiness of future teachers to work with children exhibiting deviant behaviour remains insufficiently studied. This research gap determined the focus of the present study.

The concept of a teacher's professional readiness has been widely discussed in education and psychology. However, there is still no single and universally accepted definition. In educational research, professional readiness is generally understood as an integrated personal and professional characteristic. It is based on a person's experience and is developed through professional knowledge, practical skills and abilities. A major contribution to the study of professional readiness was made by the Kazakhstani academic school led by N.D. Khmel [13]. According to this approach, a teacher's professional readiness is a complex structure that includes professional qualities, specialised knowledge and practical skills. These elements are reflected in three main components:

- motivational and value-based;
- content-related;
- process-related.

The development of future teachers' readiness to interact with children exhibiting challenging behaviour is also based on the competence-based approach. Most researchers define competence as a combination of professionally important qualities, knowledge and skills that enable teachers to perform their duties successfully. The literature indicates a close relationship between professional readiness and professional competence. Professional readiness provides the basis for future professional activity. Professional competence represents a more advanced level of development and is demonstrated through a teacher's ability to act effectively in both typical and difficult professional situations. Therefore, professional readiness can be viewed as an important stage in the development of professional competence. Competence, in turn, develops through professional education, practical training and work experience. In the context of the present study, a teacher's professional readiness to interact with children exhibiting deviant behaviour is defined as an integrated personal and professional characteristic that enables the teacher to perform relevant professional tasks successfully. It also serves as a necessary basis for the development of deviantological competence.

Professional readiness provides the foundation for the development of deviantological competence during university training and later professional practice. Deviantological competence develops from this readiness and is strengthened through its practical application. For this reason, professional readiness and deviantological competence should be considered as closely related and successive stages of professional development. In this study, a teacher's deviantological competence is defined as a specific type of professional competence that enables the teacher to prevent, identify at an early stage and address deviant behaviour among students.

The original theoretical model of teachers' deviantological competence comprises five interrelated components: cognitive, motivational-value, operational-activity, evaluative-reflective, and personal [14]. In the present study, the quantitative part of the questionnaire primarily operationalises the cognitive and operational-activity components of the model, with the latter represented in the empirical instrument by a separate block assessing respondents' practical professional skills. These components formed the theoretical basis for the development of the authors' questionnaire, "Future Teacher Awareness".

Methods and Materials. Research Design. The study employed a descriptive cross-sectional design to examine future teachers' self-assessed cognitive and practical readiness to work with children who demonstrate deviant behaviour across different teacher education programmes. The empirical data were collected using an author-developed self-report questionnaire grounded in a previously established theoretical model of teachers' deviantological competence.

Participants. The study involved 120 (N = 120) final-year undergraduate students enrolled in teacher education programmes at Karaganda National Research University named after academician Ye.A. Buketov. The sample was homogeneous in terms of the participants' main socio-professional characteristics: gender – female (100%); age – 20-23 years; educational level – undergraduate; stage

of study – final year. At the time of the study, the participants had no experience of independent professional teaching. Their practical experience of interacting with learners was limited to the teaching practicum undertaken as part of their degree programmes.

Based on their field of professional preparation, the participants were divided into two groups of equal size: 60 students (50.0%) enrolled in general teacher education programmes (prospective teachers of general education subjects) – group 1; and 60 students (50.0%) enrolled in programmes focused on psychological and pedagogical support – group 2. Thus, the two groups were comparable in terms of sample size, gender, age range, stage of study, and the absence of independent professional teaching experience. The principal difference between the groups was their field of professional preparation, which corresponded to the aim of the between-group comparative analysis.

The division into groups was based on differences in the content of their professional training. General teacher education programmes mainly focus on subject knowledge and general teaching competence. Psychological and pedagogical support programmes provide more specialised training in developmental psychology, deviant behaviour, psychological and pedagogical assessment, student support and corrective work. Differences in the content of the educational programmes provided a basis for comparing the students' self-assessment scores across the two fields of teacher education.

Research Instrument. The data were collected using an author-developed questionnaire entitled “Future Teacher Awareness”, designed to assess future teachers' self-reported levels of professional readiness to work with children who demonstrate deviant behaviour. The instrument is self-report in nature and assesses respondents' perceptions of their own professional knowledge and skills required for organising psychological and pedagogical interaction with this group of children.

The questionnaire was developed on the basis of a previously theoretically grounded structural model of teachers' deviantological competence [14, p. 159]. The original model comprises five interrelated components: cognitive, motivational-value, operational-activity, evaluative-reflective, and personal. In the present empirical study, however, the questionnaire primarily operationalised two components of professional readiness: the cognitive component, reflecting future teachers' professional knowledge, and the operational-activity component, reflecting the professional skills required to analyse, plan and organise interaction with children who demonstrate deviant behaviour. Thus, the instrument was not intended to provide a comprehensive assessment of all components of deviantological competence, as in our previous study of school teachers' deviantological competence, but rather to examine two key components of future teachers' professional readiness to work with children demonstrating deviant behaviour: the cognitive and operational-activity components. Professional readiness is viewed here as a prerequisite for the development of deviantological competence. During their professional training, future teachers acquire specific professional knowledge and skills that can be assessed independently of their teaching experience. Accordingly, the cognitive and operational-activity components can be assessed through self-report. At the initial stage of professional development, these two components can be identified most directly, whereas the remaining components require separate operationalisation associated with professional experience and were therefore beyond the scope of the present study.

The questionnaire consists of two introductory questions and 38 rated items, grouped into two main content blocks. The introductory section includes an open-ended question about the additional knowledge respondents believe they need to work with children who demonstrate deviant behaviour, as well as a question concerning the types of professional assistance and support they require. For the second question, respondents could select up to three of the most important types of support, including professional development, methodological and staffing support, consultation, opportunities for professional exchange, and internships. Responses to the introductory questions were analysed separately and were not included in the calculation of the quantitative indicators for the two main blocks.

The cognitive block consists of 13 rated items assessing future teachers' self-reported professional knowledge. The items cover knowledge of the basics of psychodiagnostics and the main signs of deviant behaviour; the educational needs and characteristics of children who demonstrate deviant behaviour; psychological patterns of age-related and personal development; specialised

teaching methods; specific tools used in organising the educational process; methods of psychological and didactic planning; ways of organising interaction with learners; and approaches to working with parents. A separate group of five items assesses knowledge of the educational needs of children displaying different forms of deviant behaviour: risk-taking, suicidal, aggressive, addictive, and delinquent behaviour.

The operational-activity block consists of 25 items grouped into five categories of professional skills: analytical and predictive skills – 4 items; planning and design skills – 4 items; organisational skills – 6 items; communication skills – 7 items; and reflective skills – 4 items.

Analytical and predictive skills reflect respondents' self-assessment of their ability to analyse the socio-psychological characteristics of a child's behaviour, identify existing problems and the factors and conditions underlying them; apply professional knowledge to specific methodological problems; analyse pedagogical situations and take the results of such analysis into account when organising interaction; and predict the child's socio-psychological development and the corresponding educational pathway.

Planning and design skills include self-assessed ability to define expected outcomes of pedagogical work, plan pedagogical interventions, formulate objectives and the conditions required to achieve them, select appropriate methods, resources and organisational formats, and design the educational process in accordance with learners' behavioural characteristics.

Organisational skills refer to respondents' self-assessed ability to manage the behaviour and activity of children displaying different forms of deviant behaviour, make decisions in non-routine situations, select appropriate psychological and pedagogical interventions, organise dialogue-based interaction, formulate tasks and requirements clearly, create an appropriate educational environment, and make effective use of the resources available within the educational organisation.

Communication skills reflect respondents' self-assessment of their ability to establish interaction with children while taking their age-related and individual characteristics into account; use different approaches to working with parents; respond to individual needs; perceive and interpret signals arising during joint activities; recognise changes in psychological state through observable behaviour and other outward signs; collaborate with other professionals; and create a supportive and psychologically safe social environment involving the child's family.

Reflective skills refer to respondents' self-assessed ability to evaluate their own professional actions in relation to intended objectives, judge the relative effectiveness of the methods and resources used, analyse achievements and difficulties in professional practice, assess their own professional readiness, and identify areas for further professional development and self-directed learning.

All 38 items were rated using a three-point scale: 1 point – low level, 2 points – satisfactory level, and 3 points – high level. All items were positively keyed, so higher scores indicated higher self-assessed levels of the relevant professional knowledge or skill; no reverse scoring was applied.

Calculation and interpretation of indicators

For the cognitive block, each respondent's mean professional knowledge score was calculated as the arithmetic mean of the ratings across all 13 items. The five items assessing knowledge of the educational needs of children displaying risk-taking, suicidal, aggressive, addictive and delinquent behaviour were additionally combined into a separate indicator entitled "Knowledge of the educational needs of children displaying different forms of deviant behaviour", calculated as the arithmetic mean of the ratings for these five items.

For the operational-activity block, five aggregated indicators of professional skills were calculated – analytical and predictive, planning and design, organisational, communication, and reflective skills – as the arithmetic mean of the items within each category. In addition, each respondent's overall professional skills score was calculated as the arithmetic mean across all 25 items in the block. Each item was given equal weight in this calculation, regardless of the category to which it belonged.

To obtain an overall indicator of the assessed components of professional readiness, the arithmetic mean of the ratings across all 38 questionnaire items was calculated for each respondent, including 13 cognitive items and 25 operational-activity items.

The resulting score retained the original range of 1 to 3 points. For substantive interpretation, the following cut-off ranges were used: 1.00-1.66 – low level; 1.67-2.33 – satisfactory level; 2.34-3.00 – high level. The overall score represented the combined self-assessment of the cognitive and operational-activity components of professional readiness and was not interpreted as a comprehensive objective measure of future teachers' overall professional readiness.

Reliability and content validity of the instrument

The internal consistency of the two main blocks of the author-developed questionnaire was assessed using Cronbach's alpha (α) on the final study sample ($N = 120$). For the cognitive block, consisting of 13 items, $\alpha = 0.858$, indicating good internal consistency. For the operational-activity block, consisting of 25 items, $\alpha = 0.946$, indicating very high internal consistency among the items.

The content validity of the questionnaire was supported by its development on the basis of a previously theoretically grounded and published structural model of teachers' deviantological competence [14, p. 159]. The theoretical constructs of the model were operationalised through a set of professional knowledge and skills directly related to future teachers' interaction with children who demonstrate deviant behaviour.

At the same time, full psychometric validation of the questionnaire, including examination of its factor structure and criterion-related validity, was not conducted as part of the present study. The findings should therefore be regarded as an initial evaluation of the instrument. Further validation should involve testing its structure in independent samples and comparing self-reported scores with performance-based measures such as situational tasks, case analysis, observation, and expert assessment of future teachers' professional practice.

Research Procedure. Data were collected in March and April 2026 as part of the grant-funded project "Psychological and Pedagogical Conditions for Developing School Teachers' Professional Readiness to Interact with Children Exhibiting Deviant Behaviour." The study was conducted at the university's faculties.

The research consisted of three stages:

- 1) preparatory;
- 2) organisational;
- 3) analytical.

At the first stage, the aim and objectives of the study were specified, the study sample was determined, and the research instrument was developed on the basis of a previously theoretically grounded and published structural model of teachers' deviantological competence. The indicators of the two aspects of professional readiness under investigation were defined, and the materials required for administering the questionnaire were prepared.

At the second stage, data were collected through an online survey using Google Forms. Respondents were asked to complete the "Future Teacher Awareness" questionnaire. The electronic questionnaire link was distributed by academic group tutors among students in their final year of teacher education programmes. Participation was voluntary, and respondents completed the questionnaire independently online under conditions of anonymity.

Before completing the questionnaire, respondents were provided with information about the purpose of the study, the voluntary nature of participation, confidentiality, and the intended use of the collected data. Completion of the questionnaire after reviewing this information was treated as informed consent to participate in the study. No personally identifying information was used in the statistical analysis or presentation of the findings.

At the third stage, the collected data were organised, statistically processed, and interpreted. Indicators reflecting future teachers' self-assessed cognitive and operational-activity components of professional readiness to work with children demonstrating deviant behaviour were calculated. Based on these data, a comparative analysis was conducted of the indicators obtained for students from the two teacher education programmes.

Data Analysis. For the between-group analysis, the indicators were calculated separately for students from the two teacher education programmes. The statistical significance of differences between the groups was assessed using the Mann-Whitney U test with a significance level of $p \leq 0.05$. In addition to statistical significance, the magnitude of between-group differences was assessed using the rank-biserial correlation coefficient as a measure of effect size. The use of the Mann-Whitney U test for comparing two independent groups was consistent with the study design. Statistical analyses were conducted using Jamovi software (version 2.6).

Results and their Discussion. As part of the project, the research team conducted an online survey to examine future teachers' self-assessed professional readiness to work with children who demonstrate deviant behaviour across different teacher education programmes.

In line with the study aim and the main research question, the analysis focused on respondents' self-assessed professional knowledge in deviantology and professional skills related to working with children who demonstrate deviant behaviour. The survey also explored respondents' needs for specific types of support, including educational, psychological, and methodological support. The findings provide an overview of how future teachers assess the cognitive and operational-activity components of their own professional readiness to work with children who demonstrate deviant behaviour. The results of the analysis of the cognitive block are presented in Figure 1.

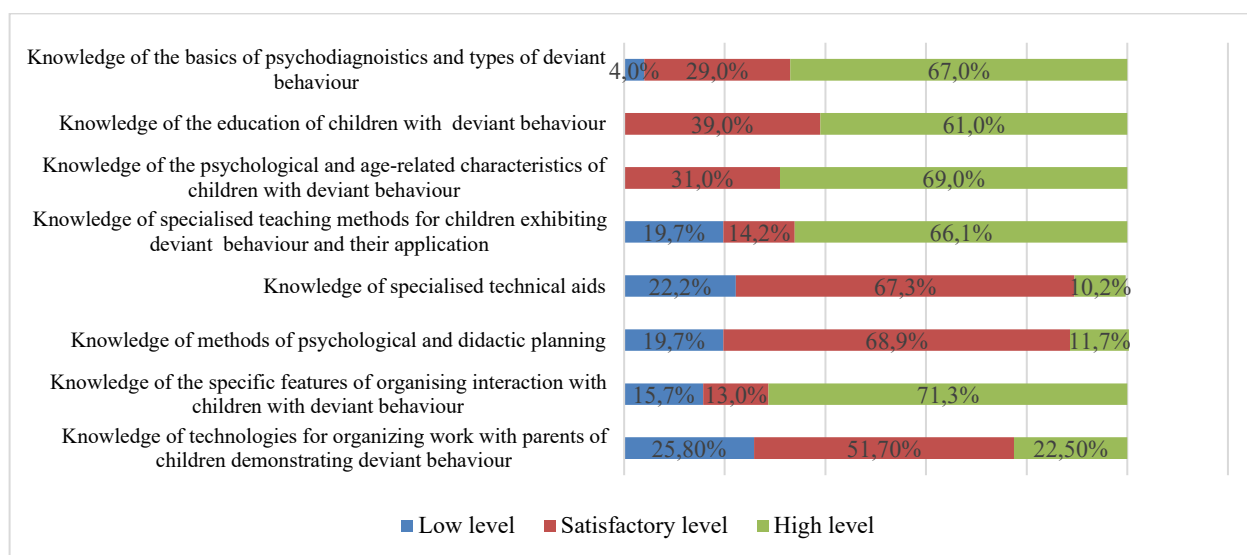


Figure 1. Indicators of self-assessed knowledge levels in deviantology and in working with children who demonstrate deviant behaviour

Source: compiled by the author

As shown in Figure 1, high and satisfactory self-assessments of professional knowledge predominated across most of the areas examined. The highest proportions of high self-assessments were reported for knowledge of how to organise interaction with children exhibiting deviant behaviour (71.3%), knowledge of their age-related and individual personality characteristics (69%), basic knowledge of the psychodiagnosis of behavioural deviations (67%), and specialised intervention methods (66.1%).

At the same time, satisfactory self-assessments predominated in several areas, particularly knowledge of psychological and didactic design methods (68.9%) and specialised technical aids (67.3%). Relatively higher proportions of low self-assessments were observed for knowledge of technologies for working with parents (25.8%) and specialised technical aids (22.2%). Overall, the distribution of self-assessed professional knowledge was heterogeneous: alongside areas characterised by predominantly high self-assessments, several domains showed a greater prevalence of satisfactory and low ratings.

Self-assessed knowledge concerning the educational needs of children exhibiting different forms of deviant behaviour – risk-taking, suicidal, aggressive, addictive, and delinquent behaviour – was also examined separately. The distribution of the findings is presented in Table 1.

Table 1. Distribution of self-assessed knowledge of the educational needs of children with different forms of deviant behaviour

Type of deviant behaviour	Self-assessed knowledge level of educational needs of children exhibiting deviant behaviour		
	High	Satisfactory	Low
Children exhibiting risky behaviour	12.2%	70.9%	16.9%
Children exhibiting suicidal behaviour	12.6%	65.4%	22%
Children with aggressive behaviour	14.2%	70.1%	15.7%
Children with addictive behaviour	16%	61%	23%
Children with delinquent behaviour	9%	57%	34%

Source: compiled by the author

As shown in Table 1, across all types of deviant behaviour examined, satisfactory self-assessments of knowledge of educational needs of children exhibiting deviant behaviour predominated (57.0–70.9%), while the proportion of high self-assessments ranged from 9% to 16%. The highest proportion of low self-assessments was observed in relation to the educational needs of children exhibiting delinquent behaviour (34%); for the other forms of deviant behaviour, this indicator ranged from 15.7% to 23%. Thus, regardless of the specific form of deviant behaviour, moderate self-assessments of knowledge of the educational needs of children exhibiting such behaviour predominated in the overall sample, with the highest proportion of low self-assessments observed in relation to delinquent behaviour.

Within the operational-activity component of professional readiness, the self-assessment of five groups of professional skills among future teachers was examined: analytical and prognostic, design, organisational, communication, and reflective skills. The distribution of self-assessed proficiency levels across these skill groups is presented in Figure 2.

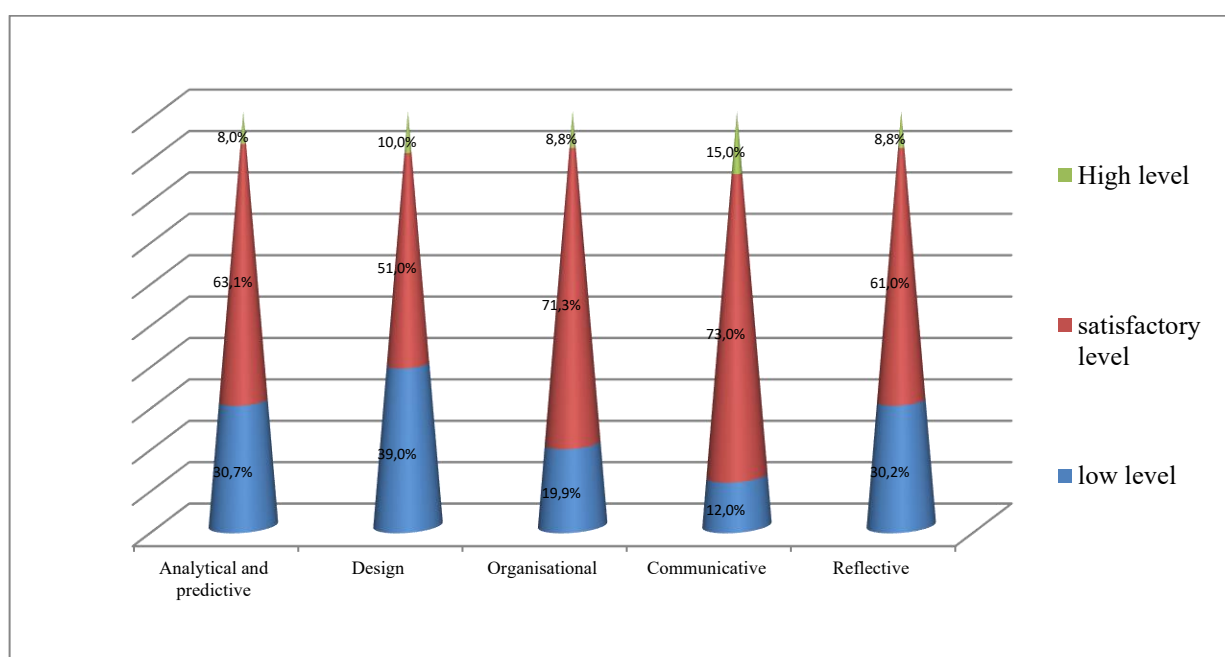


Figure 2. Self-assessed levels of professional skills among students

Source: compiled by the author

As shown in Figure 2, satisfactory self-assessments predominated across all groups of professional skills examined, ranging from 51.0% to 73.0%. The highest proportions of satisfactory self-assessments were observed for communication skills (73.0%) and organisational skills (71.3%). At the same time, the highest proportion of low self-assessments was found for design skills (39.0%), followed by analytical and prognostic skills (30.7%) and reflective skills (30.2%). Thus, although satisfactory self-assessments predominated overall, the distribution varied across the different groups of professional skills, with low self-assessments being most prevalent for design, analytical and prognostic, and reflective skills.

In accordance with the aim and hypothesis of the study, the next stage of the analysis involved comparing students' self-assessed professional readiness across the two educational pathways. The rationale for the between-group comparison was based on differences in the content of the respective educational programmes: general teacher education programmes are primarily oriented towards subject-specific and general pedagogical training, whereas psychological and pedagogical support programmes provide more in-depth preparation in developmental psychology, deviantology, psychological and pedagogical assessment, prevention, and support for learners. Accordingly, the analysis examined the presence and magnitude of between-group differences in self-assessed indicators of the cognitive and operational-activity components of professional readiness.

The comparative analysis included two groups of equal size: students enrolled in general teacher education programmes (Group 1; $n = 60$) and students enrolled in psychological and pedagogical support programmes (Group 2; $n = 60$).

The between-group comparative analysis was conducted at two successive levels. At the first stage, aggregate indicators representing the components of professional readiness under investigation were compared: the mean professional knowledge score, the knowledge score relating to the educational needs of children exhibiting different forms of deviant behaviour, the mean professional skills score, and the composite score for the components of professional readiness examined. This approach made it possible to establish the overall pattern of between-group differences before proceeding to an analysis of individual indicators of professional knowledge and skills.

The statistical significance of between-group differences was assessed using the Mann-Whitney U test, while the magnitude of the differences was estimated using the rank-biserial correlation coefficient (r). The results of the first stage of the comparative analysis based on the aggregate indicators are presented in Table 2.

Table 2. Comparative analysis of aggregated indicators of students' self-assessed professional readiness across different teacher education programmes

Indicator	Group 1 ($n=60$) M	Group 2 ($n=60$) M	U	p	r
Mean indicator of professional knowledge	2.032	2.244	1222.5	0.002	0.321
Indicator of knowledge of the educational needs of children displaying different forms of deviant behaviour	1.820	1.957	1438.0	0.055	0.201
Mean indicator of professional skills	1.765	1.895	1400.0	0.036	0.222
Overall indicator of the assessed components of professional readiness	1.856	2.014	1372.0	0.025	0.237

Source: compiled by the author

The results of the first stage of the between-group analysis revealed statistically significant differences in three of the four aggregate indicators of professional readiness. All statistically significant differences were in the same direction, with higher self-assessed scores observed among students enrolled in psychological and pedagogical support programmes. The most pronounced difference among the aggregate indicators was found for the mean professional knowledge score: M

= 2.244 in the psychological and pedagogical support group and $M = 2.032$ in the general teacher education group ($U = 1222.5$; $p = 0.002$; $r = 0.321$). A statistically significant difference was also identified for the mean professional skills score: $M = 1.895$ and $M = 1.765$, respectively ($U = 1400.0$; $p = 0.036$; $r = 0.222$). A similar pattern was observed for the composite indicator of the components of professional readiness examined, with a mean score of $M = 2.014$ among students enrolled in psychological and pedagogical support programmes and $M = 1.856$ among students in general teacher education programmes ($U = 1372.0$; $p = 0.025$; $r = 0.237$).

Comparison of the effect sizes provided an additional assessment of the magnitude of the observed between-group differences. Among the statistically significant aggregate indicators, the largest rank-biserial correlation coefficient was obtained for the mean professional knowledge score ($r = 0.321$). The effect sizes for the mean professional skills score ($r = 0.222$) and the composite indicator of the components of professional readiness examined ($r = 0.237$) were smaller. Thus, at the level of the aggregate indicators, the differences between the two groups were most pronounced in the self-assessment of professional knowledge, whereas the differences in self-assessed professional skills and the composite indicator were less pronounced. These findings indicate that the statistically significant between-group differences varied in magnitude depending on the component of professional readiness examined.

In contrast to the other three aggregate indicators, no statistically significant between-group difference was found for knowledge of the educational needs of children exhibiting different forms of deviant behaviour ($U = 1438.0$; $p = 0.055$; $r = 0.201$). The mean score for this indicator was somewhat higher in the psychological and pedagogical support group ($M = 1.957$) than in the general teacher education group ($M = 1.820$); however, the observed difference did not reach the conventional threshold for statistical significance. Thus, the pattern of between-group differences identified for the other aggregate indicators did not extend to all characteristics of the cognitive and operational-activity components of professional readiness examined.

At the second stage of the between-group analysis, individual content-specific indicators of professional knowledge and skills were compared. Table 3 presents the arithmetic means (M) and standard deviations (SD) for the indicators showing the most pronounced between-group differences in the study sample. Examining these indicators helped to refine the overall pattern identified through the analysis of the aggregate measures and to determine the specific characteristics of professional readiness for which differences between students from the two educational pathways were most evident.

Table 3. Indicators of differences within the sample according to individual criteria of the cognitive component of professional readiness among future teachers from different training programmes for working with children exhibiting deviant behaviour

Criterion	Group 1 ($n=60$), $M \pm SD$	Group 2 ($n=60$), $M \pm SD$	Mann-Whitney U	p	Effect size (r)
Knowledge of the psychological and age-related characteristics of children with deviant behaviour	2.60 ± 0.49	2.78 ± 0.42	1,470.0	0.031	0.18
Knowledge of the educational needs of children with addictive behaviour	1.82 ± 0.65	2.03 ± 0.58	1,478.5	0.053	0.18
Design skills	1.57 ± 0.59	2.15 ± 0.68	1010.5	< 0,001	0,44

Source: compiled by the author

A detailed analysis of the individual content-specific indicators revealed statistically significant between-group differences for two of the three indicators presented in Table 3. Regarding self-assessed knowledge of the psychological and age-related characteristics of children exhibiting deviant behaviour, the mean score was higher among students enrolled in psychological and pedagogical support programmes ($M = 2.78$; $SD = 0.42$) than among students enrolled in general

teacher education programmes ($M = 2.60$; $SD = 0.49$). This difference was statistically significant ($U = 1470.0$; $p = 0.031$; $r = 0.18$).

The most pronounced between-group difference among the individual indicators presented was found for design skills. The mean self-assessment score was $M = 2.15$ ($SD = 0.68$) among students enrolled in psychological and pedagogical support programmes, compared with $M = 1.57$ ($SD = 0.59$) among students in general teacher education programmes. The difference was statistically significant ($U = 1010.5$; $p < 0.001$), and the effect size ($r = 0.44$) was larger than those observed for the other individual indicators presented in Table 3. Thus, the clearest difference between the two groups was found in the self-assessment of design skills.

For self-assessed knowledge of the educational needs of children exhibiting addictive behaviour, the mean score was also higher in the psychological and pedagogical support group ($M = 2.03$; $SD = 0.58$) than in the general teacher education group ($M = 1.82$; $SD = 0.65$). However, the observed between-group difference did not reach the conventional threshold for statistical significance ($U = 1478.5$; $p = 0.053$; $r = 0.18$). Therefore, the findings do not provide sufficient evidence of a statistically significant difference between the two groups on this indicator.

Overall, the analysis of the individual content-specific indicators confirmed the heterogeneous nature of the between-group differences. Statistically significant differences were found in the self-assessment of knowledge of the psychological and age-related characteristics of children exhibiting deviant behaviour and in design skills, with effect sizes of $r = 0.18$ and $r = 0.44$, respectively. No statistically significant between-group difference was identified in self-assessed knowledge of the educational needs of children exhibiting addictive behaviour. Overall, the results of the second stage of the analysis indicate that the between-group differences were selective: among the individual indicators examined, they were most pronounced in relation to design skills, whereas differences in other characteristics were less marked or did not reach statistical significance.

The higher self-assessed scores observed among students enrolled in psychological and pedagogical support programmes for certain characteristics may be associated with the specific content of their professional training. However, the professional readiness of future teachers may also be influenced by other factors that were not directly assessed in the present study, including the amount of teaching practice, experience of interacting with children, professional motivation, and the quality of practice-oriented training. Consequently, the research design does not allow causal relationships to be established between the field of study and the differences identified. The findings should therefore be interpreted as reflecting between-group differences within the study sample rather than as evidence of a determining effect of the educational pathway on future teachers' professional readiness.

Overall, the results of the between-group analysis indicate statistically significant differences in selected self-assessed indicators of the cognitive and operational-activity components of professional readiness among students enrolled in the two educational pathways. However, differences were not observed across all characteristics examined and varied in magnitude, indicating partial support for the proposed hypothesis. To situate these findings within the existing scholarly context, the results are subsequently compared with evidence from Kazakhstani and international studies.

Kazakhstani researchers Zh.B. Baisseitova, B.A. Nurmagambetova and G.B. Akhataeva concluded that higher education programmes in Kazakhstan provide insufficient targeted preparation for working with children exhibiting deviant behaviour. They also noted that teaching practice often lacks tasks designed specifically to prepare future teachers to work with this group of students [8, p. 154]. Similar conclusions were reached by the research team during its analysis of teacher education programmes conducted as part of the project in 2024–2026.

Studies by L.A. Grigorovich, A.A. Gorelov, A.Yu. Chudakov, A.V. Drozdova, M.I. Koshenova and other researchers also indicate that future teachers, psychologists and childcare professionals often lack the competences required to work with children exhibiting deviant behaviour [15, 16]. Most studies describe shortcomings in professional preparation, while relatively few include an intervention or formative stage aimed at improving students' readiness [17].

The problem of teachers' interaction with adolescents who exhibit negative behavioural tendencies has been examined by international researchers from the perspective of cognitive-behavioural approaches [18]. In contemporary American and European scholarship, the term “deviant behaviour” is rarely used in the same sense as it is in Russian-language pedagogy and deviantology. International research commonly uses neutral terms such as *behaviour problems*, *conduct problems*, *disruptive behaviour*, *externalising behaviour* and *at-risk students* rather than the term *deviant behaviour* [19, 20, 21]. This terminology reduces the risk of stigmatising children and focuses attention on specific behavioural manifestations within their social and educational context.

International studies associate behavioural difficulties with limited self-regulation, emotional instability, family problems, high stress levels and insufficient social support. Teacher preparation in this area often includes social and emotional learning programmes (SEL). These programmes focus on five main competences: self-awareness, self-regulation, social awareness, relationship skills and responsible decision-making [22].

International research also indicates the effectiveness of the Positive Behavioural Interventions and Supports model. When implemented effectively, this approach may reduce disciplinary incidents, behavioural problems and school exclusions while contributing to a more supportive school environment. Its effectiveness, however, depends on the quality and consistency of its implementation.

A systematic review by S.N. McGuire et al. (2024) concluded that the preparation of future teachers to work with children experiencing behavioural difficulties remains insufficiently studied. At the same time, the development of relevant professional competences is recognised as an important task in contemporary teacher education [23].

The authors of the present study agree with T.E. Smith, A.M. Thompson and B.R. Maynard (2022), who argue that teacher preparation should include more than theoretical knowledge of behavioural problems. It should also develop social and emotional competence, behaviour-management skills, problem-solving, professional reflection and constructive teacher–student interaction [24].

International studies also report that newly qualified teachers may possess theoretical knowledge but feel unprepared when facing aggression, bullying or other serious behavioural problems in schools. However, several studies have identified difficulties experienced by future and novice teachers in applying their knowledge in practice when managing and preventing students' behavioural difficulties. As a result, they may rely on reactive and situational responses rather than on previously developed professional strategies.

The findings of the present study support this conclusion. Students in both groups demonstrated gaps in their knowledge of specific forms and causes of deviant behaviour. They also showed insufficiently developed practical skills and limited experience of interacting with students exhibiting behavioural difficulties.

The findings of the present study are broadly consistent with these trends. In both groups, alongside high and satisfactory self-assessments, a proportion of respondents reported low levels of self-assessed professional knowledge and skills in specific areas. This was particularly visible in respondents' assessments of their knowledge of the educational needs of children displaying certain forms of deviant behaviour, as well as in several practice-oriented skill areas. At the same time, the self-report nature of the instrument does not allow these findings to be interpreted as objective evidence of deficiencies in professional preparation or an actual lack of practical experience.

The distinctive feature of the present study lies in its comparative analysis of self-assessed indicators of the cognitive and operational-activity components of future teachers' professional readiness to work with children who demonstrate deviant behaviour across different teacher education programmes, drawing on a structural model of teachers' deviantological competence previously developed by the authors [14, p. 159].

Limitations of the study. Several limitations should be taken into account when interpreting the findings. First, the sample was drawn from a single higher education institution and comprised 120

final-year students enrolled in teacher education programmes. This limits the extent to which the findings can be generalised to future teachers studying at other universities or in other regions.

Second, the study employed a cross-sectional design. Therefore, the differences identified between students from the two teacher education programmes reflect characteristics of the study sample and do not allow causal relationships to be established between the field of teacher education and the observed indicators of professional readiness.

Third, the primary method of data collection was self-report questionnaire-based assessment. Consequently, the findings reflect respondents' subjective evaluations of their own professional knowledge and skills and may be influenced by individual self-assessment tendencies and social desirability bias.

Furthermore, the present study did not involve comprehensive psychometric validation of the authors' questionnaire, including an assessment of its factor structure and criterion-related validity. Therefore, the findings obtained using this instrument should primarily be interpreted as self-assessed indicators of the components of professional readiness under investigation rather than as results of a standardised diagnostic assessment.

Future research should examine the psychometric properties of the instrument using larger and independent samples and complement self-report data with objective assessment methods, including situational tasks, case analysis, observation, and expert evaluation of future teachers' professional performance.

Prior to the commencement of empirical data collection, a working meeting was held on 25 February 2026 at the University's Centre for Psychological Support of Educational Activities, with the participation of members of the research team and Centre staff. The meeting addressed the organisational and ethical aspects of the planned study. Particular attention was paid to ensuring the principles of voluntary participation, informed consent, anonymity and confidentiality, as well as to the procedures for collecting, processing and using the data obtained. Following the discussion, the research procedure was agreed upon in accordance with the ethical requirements outlined above.

Before completing the questionnaire, participants were provided with information about the purpose and procedures of the study, the voluntary nature of participation, anonymity, and the use of the data collected. Completion of the questionnaire after reviewing this information was regarded as informed consent to participate in the study. No personally identifiable information was collected or used in the statistical analysis or presentation of the findings.

Empirical data were collected in March - April 2026. Following the completion of data collection and analysis, the study findings and matters relating to compliance with ethical principles were considered and discussed at a meeting of the Council of the Faculty of Philosophy and Psychology of the University (Minutes No. 10, dated 22 May 2026).

Conclusions. The study of future teachers' self-assessed professional readiness to work with children who demonstrate deviant behaviour across different teacher education programmes leads to the following conclusions:

In the cognitive component of professional readiness, satisfactory and high self-assessments of professional knowledge predominated in the overall sample, although a proportion of respondents reported low self-assessed levels in specific content areas. Similarly, satisfactory self-assessments predominated with regard to knowledge of the educational needs of children exhibiting different forms of deviant behaviour, with the highest proportion of low self-assessments relating to the educational needs of children exhibiting delinquent behaviour.

In the operational-activity component, satisfactory self-assessments predominated across all groups of professional skills examined. At the same time, the highest proportions of low self-assessments were observed for design, analytical and prognostic, and reflective skills, indicating heterogeneity in the self-assessed levels of individual components of future teachers' professional skills.

The between-group analysis revealed statistically significant differences in selected self-assessed indicators of professional readiness among students enrolled in the two educational pathways. Higher self-assessed scores for mean professional knowledge, mean professional skills,

and the composite indicator were observed among students enrolled in psychological and pedagogical support programmes. Analysis of the individual content-specific indicators showed that the most pronounced between-group difference was observed in relation to design skills.

The between-group differences were selective and varied in magnitude. No statistically significant differences were identified for the aggregate indicator of knowledge of the educational needs of children exhibiting different forms of deviant behaviour or for the individual indicator of knowledge of the educational needs of children exhibiting addictive behaviour. Thus, higher self-assessed scores among students enrolled in psychological and pedagogical support programmes were not observed across all characteristics of professional readiness examined.

The findings provide partial support for the research hypothesis: statistically significant differences between students enrolled in the two educational pathways were identified for a number of cognitive and operational-activity indicators; however, such differences were not observed across all characteristics of professional readiness examined.

The findings suggest that strengthening the operational-activity component of teacher education aimed at preparing future teachers to interact with children exhibiting deviant behaviour represents a promising direction for the enhancement of educational programmes. Particular attention may be warranted in developing design, analytical and prognostic, and reflective skills, as well as expanding knowledge of the educational needs of children exhibiting different forms of deviant behaviour.

The findings highlight the need for further research into and development of future teachers' professional readiness to interact with children exhibiting deviant behaviour, regardless of their educational pathway. The development of teachers' deviantological competence may be regarded as one of the areas for enhancing the professional preparation of future teachers.

The scientific novelty of the study lies in generating comparative data on the self-assessed cognitive and operational-activity components of professional readiness among final-year students enrolled in different teacher education programmes in relation to their readiness to interact with children exhibiting deviant behaviour. The findings demonstrate that between-group differences are selective and vary in magnitude depending on the specific indicator of professional readiness examined.

The theoretical significance of the study lies in extending current understandings of future teachers' professional readiness to interact with children exhibiting deviant behaviour through a comparative analysis of self-assessed cognitive and operational-activity components among students enrolled in different educational pathways. The findings contribute to understanding the heterogeneous nature of individual components of professional readiness and help to further specify the application of the concept of "teachers' deviantological competence", previously developed by the authors, to the professional preparation of future teachers.

The practical significance of the study lies in the potential application of the findings to the enhancement of future teachers' professional preparation, particularly its operational-activity component. The findings may inform the development of educational modules, scenario-based tasks, case studies, academic courses, and teaching and learning materials aimed at developing design, analytical and prognostic, and reflective skills, as well as expanding future teachers' knowledge of the educational needs of children exhibiting different forms of deviant behaviour.

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БОЛАШАҚ ПЕДАГОГТЕРДІҢ ДЕВИАНТТЫ МІНЕЗ-ҚҰЛЫҚ ТАНЫТАТЫН БАЛАЛАРМЕН ӨЗАРА ӘРЕКЕТТЕСУГЕ ДАЙЫНДЫҒЫН ЗЕРТТЕУ

Аңдатпа

Зерттеуде әртүрлі педагогикалық білім беру бағдарламаларында білім алатын болашақ педагогтердің девиантты мінез-құлық танытатын балалармен өзара әрекеттесуге кәсіби даярлығы қарастырылады. Зерттеудің өзектілігі девиантты мінез-құлықтың алдын алуда, психологиялық қолайсыздықтың алғашқы белгілерін ерте анықтауда және білім алушылардың проблемалық мінез-құлқына байланысты тәуекелдерді айқындауда

педагогтің маңызды рөлімен негізделеді. Зерттеудің мақсаты – әртүрлі педагогикалық даярлық бағыттарында білім алатын болашақ педагогтердің девиантты мінез-құлық танытатын балалармен жұмыс істеуге кәсіби даярлығының когнитивтік және операциялық-іс-әрекеттік компоненттеріне қатысты өзіндік бағалау көрсеткіштерін зерделеу және салыстыру. Деректер кәсіби білімдер мен дағдыларды бағалауға арналған авторлық өзіндік есеп беру сауалнамасы арқылы жиналды. Статистикалық талдау Jamovi бағдарламасының 2.6 нұсқасы арқылы жүргізілді. Топтар арасындағы айырмашылықтарды анықтау үшін Манн-Уитнидің U-критерийі қолданылды, сондай-ақ әсер көлемін бағалау мақсатында рангтік-бисериалдық корреляция коэффициенті есептелді. Зерттеу нәтижелері бірқатар жалпы және жекелеген өзіндік бағалау көрсеткіштері бойынша топтар арасында статистикалық тұрғыдан маңызды айырмашылықтардың бар екенін көрсетті. Психологиялық-педагогикалық сүйемелдеу бағдарламаларында білім алатын студенттер кәсіби білімдері мен дағдыларын жоғарырақ бағалаған, сондай-ақ интегралдық көрсеткіш бойынша да жоғары нәтижелер көрсеткен. Бағаланған жекелеген дағдылардың ішінде топтар арасындағы ең үлкен айырмашылық педагогикалық жобалау дағдылары бойынша анықталды ($r = 0.44$). Алайда зерттелген көрсеткіштердің барлығы бойынша статистикалық тұрғыдан маңызды айырмашылықтар анықталған жоқ. Бұл топтар арасындағы айырмашылықтардың іріктемелі сипатта болғанын көрсетіп, зерттеу гипотезасының ішінара расталғанын айғақтайды. Алынған нәтижелер педагогтерді даярлаудың практикалық бағдарын күшейтуді болашақ педагогтердің кәсіби даярлығын жетілдірудің перспективасы бағыты ретінде қарастыруға мүмкіндік береді. Нәтижелерді түсіндіру кезінде қолданылған құралдың өзіндік есеп беру сипатын ескеру қажет: анықталған айырмашылықтар қатысушылардың өздерінің кәсіби даярлығына берген бағасын көрсетеді және кәсіби құзыреттіліктің нақты деңгейіндегі объективті айырмашылықтар ретінде түсіндірілмеуі тиіс.

Түйінді сөздер: кәсіби даярлық, болашақ педагогтер, өзіндік бағалау, психологиялық-педагогикалық сүйемелдеу, девиантты мінез-құлық танытатын балалар, девиантты мінез-құлықтың алдын алу, девиантологиялық құзыреттілік.

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ИССЛЕДОВАНИЕ ГОТОВНОСТИ БУДУЩИХ ПЕДАГОГОВ К ВЗАИМОДЕЙСТВИЮ С ДЕТЬМИ, ПРОЯВЛЯЮЩИМИ ДЕВИАНТНОЕ ПОВЕДЕНИЕ

Аннотация

В статье рассматривается проблема профессиональной готовности будущих педагогов разных направлений подготовки к взаимодействию с детьми, демонстрирующими девиантное поведение. Актуальность исследования обусловлена значимой ролью педагога в профилактике девиантного поведения детей, раннем выявлении психологического неблагополучия и рисков проблемного поведения обучающихся. Цель исследования - изучить и сопоставить самооценочные показатели когнитивного и операционально-деятельностного компонентов профессиональной готовности будущих педагогов разных направлений подготовки к взаимодействию с детьми, демонстрирующими девиантное поведение. Для сбора данных использовалась авторская самоотчётная анкета, направленная на оценку профессиональных знаний и умений. Статистическая обработка выполнена в программе Jamovi (версия 2.6). Для оценки межгрупповых различий применялся U-критерий Манна-Уитни; дополнительно рассчитывался коэффициент рангово-бисериальной корреляции как показатель величины эффекта. В результате исследования выявлены статистически значимые межгрупповые различия по отдельным обобщённым и частным самооценочным показателям. Более высокие значения среднего показателя профессиональных знаний, среднего показателя профессиональных умений и интегрального показателя наблюдались у студентов образовательных программ психолого-педагогического сопровождения. Среди представленных отдельных характеристик наиболее выраженное межгрупповое различие выявлено по проектировочным умениям ($r = 0.44$). Вместе с тем статистически значимые различия установлены не по всем исследуемым показателям, что свидетельствует об избирательном характере межгрупповых различий и частичном подтверждении гипотезы исследования. Полученные результаты позволяют рассматривать усиление практико-ориентированной составляющей как перспективное направление совершенствования профессиональной подготовки будущих педагогов. При интерпретации результатов следует учитывать самоотчётный характер используемого инструмента: выявленные различия отражают самооценку профессиональной готовности и не могут рассматриваться как объективно установленные различия в фактическом уровне профессиональной компетентности.

Ключевые слова: профессиональная готовность, будущие педагоги, самооценка, психолого-педагогическое сопровождение, дети, проявляющие девиантное поведение, профилактика девиантного поведения, девиантологическая компетентность.

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MODELS OF PEDAGOGICAL SUPPORT IN THE EDUCATIONAL PROCESS OF CHILDREN WITH AUTISM

Abstract

The growing number of children with autism spectrum disorder (ASD) enrolled in mainstream schools has intensified the need for effective pedagogical support systems that facilitate their academic achievement, social adaptation, and inclusion. Despite increasing attention to inclusive education, comprehensive and evidence-based pedagogical support models for children with ASD remain insufficiently developed.

The purpose of this study was to identify, systematize, and substantiate effective models of pedagogical support for children with ASD in inclusive educational settings.

The study was based on a theoretical analysis of current research on inclusive education and the education of children with ASD. Scientific publications were reviewed and compared to identify the main approaches to pedagogical support, their common features, and differences in practical application, with particular attention to systematizing existing models and their structural and functional characteristics.

The analysis showed that successful educational support cannot rely on a single method or specialist, but is built through individualized educational planning, flexible teaching practices, coordinated work of teachers, psychologists, speech therapists, and tutors, and continuous cooperation with families. Pedagogical support models were examined and grouped according to their key functions and implementation conditions; although they differ in organization, all share the goal of creating learning environments responsive to the individual needs of children with ASD. A well-organized, adaptable support system was found to promote greater classroom participation, strengthen communication and social interaction, and improve the overall quality of inclusive education. The scientific significance lies in clarifying theoretical foundations and developing a structured classification of pedagogical support models; the practical significance lies in the applicability of the proposed models in schools, resource centers, and special education institutions.

The study concludes that successful inclusion of children with autism depends on adaptive, interdisciplinary, and child-centered pedagogical support systems that address individual educational needs and promote full participation in the learning process.

Keywords: children with autism, autism spectrum disorders, inclusive education, pedagogical support, support models, individualized learning, tutoring, educational environment, socialization.

Introduction. In the conditions of the globalization of the educational space and the transition to a humanistic paradigm of education, the development of inclusive education as a mechanism for ensuring equal opportunities for all categories of students is particularly important. In the Republic of Kazakhstan, inclusive education is considered a strategic direction of state educational policy, aimed at integrating children with special educational needs, including those with autism spectrum disorders (ASD), into the general educational environment.

Inclusive education in Kazakhstan is supported by a well-established legislative framework. The main legal documents include the Law of the Republic of Kazakhstan «On Education», the Law «On the Rights of the Child in the Republic of Kazakhstan», and the Law «On Social and Medical-Pedagogical Correctional Support for Children with Disabilities». Together, these acts guarantee every child's right to education and require educational institutions to provide appropriate learning conditions for students with diverse educational needs. Their implementation is reinforced through national education development strategies that promote inclusive practices and improve the accessibility of the educational environment.

The growing number of children diagnosed with autism spectrum disorder (ASD) has made the search for effective pedagogical support approaches increasingly important. For many schools, inclusion is no longer viewed as a future objective but as an everyday educational reality. Children with ASD often experience difficulties in social interaction, communication, and self-regulation, although the nature and severity of these challenges vary from one child to another. As a result, educational support should be flexible, individualized, and based on close cooperation among teachers, specialists, and families. These circumstances highlight the need to examine pedagogical support models that can be effectively implemented in inclusive educational settings. Despite certain achievements in the development of inclusive education in Kazakhstan, systemic problems remain related to the insufficient training of teaching staff, the lack of unified methodological approaches, and inadequate interdepartmental coordination.

Despite substantial progress in legislative regulation and institutional development, the implementation of inclusive education for children with ASD remains associated with numerous pedagogical challenges. Children with autism often experience persistent difficulties in communication, social interaction, behavioral regulation, executive functioning, and adaptive learning skills. Consequently, conventional teaching approaches frequently fail to meet their educational needs, making systematic pedagogical support an essential component of successful inclusion.

Recent international studies demonstrate that effective educational support should be based on individualized educational planning, interdisciplinary collaboration among educational professionals, active parental involvement, structured learning environments, and continuous assessment of children's developmental progress. Rather than relying on isolated interventions, contemporary educational practice increasingly recognizes the importance of integrated pedagogical support systems that combine multiple evidence-based approaches.

Although Kazakhstan has made considerable progress in developing inclusive education, existing research indicates that pedagogical support for children with ASD remains fragmented. Educational institutions often lack unified methodological frameworks, standardized support procedures, and effective coordination among teachers, psychologists, speech therapists, special educators, tutors, and parents. Consequently, there is a growing need to systematize existing pedagogical support models and identify the most effective strategies applicable within the national educational context.

Unlike previous studies that mainly examined individual intervention approaches separately, the present study seeks to integrate different pedagogical support models into a comprehensive conceptual framework that reflects both international evidence and the practical realities of inclusive education in Kazakhstan. Such systematization may contribute to improving educational practice and provide a theoretical basis for developing more effective support systems for children with ASD.

The purpose of our study was to identify, systematize, and comparatively analyze pedagogical support models for children with autism spectrum disorder implemented in inclusive educational settings and to determine their educational potential for improving social adaptation, communication skills, and learning engagement.

Research Questions

The study addressed the following research questions:

- RQ1. What pedagogical support models are most frequently applied in the education of children with autism spectrum disorder within inclusive educational settings?
- RQ2. What theoretical principles underline contemporary pedagogical support models for children with ASD?
- RQ3. Which pedagogical support models demonstrate the greatest educational potential for improving social adaptation, communication skills, and learning engagement?
- RQ4. How can different pedagogical support models be integrated into a comprehensive educational support system adapted to the context of inclusive education in Kazakhstan?

Therefore, the need for scientific understanding and systematization of models of pedagogical support for children with autism underpins the relevance of our study in both theoretical and practical

aspects. During our study, we identified and systematized the main models of educational support for children with autism in the educational process:

- An individual-centered model, based on the development of individualized educational pathways tailored to each child's developmental needs.
- A tutor-based support model, which involves the ongoing involvement of a tutor, providing assistance with adaptation, communication, and mastery of educational material.
- An interdisciplinary model, which involves the collaboration of specialists from various fields.
- An inclusive-adaptive model, focused on creating an accessible educational environment and the use of adapted teaching methods.
- A family-centered model, where parents play an active role in planning, implementing, and supporting the child's educational and developmental activities. The results of our study show that the most effective approach is the integrated application of these models, which provides a holistic approach to the development of a child with autism.

Each of these models rests on a distinct theoretical foundation and offers specific advantages. The individualized model draws on the principles of person-centred pedagogy and is grounded in an Individual Educational Plan (IEP) that specifies learning goals, adaptations, and progress indicators for a particular child; its main advantage is precise correspondence between teaching strategies and the child's developmental profile. The tutor-based model is rooted in the concept of scaffolded support (L.S. Vygotsky's zone of proximal development) and relies on the continuous presence of a trained facilitator who mediates the child's interaction with the curriculum and peers, which is particularly effective in reducing anxiety and behavioural difficulties. The interdisciplinary model is based on the biopsychosocial model of disability and the principles of team-based case management; it coordinates teachers, psychologists, speech therapists and behaviour analysts around a single support plan, which increases the consistency of intervention across settings. The inclusive-adaptive model is theoretically linked to Universal Design for Learning (UDL) and focuses on modifying the physical and instructional environment (visual schedules, sensory-friendly spaces, adapted materials) rather than the child, thereby reducing barriers to participation. The family-centred model is grounded in ecological systems theory (U. Bronfenbrenner) and treats parents as active co-participants in goal setting and skills generalisation at home, which is essential for the sustainability of results achieved at school. International empirical evidence on the comparative effectiveness of these approaches, as well as the Kazakhstani context of their implementation, is discussed in the sources cited throughout this article (see References).

Literature review.

Modern approaches to inclusive education are based on international documents such as the Salamanca Declaration (UNESCO – United Nations Educational, Scientific and Cultural Organization) [1] and UN (the United Nations) Convention on the Rights of Persons with Disabilities [2], which enshrine the right of every child to education in a general education environment. Research emphasizes that Kazakhstan is actively integrating international standards into its national education system, adapting them to its own socio-cultural context.

According to the work of international researchers (M. Ainscow, T. Booth, M. Dyson), inclusive education is viewed not only as a process of integrating children with disabilities, but also as a transformation of the entire education system aimed at eliminating barriers to learning and the participation of all students.

However, as T.K. Omarova [3] notes, in Kazakhstan, inclusion is often interpreted narrowly-primarily as the inclusion of children with special needs, without profound changes in pedagogical philosophy and practice. An analysis of scientific literature shows that the legal framework for inclusive education in Kazakhstan is actively developing. A key document is the Law of the Republic of Kazakhstan "On Education," which enshrines the principle of accessibility of education for all categories of citizens. Also important is the Law "On Social and Medical-Pedagogical Correctional Support for Children with Disabilities," which regulates the organization of special assistance for children with special educational needs.

Research shows that Kazakhstan is seeing positive progress in the development of inclusive education: the number of educational institutions implementing inclusive practices is increasing, and access to education for children with special needs is expanding. However, challenges persist, including a shortage of qualified specialists, uneven development of inclusive environments across regions, and insufficient teacher training. International research places particular emphasis on developing effective support models for children with ASD. According to P.M. Zhanuzakova and A.S. Magauova [4], current practice requires a shift from fragmented support to a comprehensive system of psychological and pedagogical support, including interdisciplinary collaboration between specialists.

International studies (L. Schreibman, O. Ivar Lovaas, S. Rogers) highlight the effectiveness of approaches such as:

- applied behavior analysis (ABA),
- early intervention model – Early Start Denver Model (ESDM),
- structured learning – Treatment and Education of Autistic and Communication-Handicapped Children (TEACCH).

We believe that these approaches are aimed at developing communication, social interaction, and adaptive behavior in children with autism.

Kazakhstani studies note that the existing support system for children with ASD is not yet comprehensive: there is insufficient coordination between educational and social services, and work with the child's family is insufficiently developed. This indicates the need to implement integrative models of pedagogical support.

Modern Models of Pedagogical Support:

An analysis of domestic and international literature reveals several key models of pedagogical support:

- An individualized model based on the development of individual educational programs;
- An interdisciplinary model involving various specialists;
- An inclusive-adaptive model focused on creating an accessible educational environment;
- A family-oriented model that promotes active parental involvement;
- A tutoring model that provides individualized support for the child.

Our research shows that the most effective approach is the integration of several models, providing a comprehensive approach to the development of children with ASD.

Methods and materials. Our study was guided by three complementary methodological perspectives: the systems approach, the activity-based approach, and the student-centered approach. Together, they made it possible to examine pedagogical support for children with autism spectrum disorder (ASD) not as a set of isolated interventions, but as a dynamic process that combines educational, psychological, and social dimensions.

From a systems perspective, pedagogical support was viewed as the coordinated interaction of different participants and educational resources. The activity-based approach focused on the child's active engagement in learning and everyday school life rather than passive participation. At the same time, the student-centered approach emphasized the importance of adapting educational strategies to each learner's individual strengths, developmental profile, and educational needs. Such a methodological combination is particularly relevant because ASD presents in diverse ways, and no single pedagogical solution can be equally effective for every child.

To address the research objectives, a mixed-method design was adopted. Quantitative evidence was used to compare the effectiveness of different pedagogical support models, while qualitative data helped explain how these models function in everyday educational practice. Combining both types of evidence provided a broader understanding of the phenomenon and strengthened the practical value of the findings.

The empirical part of the study was conducted in general education schools implementing inclusive practices, resource centers, and specialized educational organizations across the Republic of Kazakhstan. Participants represented all key groups involved in supporting children with ASD, including primary and middle school students with autism, mainstream teachers, support specialists,

and parents or legal guardians. A purposive sampling strategy was selected to ensure that all participants had direct experience with inclusive educational practice and could provide meaningful information related to the research objectives.

Data were collected using several complementary methods.

Theoretical methods included a review of current scientific literature, an analysis of national regulatory documents governing inclusive education in Kazakhstan, and the classification of existing pedagogical support models. These sources provided the conceptual foundation for the study and helped identify both established practices and areas requiring further development.

Empirical methods consisted primarily of systematic classroom observation. Observations were carried out during regular educational activities in inclusive settings to examine how children with ASD interacted with teachers, classmates, and the learning environment. They also made it possible to evaluate the practical application of different pedagogical strategies and to identify behavioral and communication patterns under natural classroom conditions.

These methods provide subjective assessments of the effectiveness of pedagogical support and identify the problems and needs of participants in the educational process.

Pedagogical Experiment

Our experiment included testing various models of pedagogical support (individualized, tutoring, interdisciplinary, etc.).

Expert Evaluation Method – Experts in the field of inclusive education were involved.

Importance: Ensures an objective interpretation of the results and confirms their scientific validity.

Data Processing Methods - The following were used to analyze the obtained data:

- descriptive statistics (mean values, percentages);
- comparative analysis of results before and after the implementation of the models;
- qualitative analysis (content analysis of interviews and observations).

Comprehensive data processing ensures the reliability of the results, identifies patterns, and draws substantiated conclusions about the effectiveness of pedagogical support models.

The study involved 48 participants, including 24 children with autism spectrum disorder (ASD) assigned to the experimental group and 24 children with ASD assigned to the control group. The participants were enrolled in inclusive education programs in general secondary schools located during the 2025–2026 academic year.

The participants ranged in age from 7 to 10 years (Mean (M) = 8.5 years). The sample consisted of 34 boys (70.8%) and 14 girls (29.2%), reflecting the higher prevalence of ASD among males reported in previous research. Children attended Grades 1–4 of mainstream schools and had an official diagnosis of Autism Spectrum Disorder established by the regional Psychological-Medical-Pedagogical Consultation (PMPC) in accordance with the national diagnostic procedures.

Inclusion criteria

Participants were included in the study if they met the following criteria:

- a confirmed diagnosis of Autism Spectrum Disorder;
- enrollment in an inclusive classroom within a mainstream school;
- regular school attendance throughout the study period;
- absence of severe intellectual disability or sensory impairments preventing participation in educational activities;
- written informed consent provided by parents or legal guardians.

Children with severe neurological disorders or those receiving intensive individualized educational interventions outside the school during the study period were excluded to ensure comparability between the groups.

The experimental and control groups were comparable regarding age, gender distribution, grade level, and baseline educational characteristics. No statistically significant differences were observed between the groups before the implementation of the pedagogical support program.

To achieve the objectives of the study, a mixed-method research design was employed, combining qualitative and quantitative approaches. This design enabled a comprehensive

examination of pedagogical support models for children with autism spectrum disorder (ASD) in inclusive educational settings by integrating data obtained from literature analysis, classroom observations, semi-structured interviews, expert evaluation, and a pedagogical intervention.

Literature Analysis

The first stage of the study involved a systematic analysis of international and national scientific literature on pedagogical support for children with ASD. Peer-reviewed journal articles, monographs, methodological guidelines, and policy documents published between 2015 and 2025 were reviewed. The analysis focused on identifying the theoretical foundations, structural components, implementation strategies, and reported educational outcomes of different pedagogical support models.

Pedagogical Intervention

The pedagogical intervention was implemented over one academic semester in inclusive classrooms. The intervention was based on the integration of five pedagogical support models identified through the literature review: individualized support, tutor-assisted support, interdisciplinary collaboration, family-centered support, and inclusive-adaptive educational practices.

Teachers and support specialists implemented these approaches during regular classroom instruction. Individual educational plans were adapted to the needs of each child, visual support and differentiated learning materials were used, interdisciplinary meetings were organized on a regular basis, and parents participated in consultations concerning children's educational progress.

Children's progress was assessed before and after the implementation of the intervention using identical assessment procedures.

Classroom Observation

Structured classroom observations were conducted to assess children's educational participation and behavioural characteristics during regular classroom activities.

Each observation session lasted approximately 40–45 minutes, corresponding to one regular lesson. Every child was observed on several occasions during different instructional activities to ensure consistency of the observations.

A standardized observation checklist was developed for the study. The checklist included the following indicators:

- participation in classroom activities;
- interaction with teachers;
- interaction with peers;
- verbal and non-verbal communication;
- behavioural self-regulation;
- task completion;
- independence during learning activities.

Each indicator was evaluated using a five-point rating scale ranging from 1 (very low) to 5 (very high). Observation protocols were completed immediately after each lesson to minimize observer bias.

Semi-Structured Interviews

Semi-structured interviews were conducted with classroom teachers, special education teachers, psychologists, speech and language therapists, tutors, and parents to obtain qualitative information regarding the implementation of pedagogical support.

Each interview lasted approximately 30–40 minutes and followed a common interview guide while allowing participants to elaborate on issues relevant to their professional experience.

Sample interview questions included:

1. What educational difficulties do children with ASD most frequently experience in inclusive classrooms?
2. Which pedagogical support strategies have proved most useful in your professional practice?
3. What challenges arise during the implementation of individualized educational support?
4. How effective is collaboration among teachers, specialists, and parents?

5. What recommendations would you provide for improving pedagogical support in inclusive education?

Expert Evaluation

To assess the educational potential of the proposed pedagogical support models, an expert evaluation procedure was conducted.

The expert panel consisted of specialists in inclusive and special education with substantial professional experience in working with children with autism spectrum disorder.

Expert Selection Criteria

Experts were selected according to the following criteria:

- doctoral degree or equivalent academic qualification in education, psychology, or special education, or at least ten years of professional experience in inclusive education;
- practical experience in supporting children with ASD;
- experience in curriculum development, teacher training, or educational management;
- scientific publications or methodological work related to inclusive education.

Evaluation Procedure

Each expert independently reviewed the proposed pedagogical support models and evaluated them according to six predefined criteria:

- pedagogical effectiveness;
- applicability in inclusive classrooms;
- adaptability to individual educational needs;
- feasibility of implementation;
- promotion of interdisciplinary collaboration;
- involvement of families in the educational process.

Each criterion was assessed using a 10-point Likert scale, where 1 indicated very low relevance and 10 indicated excellent applicability.

Experts completed standardized evaluation forms independently. The anonymity of expert responses was maintained throughout the evaluation process.

Analysis of Expert Ratings

Expert ratings were summarized using descriptive statistical methods, including mean scores, standard deviations, and percentage distributions for each evaluation criterion. To determine the level of agreement among experts, Kendall's coefficient of concordance (W) was calculated. The coefficient was interpreted according to conventional guidelines, where higher values indicated stronger agreement among experts regarding the evaluation of pedagogical support models.

The combination of expert evaluation, classroom observations, interviews, and literature analysis enabled methodological triangulation and enhanced the credibility and trustworthiness of the research findings.

Results and their discussions. The empirical study tested and compared the main models of pedagogical support for children with autism spectrum disorders (ASD) in an inclusive education setting. Effectiveness was assessed using three key criteria:

- level of social adaptation;
- communication skills;
- learning engagement.

Diagnostics were conducted before and after the implementation of the pedagogical models (the experimental work lasted for a nominal period of the school year).

Following the implementation of pedagogical support models, we can see a significant decrease in the proportion of children with low levels of social adaptation was observed (from 62% to 28%). At the same time, the number of students with high levels of adaptation increased (from 8% to 27%).

This indicates that systematic pedagogical support contributes to the development of skills for interacting with the environment, reducing social isolation, and fostering more stable behavioral responses.

The most effective models were the tutoring and interdisciplinary ones, which provide ongoing support to children in the real-life educational process. (Table 1)

Table 1. Change in the level of social adaptation of children with ASD

Adaptation level	Before the implementation of models (%)	After the implementation of the models (%)
Low	62%	28%
Average	30%	45%
High	8%	27%

Source: Developed by the author based on the research data.

Our data in Table 2 demonstrates a significant improvement in communication skills in children with ASD. The increase is particularly noticeable at the intermediate and advanced levels.

This is explained by the use of: structured learning, visual support, individualized educational pathways. The most significant contribution was made by the individualized support model, as it takes into account the specific speech and nonverbal development of each child.

Table 2. Change in the level of communication skills

Level of communication skills	Before (%)	After (%)
Low	58%	25%
Average	34%	47%
High	8%	28%

Source: Developed by the author based on the research data.

The data which we obtain in Table 3 demonstrates a significant increase in learning engagement. A more than twofold reduction in low levels indicates an increase in motivation to learn. This is due to:

- adapted learning materials,
- use of game-based and visual methods,
- tutor support during the learning process. The inclusive and adaptive model, aimed at modifying the educational environment to suit the child's needs, has proven particularly effective.

Table 3. Level of academic engagement

Level of engagement	Before (%)	After (%)
Low	65%	30%
Average	28%	44%
High	7%	26%

Source: Developed by the author based on the research data.

A comparative analysis shows that the following models demonstrate the highest results (Table 4):

- tutoring model (8.8)
- interdisciplinary model (8.8)

This supports our assertion about the need for comprehensive support for children with ASD.

The family-centered model is also highly significant, but its effectiveness depends on the degree of parental involvement. Aggregated data allows us to draw the following conclusions: All developmental indicators of children with ASD improved after the implementation of pedagogical models. The greatest effect is achieved with a combination of several support models, rather than using a single strategy. Positive dynamics are most pronounced in social adaptation and communication skills. Academic engagement directly depends on the degree of individualization of the educational process. The results of our study confirm that effective pedagogical support for children with ASD must be systemic and comprehensive. The most productive approach is the integration of tutoring, interdisciplinary, and individualized models, which ensures:

- sustainable development of social skills;
- improved communication;

- increased academic motivation;
- successful adaptation to an inclusive environment.

Table 4. Summary assessment of the effectiveness of the models (on a 10-point scale)

Model of pedagogical support	Social adaptation	Communication	Academic engagement	Average score	<i>p</i> -value
Individual Model	8.2	8.7	8.5	8.5	0.041
Tutoring Model	9.1	8.3	8.9	8.8	0.009
Interdisciplinary Model	9.0	8.8	8.6	8.8	0.012
Inclusive-Adaptive Model	8.7	8.2	9.0	8.6	0.027
Family-Centered Model	8.5	8.6	8.1	8.4	0.048

Source: Developed by the author based on the research data.

Notes: The *p*-value indicates the probability that the observed differences in effectiveness scores between the models occurred by chance under the null hypothesis of no real difference; smaller values provide stronger statistical evidence of a genuine difference between models. *p*-values were obtained using one-way analysis of variance (ANOVA) followed by a post hoc Tukey's Honestly Significant Difference (HSD) test. Statistical significance was established at $p < 0.05$.

The figure1 illustrates the effectiveness of pedagogical support models for children with autism spectrum disorder (ASD) by comparing key developmental indicators before and after the intervention. It presents three main domains of development:

- Social Adaptation;
- Communication Skills;
- Learning Engagement.

Each domain is represented by two bars: Before Intervention (baseline level), After Intervention (post-implementation of pedagogical support models).

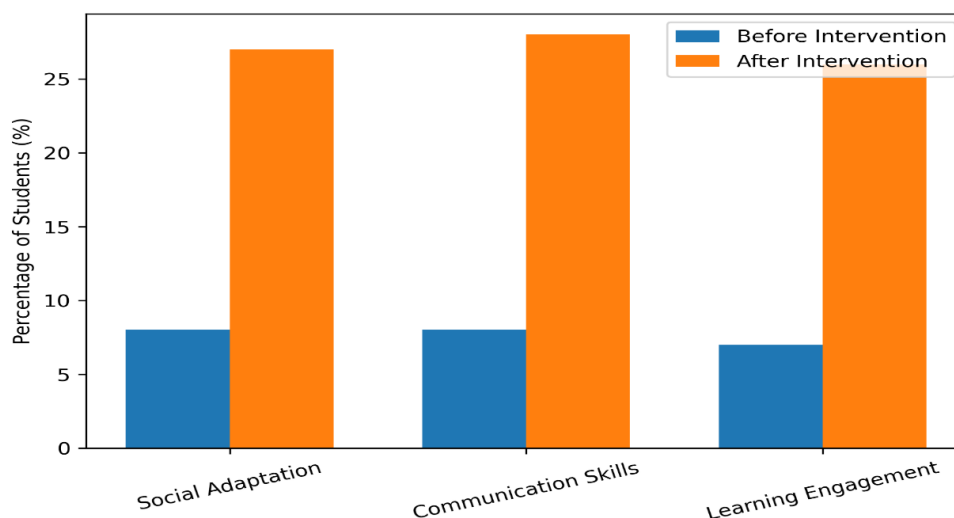


Figure1. Effect of Pedagogical Support Models on Children with ASD

Source: Developed by the author based on the research data.

Our results clearly show a significant improvement across all measured areas. In particular, there is a marked increase in the percentage of students demonstrating higher levels of functioning after the implementation of structured pedagogical support models. Social adaptation increased substantially, indicating better integration and interaction with peers and teachers. Communication skills also improved, reflecting enhanced ability to express needs and engage in social communication. Learning engagement showed a similar positive trend, demonstrating increased motivation and active participation in educational activities. Overall, the figure visually confirms that our findings indicate that comprehensive pedagogical support contributes to better educational outcomes for children with autism spectrum disorder (ASD) in inclusive schools. Children who

received structured and coordinated support showed greater progress in learning and everyday school participation.

The analysis revealed positive changes in several areas. Improvements were observed in social interaction, communication, and engagement in classroom activities. These findings suggest that support is most effective when it is flexible, individualized, and coordinated by different professionals working toward shared educational goals.

Effectiveness of Integrated Pedagogical Support Models

Among the approaches examined, tutoring and interdisciplinary support produced the most consistent results. Both models encouraged closer cooperation between teachers, specialists, and families. They also made it easier to adapt teaching strategies to each child's individual needs and developmental profile. This is consistent with international research, which emphasizes that continuous individual support for children with ASD contributes to significant improvements in social and academic outcomes (B. A. Boyd, S. L. Odom, B. P. Humphreys, & A. M. Sam) [5]

The tutoring model, which ensures the constant presence of an adult facilitator in the educational process, helps reduce anxiety and develop sustainable academic skills. Similar results were obtained in research by L. M. White et al. [6], which noted that individual support is a key factor in the successful inclusion of children with autism. The interdisciplinary approach, identified as one of the most effective in this study, is also supported by the work of L. Koegel et al. [7], who emphasize the need for collaboration between teachers, psychologists, and behavioral specialists to achieve sustainable results.

2. Improved Social Adaptation

A significant reduction in the proportion of children with low social adaptation (from 62% to 28%) confirms the effectiveness of the implemented educational models. In the context of Kazakhstan, the obtained results correlate with the findings of P.M. Zhanuzakova and A.S. Magauova [4, p. 115], who emphasize that systemic psychological and pedagogical support is the foundation for the successful social adaptation of children with special educational needs.

3. Development of communication skills

The improvement in communication skills identified in the study confirms the effectiveness of the individualized learning model. The obtained results are consistent with the data of J. Yi, W. Kim, J. Lee, et al. [8] who note that communication development in children with autism is most effective when using individualized educational strategies and alternative communication tools.

Furthermore, the use of visual supports and structured tasks is consistent with the principles of the TEACCH approach J. Li et al. [9], which is widely used internationally and has proven effective in developing communication skills.

4. Increased Academic Engagement – the increased academic engagement of students with ASD in this study was associated with the adaptation of the educational environment and the use of an inclusive-adaptive model. This is supported by research by M. McKinlay et al. [10], who note that adapting the educational process to the individual characteristics of students significantly increases their motivation and engagement. The results are also consistent with the work of C. Kasari et al. [11], who demonstrated that a structured educational environment and tutor support contribute to an increase in the time a child spends actively participating in educational activities.

5. The Role of Family Involvement

The family-centered model, although showing somewhat lower average effectiveness rates, plays an important role in the long-term. This is confirmed by research by B.A. Boyd et al. [5, p. 75], which emphasizes that parental involvement in the educational process is a critical factor in the sustainability of intervention results.

On the example of Kazakhstan, this conclusion is supported by research by N.A. Adayeva [12], which notes the insufficient involvement of parents in the inclusive process, which reduces the effectiveness of educational programs. Our study results support the provisions of the systemic and student-centered approaches. According to M. Ainscow [13], inclusive education should be viewed as a transformation of the entire educational system, not just the adaptation of individual children. Our findings also support the ideas of M. Ainscow [13, p. 8], according to which successful inclusion

is possible only through changes in the educational environment, and not solely through individual interventions. Thus, we concluded that the results of our study demonstrate that:

- a combination of several models of pedagogical support is most effective;
- individualization, structure, and interdisciplinary interaction are key success factors;
- sustainable positive changes are achieved through systematic support for children with ASD.

The scientific significance lies in the confirmation of international theoretical principles using empirical data in the context of the Republic of Kazakhstan, which expands the evidence base for the effectiveness of inclusive models in developing educational systems.

The scientific novelty of our study lies in the development and comparative evaluation of five pedagogical support models for children with autism spectrum disorder within the context of inclusive general education. Unlike previous studies, which have predominantly examined isolated support strategies such as tutoring, family involvement, or interdisciplinary collaboration, the present research integrates these approaches into a unified comparative framework using common evaluation criteria. The study provides empirical evidence regarding the relative strengths of each model across three key dimensions: social adaptation, communication, and academic engagement. Furthermore, the findings extend existing research by demonstrating that different pedagogical support models contribute to distinct aspects of children's inclusion rather than identifying a universally superior approach. This multidimensional perspective offers a more comprehensive basis for selecting pedagogical support strategies in general education institutions and contributes to the evidence base for inclusive educational practice.

Conclusion. Our study aimed to examine and substantiate the effectiveness of pedagogical support models for children with autism spectrum disorders (ASD) in inclusive education settings. Our findings allow us to draw a number of substantiated scientific and practical conclusions.

One of the main findings was that comprehensive pedagogical support was associated with better developmental outcomes for children with autism spectrum disorder (ASD). The most positive results were observed when tutoring, interdisciplinary collaboration, individualized instruction, inclusive-adaptive practices, and family-centered support were combined within a single educational framework. The most pronounced positive dynamics were recorded in the areas of social adaptation, communication skills, and academic engagement.

Second, we confirmed that the tutoring and interdisciplinary models are the most effective, as they ensure continuous support for the child and coordinate the efforts of various specialists. These results are consistent with international research emphasizing the importance of individualized and teamwork in educating children with autism (S. Rogers & G. Dawson) [14].

Third, the significant role of the family in the educational process was identified. Despite somewhat lower quantitative indicators, the family-centered model is an important factor in the sustainability of the achieved results, as confirmed by research by B.A. Boyd et al [5, p. 89].

This study compared five pedagogical support models for children with autism spectrum disorder in inclusive general education using indicators of social adaptation, communication, and academic engagement. The findings revealed differences in the average assessment scores across the models, suggesting that each approach demonstrates particular strengths in supporting specific aspects of children's inclusion. However, these results should be interpreted with caution because the study was conducted on a limited sample and further validation with larger populations is required.

Rather than identifying a single universally effective model, the findings indicate that pedagogical support should be selected according to children's individual educational and social needs. The proposed comparative framework may assist general education institutions in designing evidence-informed support strategies for children with ASD.

Future research should involve larger and more diverse samples, longitudinal designs, and additional objective outcome measures to further examine the effectiveness and generalizability of different pedagogical support models.

Thus, the study results confirm the need for a systemic, comprehensive, and interdisciplinary approach to organizing pedagogical support for children with ASD. The practical significance of the work lies in the possibility of applying the developed models in educational organizations of the

Republic of Kazakhstan to improve the quality of inclusive education and social integration of children with autism.

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Conflict of Interest Statement

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БІЛІМ БЕРУ ҮДЕРІСІНДЕ АУТИЗМ СПЕКТРІНІҢ БҰЗЫЛЫСТАРЫ БАР БАЛАЛАРДЫ ПЕДАГОГИКАЛЫҚ ҚОЛДАУ МОДЕЛЬДЕРІ

Аңдатпа

Жалпы білім беру ұйымдарында білім алатын аутизм спектрінің бұзылыстары (АСБ) бар балалар санының артуы олардың табысты білім алуын, әлеуметтік бейімделуін және білім беру ортасына толыққанды кірігуін қамтамасыз ететін тиімді педагогикалық қолдау жүйелерін қалыптастыру қажеттілігін күшейтті. Инклюзивті білім беру мәселелеріне қызығушылықтың артуына қарамастан, АСБ бар балаларды педагогикалық қолдаудың кешенді әрі ғылыми негізделген модельдерін енгізу жеткілікті деңгейде дамымаған.

Зерттеудің мақсаты - инклюзивті білім беру жағдайында аутизм спектрінің бұзылыстары бар балаларды педагогикалық қолдаудың тиімді модельдерін анықтау, жүйелеу және ғылыми тұрғыдан негіздеу.

Зерттеу инклюзивті білім беру және АСБ бар балаларды оқыту мәселелеріне арналған қазіргі ғылыми еңбектерді теориялық талдауға негізделді: педагогикалық қолдаудың негізгі тәсілдерін, олардың ортақ белгілері мен практикалық қолданылу ерекшеліктерін анықтау мақсатында ғылыми жарияланымдарға шолу және салыстырмалы талдау жүргізіліп, қолданыстағы модельдердің құрылымдық әрі функционалдық ерекшеліктері жүйеленді.

Талдау нәтижелері тиімді педагогикалық қолдау бір ғана әдіске немесе бір маманның қызметіне негізделмеуі тиіс екенін көрсетті: ол білім беруді жеке жоспарлауды, икемді педагогикалық тәсілдерді, педагогтердің, психологтердің, логопедтердің, тьюторлардың өзара үйлесімді жұмысын және отбасымен тұрақты ынтымақтастықты біріктіру арқылы жүзеге асырылады. Педагогикалық қолдаудың әртүрлі модельдері негізгі функциялары мен іске асыру жағдайларына сәйкес талданып, жүйеленді; ұйымдастырылу ерекшеліктеріне қарамастан, барлық модельдерді біріктіретін ортақ мақсат - АСБ бар балалардың жеке білім беру қажеттіліктеріне жауап беретін білім беру ортасын қалыптастыру. Дұрыс ұйымдастырылған әрі икемді қолдау жүйесі білім алушылардың оқу үдерісіне белсенді қатысуына, қарым-қатынас және әлеуметтік дағдыларының дамуына, инклюзивті білім беру сапасының артуына ықпал етеді. Зерттеудің ғылыми маңыздылығы - АСБ бар балаларды педагогикалық қолдау модельдерінің теориялық негіздерін нақтылап, олардың құрылымдалған жіктелісін ұсыну; практикалық маңыздылығы - ұсынылған модельдерді жалпы білім беру мектептерінде, ресурстық орталықтарда және арнайы білім беру ұйымдарында қолдану мүмкіндігімен айқындалады.

Зерттеу қорытындысы бойынша АСБ бар балаларды табысты инклюзиялау олардың жеке білім беру қажеттіліктерін ескеретін және оқу үдерісіне толыққанды қатысуын қамтамасыз ететін бейімделген, пәнаралық және балаға бағдарланған педагогикалық қолдау жүйелерін енгізу арқылы жүзеге асатыны анықталды.

Түйін сөздер: аутизм бар балалар, аутизм спектрінің бұзылыстары, инклюзивті білім беру, педагогикалық қолдау, қолдау модельдері, жекелендірілген оқыту, тьюторлық, білім беру ортасы, әлеуметтену.

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МОДЕЛИ ПЕДАГОГИЧЕСКОГО СОПРОВОЖДЕНИЯ ДЕТЕЙ С РАССТРОЙСТВАМИ АУТИСТИЧЕСКОГО СПЕКТРА В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ

Аннотация

Рост числа детей с расстройствами аутистического спектра (РАС), обучающихся в общеобразовательных организациях, обусловил необходимость создания эффективных систем психолого-педагогического сопровождения, обеспечивающих их успешное обучение, социальную адаптацию и полноценную инклюзию в образовательную среду. Несмотря на возрастающее внимание к вопросам инклюзивного образования, внедрение комплексных и научно обоснованных моделей педагогического сопровождения детей с РАС остается недостаточно разработанным.

Целью данного исследования являлось выявление, систематизация и научное обоснование эффективных моделей педагогического сопровождения детей с расстройствами аутистического спектра в условиях инклюзивного образования.

Исследование основывалось на теоретическом анализе современных научных работ, посвященных инклюзивному образованию и обучению детей с РАС: был проведен обзор и сравнительный анализ научных публикаций с целью выявления основных подходов к педагогическому сопровождению, их общих характеристик и различий в практическом применении, систематизации существующих моделей сопровождения и выявления их структурных и функциональных особенностей.

Результаты анализа показали, что эффективное педагогическое сопровождение не может основываться на использовании одного метода или деятельности одного специалиста. Оно строится на сочетании индивидуализированного образовательного планирования, гибких педагогических подходов, скоординированного взаимодействия педагогов, психологов, учителей-логопедов, тьюторов, а также постоянного сотрудничества с семьей. Различные модели педагогического сопровождения были проанализированы и систематизированы в соответствии с их основными функциями и условиями реализации; несмотря на организационные различия, все модели объединяет общая цель - создание образовательной среды, отвечающей индивидуальным потребностям детей с РАС. Грамотно организованная и адаптивная система сопровождения способствует более активному участию обучающихся в образовательном процессе, развитию коммуникативных и социальных навыков, а также повышению качества инклюзивного образования. Научная значимость исследования заключается в уточнении теоретических основ и разработке структурированной классификации моделей педагогического сопровождения детей с РАС; практическая значимость обусловлена возможностью применения предложенных моделей в общеобразовательных школах, ресурсных центрах и организациях специального образования.

Сделан вывод о том, что успешная инклюзия детей с расстройствами аутистического спектра возможна при условии внедрения адаптивных, междисциплинарных и личностно ориентированных систем педагогического сопровождения, учитывающих индивидуальные образовательные потребности каждого ребенка и обеспечивающих его полноценное участие в образовательном процессе.

Ключевые слова: дети с аутизмом, расстройства аутистического спектра, инклюзивное образование, педагогическое сопровождение, модели сопровождения, индивидуализированное обучение, тьюторство, образовательная среда, социализация.

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КОМАНДАЛЫҚ ЖҰМЫСҚА ДАЙЫНДАУДЫҢ ПЕДАГОГИКАЛЫҚ ЖӘНЕ ПСИХОЛОГИЯЛЫҚ АСПЕКТІЛЕРІ: СОҢҒЫ ЗЕРТТЕУЛЕРГЕ ШОЛУ (2015–2025 жж.)

Аңдатпа

Мақала мазмұнында 2015–2025 жылдар аралығындағы отандық және шетелдік педагогикалық және психологиялық зерттеулерге шолу негізінде болашақ мамандарды командалық жұмысқа даярлаудың теориялық-әдіснамалық және практикалық аспектілері талданады. Зерттеудің өзектілігі командалық жұмысқа дайындық ұғымының мазмұндық-құрылымдық сипаттамасының ғылыми еңбектерде бірізді **жүйелеу және** оны дамыту тетіктерін өзгермелі білім беру кеңістігі жағдайында қайта пайымдау қажеттілігімен байланысты. Зерттеудің мақсаты – командалық жұмысқа дайындық ұғымының мазмұндық-құрылымдық мәнін нақтылау және оны қалыптастыру тетіктерінің эволюциялық динамикасын жүйелеу. **Зерттеу салалық кешенді әдеби шолу** әдісіне негізделіп, контенттік және тақырыптық талдау тәсілдері қолданылды. Сараптамалық іріктеу Google Scholar және DisserCat ғылыми дерекқорларында жарияланған рецензиядан өткен еңбектер мен диссертациялық зерттеулер негізінде жүргізілді. Зерттеу жұмысының нәтижесі ретінде командалық жұмысқа дайындықтың ғылыми еңбектердегі компоненттері талданып, негізгі алты компоненті анықталды. Олар: мотивациялық; рөлдік және функционалдық; коммуникативтік; командалық шешім қабылдау; эмоционалдық және мінез-құлықтық; рефлексивтік компоненттер. Ұсынылған мақаланың ғылыми маңызы қазақстандық ғылыми журналдардағы мақалалар мен халықаралық диссертацияларды талдай отырып, командалық жұмысқа дайындықты жай ғана дағды емес, тұлғаның (болашақ маманның) адамдармен қарым-қатынасында, бірге әрекет етуінде, мақсатқа команда болып жетуде ерекше рөл атқаратын көпдеңгейлі жүйе деп **анықталғандығында**.

Түйінді сөздер: командалық жұмысқа дайындық, командалық өзара әрекет, кәсіби орта, командалық жұмыстың цифрлық форматтары, коллаборациялық орта, көшбасшылық, ынтымақтастық.

Кіріспе. Адами капиталды дамыту ел азаматтарының білім және денсаулық деңгейімен байланыстырылып қарастырылады. Алайда қазіргі жағдайда ол өскелең ұрпақтың өзгермелі әлемнің (VUCA, BANI, SHIVA, TACI) сипаттамаларына бейімделуін қамтамасыз ететін дағдылар жүйесімен айқындалады. VUCA тұжырымдамасына сәйкес әлем құбылмалы (Volatile), белгісіз (Uncertain), күрделі (Complex) және екіұшты (Ambiguous) сипатқа ие. BANI моделі әлемді осал (Brittle), алаңдаушылық тудыратын (Anxious), сызықты емес (Nonlinear) және толық түсінуге қиын (Incomprehensible) жүйе ретінде сипаттайды. SHIVA парадигмасы әлемнің ыдыраған (Separated), шамадан тыс байланысқан (Hyperconnected), түсініксіз (Incomprehensible), осал (Vulnerable) және жеделдетілген (Accelerated) сипатын айқындайды. Ал TACI тұжырымдамасы әлемнің турбулентті (Turbulent), кездейсоқ (Accidental), бей-берекет (Chaotic) және дұшпандық (Inimical) сипаттарын көрсетеді.

Әлемдік еңбек нарығындағы өзгерістерді стратегиялық түсінудің және болашақ дағдыларды айқындаудың негізгі дереккөзі – халықаралық «The Future of Jobs Report» («Болашақ жұмыс орындары туралы») есебі. Білім беру, кадрларды даярлау, елдің кадрлық саясатын құрастыруда қолданылатын бұл есеп соңғы он жылдықта 2016, 2018, 2020, 2023 және 2025 жылдары бес рет жарияланды. Бұл есептерде аналитикалық деректер мен еңбек нарығындағы беделді компания өкілдерінен, басшыларынан алынған сауалнамалардың нәтижесіне сүйеніп, алдағы уақытта қажетті дағдылардың тізімі ұсынылады.

Алғашқы 2016 және 2018 жылдары жарияланған есептерге талдау жұмысын жүргізген уақытта командалық жұмыс немесе командалық жұмысқа дайындық ұғымы тікелей

айтылмайды. Дегенмен болашақта қажетті дағдылар қатарындағы әлеуметтік дағдылар (social skills), адамдар арасындағы өзара әрекет дағдылары (interpersonal relations) мен ынтымақтастық дағдыларында (cooperation) командада бірге жұмыс жасау, командалардың бір-бірімен өзара мақсаттарға жетуінің маңыздылығы атап көрсетіледі. Есепте оның себебі ретінде технологиялық өзгерістердің үздіксіз орын алуына байланысты нәтижеге жету мен жұмыс орнында өнімділікті арттыру басты мақсат деп түсіндіреді. Болашақта қажетті дағдыларға қатысты бірінші және екінші есептің өзінде командада жұмыс жасай алудың бірнеше дағдылардың құрамдас бөлігі екенін байқаймыз.

Кейінгі бес жылдықта, яғни 2020 және 2023 жылдары шыққан «Болашақ жұмыс орындары туралы» талдамалық есептерде командалық өзара әрекет, ынтымақтастық және бірлесіп жұмыс жасау дағдылары жеке аталады. Дегенмен 2020 жылғы есепте сарапшылардың пікірі мен зерттеулердің қорытындысы бойынша еңбек нарығында жоғары сұранысқа ие деп «көшбасшылық және әлеуметтік ықпал (leadership and social influence)», ынтымақтастық (collaboration), қарым-қатынас (communication), эмпатия (empathy) дағдылары аталады. Осы жылғы есепте командалық жұмыс кәсіби ортадағы байланыс емес, бірге жұмыс жасайтын адамдар арасындағы креативтілікті және икемділікті арттыратын фактор ретінде аталып көрсетіледі. Екі жылдан кейін қайта жүргізілген зерттеуде заманның қарқынды дамуының себебінен адамдардың құндылықтарының өзгеруінен командада жұмыс жасаудың артықшылықтары айтылады. Адамдар арасындағы сенім, ынтымақтастық және ортақ мақсатқа жету үшін бір-бірімен тиімді жұмыс жасаудың негізі ретінде тұлғааралық қабілеттердің болашақта кез келген елдің экономикасын арттыруда маңыздылығын атап өтеді.

Алдыңғы есептерден байқағандай, болашақтағы жұмыс орындарында қызметкерлердің негізгі кәсіби білімі мен дағдылары емес, біртіндеп икемді дағдыларға нақты назар аударылады. Соңғы 2025 жылғы зерттеу нәтижелерінде де жаңа талаптар ретінде ұжымдық интеллект және ортақ көшбасшылық (collective intelligence, shared leadership) ұғымдары енгізілді. Жаңа талаптардың барлығы болашақтағы табысты маманды жеке кәсіби шеберлігімен өлшемейді, керісінше командада ортақ шешім қабылдай алу, өзара сенім орнатып, бірлескен әрекеттердегі қабілеттілігімен өлшейді. Сонымен қоса есепте жастардың жұмысқа, ұжымға, құндылықтарға мән беріп жүргені айтылады [1]. Жоғарыдағы талдауды қорытындылай келе, 2016 жылдан 2025 жылға дейінгі аралықта «The Future of Jobs Report» есептеріндегі командалық жұмыс түсінігі жанама әлеуметтік құзыреттен стратегиялық кәсіби қабілет деңгейіне дейін дамыды. Бұл эволюция жоғары білім беру саясатын қайта қарастырудың, соның ішінде болашақ мамандарды командалық жұмысқа даярлаудың әлемдік деңгейдегі маңыздылығын айқындайды.

Қазақстандық контексте болашақ мамандардың командада жұмыс істеу дағдыларының маңыздылығы еліміздегі салалық және өңірлік жаңа мамандықтар атластарымен айқындауға болады. Елімізде аталған атластарды дайындау екі кезеңде жүргізілді. Біріншісі Қазақстан Республикасы Еңбек және халықты әлеуметтік қорғау министрлігінің тапсырысымен Жаңа мамандықтар мен құзыреттілік Атласы, екіншісі «Халық табысын арттырудың 2029 жылға дейінгі бағдарламасы» кешенді жоспары аясындағы Қазақстан Республикасы Ғылым және жоғары білім министрлігі (ҚР ҒЖБМ) Жоғары білім беруді дамыту ұлттық орталығының «Мамандығым – Болашағым» бағдарламасы бойынша жасалған атластар.

Әдістер мен материалдар. Зерттеу сұрағы «қазіргі педагогикалық және психологиялық зерттеулерде командалық жұмысқа дайындық ұғымының мазмұны мен құрылымы қалай айқындалады?», «2015–2025 жылдар аралығындағы зерттеулерде командалық жұмысқа дайындықты қалыптастырудың педагогикалық және психологиялық тетіктерінде қандай даму үрдістері байқалады?» деп тұжырымдалды.

Зерттеу сапалық сипаттағы кешенді әдеби шолу әдісі бойынша орындалып, 2015-2025 жылдар аралығында жарияланған ғылыми еңбектерге сүйене отырып, командалық жұмысқа дайындық ұғымының педагогикалық және психологиялық тұрғыдан қарастырылу ерекшеліктерін талдау мақсатын көздеді.

Әдебиеттерді іздеу қазақ тіліндегі жарияланымдар үшін «Google Scholar», ал орыс тіліндегі диссертациялық зерттеулер үшін «DisserCat» (Научная электронная библиотека диссертаций и авторефератов) дерекқорларында жүзеге асырылды. Іздеу барысында «командалық жұмыс», «команда», «командная работа» түйінді сөздері қолданылды. Негізгі іріктеу критерийлері: жарияланым мерзімі 2015 жылдан 2025 жылға дейін; жариялану тілі қазақ, орыс; материалдың ғылыми сипаты мен рецензиялануы.

Әдебиеттерді салыстырмалы талдау барысында Bloomberg және Volpe (2012) ұсынған сапалық зерттеулерге арналған әдеби шолу матрицасы қолданылды. Іріктелген еңбектер мазмұндық және тақырыптық талдау (content and thematic analysis) әдістерімен жүйеленді.

Бірінші кезеңде командалық жұмысқа дайындық ұғымының мазмұндық мәні анықталды; Екінші кезеңде оның құрылымдық компоненттері топтастырылды; Үшінші кезеңде командалық өзара әрекетті дамытуға бағытталған педагогикалық тәсілдер мен психологиялық тетіктер жіктелді. Зерттеуде тек ашық қолжетімді және рецензияланған дереккөздер пайдаланылды.

Нәтижелер мен оларды талқылау. Қазақстандық ғылыми еңбектерге талдау жүргізу барысында командалық жұмысқа тікелей қатысты (атауында немесе тарау, тарауша атауларында) кандидаттық және докторлық диссертация табылмады. Google Scholar академиялық іздеу жүйесінде «командалық жұмыс» кілт сөзі бойынша алынған ғылыми жарияланымдарға контенттік сараптау жүргізілді. Сараптау аталған платформаның бірінші және жетінші беттерінде ұсынылған материалдар бойынша орындалды. Бұл командалық жұмыс ұғымына қатысты зерттеулердің мазмұнын, тақырыбын және ғылыми репрезентация деңгейін жүйелі бағалауға мүмкіндік берді.

Жоғарыда көрсетілген платформалардан зерттеу тақырыбына қатысты деп іріктеліп алынған мақалалардағы зерттеулерде командалық жұмыс үш контексте қарастырылады деп тұжырымдауға болады. Біріншісі – жоғары оқу орындарының (бұдан әрі – ЖОО) білім алушыларына қатысты зерттеулер; екіншісі – мектеп оқушыларына бағытталған зерттеулер; үшіншісі – әртүрлі деңгейдегі білім беру мекемелерінде жұмыс жасайтын педагогтерге қатысты зерттеулер. Олар туралы ақпарат 1-кестеде берілген.

1-кесте. Командалық жұмысқа дайындық ұғымының отандық еңбектерде қарастырылуы

Зерттеу бағыттары	Авторлар	Мақала тақырыбы	Командалық жұмысқа қатысты тұстары
Академиялық ортадағы білім алушыларға қатысты зерттеулер	М.Қ. Уандықова, Т.Ш. Миркасімова, Г.Н. Астаубаева, Г.С. Мухамеджанова, А.Д. Елеукулова (2024)	Жіра курсын оқу үрдісіне енгізудің қажеттіліктері мен артықшылықтары (Жіра – бағдарламалық өнімнің атауы)	Жіра курсын бакалавриат деңгейіндегі білім беру бағдарламаларына енгізу арқылы студенттердің командалық жұмыс дағдыларын дамыту жолдарын қарастырған [2].
	С.Т. Мамадалиев, А.Н. Аутаева және А.Т. Бекмурат (2025)	Арнайы педагогтарды кәсіби даярлауда жобалық технологияны қолдану моделі	Жобалық оқыту экспериментін жүргізу барысында кәсіби біліктілігін, зерттеу және командалық жұмыс қабілеттерін қалыптастыруға арналған арнайы мазмұндағы тапсырмалар мен әдістемелік құралдарды пайдаланған [3].
	Э.А. Айтенова, Қ.Н. Сарыбекова, А.А. Сманова және З.Д. Кошимбетова (2024)	Коллаборациялық орта негізінде болашақ педагогтің кәсіби даярлығының теориялық-әдіснамалық негіздемесі	Коллаборациялық орта құрудың әдісі ретінде ойындар негізінде командада оқытуды, сабақта студенттердің командалық әрекетін ұйымдастыруды атап көрсеткен [4].
Мектеп оқушыларына	Д.С. Кадерова мен А.Б. Медешова (2024)	STEM (Science, Technology, Engineering	Командалық жұмысты ұйымдастырудың және

бағытталған зерттеулер		and Mathematics – Ғылым, Технология, Инженерия, Математика) технологияларын енгізу және оларды физика сабағында қолдану	командада жұмыс жасауды маңызды дағды ретінде атап өткен [5].
	Г. Ризаходжаева, И. Усембаева және Б. Баймуханбетов (2025)	Мектеп оқушыларының саяхатқа деген ынтасын арттырудағы soft skills (ікемді дағдылар) дағдыларының рөлі	Soft skills дағдылар ретінде «коммуникация дағдылары, командалық жұмыс, шығармашылық ойлау, көшбасшылық қасиеттерді» белгілеп алған; Эксперимент арқылы командалық жұмыстың оқу және тәрбиедегі маңыздылығын айқындаған [6].
	Г.С. Кайсағалиева мен А.О. Абдрахманова (2025)	Оқушылардың сыни ойлауын дамытудағы CLIL рөлі: белсенді оқыту мен ақпаратты талдауға ықпал ететін тәжірибелерді зерттеу	CLIL әдісі (Content and Language Integrated Learning) арқылы командалық жұмыстың қалыптастырудағы маңыздылығын сипаттаған; «Топтық жұмыс» және «Командалық жұмыс» ұғымдарын бірдей мазмұнда қарастырған [7].
Өртүрлі деңгейдегі білім беру мекемелерінде жұмыс жасайтын педагогтерге қатысты зерттеулер	М.А. Бакетова мен Г.З. Таубаева (2022)	Болашақ мектепке дейінгі білім беру мамандарын даярлаудағы педагогикалық үдерістің маңызы	Бәсекеге қабілеттілікті командада жұмыс жасауды меңгеру арқылы арттыруға болатындығын сипаттаған; «Командалық жұмысқа дайындық» ұғымын коммуникативтік және аксиологиялық дайындықтардың бірлігі деп түсіндіреді [8].

Дереккөз: авторлар дайындаған.

Тәуелсіз мемлекеттер достастығы (ТМД) елдерінде командалық жұмыс, командалық жұмысқа дайындық мәселесін қарастыру үшін 2006 жылдан бастап диссертациялардың қоры жинақталған dissercat.com электрондық кітапханасында талдау жұмысы жүргізілді. Аталған платформада педагогика (13.00.00) және психология (19.00.00) бағыттары бойынша 2015-2025 жылдар аралығы деген фильтр қойылып, «командная работа» кілт сөзімен кеңейтілген іздеу жүргізілді. Бұл іздеудің нәтижесінде 296 диссертация табылды. Оларды талдау барысында көпшілігі түйінді сөздің «команда», «командный», «командное», «командных» деген нұсқаларында және спорт саласындағы «команда» сөзімен байланысты да диссертацияларды бергені анықталды. Осыған байланысты нақты командалық жұмысқа қатысты еңбектерді айқындау үшін қосымша контенттік сараптау жасалды. Іріктеу критерийлері ретінде: тақырыпта «командная работа / командная деятельность / работа в команде» тіркестерінің дәл болуы және мазмұнында (жоспарында) командалық өзара әрекетке, топтық жұмысқа немесе командалық жұмысқа даярлыққа қатысты нақты ғылыми тұжырымдардың кездесуі алынды. Жүргізілген талдау нәтижесінде ғылыми-педагогикалық және психологиялық контекстте командалық жұмысқа тікелей қатысты 6 диссертация анықталды. Сонымен қатар аталған жүйеде кейбір еңбектердің мамандық шифрлары көрсетілмейтінін ескеріп, іздеудің қайталама (коды көрсетілмеген) нұсқасы орындалды, оның нәтижесінде тақырыпқа сәйкес қосымша 4 зерттеу табылды. Жалпы алғанда, командалық жұмысқа қатысты мазмұндық және тақырыптық деңгейде нақты қарастырған 10 диссертациялық жұмыс анықталды.

Біз сараптаған еңбектерде командалық жұмысқа дайындық мәселесі педагогикалық, психологиялық, білім берудегі менеджмент және мамандарды кәсіби даярлау (медицина

саласы мен құқық саласы) бағыттары бойынша жүргізілген. Педагогикалық бағытта А.Д.Малышева (2018) қарастырған болса, психологиялық бағытта Е.А. Проненко (2019), ал білім беру менеджменті бойынша командалық жұмысқа дайындықты А.В. Хохлов (2020) зерттеген. Жеке бір білім беру бағдарамасы аясында болашақ мамандарды командалық жұмысқа дайындығы мәселесімен М.Р. Хакимова (2025) мен Е.Г.Князева (2023) айналысқан. Аталған ғалымдардың еңбектерін талданып, нәтижелері 2-кесте мазмұнында көрсетілді.

2-кесте. Командалық жұмысқа дайындық ұғымының мазмұндық-құрылымдық мәні

№	Автор, диссертациялық жұмыстардың тақырыптары, жылы	Зерттеу пәні	Командалық жұмысқа дайындық құралатын компоненттер
1	А.Д. Малышева, «Педагогические условия формирования готовности к работе в команде студентов-библингеров Республики Саха (Якутия)», (2018)	Университеттегі екі тілді студенттердің командалық жұмысқа дайындығын дамытудың педагогикалық шарттары.	Коммуникативтік; Тұлғалық; Когнитивтік
2	Е.А. Проненко, «Психологические особенности смыслообразования и формирования межличностных смыслов в ситуации командного взаимодействия», (2019)	Командалық өзара әрекеттесу контексіндегі жеке тұлғаның мағаналық сферасы.	Жаңа тұлғааралық және тұлғалық мағыналар; Іс-әрекет, Міндеттер мен шешімдердің мағынасы мен мәні
3	А.В. Хохлов, «Развитие у руководителей общеобразовательных организаций культуры командной работы», (2020)	Қосымша кәсіби білім беру аясында жалпы білім беру ұйымдарының басшылары арасында командалық жұмыс мәдениетін дамыту процесі.	Бір – біріне сенім; Бірге шешім қабылдау; Жоспарлау мен міндеттерді бөлісуде барлығының пікірінің ескерілуі
4	Е.Г.Князева, «Формирование компетенции командной работы студентов медицинских специальностей средствами симуляционных технологий» (2023)	Симуляциялық технологияларды қолдана отырып, студенттердің командалық жұмыс құзыреттілігін дамытудың педагогикалық моделі.	Когнитивтік; Мотивациялық-құндылықты; Рефлексивті-белсенділік
5	М.Р. Хакимова «Формирование опыта командной работы у будущих юристов в вузе» (2025)	Болашақ заңгерлердің университеттегі кәсіби дайындығы кезінде командалық жұмыс тәжірибесін дамытудың мазмұны, ұйымдастырушылық және педагогикалық құралдары.	Эмоционалды үйлесімділік; Өртүрлі командалық рөлдерді меңгеру; Шығармашылық шешімдерге ашықтық; Өнімді өзара әрекеттесу

Дереккөз: авторлар дайындаған.

Жоғарыдағы көрсетілгендей командалық жұмысқа дайындық мазмұндық-құрылымдық компоненттерден тұратындығы бірнеше рет дәлелденген. Демек, командалық жұмысқа дайындықты ғылыми түрде қарастыруда алдымен оның компоненттерін анықтап алу қажеттілігін көрсетеді. Сәйкесінше қарастырылған еңбектердегі тұжырымдарды талдап, зерттеу сұрағы аясында жүйелеп командалық жұмысқа дайындық ұғымының мазмұндық-құрылымдық мәнін ұсынамыз. Біздің пайымдауымызша 2015-2025 жылдар аралығында жарияланған еңбектер бойынша командалық жұмысқа дайындық мотивациялық; рөлдік және функционалдық; коммуникативтік; командалық шешім қабылдау; эмоционалдық және мінез-құлықтық; рефлексивтік деген компоненттерден құралады (1-сурет).

Екінші зерттеу сұрағы бойынша 2015-2025 жылдар аралығындағы жарияланған ғылыми-зерттеулерге сүйене отырып, командалық жұмысқа дайындықты дамытуға ықпал ететін педагогикалық және психологиялық тетіктері зерделенді. Белгіленіп алынған уақыт аралығындағы диссертацияларды талдау нәтижесінде келесі жылдар бойынша ұқсастықтары бойынша жіктелді: 2017-2019, 2018-2021, 2022-2025, 2023-2025. Көрсетілген уақыттарда командалық жұмысқа дайындықты қалыптастыру және оған дағдыландыру жалпы педагогикалық әдістерден басталып, практикалық психологиялық механизмдер және кәсіби

контекстегі рөлдік модельдер мен цифрлы ортадағы командалық форматтарға дейін дамығандығы анықталады.



1-сурет. Командалық жұмысқа дайындықтың мазмұндық-құрылымдық компоненттері
Дереккөз: авторлар дайындаған.

Жалпы алғанда, 10 диссертацияны жүйелі талдау командалық жұмысқа дайындықты дамыту тетіктерінің уақыт бойынша төрт негізгі кезең бойынша эволюцияланғанын дәлелдейді: педагогикалық әдістерге негізделген кезең; тұлғалық-психологиялық механизмдерге ауысу; кәсіби рөлдік орталарда қалыптасу; онлайн форматтарға бейімделу (3-кесте).

3-кесте. Командалық жұмысқа дайындықты дамыту тетіктерінің эволюциялық динамикасы (2017–2025 жж.)

№	Жылдар	Авторлар	Педагогикалық және психологиялық тетіктер	Кезеңдер атауы
1	2017–2018	Ю.В. Васильева [9]	Проблемалық оқыту; оқыту семинарлары; тренингтер; бинарлық және интеграциялық сабақтар; кейстерді шешу; жобалау; кәсіби жағдаяттарды бірлесіп талдау; рөлдік ойындар; топтық дискуссиялар	Педагогикалық әдістерге негізделген кезең
2	2018–2021	А.Д. Малышева [10] Е.А. Проненко [11] А.В.Хохлов [12]	Тұлғааралық өзара әрекет; мән (мағына) мәселесі; эмоционалды күй; командалық жұмысқа дайындыққа психологиялық стрессті болдырмау; эмоционалдық тұрақтылықты қалыптастыру; жолдастық көмек көрсету	Тұлғалық-психологиялық механизмдер кезеңі
3	2022-2025	М.Р. Хакимова [13] Е.Г. Князева [14]	Командалық дайындықты кәсіби рөлдер арқылы қалыптастыру	Кәсіби рөлдік орталарда қалыптасу кезеңі
4	2025	П.А. Балышев [15]	«Виртуарлы команда», «қашықтан өзара байланыс», «командалық жұмыстың цифрлық форматтары» негізгі тенденция ретінде	онлайн форматтарға бейімделу кезеңі

Дереккөз: авторлар дайындаған.

Бұл тенденциялар командалық жұмысқа дайындық тек дағды немесе құзырет емес, тұлғаның кәсіби, әлеуметтік, мағыналық және технологиялық бейімделуін талап ететін көпдеңгейлі жүйе екенін дәлелдейді.

Қорытынды. Біз болашақтың жоғары технологиялық және өзгермелі еңбек нарығы үшін кадрлар резервін қалыптастыруымыз қажет. Демек, заманның талабы саналатын командада жұмыс жасауға дайындау маман даярлаудың барлық деңгейіндегі білім беруді дамытуға бағытталған тиісті шаралардың бірі болуы шарт.

Көрсетілген тақырыптар бойынша зерттеу барысында қол жеткізілген нәтижелер мынадай қорытындылар мен ұсыныстар жасауға мүмкіндік береді: 1. Командалық жұмысқа дайындық ұғымының мазмұндық-құрылымдық мәні құрылды. 2. Соңғы он жылда жоғары оқу орны жағдайында командалық жұмысқа дайындықты дамытуға ықпал ететін педагогикалық және психологиялық тетіктер жіктеліп, жүйеленді. 3. Командалық жұмысқа дайындаудың маңыздылығы туралы көзқарастар айқындалғанымен, отандық ғылымда жеке диссертация тақырыбы ретінде кешенді қарастырылмағандығы айқындалды. 4. Еліміздегі зерттеулерде командалық жұмыс нәтиже ретінде алынып, жобалық оқыту, STEM және CLIL инновациялық оқыту әдістері арқылы жетуге болатындығы дәлелденеді және soft skills пен 4К (Critical thinking – сыни ойлау, Creativity – креативтілік, Communication – қарым-қатынас, Collaboration – ынтымақтастық) дағдыларының ішіндегі маңызды бір бөлігі ретінде көрініс табады.

Алынған нәтижелер, Google Scholar және DissersCat дерекқорларының біз тапқан еңбектердің аясында жан-жақты қарастырылып, талданды. Дегенмен, бұл мәселе ғылыми-педагогикалық тұрғыдан негізделгенде аталған жүйелермен шектелді. Алайда, болашақта Scopus және Web of Science сайттарындағы ғылыми жарияланымдар зерделеніп, біз ұсынған тұжырымдар әрі қарай толықтырылып, жоғары мектеп жағдайында оқу-танымдық, тәрбиелік қызмет түрін ұйымдастыруда сынақтан өткізу мен растау арқылы мәселені эмпирикалық әдістер арқылы зерттеуге мүмкіндік береді.

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ПЕДАГОГИЧЕСКИЕ И ПСИХОЛОГИЧЕСКИЕ АСПЕКТЫ ПОДГОТОВКИ К КОМАНДНОЙ РАБОТЕ: ОБЗОР СОВРЕМЕННЫХ ИССЛЕДОВАНИЙ (2015–2025 гг.)

Аннотация

В статье на основе обзора отечественных, зарубежных педагогических и психологических исследований за 2015–2025 годы анализируются теоретико-методологические и практические аспекты подготовки будущих специалистов к командной работе. Актуальность исследования обусловлена отсутствием единой систематизации содержательно-структурной характеристики понятия готовности к командной работе и необходимостью переосмысления механизмов её развития в условиях трансформирующегося образовательного пространства. Цель исследования – уточнение содержательно-структурной сущности понятия готовности к командной работе и систематизация эволюционной динамики механизмов её формирования. Исследование основано на методе комплексного качественного обзора литературы с применением контент-анализа и тематического анализа. Экспертный отбор источников осуществлялся на основе рецензируемых публикаций и диссертационных исследований, размещённых в научных базах данных Google Scholar и DissersCat. В качестве результата исследовательской работы были проанализированы компоненты готовности к командной работе в научных трудах и определены шесть основных компонентов. Это: мотивационный; ролевой и функциональный; коммуникативный; принятие групповых решений; эмоциональный и поведенческий; рефлексивный компоненты. Научная значимость представленной статьи заключается в том, что на основе анализа статей в казахстанских научных журналах и международных диссертаций готовность к командной работе определена не просто как навык, а как многоуровневая система, играющая особую роль во взаимодействии личности (будущего специалиста) с людьми, в совместной деятельности и в достижении цели в команде.

Ключевые слова: готовность к командной работе, командное взаимодействие, профессиональная среда, цифровые форматы командной работы, коллаборативная среда, лидерство, сотрудничество.

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PEDAGOGICAL AND PSYCHOLOGICAL ASPECTS OF READINESS FOR TEAMWORK: A REVIEW OF CONTEMPORARY RESEARCH (2015–2025)

Abstract

The article analyzes the theoretical-methodological and practical aspects of preparing future specialists for teamwork based on a review of domestic and international pedagogical and psychological studies published between 2015 and 2025. The relevance of the study is due to the lack of unified systematization of the content-structural characteristics of the concept of readiness for teamwork, as well as the need to reconsider the mechanisms of its development in the context of a transforming educational environment. The purpose of the study is to clarify the content-structural essence of the concept of readiness for teamwork and to systematize the evolutionary dynamics of the mechanisms underlying its formation. The research is based on a comprehensive qualitative literature review using content analysis and thematic analysis methods. The expert selection of sources was carried out on the basis of peer-reviewed publications and dissertation studies indexed in the Google Scholar and DissertCat scientific databases. As a result of the research work, the components of readiness for teamwork in scientific works were analyzed, and six main components were identified. These are: motivational; role and functional; communicative; group decision-making; emotional and behavioral; and reflective components. The scientific significance of the presented article lies in the fact that, based on the analysis of articles in Kazakhstani scientific journals and international dissertations, readiness for teamwork is identified not just a skill, but a multilevel system that plays a special role in the interaction of a person (future specialist) with people, in joint activity, and in achieving a goal as a team.

Keywords: readiness for teamwork, team interaction, professional environment, digital formats of teamwork, collaborative environment, leadership, cooperation.

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ВОВЛЕЧЕННОСТЬ ПЕДАГОГОВ ДОПОЛНИТЕЛЬНОГО ОБРАЗОВАНИЯ В ОБУЧЕНИЕ НА КУРСАХ КАК ФАКТОР ПРОФЕССИОНАЛЬНОГО РАЗВИТИЯ

Аннотация

В системе дополнительного образования наблюдается проблема качества кадрового состава педагогов. Ее решение может быть связано с эффективностью обучения на курсах повышения квалификации. Названная эффективность определяется таким качеством обучения, которое стимулирует нелинейное и устойчивое профессиональное развитие педагогов. В статье представлены результаты анализа показателей вовлеченности педагогов в обучение на курсах с целью определения ее влияния на актуализацию профессионального развития. Для реализации цели применялись методы анализа и синтеза, анкетного опроса, наблюдения. Результаты исследования связаны с уточнением внутренних и внешних мотивов, а также факторов вовлеченности педагогов в развивающее обучение на курсах, со средой курсов для долгосрочного действия мотивов и факторов, с персонализацией для обновления контента курсов повышения квалификации. Значимость результатов связана с дизайном и редизайном образовательных программ курсов и организацией сопровождения профессионального развития педагогов на рабочем месте. Таким образом, результаты исследования имеют практическую ценность для педагогов и администрации организаций дополнительного образования, разработчиков образовательных программ и специалистов системы повышения квалификации, аналитиков и экспертов в области образования.

Ключевые слова: дополнительное образование, курсы повышения квалификации, профессиональное развитие, профессиональная вовлеченность, баланс факторов вовлеченности, персонализация, метакогнитивная компетентность.

Введение. К настоящему времени дополнительное образование (далее – ДО) в Республике Казахстан – это 2 013 организаций образования, в которых получают развитие 1 147 187 учащихся [1].

С одной стороны, ДО развивается как неотъемлемая часть национальной системы поиска и поддержки талантов, основа профессионального самоопределения, ориентации и мотивации детей и молодежи к участию в инновационной деятельности в сфере высоких технологий и производства. С другой стороны, необязательность и негарантированность ДО на уровне национального законодательства создает дополнительные риски и проблемы с точки зрения социальной стратификации, подтверждаемые на практике:

- неравенство доступа услуг, обусловленное различными факторами – территориальными, социально-экономическими, управленческими, информационными;
- дисбаланс в условиях фундаментальной изменчивости между содержанием ДО и интересами детей, потребностями семьи, ожиданиями государства и общества, изменениями социального и технологического уклада;
- недоиспользование потенциала ДО в работе по профессиональному самоопределению и профессиональной подготовке детей и молодежи;
- преобладание отдельных оценочных процедур над целостным мониторингом качества ДО, что затрудняет научно-методическое обеспечение процессов измерения и оценивания образовательных результатов обучающихся;
- отсутствие конвертации результатов ДО.

Решение проблем связывается, в первую очередь, с человеческим фактором – качеством профессионального развития педагогов ДО, нуждающихся в развитии. Так, в 2025–2026

учебном году численность педагогов ДО составляет 25 806 человек. По уровню образования статистика такова: 64,17% имеют высшее педагогическое образование, 18,27% – высшее профессиональное, 9,78% – техническое и профессиональное (педагогическое), 3,5% – техническое и профессиональное. Вместе с тем 1,62% имеют лишь общее среднее образование, 2,65% – послевузовское образование. В разрезе квалификационных категорий: 50,68% не имеют категории, 8,49% имеют вторую, 6,53% – первую, 6,34% – высшую категорию [1, с. 298]. Таким образом, лишь 27,96% педагогов (менее трети) имеют категории модератора, эксперта, исследователя, мастера. Между тем, в числе требуемых умений, согласно Карточкам профессии педагогов ДО, – планировать индивидуальную траекторию развития, пользоваться навыками исследовательской, экспериментальной работы, вести работу по апробации новых методик, разрабатывать и публиковать авторские методические разработки [2].

Для развития качества педагогов ДО предлагается ресурс вовлеченности в профессиональное развитие. Исследовательского внимания заслуживает концепция «вовлеченность – вовлечение» личностно-профессионального развития педагогов: «комплекс эмоционально-ценностных состояний педагога – вовлеченность в профессию – сопровождается осмыслением, оцениванием, изменением собственного поведения и отношений с учащимися, что обуславливает процесс вовлечения – систему конкретных действий педагога по активному включению учащихся в учебную деятельность, то есть повышение степени их вовлеченности в образовательный процесс» [3]. *Вовлеченность педагогов в обучение на курсах* – это динамический процесс, когда слушатели интерпретируют и встраивают контент обучения в компоненты опыта: профессиональные цели, ценности, убеждения, знания, навыки, компетенции. Обогащенный опыт стимулирует профессиональное развитие.

Профессиональное развитие педагога (далее – ПРП) – деятельность и процессы (рефлексия, обучение и действия), мотивируемые улучшением профессиональных знаний и компетентности и выполняемые на протяжении всей карьеры педагога.

Выбором ресурса обусловлена *цель исследования* – выявление факторов и характеристик вовлеченности педагогов в обучение на курсах, связанных с их профессиональным развитием.

Тематический обзор научной литературы 2024–2026 годов позволил выделить основные дефициты курсов повышения квалификации педагогов, критически значимые для ДО:

- сохранение в образовательных программах курсов традиционных убеждений о преподавании и обучении без учета влияния личных убеждений, взглядов и ценностей педагогов на интерпретацию и реализацию инновационных подходов (США) [4];
- обучение педагогов как исполнителей учебной программы, активных в условиях класса, без должного внимания к их трансформационной активности посредством взаимодействия с внешкольными сообществами для адаптации более широких практик к современному образовательному ландшафту (Канада) [5];
- линейное оценивание педагогов на курсах в различных областях навыков преподавания, не связанное с формированием представлений педагогов о собственной эффективности через единую модель компетентности (Турция) [6];
- сфокусированность содержания на преподавательской самостоятельности педагогов при ограниченном внимании факторам и результатам развития исследовательской активности, особенно в посткурсовой период и на рабочем месте (Китай) [7];

Указанные дефициты не обеспечивают устойчивости и полноты ПРП, а именно: содействие рефлексии, повышение самосознания сильных и слабых сторон, расширение контекстного понимания, повышение мотивации и креативности, положительное влияние на обучение учащихся [8]. Цель исследования потребовала уточнения позиций.

Исследовательские вопросы:

Исследовательский вопрос 1. Какие ожидания, потребности и мотивы педагогов ДО определяют их вовлеченность на курсах повышения квалификации?

Исследовательский вопрос 2. Каковы особенности формирования ожиданий, потребностей и мотивов?

Исследовательский вопрос 3. Какие ресурсы и механизмы курсовой подготовки трансформируют вовлеченность педагогов в ПРП?

Исследовательские вопросы связаны с *гипотезой*: если курсовая подготовка учитывает индивидуальную (персонифицированную) траекторию развития обучающихся педагогов, то это может стимулировать процессы ПРП, в том числе в посткурсовой период, т.к. персонификация становится действенным механизмом профессиональной вовлеченности, формирования смыслов и ценностей развития, самореализации в условиях улучшения собственной практики. *Персонификация* – дифференциация и индивидуализация обучения с учетом текущего уровня ПРП, процесс личностных и деятельностных изменений педагога вследствие реализуемых потребностей и субъектного опыта, что проявляется в готовности и способности улучшать профессиональную деятельность посредством стратегий саморазвития, применяемых в экосистеме формального, неформального и информального образования.

Методы и материалы. Методом стандартизированного сбора количественных данных с целью исследования проблемы послужил *анкетный опрос* всех слушателей курсов повышения квалификации на базе Республиканского учебно-методического центра ДО (далее – РУМЦ ДО).

Структура разработанной авторами анкеты включает блоки: 1) Общая информация, 2) Опыт предыдущих курсов повышения квалификации, 3) Ожидания и мотивы повышения квалификации в формате курсов, 4) Дефициты курсов повышения квалификации, 5) Направления улучшения практики курсов повышения квалификации, 6) Социально-педагогическая эффективность курсов повышения квалификации.

Надежность опросника подтверждена повторным проведением опроса на выборке слушателей групп курсов повышения квалификации, внутренней согласованностью блоков и утверждений в них. Пункты опросника раскрывают аспекты исследуемой вовлеченности, что говорит о содержательной валидности.

Опрос является обязательным для слушателей и организуется в два этапа - на входе (блоки 1–3) и по окончании двухнедельного курсового обучения (блоки 4–6).

В рамках данного исследования проанализированы и интерпретированы ответы по блоку 3. Цель опроса - выявление взаимосвязи между вовлеченностью слушателей в процесс курсового обучения и их профессиональным развитием. Задачи, определяемые целью исследования: а) выявить факторы вовлеченности в курсовое обучение, б) установить их влияние на профессиональное развитие педагогов, в) определить направления улучшения курсового обучения для трансформации от профессионального обучения к профессиональному развитию.

Варианты ответов измерялись по номинальной шкале. Полученные данные представляют собой абсолютные частоты.

Достоверность и валидность данных поддерживаются объемом выборки и ее региональной представленностью. Так, в опросе участвовали 1627 слушателей 34-х курсов повышения квалификации педагогов по музыкальному, художественно-эстетическому, эколого-биологическому, научно-техническому, социально-педагогическому направлениям, что составляет около 6,5% от общего числа педагогов ДО в Казахстане. Курсы проходили в период с 20.04. по 15.05.2026 года.

Слушатели представляли 17 областей Казахстана и три города республиканского значения.

6% педагогов имеют стаж до одного года, 13% – от одного до трёх лет, 26% – от трёх до десяти лет, 30% – от десяти до двадцати лет, 26% – более двадцати лет.

Качественный состав педагогов: 4% педагогов-стажёров, 39% педагогов, 34% педагогов-модераторов, 13% педагогов-экспертов, 9% педагогов-мастеров, 0,37% и 0,55% имеют первую и вторую квалификационные категории соответственно.

В целом выборка характеризуется как простая случайная (из числа слушателей курсов повышения квалификации), удобная (доступ к которой обеспечен как к участникам обязательного опроса по результатам обучения на курсах), нестратифицированная. Респонденты информированы о задачах исследования, участвовали в опросе как обязательной процедуре курсового обучения на платформе РУМЦ ДО и имели для этого доступные ресурсы, изъявили готовность участвовать в исследовании.

Результаты и их обсуждение. Утверждение № 1 опросника допускало множественный выбор из предложенных вариантов. Каждый вариант кодировался как отдельная номинальная категория. Для него рассчитывались абсолютное количество выборов, доля соответствующего варианта в общем количестве зафиксированных выборов и доля респондентов, отметивших данный вариант. По этой причине сумма процентных значений могла превышать 100%. Для утверждений № 2 и 3 с единственным вариантом ответа рассчитывались абсолютные и относительные частоты.

Обработка данных включала проверку полноты ответов, кодирование категорий и расчёт абсолютных частот и процентных распределений. Статистические модели связи и методы проверки причинного влияния не применялись, т.к. анализируемый блок включал преимущественно номинальные показатели и использовался для описания структуры мотивов и ожиданий педагогов. Интерпретация результатов носила разведочный характер.

Итак, утверждение № 1 – *В наибольшей степени меня мотивирует пройти курсы повышения квалификации (возможны 1–3 варианта ответов)* – предлагало 12 вариантов выбора.

В таблице 1 представлены данные выбора респондентов, отражающие вовлеченность как личностно-активный потенциал, который может динамично проявляться при выполнении профессиональных ролей и включает когнитивный аспект – убеждения, эмоциональный – характер и силу эмоциональной связи, а также поведенческий – энергию, вкладываемую в выполнение соответствующих ролей [9]. При этом варианты выбора классифицированы как базовые определения феномена вовлеченности в интерпретации разных авторов.

Таблица 1. Данные выбора респондентами мотиваторов курсового обучения

<i>В наибольшей степени меня мотивирует пройти курсы повышения квалификации (возможны 1–3 варианта ответов):</i>	<i>Преобладающий компонент вовлеченности</i>	<i>Общее количество выбора варианта (в % отношении от количества ответов)</i>	<i>Количество респондентов, выбравших ответ в % отношении</i>
Обновление знаний в контексте современных требований (1)	внешний компонент мотивации [10]	897 (17,9%)	54%
Освоение практических инструментов для внедрения в образовательный процесс (2)	преднамеренная саморегуляция [11]	748 (15%)	45%
Обмен профессиональным опытом (3)	гибкая и надежная профессиональная идентичность [12]	725 (14,5%)	44%
Коллективная творческая проектная деятельность (4)	интерес возможностей [13]	295 (5,9%)	18%
Получение консультаций экспертов (5)	интерес возможностей [13, р. 555] (при повторной ссылке на источник необходимо указывать страницу)	319 (6,4%)	19%
Демонстрация собственных профессиональных достижений (6)	преднамеренная саморегуляция [11, р. 25] (при повторной ссылке на источник необходимо указывать страницу)	247 (4,9%)	15%
Посещение организаций дополнительного образования (7)	гибкая и надежная профессиональная идентичность [12, с. 136–137] (при повторной ссылке на источник необходимо указывать страницу)	225 (4,5%)	14%
Повышение	позитивная ориентировка в	482 (9,6%)	29%

профессиональной категории (8)	«положительной» деятельности [14]		
Карьерно-образовательный рост (9)	самоэффективность [15]	290 (5,8%)	18%
Получение документа о прохождении курса повышения квалификации (10)	позитивная ориентировка в «положительной» деятельности [14, р. 1087] (при повторной ссылке на источник необходимо указывать страницу)	370 (7,4%)	22%
Организация собственного профессионального развития (11)	самоэффективность [15, р. 634] (при повторной ссылке на источник необходимо указывать страницу)	402 (8,1%)	24%
Другое (указать) (12)	решение собственных затруднений, возможность профессиональной уверенности	2 (0,04%)	0,12%
Общее количество ответов		5002	

Источник: разработано авторами

По данным опроса, ведущими мотиваторами участия педагогов в курсах повышения квалификации стали обновление знаний в соответствии с современными требованиями, освоение практических инструментов для внедрения в образовательный процесс, а также обмен профессиональным опытом. Среди внешних мотиваторов наиболее распространёнными оказались повышение профессиональной категории, выбранное 29% респондентов, и получение документа о прохождении курса повышения квалификации – 22%. Их доля в общем количестве ответов составила соответственно 9,6% и 7,4%. Мотиваторы, связанные с ПРП и самоэффективностью, также имели существенное значение. Организацию собственного профессионального развития отметили 24% респондентов, а карьерно-образовательный рост – 18%; в общей структуре ответов их доля составила соответственно 8,1% и 5,8%. Реже педагоги выбирали возможности профессионального взаимодействия и представления собственного опыта. Получение консультаций экспертов отметили 19% респондентов, коллективную творческую проектную деятельность – 18%, демонстрацию собственных профессиональных достижений – 15%, посещение организаций дополнительного образования – 14%. Доля этих вариантов в общем количестве ответов варьировалась от 4,5% до 6,4%.

Приведенные данные коррелируют с другими группами данных. Так, в утверждении № 2 опросника «Записаться на доступные и удобные по всем видам ресурсов курсы повышения квалификации, если заинтересовала тема, несмотря на то что совсем недавно получил (-а) документ о повышении квалификации» ответы 1627-ми респондентов распределены следующим образом: однозначно могу – 840 (51,6%), скорее могу – 654 (40,1%), сомневаюсь – 88 (5,4%), скорее не могу – 40 (2,5%), однозначно не могу – 5 (0,3%).

Данные выбора ответов по утверждению № 3 «Повышение квалификации на основе курсов в наибольшей степени связываю с ...» приведены в таблице 2.

Таблица 2. Данные выбора респондентами мотиваторов курсового обучения

Повышение квалификации на основе курсов в наибольшей степени связываю с:	Преобладающий компонент вовлеченности	Количество респондентов, выбравших ответ (в % отношении)
Устранением трудностей собственной практики	конструкт саморегуляции	191 (11,7%)
Достижением успешности в собственной практике	позитивная ориентировка в «положительной» деятельности	563 (34,6%)
Организацией непрерывного профессионального развития	самоэффективность	873 (53,7%)
Общее число респондентов		1627 (100%)

Источник: разработано авторами

Результаты входного анкетного опроса посредством 3-х утверждений показывают значимость факторов вовлеченности педагогов ДО в обучение на курсах, связанных с внешней областью (источник информации и (или) информационно-методической поддержки), личностной областью (знания, убеждения и установки), областью практики (профессиональная апробация, рефлексия, экспертиза), областью последствий (саморазвитие, ПРП). Таким образом, метод качественно-количественного анализа с последующим факторным моделированием структуры вовлеченности позволил выделить и верифицировать четырехфакторную модель вовлеченности педагогов, включающую внешнюю, личностную, практическую области и область последствий.

С целью персонификации обучения методами опроса, наблюдения, рефлексии и анализа продуктов деятельности слушателей следует дифференцировать педагогов с разной степенью открытости к изменениям в трех областях. В этой связи предлагается в начале курсов формировать проблемное поле слушателей с целью уточнения потребностей в изменениях. Таким образом, главный вопрос возможной фокус-группы – в какой степени проблемы, с которыми сталкиваются педагоги в своей педагогической карьере, влияют на их вовлеченность в собственное повышение квалификации? Результаты фокус-группы позволяют усилить контекстное преподавание – обучение – оценивание, следовательно, вовлечь педагогов в ПРП.

Персонификация обучения педагогов ДО на курсах призвана сохранять баланс факторов вовлеченности – интеграцию внутренних мотивов и внешних стимулов в образовательной среде курсов. В этой связи предлагается придать программам курсов повышения квалификации метакогнитивную направленность, заменив линейную интеграцию теоретических и практических знаний наблюдением за собственной практикой, исследованием новых способов действий для достижения существующих или расширенных профессиональных целей, а также освоением новых идей и подходов к совершенствованию сложившейся практики. ПРП происходит тогда, когда педагоги участвуют в планировании, реализации и оценке предлагаемых метакогнитивных стратегий развития – посредством формирования метакогнитивной компетентности, расширяющей возможности дисциплинарной компетентности как цели традиционных курсов повышения квалификации.

В ходе исследования использован метод наблюдения: полевого (в процессе занятий курсового обучения), включенного (преподаватель уточнял у слушателей причины вовлеченности в обучение и характеристики профессионального развития), систематического (наблюдение охватывало весь период курсового обучения), структурированного (с предварительным определением параметров вовлеченности слушателя (а) *мотивационных*: четко формулирует личные образовательные цели за рамками программы курса, находит дополнительную информацию и ее источники, успешно осваивает учебный материал в аспекте решения проблем профессиональной практики, проявляет эмоциональный опыт (по Дж. Дьюи), вербализует связь между содержанием курса и личными дефицитами; б) *когнитивных*: использует разные стратегии обработки информации, задает вопросы для запуска мышления, конструктивно критикует и предлагает инновационные решения, решает педагогическую задачу разными способами, организует собственную рефлексивную практику, связывает учебный материал с собственной практикой; в) *поведенческих*: вступает в коллаборацию, участвует в диалоге/дискуссии/обмене опытом, берет на себя ответственность в групповой работе, регулярно и своевременно выполняет задания, сосредоточен на учебном процессе.

Педагогическое наблюдение в процессе занятий использовалось как дополнительный источник контекстной интерпретации результатов анкетирования.

Наблюдения в качестве преподавателей курсов подтверждают: недостаток вовлеченности – более критичный фактор, чем дефицит у слушателей реальных педагогических знаний и технологических навыков. Напротив, вовлеченные в обучение педагоги менее тревожны,

более целенаправленны и уверены в значимости контента курса, ценности его применения в собственной практике.

Заклучение. Выводы сформулированы как ответы на исследовательские вопросы на основе полученных результатов.

Исследовательский вопрос 1. Вовлеченность педагогов в деятельность курсов повышения квалификации в наибольшей степени зависит от учета стремления к преодолению трудностей, потребностей решения проблем, обусловленных растущей ответственностью педагога, и мотивов улучшения собственной практики. Именно внутренние и внешние мотивы определяют способность педагогов к эффективному формальному обучению (на курсах) с перспективой неформального образования на рабочем месте. Таким образом, исследуемая вовлеченность отражает взаимодействие восприятия, эмоций и наблюдаемого поведения. Сложившееся взаимодействие влияет на качество практики ДО и достижения обучающихся. Вместе с тем анализ состояния ДО показывает: профессиональная вовлеченность не всегда приводит к указанным результатам.

Исследовательский вопрос 2. Для достижения результатов важно, во-первых, долгосрочное формирование ожиданий, потребностей и мотивов педагогов, благодаря правильно построенной институциональной поддержке на рабочем месте и организации ПРП в соответствии с политикой и имеющимися ресурсами. Во-вторых, значительную роль играет баланс вышеназванных внешних и укрепляющихся внутренних факторов: педагогический опыт педагогов, усилия, компетентность, приверженность профессиональному развитию.

Исследовательский вопрос 3. Своевременное обновление контента курсов повышения квалификации в направлении индивидуализации и персонификации может способствовать переходу от формального и линейного участия в курсовых мероприятиях к нелинейному преподаванию – обучению – оцениванию в условиях целенаправленного и добровольного вложения времени, энергии и ресурсов со стороны педагогов. Ведущей идеей обновления должна стать смена фокуса – от наблюдения практики ДО (эффективной и неэффективной) к исследованию преподавания и его изменению под влиянием самореализации педагога.

Предполагается, что персонификация может трансформироваться из условия вовлеченности педагогов в обучение на курсах в предпосылку самоорганизации педагогов, когда они интегрируют самостоятельное обучение с формальными программами повышения квалификации, выстраивая собственные пути ПРП посредством рефлексии, взаимодействия с коллегами и использования цифровых инструментов.

Полученные результаты имеют методологическое значение для дизайна и редизайна образовательных программ курсовой подготовки педагогов ДО.

Научная новизна результатов связана с рассмотрением повышения квалификации педагогов ДО в аспекте персонифицированного профессионального развития. Практическая ценность позволяет разрабатывать образовательные программы курсов и организовывать курсы как рефлексивно-исследовательскую практику педагогов ДО вокруг предмета анализа – текущий профиль и динамика профессионального развития.

Данное исследование не лишено ограничений. Так, интерпретированы неполные данные анкетного опроса (блока 3 из 6), ввиду значительного количества респондентов и сфокусированности приведенных данных указанного блока на предмете исследования. Не уточнены статистические модели связи между уровнем вовлеченности и показателями профессионального развития. Кроме того, исследование не охватывало посткурсовое сопровождение педагогов ДО, поскольку его изучение требует длительного периода наблюдения и выходит за рамки цели настоящей статьи. Ограничения подчеркивают необходимость будущих исследований с более детализированными методами сбора данных, включая структурирование категории вовлеченности педагогов в ПРП, механизмов персонификации курсового обучения и организации ПРП на рабочем месте. Будущие исследования должны быть направлены на устранение указанных пробелов посредством включения лонгитюдных проектов с несколькими точками сбора данных и подробных исследований научной специфики вовлеченности, институциональной организации ее

поддержки и укрепления на горизонтальном и вертикальном уровнях системы ДО. Такой подход обеспечит комплексное рассмотрение процессов ПРП в системе образования.

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ҚОСЫМША БІЛІМ БЕРУ ПЕДАГОГТЕРІНІҢ КУРСТАРДА ОҚУҒА ТАРТЫЛУЫ КӘСІБИ ДАМУ ФАКТОРЫ РЕТІНДЕ

Аңдатпа

Қосымша білім беру жүйесінде бүгінгі таңда педагогтердің кадрлық сапасы мәселесі байқалады. Бұл мәселенің шешімі біліктілікті арттыру курстарымен байланысты бола алады. Бұл мәселенің шешімі өз кезегінде біліктілікті арттыру курстарымен байланысты бола алады. Мақалада бұл ретте кәсіби дамуды өзектендіруге ықпалын анықтау мақсатында педагогтердің курстарда оқуға тартылу көрсеткіштерін талдау нәтижелері ұсынылған. Осы мақсатты іске асыру үшін талдау және синтез, сауалнама, бақылау әдістері қолданылды. Зерттеу нәтижелері педагогтердің курстардағы дамытушылық оқытуға тартылуының ішкі және сыртқы уәждерін (мотивтерін), сонымен қатар факторларын нақтылаумен, уәждер мен факторлардың ұзақ мерзімді әрекет етуіне арналған ортамен, біліктілікті арттыру курстарының мазмұнын жаңартуға арналған дербестендірумен (персонификациямен) байланысты. Нәтижелердің маңыздылығы атап айтқанда, курстардың білім беру бағдарламаларын жобалаумен (дизайнымен) және қайта жобалаумен (редизайнымен) және жұмыс орнында педагогтердің кәсіби дамуын сүйемелдеуді ұйымдастырумен айқындалады. Осылайша, зерттеу нәтижелері қосымша білім беру ұйымдарының педагогтері мен әкімшілігі, білім беру бағдарламаларын әзірлеушілер мен біліктілікті арттыру жүйесінің мамандары, білім беру саласындағы талдаушылар мен сарапшылар үшін практикалық құндылыққа ие.

Түйінді сөздер: қосымша білім беру, біліктілікті арттыру курстары, кәсіби даму, кәсіби тартылу, тартылу факторларының теңгерімі, дербестендіру (персонификация), метакогнитивтік құзыреттілік.

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ENGAGEMENT OF SUPPLEMENTARY EDUCATION TEACHERS IN COURSE-BASED LEARNING AS A FACTOR OF PROFESSIONAL DEVELOPMENT

Abstract

The system of supplementary education faces the problem of teacher quality. Addressing this issue may be linked to the effectiveness of professional development courses. This effectiveness is determined by the quality of training that stimulates nonlinear and sustainable professional growth among teachers. This article presents the results of an analysis of teachers' engagement in professional development courses, with the aim of identifying its impact on the actualization of their professional growth. To achieve this aim, the study employed methods of analysis and synthesis, questionnaire surveys, and observation. The research findings are related to the clarification of internal and external motives, as well as factors influencing teacher's engagement in developmental learning within professional development courses. They also concern the course environment that supports the long-term effect of these motives and factors, as well as the personalization of learning for updating the content of professional development courses. The significance of the results lies in their relevance to the design and redesign of educational programs for professional development courses and to

the organization of support for teacher's professional growth in the workplace. Thus, the findings have practical value for teachers and administrators of supplementary education organizations, developers of educational programs, specialists in the professional development system, as well as analysts and experts in the field of education.

Keywords: supplementary education, professional development courses, professional growth, professional engagement, balance of engagement factors, personalization metacognitive competence.

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FROM LEARNING STYLES TO EVIDENCE-BASED DIAGNOSTICS: PSYCHOMETRICS OF INDIVIDUAL DIFFERENCES IN ELT

Abstract

For decades, the concept of learning styles has influenced English language teaching (ELT), encouraging teachers to adapt instruction to assumed visual, auditory, or kinesthetic learner preferences. However, this approach has been increasingly criticized for its weak empirical foundation and limited pedagogical value. The purpose of this article is to justify a shift from learning styles to evidence-based psychometric diagnostics of individual differences in ELT. The study focuses on measurable learner characteristics such as L2 motivation, speaking anxiety, self-efficacy, and self-regulation. Methodologically, the article combines theoretical analysis with pilot data from an 8-week school-based quasi-experimental study conducted in Astana, Kazakhstan, where psychometric profiling was integrated into English language instruction. The results showed acceptable reliability of the main diagnostic scales, comparable baseline profiles between experimental and control groups, and stronger learning gains in the experimental condition, particularly in speaking performance. In addition, learners who received psychometrically informed instruction reported more supportive assessment experiences, greater willingness to communicate, and lower anxiety during assessed speaking tasks. These findings are significant because they demonstrate that psychometric diagnostics can provide teachers with more valid and actionable information than traditional learning-style categories. The article concludes that evidence-based diagnostics offer a more scientifically grounded and pedagogically useful approach to individual differences in ELT, improving instructional fit and supporting positive washback in classroom assessment.

Keywords: learning styles, psychometrics, individual differences, ELT, speaking anxiety, washback, evidence-based psychometric diagnostics

Introduction. In contemporary English Language Teaching (ELT), increasing attention is being paid to individual differences among learners. Students in the same classroom may differ significantly in their motivation, language anxiety, self-confidence, self-regulation, willingness to communicate, and classroom participation. These differences influence how learners respond to instructional tasks, interact with peers, participate in speaking activities, and make progress in language learning. Therefore, effective ELT requires not only well-designed teaching materials and communicative tasks, but also a systematic understanding of the psychological and learning-related factors that shape students' performance.

For many years, the concept of learning styles has been widely used in educational practice. According to this approach, learners are often classified as visual, auditory, kinesthetic, or other types of learners. This approach has been attractive to teachers because it seems simple, practical, and easy to apply in the classroom. However, the scientific validity of learning styles has been seriously questioned. Pashler, McDaniel, Rohrer, and Bjork argue that there is insufficient empirical evidence to prove that matching instruction to a learner's preferred learning style improves learning outcomes [1]. In the context of ELT, this criticism is especially relevant because language learning is a complex process that depends on cognitive, affective, social, and behavioural factors rather than on one preferred channel of receiving information.

Recent research in second language acquisition provides a stronger basis for understanding learner differences. Dörnyei and Ryan emphasize that language learners differ in a wide range of psychological and behavioural characteristics, including motivation, anxiety, aptitude, personality, and learning strategies [2]. Similarly, Li, Hiver, and Papi argue that individual differences in second language acquisition should be understood as multidimensional and dynamic factors that influence learners' engagement, performance, and development [3]. These studies show that learner diversity

cannot be fully explained through broad learning-style categories. Instead, it should be examined through evidence-based constructs that can be measured, interpreted, and connected with pedagogical decisions.

Among these constructs, language anxiety is especially important in ELT because it directly affects learners' participation in speaking activities. Papi and Khajavy note that second language anxiety is a complex construct that influences learners' emotional state, classroom behaviour, and language performance [4]. Alrabai also demonstrates that anxiety and motivation play a predictive role in second language (L2) proficiency, showing that affective factors are closely related to language achievement [5]. This is particularly relevant for speaking tasks, where fear of mistakes, public evaluation, and low confidence may prevent learners from using the target language actively.

At the same time, the use of psychometric diagnostics in ELT requires careful attention to the quality of measurement. Sudina emphasizes that second language survey research must consider scale quality, reliability, and construct validity, especially when measuring anxiety and motivation [6]. This means that psychometric tools should not be used mechanically or superficially. They should be selected and interpreted responsibly, with attention to whether they provide meaningful information for teaching and learning.

The issue of validity is central to this discussion. Kane argues that test scores should be validated not only as numerical results, but also in terms of their interpretations and uses [7]. Similarly, Messick's concept of validity and washback highlights that assessment should be evaluated by its educational consequences as well as by its measurement quality [8]. From this perspective, psychometric diagnostics can be useful in ELT only when the results are used ethically and formatively: not for labelling or ranking students, but for adapting instruction, reducing barriers to participation, and supporting learner progress.

Despite this theoretical foundation, in many school contexts, including ELT classrooms in Kazakhstan, individual differences are still often addressed intuitively rather than systematically. Teachers may notice that some learners are passive, anxious, unmotivated, or reluctant to speak, but these observations are not always supported by diagnostic tools or translated into specific pedagogical strategies. This creates a practical problem: teachers recognize learner diversity, but they may lack an evidence-based framework for responding to it.

Therefore, the main problem addressed in this study is the limited use of psychometric diagnostics as a practical tool for adapting ELT instruction to learners' individual needs. The aim of the study is to examine how evidence-based psychometric diagnostics of individual differences can be used as an alternative to the learning styles approach in English language teaching. More specifically, the study aims to develop and test a Psycho-Diagnostic ELT Model that links diagnostic information about learners with concrete pedagogical decisions in the classroom.

The study was conducted with Grade 9 students in a school-based ELT context. The learners were divided into an experimental group (EG) and a control group (CG). In the experimental group, teaching was adapted according to diagnostic data on learners' motivation, language anxiety, self-efficacy, and self-regulation. In the control group, instruction followed the regular teaching approach without systematic psychometric diagnostics. The study examined whether diagnostic-based teaching could contribute to higher motivation, lower language anxiety, more active participation in speaking tasks, and better overall language progress.

The significance of the study lies in providing a practical evidence-based alternative to learning styles in ELT. Instead of labelling students as visual, auditory, or kinesthetic learners, the proposed approach identifies real learning-related needs and uses this information to improve instructional fit, reduce barriers to participation, and support language learning.

Methods and Materials. This study employed a mixed-methods approach within an 8-week school-based quasi-experimental design to examine the effectiveness of evidence-based psychometric diagnostics in English Language Teaching. The quasi-experimental component compared an experimental and a control condition using intact classes, while quantitative and qualitative methods were combined to measure changes in students' English language performance,

motivation, foreign language anxiety, self-efficacy, self-regulation, and classroom participation. The research was conducted in three stages.

Stage 1. Diagnostic and Analytical Stage

At the initial stage, a diagnostic assessment of learners' individual differences was conducted in order to identify baseline levels of L2 motivation, foreign language anxiety, self-efficacy, and self-regulation. In parallel, a theoretical analysis of contemporary approaches to learner individualization in ELT was carried out through a review of research on learning styles, psychometrics, validity, washback, and individual differences in second language acquisition.

This stage provided the conceptual foundation for designing the Psycho-Diagnostic ELT Model, which was developed as an evidence-based alternative to the traditional learning styles approach. The model was based on the idea that teachers should not classify learners as visual, auditory, or kinesthetic types, but should identify measurable learning-related factors and use them for concrete pedagogical decisions.

Stage 2. Experimental Stage

During the experimental stage, the Psycho-Diagnostic ELT Model was implemented in the educational process. The intervention was conducted over an eight-week period in Grade 9 English classes at Nurorda School-Lyceum.

Two Grade 9 classes, 9A and 9C, served as the experimental condition and received psychometrics-informed instruction guided by explicit decision rules. Two Grade 9 classes, 9B and 9D, served as the control condition and followed the regular ELT program without psychometric profiling or systematic psycho-informed adaptations.

The instructional activities in the experimental group included gradual speaking tasks, pair and group rehearsal, delayed or private feedback, micro-goals, learning checklists, progress visualization, structured turn-taking, and choice-based communicative tasks. These activities were selected according to the learners' diagnostic profiles.

The content and functional structure of the proposed model, including its main components, implementation forms, and expected outcomes, are presented in Table 1.

Table 1. Structure and components of the Psycho-Diagnostic ELT Model

Components of the model	Function	Implementation forms	Expected outcomes
Diagnostic component	Identification of learners' individual differences	Psychometric battery, pre-test, teacher observation	Learner profiles based on motivation, anxiety, self-efficacy, and self-regulation
Motivational component	Increasing learners' interest and engagement	Choice-based tasks, real-life topics, progress visualization	Higher motivation and more active participation
Anxiety-reduction component	Reducing fear of speaking and evaluation	Speaking ladder, pair rehearsal, delayed/private feedback	Lower speaking anxiety and greater willingness to communicate
Self-efficacy component	Developing learners' confidence in English tasks	Gradual task difficulty, success-oriented tasks, supportive feedback	Improved confidence and persistence
Self-regulation component	Supporting planning and independent learning	Micro-goals, checklists, short deadlines, formative checkpoints	Better task completion and learning organization

Communicative component	Increasing oral participation	Structured turn-taking, pair work, small-group interaction	Improved speaking performance and classroom interaction
Assessment and reflection component	Monitoring learning outcomes and washback	Post-test, perception questionnaire, learner reflection	Evidence of language progress, positive feedback, and improved learner awareness

Source: developed by the authors.

The model connects diagnostic results with practical classroom actions. Its main function is to help the teacher adapt motivation support, speaking tasks, feedback, and self-regulation strategies according to learners' profiles.

Stage 3. Evaluation Stage

The final stage focused on evaluating the effectiveness of the proposed model through comparison of pre- and post-intervention results between the experimental and control groups. At this stage, students completed a language post-test, a repeated psychometric questionnaire, and a brief washback/perception questionnaire. Teacher observations and short learner reflections were also collected to identify changes in participation, confidence, and attitudes toward English lessons.

The evaluation stage made it possible to compare both achievement-related outcomes and psychological indicators. Particular attention was paid to speaking performance, because oral participation is strongly influenced by anxiety, self-confidence, and motivation.

Participants. The study was conducted at Nurorda School-Lyceum in Astana, Kazakhstan. A total of 40 Grade 9 students participated in the research. The participants were selected from four intact classes: 9A, 9B, 9C, and 9D, with 10 students in each class.

Data Collection Instruments. Several data collection tools were used to ensure methodological triangulation. First, a psychometric questionnaire measured learners' individual differences across four constructs, each assessed on a five-point Likert scale. L2 motivation was measured using the L2 Motivation Scale, a researcher-developed instrument capturing goal orientation and effort persistence (6 items, $\alpha = .84$). Speaking and evaluation anxiety was measured using the Speaking/Evaluation Anxiety Scale, a short-form instrument aligned with the Foreign Language Classroom Anxiety framework (6 items, $\alpha = .88$). L2 self-efficacy was measured using the L2 Self-Efficacy Scale, a researcher-developed instrument of task-specific items reflecting confidence in classroom English performance, informed by Bandura's self-efficacy framework (5 items, $\alpha = .82$). Self-regulation was measured using the Self-Regulation Scale, a researcher-developed instrument of brief indicators assessing planning, monitoring, and persistence suitable for school contexts, informed by Zimmerman's model of self-regulated learning (5 items, $\alpha = .79$). Composite scores for each scale were computed as the mean of item responses, with reverse-coded items recalculated prior to averaging. Scale reliability was assessed using Cronbach's alpha as a measure of internal consistency; all coefficients exceeded the conventional threshold of .70, indicating acceptable reliability for classroom-based research.

Instrument Adaptation and Language of Administration. The Speaking/ Evaluation Anxiety Scale was adapted from the Foreign Language Classroom Anxiety framework; item wording was shortened and simplified for Grade 9 readability while preserving the original construct definitions. The remaining scales (L2 Motivation, L2 Self-Efficacy, and Self-Regulation) were researcher-developed for this study and were not adaptations of existing published instruments and therefore did not require a formal translation-adaptation procedure. All instruments, including the language-achievement test and the washback/perception questionnaire, were administered in English, consistent with the communicative focus of the intervention and students' Grade 9 proficiency level, which was sufficient for comprehending the simplified item wording.

Second, pre-test and post-test tasks were used to assess English language achievement before and after the intervention. The test consisted of three components with a maximum total score of 100 points: a combined reading and listening component (50 points), a lexico-grammatical component

(30 points), and a speaking component (20 points). Parallel test forms of equivalent difficulty were used at pre-test and post-test to support comparability across measurement points. The total score was calculated as the sum of the three component scores. Oral performance was evaluated using a speaking rubric based on four criteria: accuracy, fluency, lexical range, and interaction, each contributing proportionally to the 20-point speaking score.

The speaking rubric evaluated oral performance according to four analytic criteria, each scored on a 0-5 point scale, for a maximum total of 20 points: (a) accuracy – grammatical and lexical correctness with minimal errors that do not impede communication; (b) fluency – smoothness and pace of speech with limited hesitation or unnatural pauses; (c) lexical range – variety and appropriateness of vocabulary relative to the task; and (d) interaction – ability to initiate, sustain, and respond appropriately within a spoken exchange. Each criterion was scored independently by the rater using descriptive band levels (0 = minimal/no evidence, 1-2 = limited, 3 = adequate, 4 = good, 5 = excellent), and the final speaking score was calculated as the sum of the four criterion scores.

In addition, teacher observation notes were collected during the intervention to record students' participation, confidence, speaking initiative, task completion, and cooperation. Classroom observation was conducted using a structured observation checklist completed by the teacher-researcher during three lessons per week across the eight-week intervention period (24 lessons in total for each condition). For each of the five indicators reported in Table 5 (active participation in pair work, speaking initiative, confidence during speaking, task completion, and cooperation with classmates), the observer recorded, for every student, whether the target behaviour was demonstrated during each observed lesson (1 = demonstrated, 0 = not demonstrated). Active participation in pair work was recorded when a student engaged in the assigned pair or group task without prompting; speaking initiative was recorded when a student volunteered to speak without being called on; confidence during speaking was recorded based on fluency and absence of visible hesitation or avoidance behaviours; task completion was recorded when a student finished the assigned classroom task within the given time; and cooperation with classmates was recorded when a student assisted or responded constructively to peers during group work. The percentage reported for each indicator in Table 5 was calculated as the number of lessons in which the behaviour was observed for a given student, averaged across all students in the condition, divided by the total number of observed lessons, and expressed as a percentage. At the end of the experiment, a washback/perception questionnaire was administered to identify students' attitudes toward learning, perceived support, anxiety, confidence, and willingness to participate in English lessons.

The psychometric battery and perception questionnaire were administered through Google Forms, and the collected data were organized in Microsoft Excel.

Data Analysis. Quantitative data were analyzed using descriptive statistics. Mean scores and pre-test/post-test gains were calculated for the experimental and control groups to identify changes in English achievement and speaking performance. Questionnaire data were analyzed by comparing average scores for motivation, anxiety, self-efficacy, and self-regulation. For the primary outcome indicators (general achievement, speaking performance, and anxiety during assessed speaking), between-group differences at posttest were additionally tested using independent-samples Welch's t-tests, with Cohen's d calculated to estimate effect size (see Table 6). Qualitative data from teacher observations and learner reflections were summarized thematically, focusing on participation, confidence, cooperation, and attitudes toward feedback.

Ethical Considerations. Since the participants were minors, the study followed standard ethical principles of classroom-based research. School-level approval was obtained, and the procedures were coordinated with the administration. Parental consent and student assent were secured before data collection.

Participation was voluntary and unrelated to students' grades. All data were anonymized and used only for research and pedagogical purposes. Psychometric results were not used for ranking, labelling, tracking, or punitive decisions. Their only function was to support instruction and help the teacher respond more effectively to learners' needs.

Results and Discussion. The results of the study show that psychometrics-informed instruction had a positive influence on Grade 9 students' English language achievement, speaking performance, motivation, self-efficacy, self-regulation, and classroom participation. The experimental group, consisting of classes 9A and 9C, demonstrated greater improvement than the control group, consisting of classes 9B and 9D. This confirms the main assumption of the study: individualization in ELT should be based not on fixed learning styles, but on measurable learner characteristics that can guide practical teaching decisions.

At the initial stage of the experiment, both groups had relatively similar results. This means that the experimental and control conditions were comparable before the intervention. After the implementation of the Psycho-Diagnostic ELT Model, however, the experimental group showed stronger progress in both linguistic and psychological indicators. Table 2 presents the general English achievement scores of both groups before and after the experiment.

Table 2. General English achievement before and after the experiment

Group	Number of students	Pre-test average score	Post-test average score	Growth
Experimental group, 9A and 9C	20	24.2	32.1	+7.9
Control group, 9B and 9D	20	24.5	28.6	+4.1

Source: developed by the authors.

The data in Table 2 show that both groups improved by the end of the experiment; however, the experimental group demonstrated greater progress (+7.9) than the control group (+4.1). This suggests that psychometrics-informed instruction created more favourable conditions for language learning by adapting teaching decisions to learners' diagnostic profiles, including speaking anxiety, self-regulation, and motivation. This magnitude of improvement is broadly consistent with international quasi-experimental evidence on assessment-informed instruction in EFL contexts. Zhang, Quan, Zhang, and Zhang conducted an eight-week quasi-experimental intervention with middle school EFL students that closely parallels the design of the present study and found that formative-assessment-based instruction produced greater gains in both achievement and motivation compared with conventional teaching [9]. This close correspondence in sample age, intervention length, and design supports the plausibility of the achievement gain observed here, although the effect should still be interpreted cautiously given the small, single-site sample. A graphical comparison of pre-test and post-test scores is shown in Figure 1 below.

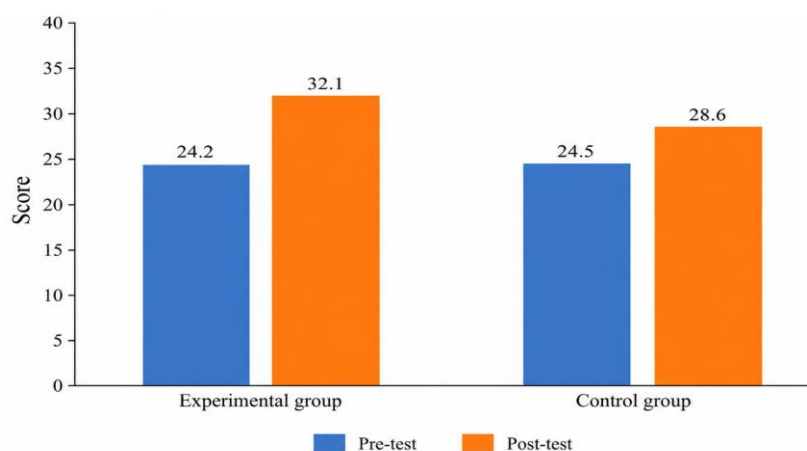


Figure 1. Dynamics of English achievement before and after the experiment

Source: developed by the authors.

Figure 1 illustrates that the experimental group demonstrated a more visible increase in general English achievement. This result supports the argument that diagnostic-based teaching may be more effective than general instruction when learners' psychological and educational needs are systematically considered.

Speaking performance was analyzed separately because oral communication is one of the most sensitive areas in ELT. Learners may possess adequate lexical and grammatical knowledge yet consistently avoid oral participation, as speaking anxiety, fear of error, and low self-confidence constitute significant affective barriers to language production. A detailed comparison of speaking performance scores is provided in Table 3.

Table 3. Speaking performance before and after the experiment

Group	Pre-test speaking score	Post-test speaking score	Growth
Experimental group	5.7	7.8	+2.1
Control group	5.8	6.7	+0.9

Source: developed by the authors.

As shown in Table 3, the experimental group improved its speaking score from 5.7 to 7.8, while the control group increased from 5.8 to 6.7. The higher growth in the experimental group (+2.1 compared with +0.9) can be explained by psycho-informed speaking strategies, including a speaking ladder, pair rehearsal, gradual public performance, and delayed/private feedback, which reduced fear of mistakes and supported learners' confidence. This finding is consistent with international evidence that structured, anxiety-sensitive speaking support disproportionately benefits oral performance relative to other language skills. Jin, Zhang, and MacIntyre found that structured speaking-commitment interventions reduced foreign language classroom anxiety and improved learners' confidence and engagement [10]. A comparable pattern was reported in a Chinese EFL context, where a speaking-support intervention – delivered through an AI-speaking assistant rather than a teacher-led format – produced a significant reduction in foreign language anxiety and a significant increase in willingness to communicate in the experimental group, with no such change in the control group [11]. Although the delivery mechanism differs from the teacher-mediated approach used in the present study, the convergence in outcome pattern (EG improvement vs. CG stability) suggests that reducing evaluative pressure around speaking, regardless of the specific method, reliably increases participation and confidence. Table 4 outlines the corresponding changes in motivation, anxiety, self-efficacy, and self-regulation.

Table 4. Changes in motivation, anxiety, self-efficacy, and self-regulation

Indicator	Experimental group before	Experimental group after	Control group before	Control group after
L2 motivation	3.4	4.2	3.5	3.8
Foreign language anxiety	3.8	2.9	3.7	3.4
L2 self-efficacy	3.2	4.0	3.3	3.6
Self-regulation	3.1	3.8	3.2	3.5

Source: developed by the authors.

As shown in Table 4, both groups demonstrated positive changes in psychological indicators, but the experimental group showed stronger improvement. Motivation increased from 3.4 to 4.2, self-

efficacy from 3.2 to 4.0, and self-regulation from 3.1 to 3.8, while foreign language anxiety decreased from 3.8 to 2.9. These results suggest that psychometrics-informed instruction supported not only language achievement, but also learners' confidence, emotional safety, and ability to organize their own learning. The observed decrease in speaking anxiety alongside increased participation is consistent with the broader intervention literature on foreign language anxiety. Alrabai's causal model established a predictive link between anxiety, motivation, and L2 proficiency [5, p. 3127]; the present findings extend this by showing the same pattern under a classroom intervention rather than a correlational design. This is further supported by direct experimental evidence: in a randomized study, Jin, Dewaele, and MacIntyre found that a structured anxiety-reduction intervention produced a significant decrease in foreign language classroom anxiety in the experimental group, while anxiety remained stable in the control group [12] – the same divergent pattern observed between the experimental and control classes in Table 4. This supports Papi and Khajavy's account of anxiety as a dynamic, emotionally mediated construct that can be shifted through targeted classroom intervention rather than a static trait [4, p. 138]. The improvement in self-efficacy (3.2 to 4.0) is consistent with Li's quasi-experimental study of a self-efficacy-based instructional intervention, which found that structured, confidence-building instruction reliably raised learners' self-efficacy beliefs and, in turn, supported their motivation and engagement in EFL learning [13]. Similarly, the improvement in self-regulation (3.1 to 3.8) parallels the broader finding that structured, formative, decision-rule-based instruction supports learners' self-organizational skills alongside achievement gains [9, p. 11]. These parallels suggest that the gains observed in this study reflect a broader, internationally replicated pattern linking diagnostic, learner-responsive instruction to stronger self-regulatory and motivational outcomes, rather than being idiosyncratic to the Kazakhstani context.

Classroom observation data also supported the quantitative results. The teacher observed students' participation, speaking initiative, confidence, task completion, and cooperation with classmates. These results are presented in Table 5.

Table 5. Classroom observation results after the experiment

Criterion	Experimental group	Control group
Active participation in pair work	85%	65%
Speaking initiative	78%	56%
Confidence during speaking	74%	58%
Task completion	88%	76%
Cooperation with classmates	82%	70%

Source: developed by the authors.

The observation results show that students in the experimental group became more active and confident during English lessons. The largest difference was found in speaking initiative: 78% in the experimental group compared with 56% in the control group. This means that students in the experimental classes were more willing to start speaking, answer questions, and participate in pair or group discussions. This gap mirrors behavioural findings from classroom-based anxiety-reduction studies internationally. In the Chinese EFL intervention discussed above, structured speaking support produced a comparable divergence in classroom participation between experimental and control conditions [11, p. 18]. This convergence across different educational contexts and delivery mechanisms suggests that the participation gains found here are unlikely to be a context-specific artifact and instead reflect a general mechanism: reducing evaluative threat around speaking reliably increases learners' willingness to initiate spoken interaction [10, p. 6; 12, p. 24].

The difference can be explained by the structure of the Psycho-Diagnostic ELT Model. Students with low participation were supported through clear group roles, structured turn-taking, and smaller-group interaction. These strategies reduced uncertainty and helped passive students become more involved in the lesson. Table 6 consolidates all key indicators from the study.

Table 6. Summary of main results

Indicator	Experimental group growth	Control group growth	t (df)	p	d
General English achievement	+7.9	+4.1	t(38.00) = 1.33	.190	0.42
Speaking performance	+2.1	+0.9	t(37.94) = 1.98	.055	0.63
Motivation	+0.8	+0.3	—	—	—
Anxiety reduction	-0.9	-0.3	t(37.9) = -2.14	.039	-0.68
Self-efficacy	+0.8	+0.3	—	—	—
Self-regulation	+0.7	+0.3	—	—	—

Source: developed by the authors.

Note: t, p, and d were calculated for the primary outcome indicators only (see Data Analysis). Motivation, self-efficacy, and self-regulation were analyzed descriptively due to the exploratory scope of this pilot. The statistical indicators are defined as follows: t refers to the t-test statistic used to assess differences between groups (with degrees of freedom in parentheses), p indicates the probability value (statistical significance level, conventionally set at $p < .05$), and d (Cohen's d) represents the effect size, reflecting the magnitude of the difference.

The summary of results clearly shows that the experimental group outperformed the control group in all measured indicators. The most important improvements were observed in speaking performance, motivation, anxiety reduction, and general English achievement. Taken together, this pattern – with the experimental group outperforming the control group on every indicator – corresponds closely to what international washback and SLA intervention research would predict: diagnostic-based, anxiety-sensitive instruction tends to produce convergent gains across achievement, affective, and behavioural indicators simultaneously, rather than isolated improvement in a single domain [4, p. 138; 5, p. 3131; 10, p. 7; 12, p. 16]. This convergence strengthens the plausibility of the underlying mechanism proposed by the Psycho-Diagnostic ELT Model, even though the pilot's small sample size means the findings should be treated as preliminary rather than conclusive. In addition to these achievement-related outcomes, washback and perception indicators collected at Week 8 are reported in Table 7.

Table 7. Washback/perception indicators by condition (Week 8)

Indicator (1–5)	Experimental M (SD)	Control M (SD)	t (df)	p	d
Perceived assessment support	4.08 (0.55)	3.46 (0.62)	t(37.5) = 3.35	.002	1.06
Fairness/clarity	4.01 (0.51)	3.58 (0.57)	t(37.5) = 2.51	.016	0.80

Willingness to communicate	3.79 (0.60)	3.25 (0.63)	$t(37.9) = 2.78$	.009	0.88
Anxiety in assessed speaking	2.62 (0.66)	3.08 (0.70)	$t(37.9) = -2.14$	.039	-0.68
Attitude toward feedback	4.15 (0.50)	3.62 (0.60)	$t(36.8) = 3.03$	.004	0.96

Source: developed by the authors.

Note: M = mean; SD = standard deviation. Independent-samples Welch's t-tests were used to compare group means; effect sizes are reported as Cohen's d. t refers to the t-test statistic (with degrees of freedom in parentheses), and p indicates the probability value (statistical significance level, conventionally set at $p < .05$). Higher values indicate more positive perceptions, except for anxiety (lower is better).

As shown in Table 7, students in the experimental group reported significantly more positive assessment experiences than those in the control group across all five indicators. Perceived assessment support ($d = 1.06$) and attitude toward feedback ($d = 0.96$) showed the largest effects, followed by willingness to communicate ($d = 0.88$) and fairness/clarity ($d = 0.80$) – all representing large effect sizes. Anxiety during assessed speaking was significantly lower in the experimental group ($d = -0.68$), consistent with the anxiety-reduction findings reported in Table 4. These results provide quantitative support for the washback claims stated in the Introduction and Abstract: psychometrics-informed instruction was associated not only with stronger achievement and speaking gains, but also with a more supportive and less threatening assessment experience.

These findings support the conceptual logic of the study: psychometric diagnostics → learner profile → pedagogical decision rules → adapted instruction → improved learning outcomes.

The study therefore argues that psychometric diagnostics should not be treated as a separate testing procedure. Its value lies in its connection with teaching practice: the teacher collects diagnostic information to understand what kind of support each learner needs.

From a scientific point of view, the findings contribute to the discussion about learning styles and evidence-based teaching. The learning styles approach usually classifies students as visual, auditory, or kinesthetic learners. However, such classification gives limited practical information to the teacher. For example, knowing that a student prefers visual materials does not explain why the student avoids speaking, feels anxious, or fails to complete independent tasks.

In contrast, psychometric diagnostics provides more actionable data. If a student has high speaking anxiety, the teacher can use gradual speaking exposure. If a student has low motivation, the teacher can provide meaningful choices and real-life tasks. If a student has low self-regulation, the teacher can introduce checklists, micro-goals, and progress monitoring. Thus, psychometric diagnostics helps the teacher move from general assumptions to concrete pedagogical decisions.

The findings also support the idea of positive washback. In traditional assessment, tests often measure only final results. In this study, diagnostic tools influenced the learning process itself. Assessment data were used to adapt teaching, reduce anxiety, increase participation, and improve feedback practices. Therefore, assessment created a positive effect on teaching and learning.

This finding is consistent with Kane's argument that validity should be evaluated through the interpretation and use of scores rather than through psychometric properties alone [7, p. 1]: in this study, diagnostic scores were not treated as endpoints but were explicitly translated into pedagogical decision rules, which is precisely the kind of validated "use" argument Kane's framework requires. It also aligns with foundational washback scholarship showing that test consequences are mediated primarily by teachers, who translate assessment information into instructional adjustment rather than the test format acting alone [14], a claim recently reaffirmed at scale across multiple stakeholder contexts [15]. This dependency is directly reflected in the design of the Psycho-Diagnostic ELT Model, where the teacher, not the diagnostic instrument itself, decides how motivation, anxiety, or self-regulation data are converted into classroom action.

Reliability of the diagnostic scales used in this study was acceptable across constructs. This is a relevant methodological point: Sudina's earlier review of second-language survey research found that reliability reporting in anxiety and motivation research is frequently incomplete, and that item-total correlations are rarely reported even when overall alpha values are provided [6, p. 1173]. A subsequent, larger-scale methodological synthesis focusing specifically on anxiety and willingness-to-communicate scales confirmed this pattern across 232 peer-reviewed articles and 385 scales, finding a general lack of evidence for scale content and construct validity [16]. In line with these recommendations, future iterations of the Psycho-Diagnostic ELT Model should also report item-total correlations and, where feasible, confirmatory factor analysis to establish structural validity rather than internal consistency alone [6, p. 1184; 16, p. 1449].

To verify that the observed between-group differences were not due to chance, independent-samples Welch's t-tests and Cohen's d were calculated for the primary outcome indicators. The difference in speaking performance approached statistical significance ($t(37.94) = 1.98, p = .055$) with a moderate-to-large effect size ($d = 0.63$), while the reduction in anxiety during assessed speaking was statistically significant ($t(37.9) = -2.14, p = .039, d = -0.68$). The difference in general English achievement, although favouring the experimental group, did not reach conventional significance ($t(38.00) = 1.33, p = .190, d = 0.42$), which is consistent with the modest sample size of this pilot study. Statistical testing was conducted for the primary outcome indicators; motivation, self-efficacy, and self-regulation scores were analyzed descriptively due to the exploratory scope of this pilot. These results indicate that the experimental condition produced a moderate practical effect, particularly for speaking-related outcomes, even where statistical significance was only marginal.

At the same time, the results should be interpreted cautiously. The experiment involved a small sample of 40 students from one school, and the modest sample size limited statistical power for detecting significance in several outcomes.

Although the observed pattern of results is consistent with the mechanisms proposed by the Psycho-Diagnostic ELT Model, alternative explanations should also be considered given the quasi-experimental, non-randomized design of this pilot. First, because students were not randomly assigned to conditions, pre-existing differences between the intact classes – beyond the psychometric variables measured at baseline – cannot be fully ruled out as contributing factors. Second, a Hawthorne-type effect is possible: students in the experimental classes may have responded positively simply because they received additional attention and a novel instructional approach, independent of the specific diagnostic content of the intervention. Third, because the same teacher-researcher delivered instruction to the experimental group and was directly involved in data collection, teacher enthusiasm or expectancy effects cannot be entirely separated from the effect of the model itself. Finally, the experimental group's additional exposure to structured speaking practice, regardless of its diagnostic basis, may partly explain the gains in speaking performance, as increased practice opportunities alone are known to improve oral proficiency. Disentangling these alternative explanations from the effect of psychometric diagnostics specifically would require a more controlled design, such as comparing the diagnostic intervention against an active control condition receiving equivalent instructional time and teacher attention without profile-based adaptation.

Nevertheless, the results demonstrate that the Psycho-Diagnostic ELT Model can be used as a feasible classroom tool. It helps teachers understand learners more systematically and respond to their needs more effectively. The study shows that individual differences in ELT should not be reduced to learning styles. They should be studied through measurable constructs such as motivation, anxiety, self-efficacy, and self-regulation.

Thus, the experimental data suggest that psychometrics-informed instruction is associated with gains in students' speaking performance and reduced speaking anxiety in particular, alongside broader positive trends in confidence, motivation, and classroom participation; however, given that the difference in general English achievement did not reach conventional statistical significance, these findings should be interpreted as preliminary evidence rather than confirmed effects.

Conclusion. The results of the study provide preliminary support for psychometrics-informed instruction as a promising evidence-based alternative to the traditional learning styles approach in

English Language Teaching, particularly for speaking-related and anxiety-related outcomes; broader claims of overall effectiveness should await replication with larger samples and stronger significance testing across all indicators. The experimental group, which received instruction based on the Psycho-Diagnostic ELT Model, demonstrated stronger progress than the control group. In particular, general English achievement increased from 24.2 to 32.1 in the experimental group, while the control group improved from 24.5 to 28.6. Speaking performance also improved more noticeably in the experimental group, rising from 5.7 to 7.8, compared with the control group's increase from 5.8 to 6.7. Positive changes were also observed in motivation, self-efficacy, self-regulation, and classroom participation, while foreign language anxiety decreased.

The scientific novelty of the study lies in the development and pilot implementation of the Psycho-Diagnostic ELT Model, which differs from existing approaches to learner individualization in three specific ways. First, unlike the learning styles approach discussed above, the model does not classify students into fixed learner types; instead, it relies on measurable, empirically grounded constructs. Second, unlike much of the existing individual-differences scholarship in SLA, which remains primarily descriptive – identifying correlations between motivation, anxiety, or self-regulation and learning outcomes without specifying how teachers should act on this information – the model is operational: it introduces an explicit construct-to-decision mapping (Table 1) that translates each diagnostic category (low/medium/high) into a defined instructional response (e.g., staged speaking exposure for high anxiety, micro-goals for low self-regulation). Third, unlike general formative assessment or differentiated instruction frameworks, which adjust teaching based on academic performance alone, the model integrates affective and motivational diagnostics into the same decision cycle as achievement data and explicitly embeds washback monitoring as part of the model's validity evidence rather than as a separate, optional evaluation step. The authorial contribution of this study is therefore not any single diagnostic construct in isolation – each of which has established roots in prior research – but their integration into a single, minimal, classroom-feasible diagnostic battery bundled with an explicit instructional decision logic: diagnosis → learner profile → pedagogical decision rules → adapted instruction → improved learning outcomes.

The practical value of the study is that the proposed model can be applied in real school ELT classrooms. It helps teachers identify learners with high speaking anxiety, low motivation, weak self-regulation, or low self-efficacy and select appropriate teaching strategies, such as gradual speaking exposure, pair rehearsal, delayed feedback, micro-goals, checklists, choice-based tasks, and progress visualization. Thus, psychometric diagnostics functions not as an additional testing burden, but as a formative tool for improving instruction and creating positive washback.

However, the study has several limitations related to its pilot scope: a single-site, intact-class design constrains generalizability, and longer-term follow-up was not possible within the eight-week window. Future research should replicate the model across multiple schools, extend the intervention period, and test its applicability across different age groups and language proficiency levels.

In conclusion, the findings suggest that learner individualization in ELT should move beyond unsupported learning styles and focus on measurable, pedagogically meaningful individual differences. The Psycho-Diagnostic ELT Model can serve as a practical evidence-based framework for improving students' motivation, confidence, speaking participation, and overall language achievement.

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ОҚУ СТИЛЬДЕРІ ТҰЖЫРЫМЫНАН ДӘЛЕЛДІ ДИАГНОСТИКАҒА БЕТБҰРЫС: АҒЫЛШЫН ТІЛІН ОҚЫТУДАҒЫ ЖЕКЕ ЕРЕКШЕЛІКТЕРДІ ПСИХОМЕТРИЯЛЫҚ ТАЛДАУ

Аңдатпа

Ондаған жылдар бойы оқу стильдері тұжырымдамасы ағылшын тілін оқытуға ықпал етіп, оқытушыларды білім алушылардың болжамды визуалды, аудиалды немесе кинестетикалық қалауларына сәйкес оқыту үдерісін бейімдеуге ынталандырып келді. Алайда соңғы жылдары бұл тәсіл эмпирикалық негізінің әлсіздігі және педагогикалық құндылығының шектеулілігі себепті жиі сынға алынуда. Осы мақаланың мақсаты — оқу стильдері тұжырымдамасынан ағылшын тілін оқытудағы жеке айырмашылықтарды дәлелді психометриялық

диагностикалауға көшудің қажеттілігін негіздеу. Зерттеу екінші тілді меңгеруге деген мотивация, сөйлеу кезіндегі мазасыздық, өзіндік тиімділік және өзін-өзі реттеу сияқты білім алушылардың өлшенетін сипаттамаларына бағытталған.

Әдіснамалық тұрғыдан мақала теориялық талдауды Қазақстанның Астана қаласындағы мектеп базасында жүргізілген 8 апталық квазиэксперименттік зерттеудің пилоттық деректерімен ұштастырады. Бұл зерттеу аясында психометриялық профильдеу ағылшын тілін оқыту үдерісіне енгізілді. Нәтижелер негізгі диагностикалық шкалалардың сенімділігі қолайлы деңгейде екенін, эксперименттік және бақылау топтарының бастапқы профильдері өзара салыстырмалы болғанын, сондай-ақ эксперименттік жағдайда оқу нәтижелерінің, әсіресе ауызша сөйлеу көрсеткіштері бойынша, анағұрлым айқын артқанын көрсетті. Сонымен қатар психометриялық деректер ескеріле отырып оқытылған білім алушылар бағалаудың қолдаушы сипатта болғанын, коммуникацияға түсуге дайындығының артқанын және бағаланатын ауызша тапсырмаларды орындау кезінде мазасыздық деңгейінің төмендегенін атап өтті.

Алынған нәтижелердің маңыздылығы мынада: олар психометриялық диагностиканың оқытушыларға дәстүрлі оқу стильдері категорияларына қарағанда анағұрлым валидті әрі тәжірибеде қолдануға жарамды ақпарат бере алатынын көрсетеді. Мақалада дәлелді диагностика ағылшын тілін оқытудағы жеке айырмашылықтарды ескерудің ғылыми тұрғыдан неғұрлым негізделген әрі педагогикалық тұрғыдан тиімді тәсілін ұсынады деген қорытынды жасалады. Бұл тәсіл оқытуды білім алушылардың ерекшеліктеріне сәйкестендіруді күшейтіп, сыныптағы бағалаудың оң кері ықпалын қолдауға мүмкіндік береді.

Түйінді сөздер: оқу стильдері, психометрика, жеке айырмашылықтар, ағылшын тілін оқыту, сөйлеу кезіндегі мазасыздық, бағалаудың кері ықпалы, дәлелді психометриялық диагностика.

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ОТ УЧЕБНЫХ СТИЛЕЙ К ДОКАЗАТЕЛЬНОЙ ДИАГНОСТИКЕ: ПСИХОМЕТРИКА ИНДИВИДУАЛЬНЫХ РАЗЛИЧИЙ В ПРЕПОДАВАНИИ АНГЛИЙСКОГО ЯЗЫКА

Аннотация

На протяжении десятилетий концепция учебных стилей оказывала влияние на преподавание английского языка, побуждая преподавателей адаптировать обучение к предполагаемым визуальным, аудиальным или кинестетическим предпочтениям учащихся. Однако в последние годы данный подход всё чаще подвергается критике из-за слабой эмпирической обоснованности и ограниченной педагогической ценности. Цель настоящей статьи — обосновать переход от концепции учебных стилей к доказательной психометрической диагностике индивидуальных различий в преподавании английского языка. Исследование сосредоточено на измеряемых характеристиках учащихся, таких как мотивация к изучению второго языка, тревожность при говорении, самозффективность и саморегуляция.

С методологической точки зрения статья сочетает теоретический анализ с пилотными данными 8-недельного квазиэкспериментального исследования, проведенного на базе школы в Астане, Казахстан. В рамках данного исследования психометрическое профилирование было интегрировано в процесс обучения английскому языку. Результаты показали приемлемую надёжность основных диагностических шкал, сопоставимость исходных профилей экспериментальной и контрольной групп, а также более выраженный прирост учебных результатов в экспериментальных условиях, особенно в показателях устной речи. Кроме того, учащиеся, обучавшиеся с учётом психометрических данных, отмечали более поддерживающий характер оценивания, большую готовность к коммуникации и более низкий уровень тревожности во время оцениваемых устных заданий.

Значимость полученных результатов заключается в том, что они демонстрируют: психометрическая диагностика способна предоставить преподавателям более валидную и практически применимую информацию, чем традиционные категории учебных стилей. В статье делается вывод о том, что доказательная диагностика предлагает более научно обоснованный и педагогически полезный подход к учёту индивидуальных различий в преподавании английского языка, способствуя повышению соответствия обучения особенностям учащихся и поддерживая положительный обратный эффект оценивания в классе.

Ключевые слова: учебные стили, психометрика, индивидуальные различия, преподавание английского языка, тревожность при говорении, обратный эффект оценивания, доказательная психометрическая диагностика.

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PERCEPTIONS OF LIFELONG LEARNING: CASE STUDY AT O. ZHANIBEKOV SOUTH KAZAKHSTAN PEDAGOGICAL UNIVERSITY

Abstract

In the context of global and rapid change, the demand for continuous self-development of professionals is increasing. This article addresses the problem of fostering lifelong learning (LLL) skills among university teachers, driven by the shortening shelf-life of professional knowledge – according to forecasts, 39% of existing skills will become outdated or transformed by 2030. The aim of the study is to identify how in-service teachers at a Kazakhstani pedagogical university perceive lifelong learning, as well as to determine the key barriers and possible strategies for developing these skills within the institutional environment. The methodology is based on a qualitative case study: structured online interviews were conducted with six teachers from O. Zhanibekov South Kazakhstan Pedagogical University, and the data were analysed using thematic analysis. The results show that teachers generally recognize the importance of LLL, but in practice they face limited time, heavy teaching loads, lack of motivation, and insufficient institutional support. The most sought-after strategies include mentorship, allocated time for reflection, and integration of research-based practices into the curriculum. The significance of the study lies in its empirical evidence of the gap between declared LLL policies and actual conditions for their implementation at O. Zhanibekov South Kazakhstan Pedagogical University. The conclusions point to the need to revise workloads, strengthen mentoring support, and create a sustainable motivational environment for teachers' professional development.

Key words: lifelong learning, continuous professional development, in-service teachers, higher education, challenges in developing lifelong learning skills, teacher education, teaching practices, lifelong learning skills.

Introduction. The rapidly evolving world sets the priorities that push the implementation of objectives to meet the demands of both individuals and society in the light of economic, social, educational, political, and technological demands. In the foreground of global changes, the requirements to competencies and job qualifications will only keep increasing that stipulates the need to activate the policy to settle the national job market and improvement of educational system aimed at upgrading the quality of staff potential of the country and its efficient use. It should also be noted that the shelf-life of professional knowledge has dramatically shortened, with some estimates suggesting that specific skills may remain relevant for only a few years [1].

The fact that Kazakhstan integrated into a global economy acutely causes the need in prompt responses to revolutionary fluctuations around so that to experience less challenges on the way to promote the country to the list of top 30 developed countries by 2050.

Following the Programme for the International Assessment of Adult Competencies (PIAAC) research 50% of Kazakhstan population achieves just the second level of skills (functional literacy) development which speaks of the fact that majority of people are capable of only reproducing the knowledge having no traces of innovation potential [2].

Therefore, one of the top priorities of today is to furnish the growing generation with the competence, knowledge and skills required for a specialist capable of overcoming the challenges facing in contemporary world. Otherwise, no rise can be expected since according to the Future of Jobs Report 2025, on average, workers can expect that two-fifths (39%) of their existing skill sets will be transformed or become outdated over the 2025-2030 period [1, p. 6]. AI and big data top the list of fastest-growing skills, followed closely by networks and cybersecurity as well as technology literacy. Complementing these technology-related skills, creative thinking, resilience, flexibility and agility, along with curiosity and *lifelong learning*, are also expected to continue to rise in importance over the 2025-2030 period [1, p. 6]. This is the reason why alongside with soft and hard skills, the

specialist of today is to possess lifelong learning skills bearing great significance for formation of competitive personality.

Teachers occupy a unique and pivotal position within this paradigm. Since they are expected not only to develop lifelong learning skills (LLL) but to embody the mentioned principles themselves. This requires teachers “to adopt a different view of their role, and a different answer to the question ‘who am I as a teacher?’” [3]. However, successful implementation of national and global LLL policies largely depends on teachers’ own perceptions, experiences, and real opportunities for continuous professional development.

It should be noted that despite high relevance of the issue, there is a noticeable research gap regarding how this concept is perceived and implemented by in-service teachers in Kazakhstani higher education institutions. Most existing studies focus on Western contexts or general theoretical frameworks, while empirical research in the Kazakhstani pedagogical university environment remains limited.

In this regard, the object of the study is the process of forming a culture of lifelong learning among university teachers. The subject of the study is the perceptions, experiences, and key challenges to the development of lifelong learning skills among in-service teachers in a pedagogical university in the context of digitalization and globalization.

The purpose of the study is to identify the peculiarities of how in-service teachers at a Kazakhstani pedagogical university perceive lifelong learning and to determine the main challenges and possible strategies for developing these skills in the institutional environment.

To achieve this purpose, the following research questions were formulated:

1. How do in-service teachers at O. Zhanibekov South Kazakhstan Pedagogical University understand and perceive the concept of lifelong learning?
2. What are the main challenges and barriers they face in developing lifelong learning skills?
3. What strategies and institutional conditions do teachers consider most effective for fostering lifelong learning?

Literature review. The concept of lifelong learning (LLL), while often perceived as a modern response to globalization and technological change, has philosophical roots extending back centuries. Echoes of the principle can be found in the Socratic idea of intellectual humility ("I know that I know nothing") and in teachings of great thinkers across cultures, such as the Kazakh philosopher and poet Abay Kunanbaiuly, who emphasized the perpetual pursuit of knowledge and self-improvement. However, in its contemporary formulation, LLL has evolved into a structured educational policy imperative.

Globally, LLL is defined as “all learning activity undertaken throughout life, with the aim of improving knowledge, skills, and competences within a personal, civic, social and/or employment-related perspective” [4]. The key policy document enshrining LLL principle is the Concept for developing the higher education and science in the Republic of Kazakhstan for 2023-2029 [5]. The Concept defines LLL as a backbone element to enhance human capital and national competitiveness of the country. It creates official, “top-down” request to shape the culture of continuous education among teacher educators.

“As an increasingly popular slogan in the field of European Union (EU) educational policy” [6], lifelong learning has become a challenging term since the 70’s. Within academic discourse, scholars have explored LLL from various angles. Taubayeva et al. [7] frame it as an essential, continuous process of updating knowledge that is immediately susceptible to obsolescence in the information age. Others, such as Endres, Leber, and Böttger, focus on LLL as a mechanism for self-regulation and maximal professional development across diverse fields [8]. In teacher education specifically, LLL is recognized as a core competency. Korthagen argues that it requires teachers to fundamentally re-conceptualize their professional identity, moving from a stance of mastered knowledge to one of continuous inquiry [3, p.80].

A significant body of research focuses on the challenges to fostering LLL among educators. While the research by Cornford revealed identified common barriers including heavy workload, lack of time, insufficient institutional support, and limited access to resources [9], later studies by Van

Woezik shifts the focus on often cited effective strategies involving mentorship programs, collaborative communities of practice, reflective teaching practices, and the integration of research into curricula.

Though the importance of LLL is universally acknowledged, there is a discernible gap in the literature regarding its specific implementation and perception within the context of teacher education in Kazakhstan as most studies focus on Western or general educational contexts.

Despite clear political mandate of Kazakhstan for LLL development, there are no any empirical studies concentrated on how this imperative is perceived and implemented by pivotal agents of educational process - in-service teachers. Consequently, this study aims to address this gap by investigating the perceptions of in-service teachers at a Kazakhstani university, thereby contextualizing the global theory of LLL within a specific national and institutional framework.

Methods and materials. The study employed a qualitative case study design, which is an empirical investigation that examines a contemporary phenomenon in detail and within its real-life context [10]. This approach allowed the researchers to gain a detailed understanding of how lifelong learning is perceived and experienced by in-service teachers in a real-life university environment.

The research was conducted in two interrelated stages:

1. Theoretical and documentary analysis

A systematic review and critical analysis of scholarly literature and official policy documents were carried out to establish the theoretical and conceptual framework of the study. This stage included:

- Analysis of scientific publications on lifelong learning from international and national databases;
- Examination of key philosophical and pedagogical concepts of continuous education;
- Policy analysis of strategic documents of the Republic of Kazakhstan, particularly the Concept for the Development of Higher Education and Science for 2023–2029.

2. Empirical investigation

The empirical part of the study was based on a qualitative case study of O. Zhanibekov South Kazakhstan Pedagogical University. Data were collected through structured online interviews.

Six in-service teachers from O. Zhanibekov South Kazakhstan Pedagogical University participated in the study. The sample included teachers with different lengths of teaching experience (from less than 5 to more than 10 years). All participants worked in the university located in Shymkent, Kazakhstan.

The sample size ($n=6$) is consistent with the requirements of qualitative case study research, where the emphasis is on information-rich cases rather than statistical generalizability. As Yin [10, pp.40-41] notes, qualitative case studies aim for analytical generalization, not statistical representation. The selection of teachers from Foreign Languages Department was purposive: these teachers are regularly involved in continuous professional development activities (e.g., language proficiency updates, methodological training) and are therefore well-positioned to reflect on LLL practices. Given the small scale and focused scope, this study should be considered exploratory and pilot in nature. The findings provide initial insights into LLL perceptions at one department of a single university; they are not intended to be generalized to the entire institution or to all academic disciplines. Future research with larger and more diverse samples, including teachers from different departments and universities across Kazakhstan, is needed to validate and extend these findings.

Structured interviews were conducted using a questionnaire consisting of 10 open-ended and multiple-choice questions delivered via Google Forms. Due to the holiday period and busy schedules of the respondents, the link to the questionnaire was distributed through WhatsApp and email. This format allowed participants to respond at a convenient time while providing detailed written answers.

The obtained qualitative data were processed using thematic analysis following the six-phase framework proposed by Kiger and Varpio [11]: (1) familiarization with the data through repeated reading of interview responses; (2) generating initial codes by identifying meaningful segments of text; (3) searching for themes by grouping related codes; (4) reviewing themes to ensure consistency with the data set; (5) defining and naming themes; and (6) producing the final report.

To ensure analytical rigour, the coding process below (Table 1) was conducted by researchers and reviewed by the co-authors. Discrepancies were resolved through discussion until consensus was reached.

Table 1. Examples of the coding process

Data excerpt (participant response)	Initial code	Theme
«Limited time to engage in professional development» (P2)	Time constraint	Barriers to LLL
«I stay updated with the latest research, engage in discussions with peers» (P2)	Research engagement	Self-directed learning strategies
«Staying curious» (P3)	Curiosity / intrinsic motivation	Personal motivation
«Exploring new digital tools, apps, and platforms to enhance learning and keeping up with technological advancements» (P4)	Technology integration	Professional development strategies
«Lack of motivation to engage in continuous learning» (P1)	Low motivation	Barriers to LLL

Source: developed by the author as a result of research

After initial coding, related codes were grouped into broader themes that directly corresponded to the research questions: 1) Understanding of LLL; 2) Barriers to LLL (e.g., time constraints, heavy workload, lack of motivation, insufficient institutional support); 3) Engagement in LLL activities (e.g., workshops, online courses, reading, reflection, collaboration); and 4) Strategies for improvement (e.g., mentorship, reflection time, research integration).

The combination of theoretical analysis and empirical qualitative data provided a comprehensive understanding of the research problem, linking global and national theoretical concepts with real practices and perceptions of university teachers.

Results and their discussion. The study covered analyzing perceptions of lifelong learning skills by in-service teachers of O. Zhanibekov South Kazakhstan Pedagogical University located in Shymkent, southern part of Kazakhstan. There were total of 6 teachers with varied experiences participating in the research in the form of online interview (Table 2.).

Table 2. Information on research participants

Participant ID	Years of Teaching Experience	Gender	Taught discipline
P1	10+	Female	Methods of Foreign Language (FL) teaching
P2	10+	Male	English as a FL
P3	10+	Female	General English
P4	10+	Female	General English
P5	5-10	Female	Lexicology
P6	<5	Female	English as a FL

Source: developed by the author as a result of research

There were 4 teachers with 10 and more years of experience, 1 teacher having teaching experience between 5-10 years and 1 teacher with less than 5 years of experience. All participating teachers work in the city.

Overall, the interview guide consisted of mix of 10 open-ended and multiple-choice questions presented by Google Forms addressing teacher's perceptions of lifelong learning. Interview questions were delivered online by sending the link to the questions by WhatsApp and e-mail due to holiday period and diverse work schedule of interviewees. Responses were collected and recorded electronically in Excel table in Google Forms. The study sought to answer the questions as follows:

Q1 How would you define "lifelong learning" teaching?

Q2 Do you believe that lifelong learning is important for teachers?

Q3 Which of the following lifelong learning activities do you currently engage in (select all that apply)?

Q4 Do you believe that lifelong learning is emphasized in your teacher education program?

Q5 What do you perceive as the biggest challenge in developing lifelong learning skills during your teaching experience?

Q6 Do you feel that your teacher education program has adequately prepared you for lifelong learning as a teacher?

Q7 Which of the following strategies would be most helpful in improving lifelong learning skills for teachers (select all that apply)?

Q8 Are you provided sufficient opportunities to engage in research and reflect on your teaching practices?

Q9 Do you believe your institution supports the integration of technology and modern research into teaching?

Q10 What strategies do you personally use to continue your professional development and learning?

The data were analyzed using thematic analysis. This method was selected for its effectiveness in identifying, analyzing, and reporting patterns (themes) within rich qualitative data. The process involved initial coding of responses, searching for themes, reviewing themes, and defining and naming them to develop a coherent narrative of the findings [12].

Ten questions were developed based on literature review, research gaps revealed as result of literature review and personal concerns of the researcher on lifelong learning in line with research questions. Each participant was assigned a code, for instance P1, P2...P6. It should also be noted that research questions were created to suit general purpose of the study, and all the participants were provided sufficient time during the interview.

Understanding of lifelong learning

Regarding the question to define the term “lifelong learning” which required open-ended answers, the interviewees provide constructed response. According to their responses, three of the interviewees agree that “In the context of teaching, “lifelong learning” refers to the continuous, self-directed process of acquiring, enhancing, and refining skills throughout an individual's life. It emphasizes the idea that language learning does not end after formal education but is an ongoing pursuit that adapts to changing personal, professional, and cultural needs.

The following are some quotations:

Lifelong learning in teaching refers to the continuous, self-motivated pursuit of language skills throughout one's life, emphasizing not only formal instruction but also informal, ongoing practice and development. (P2)

“Lifelong learning” in teaching refers to the continuous process of acquiring and improving language skills throughout one's life, emphasizing the importance of ongoing practice, self-motivation, and adapting to new learning methods in a globalized world. (P4)

Whereas other 2 are confirmed that “lifelong learning is improving teaching skills throughout one's life” (P3) and 1 interviewee has a belief that it is “self-development” (P5) only.

Perceived importance

Five out of six interviewees (P1, P2, P4, P5, P6) consider lifelong learning important for teachers, while one respondent (P3) holds a negative view (Figure 1). As shown in Figure 1, the majority of teachers (five out of six) recognize lifelong learning as an important component of their professional activity. Only one respondent expressed a negative view, indicating that the overall perception of LLL among the teaching staff at Zhanibekov University is predominantly positive.

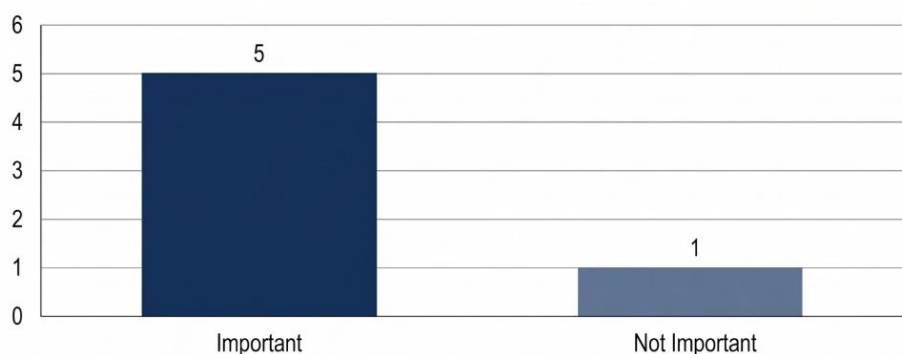


Figure 1. Distribution of respondents' answers on the importance of lifelong learning for teachers
Source: compiled by the authors based on interview data using NotebookLM

Current engagement

The interview data reveal varying levels of engagement across different lifelong learning activities (Figure 2).

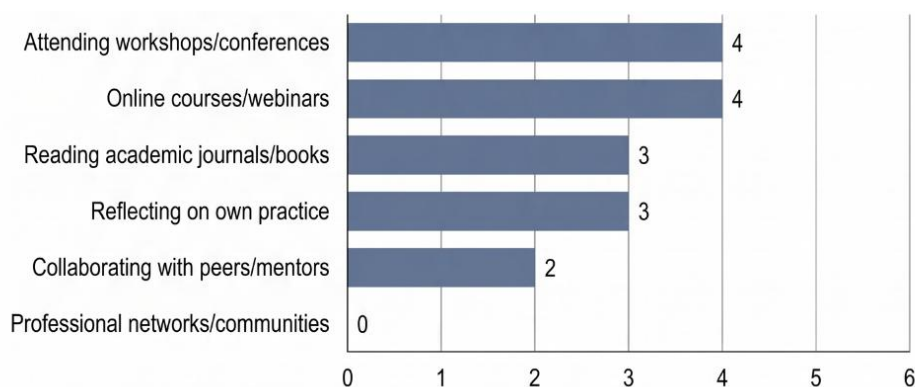


Figure 2. Lifelong learning activities that teachers are currently engaged in
Source: compiled by the authors based on interview data using NotebookLM

The graph above illustrates that nowadays 4 teachers (P2, P4, P5, P6) at O. Zhanibekov South Kazakhstan Pedagogical University are mostly engaged in both attending workshops and conferences, demonstrate activeness in online courses or webinars. Three teachers (P3, P5, P6) show interest in reading academic journals or books on language teaching as well as reflecting on own teaching practice. The activity related to collaborating with peers or mentors is engaged by 2 teachers only (P2, P4). Notably, none of the respondents participates in professional networks or communities.

Institutional focus and preparedness

In terms of the content of teacher education program where the emphasis is made on lifelong learning, five (P1, P2, P4, P5, P6) out of 6 teachers are confident that lifelong learning is a central focus in their teacher education program while one teacher (P3) believes that there is focus though considered to be insufficient.

Challenges to developing lifelong learning skills

In view of the biggest challenges in developing lifelong learning skills during teacher education the responses of interviewees vary a lot. Analysis of interview data reveals a range of challenges that teachers face in developing lifelong learning skills during their teaching experience. The most frequently cited challenge was limited time to engage in professional development, mentioned by four participants (P2, P3, P4, P6). An equal number of respondents (P1, P3, P4, P5) identified lack of motivation to engage in continuous learning as a significant barrier.

Heavy workload and academic pressure were reported by three teachers (P3, P5, P6), while limited institutional support or mentorship was also noted by three participants (P2, P4, P5). Lack of access to current research or academic resources was mentioned by two teachers (P4, P6). Notably,

resistance to new teaching methods or research was not reported as a challenge by any of the respondents.

The predominance of time-related and motivational barriers suggests that teachers face structural and psychological constraints rather than ideological resistance to change. The fact that access to resources was cited less frequently may indicate that institutional provisions are relatively adequate, or that other factors (time, motivation) are perceived as more pressing. The complete absence of resistance to innovation is a positive indicator, suggesting openness to new approaches provided that time and institutional support are improved.

Preparation of teacher education program for lifelong learning

The question regarding how well teacher education program prepares a teacher for lifelong learning caused detailed responses on the part of interviewees three of which (P2, P3, P4) were really confident of the program content relevance while two (P1, P6) partially agreed with the fact mentioned above. 1 interviewee (P5) was entirely unsupportive of this view.

Strategies for improvement

In the light of strategies that would be most helpful in improving lifelong learning skills for teachers, 4 interviewees chose the strategies referring to “More opportunities for mentorship and guidance from experienced teachers” (P2, P3, P5, P6) and “Time allocated for reflection on teaching practices” (P1, P3, P4, P6). Half of interviewees suppose that “Greater integration of research-based practices into the curriculum”, “Encouragement to collaborate with peers in a community of practice” and “Workshops on how to engage with and apply academic research in teaching” can serve as better strategies that would assist in target skills improvement for teachers. Only 2 interviewees (P2, P4) made an option in favor of the strategy “More accessible resources for professional development (e.g., online courses, conferences)” whilst 1 interviewee (P3) believe that “Increased focus on self-directed learning and personal growth” could be the best strategy beneficial in improving lifelong learning skills for teachers.

Opportunities to engage in research and reflect on your teaching practices

Institutional support in integrating technology and modern research into teaching is of crucial importance. In this regard, it can be evidently seen that four of interviewees (P1, P2, P4, P6) believe that there is support on behalf of institution although two interviewees (P3, P5) have quite negative view on this matter (Figure 3).

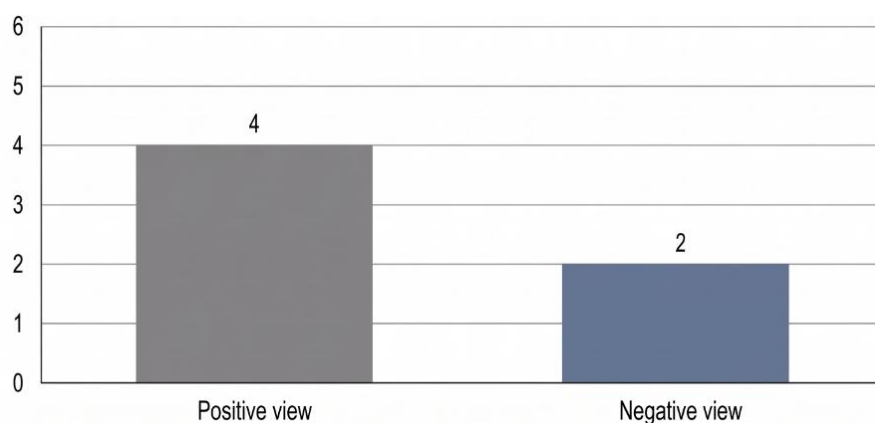


Figure 3. Support of university in integrating technology and modern research into teaching

Source: developed by the author as a result of research using NotebookLM

In terms of strategies teachers use to continue their professional development and learning the responses varied differently.

Some of quotations are:

To continue my professional development, I stay updated with the latest research, engage in discussions with peers, attend workshops and webinars, and regularly reflect on my practices to identify areas for improvement. (P2)

Staying curious. (P3)

Exploring new digital tools, apps, and platforms to enhance learning and keeping up with technological advancements in education. (P4)

Discussion. The present study provides valuable insights into the realities of fostering a culture of lifelong learning among teachers in a Kazakhstani university context.

In general, judging by the responses, teachers' profound understanding of lifelong learning aligns with global definition and suggests that O. Zhanibekov South Kazakhstan Pedagogical University successfully implements the strategies and policies fostering lifelong learning ideas. However, a gap exists between conceptual recognition and deep, self-directed learning. High engagement in mandatory activities like workshops (four teachers) contrasts with low involvement in reading, reflection and, especially, participation in professional networks (none of the teachers) (Table 3).

Table 3. Lifelong learning activities that teachers are currently engaged in

Activity	Number of teachers engaged	Nature of engagement
Attending workshops or conferences	4	Often institutional, structured, sometimes mandatory
Engaging in online courses/webinars	4	Flexible, but may be driven by institutional requirements
Reading academic journals or books	3	Self-directed, sustained intellectual engagement
Collaborating with peers or mentors	2	Relational, community-based, informal
Participating in professional networks	0	External community engagement and broader field connection

Source: compiled by the authors based on interview data using NotebookLM

Meanwhile, positive responses regarding the focus on lifelong learning in teacher education program proves the actions that O. Zhanibekov South Kazakhstan Pedagogical University takes to promote full-fledged development of lifelong learning skills in its future specialists. At the same time, insufficient time to engage in professional development and subsequently lack of motivation to get into lifelong learning are considered to be the biggest challenges. The stated picture was predictable by all means subject to curriculum, social and academic work of teachers.

With reference to the strategies to improve lifelong learning skills of in-service teachers, the interviewees agree on withdrawing the part of burden thus allocating more time for opportunities to go in for mentorship and guidance from experienced teachers, as well as reflect on their teaching practices since this is one of efficient ways to speculate on improvements and backlogs in their work. Other strategies such as integration of research-based practices into curriculum, increased focus on self-directed growth seem to be of much less significance supposedly due to economic factors as well.

It becomes obvious that O. Zhanibekov South Kazakhstan Pedagogical University stipulates adequate tools and funds to encourage lifelong learning tendency of teachers which is repeatedly confirmed by the share of positive feedback as per the diagrams.

Although the time constraint and workload somehow limit teacher's will and desire to get engaged in lifelong learning activities, the research shows that committed to continue their education using available resources.

Limitations. This study has several limitations that should be acknowledged. First, the sample consisted of only six teachers from a single department (Foreign Languages) at one university, which limits the generalizability of the findings to other academic disciplines and institutions in Kazakhstan. Second, the study relied exclusively on self-reported data through structured online interviews, which may be subject to social desirability bias and may not fully capture actual teaching practices or LLL engagement behaviors. Third, data collection took place during the holiday period, which may have affected the availability and responses of participants. Fourth, the study did not include triangulation with other data sources (e.g., observations, document analysis) that could have provided a more

comprehensive understanding of LLL practices. These limitations are characteristic of exploratory qualitative research and do not diminish the value of the insights gained; rather, they highlight the need for further investigation. Future research should address these limitations by including larger and more diverse samples, employing multiple data collection methods, and conducting comparative studies across different types of higher education institutions in Kazakhstan.

Conclusion. The study reveals that in-service teachers at Zhanibekov University demonstrate a generally positive awareness of lifelong learning, with the majority defining it as a continuous, self-directed process of updating knowledge and professional skills. However, the depth of understanding varies: while some respondents provided comprehensive definitions, others offered narrower interpretations, such as “self-development” or “improving teaching skills”, and one participant questioned the importance of LLL altogether.

The main barriers to the development of LLL skills are consistently identified as time constraints, heavy workloads, lack of intrinsic motivation, and insufficient institutional support. These challenges are perceived as more pressing than resistance to new methods or lack of access to resources.

Regarding strategies, the teachers consider mentorship, dedicated time for reflective practice, and the integration of research-based approaches into the curriculum as the most promising institutional interventions. Less emphasis is placed on self-directed learning or increased resource availability, which may reflect the current economic and organizational realities.

While the university provides formal structures (workshops, courses) that encourage LLL engagement, the gap between mandatory participation and deep, self-motivated learning remains significant. The findings suggest that to foster a genuine culture of lifelong learning, university management should reduce excessive workloads, strengthen mentoring systems, and create conditions that support both professional reflection and emotional sustainability. These steps are essential for preparing teachers to meet the rapidly evolving demands of education and for fulfilling the national agenda of enhancing human capital and competitiveness.

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ҮЗДІКСІЗ БІЛІМ АЛУҒА КӨЗҚАРАС: Ө. ЖӘНІБЕКОВ АТЫНДАҒЫ ОҢТҮСТІК ҚАЗАҚСТАН ПЕДАГОГИКАЛЫҚ УНИВЕРСИТЕТІНДЕГІ КЕЙСТІ ЗЕРТТЕУ

Аңдатпа

Жаһандық және қарқынды өзгерістер жағдайында мамандардың үздіксіз өзін-өзі дамытуына деген сұраныс артуда. Мақала жоғары оқу орындары оқытушыларының үздіксіз білім алу дағдыларын қалыптастыру мәселесіне арналған, себебі кәсіби білімнің өзектілік мерзімі қысқаруда – болжам бойынша, 2030 жылға қарай қолданыстағы дағдылардың 39%-ы ескіреді немесе трансформацияланады. Зерттеудің мақсаты – қазақстандық педагогикалық университеттің оқытушыларының өмір бойы оқуға деген көзқарасын анықтау, сондай-ақ осы дағдыларды дамытудағы негізгі кедергілер мен мүмкін болатын стратегияларды институционалдық ортада айқындау. Әдіснама сапалы кейс-зерттеуге негізделген: Ө.Жәнібеков атындағы Оңтүстік Қазақстан педагогикалық университетінің алты оқытушысымен құрылымдық онлайн-сұхбаттар жүргізіліп, алынған мәліметтер тақырыптық талдау арқылы өңделді. Нәтижелер оқытушылардың үздіксіз білім алудың маңыздылығын мойындайтынын, алайда іс жүзінде уақыттың шектеулілігіне, жүктеменің ауырлығына, ынтаның жеткіліксіздігіне және институционалдық қолдаудың тапшылығына тап болатынын көрсетті. Ең тиімді стратегиялар ретінде тәлімгерлік, рефлексияға уақыт бөлу және зерттеуге негізделген тәжірибелерді оқу бағдарламасына енгізу аталды. Зерттеудің маңыздылығы – Ө.Жәнібеков атындағы Оңтүстік Қазақстан педагогикалық университетінде жарияланған үздіксіз білім алу саясаты мен оны жүзеге асырудың нақты жағдайлары арасындағы алшақтықты эмпирикалық түрде дәлелдеуі. Қорытындылар жүктемені қайта қарау, тәлімгерлік қолдауды күшейту және оқытушылардың кәсіби дамуы үшін тұрақты мотивациялық орта құру қажеттігін көрсетеді.

Түйінді сөздер: үздіксіз білім алу, үздіксіз кәсіби даму, оқытушылар, жоғары білім, үздіксіз білім алу дағдыларын дамытудағы кедергілер, педагогикалық білім, оқыту тәжірибелері, үздіксіз білім алу дағдылары.

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ВОСПРИЯТИЕ НЕПРЕРЫВНОГО ОБРАЗОВАНИЯ: ИЗУЧЕНИЕ КЕЙСА В ЮЖНО-КАЗАХСТАНСКОМ ПЕДАГОГИЧЕСКОМ УНИВЕРСИТЕТЕ ИМЕНИ О.ЖАНИБЕКОВА

Аннотация

В условиях глобальных и стремительных изменений возрастает потребность в непрерывном саморазвитии специалистов. Статья посвящена проблеме формирования навыков обучения на протяжении всей жизни (lifelong learning, LLL) у преподавателей высшей школы, что обусловлено сокращением срока актуальности профессиональных знаний – по прогнозам, к 2030 году 39% существующих навыков устареют или трансформируются. Цель исследования - выявить особенности восприятия lifelong learning преподавателями

казахстанского педагогического университета, а также определить ключевые барьеры и возможные стратегии развития этих навыков в институциональной среде. Методология базируется на качественном кейс-исследовании: проведены структурированные онлайн-интервью с шестью преподавателями Южно-Казахстанского педагогического университета имени О. Жанибекова, данные проанализированы с использованием тематического анализа. Результаты показали, что преподаватели в целом осознают важность LLL, однако на практике сталкиваются с ограниченностью времени, высокой учебной нагрузкой, недостатком мотивации и нехваткой институциональной поддержки. Наиболее востребованными стратегиями признаны наставничество, выделение времени на рефлексию и интеграция исследовательских подходов в учебный процесс. Значимость исследования заключается в эмпирическом обосновании разрыва между декларируемой политикой LLL и реальными условиями её реализации в казахстанском вузе. Выводы указывают на необходимость пересмотра рабочей нагрузки, усиления менторской поддержки и создания устойчивой мотивационной среды для профессионального развития преподавателей.

Ключевые слова: непрерывное образование, непрерывное профессиональное развитие, преподаватели, высшее образование, препятствия в развитии навыков непрерывного образования, педагогическое образование, практики преподавания, навыки непрерывного образования.

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ФОРМИРОВАНИЕ ИИ-КОМПЕТЕНТНОСТИ БУДУЩИХ УЧИТЕЛЕЙ ИНОСТРАННОГО ЯЗЫКА НА ОСНОВЕ ПОДХОДОВ ТРАСК-AI И ТЕХНОЛОГИЧЕСКОЙ САМОЭФФЕКТИВНОСТИ TAICS

Аннотация

В статье исследуется актуальная проблема формирования ИИ-компетентности будущих учителей иностранного языка в условиях глобальной цифровизации. Целью исследования является теоретическое обоснование и экспериментальная проверка модели формирования ИИ-компетентности, основанной на интеграции структуры Technological Pedagogical Content Knowledge - Artificial Intelligence (TPACK-AI) и компонента технологической самоэффективности Teacher AI Competence Self-efficacy (TAICS).

Методология исследования базируется на смешанном подходе (mixed-methods) и включает тестирование и анкетирование 84 студентов и лингвистический контент-анализ рефлексивных отчетов с помощью инструмента Linguistic Inquiry and Word Count (LIWC). Процесс обучения был организован в течение академического семестра и включал обучение с использованием генеративных языковых моделей для создания учебных материалов и текстовые ИИ-симуляторы для моделирования реальных педагогических ситуаций. Технические условия для проведения обучения включали доступ к языковым моделям, специализированным ИИ-сервисам для педагогов, сервисам отработки и оценки иноязычной устной речи и текстовым ИИ-симуляторам.

Экспериментально доказана эффективность предложенной модели. Выводы статьи коррелируют с поставленной целью и доказывают, что системная интеграция ИИ-инструментов, подкреплённая моделью ТРАСК-AI+TAICS способствует формированию ИИ-компетентности будущих учителей и качественной трансформации их педагогического мышления, способствуя преодолению технологического разрыва в образовании.

Ключевые слова: искусственный интеллект, ИИ-компетентность, языковые модели, специализированные ИИ-сервисы для педагогов, текстовые ИИ-симуляторы, технологическая самоэффективность (TAICS), педагогическая рефлексия.

Введение. Современный этап развития образования характеризуется переходом к интеллектуализированным цифровым экосистемам, в которых искусственный интеллект становится не просто инструментом, а полноценным участником образовательного процесса. Особенно значимы эти изменения в области преподавания иностранных языков, где язык одновременно выступает и объектом, и средством обучения. Интеграция искусственного интеллекта (ИИ) в языковое образование радикально трансформирует традиционные педагогические подходы, смещая акцент с передачи знаний на организацию персонализированных образовательных траекторий.

Исторически развитие технологий в преподавании иностранных языков проходило несколько этапов: от компьютерного обучения – Computer-Assisted Language Learning (CALL) к мобильному обучению – Mobile-Assisted Language Learning (MALL) и далее к адаптивным интеллектуальным системам. В настоящее время наблюдается формирование новой парадигмы AI enhanced language learning (изучение языка, усиленное технологиями искусственного интеллекта), в рамках которой ИИ обеспечивает автоматическую генерацию учебных материалов, анализ языковых ошибок, моделирование диалогов и персонализацию обучения.

Исследования последних лет свидетельствуют о том, что интеграция искусственного интеллекта, в частности языковых моделей и ИИ-сервисов, и инструментов в образовании оказывает существенное влияние на педагогическую практику и структуру учебного процесса [1–5]. Так, в работах Tuomi I. [6], Roll I., Wylie R. [7] освещаются вопросы практики перехода

к персонализированному обучению с помощью ИИ-технологий, основанные на анализе больших данных и адаптивных алгоритмах. Отмечается, что в условиях перехода к цифровым и ИИ-технологиям, и технологического скачка основной проблемой остаётся недостаточная готовность педагогов к внедрению и использованию возможностей ИИИ-сервисов и инструментов [8–10].

Согласно аналитическим данным ЮНЕСКО (United Nations Educational, Scientific and Cultural Organization – ЮНЕСКО Организация Объединенных Наций по вопросам образования, науки и культуры), внедрение инструментов искусственного интеллекта охватило свыше 70% мировых образовательных систем, однако квалификация педагогических кадров в этой сфере признана недостаточной [5, с.15]. В академической среде наблюдается выраженное противоречие: высокая теоретическая оценка потенциала ИИ учителями не подкрепляется реальными навыками его интеграции в учебный процесс. Данный дисбаланс наиболее остро проявляется в развивающихся государствах, включая Казахстан.

Актуальность настоящего исследования обусловлена необходимостью формирования у будущих преподавателей иностранных языков системных цифровых компетенций. Речь идёт не просто о технической грамотности, а о глубоком понимании дидактических, этических и критических аспектов-факторов применения технологий. В контексте полиязычного обучения ИИ выступает не только прикладным образовательным инструментом, но и механизмом трансляции культурной идентичности. При этом, несмотря на обширный массив научных трудов по цифровой педагогике, комплексные модели профессиональной подготовки учителей к синергии с ИИ до сих пор не институционализированы.

В частности, отсутствуют интегрированные подходы, учитывающие одновременно технологические, педагогические и когнитивные аспекты.

В настоящем исследовании мы поставили своей целью проанализировать эффективность практико-ориентированной модели формирования ИИ-компетентности будущих педагогов иностранного языка, базирующейся на интеграции концепций ТРАСК-АИ и компонента технологической самооэффективности (ТАИКС). Данная модель рассматривается как интегративная система, объединяющая знания, навыки и установки, необходимые для эффективного использования ИИ в образовательной практике. В ходе оценивания уровня ИИ-компетентности применялись методы тестирования (усвоения знаний навыков в области применения ИИ-инструментов и сервисов, и анкетирования для самооценки навыков педагогической рефлексии, автономности и самооэффективности).

Методы и материалы. Выбор методологии исследования соответствует современным международным подходам к изучению цифровой трансформации образования, основанным на смешанных методах анализа (mixed-methods) [11–13]. Экспериментальная работа проводилась в течение учебного семестра, в рамках дисциплины «Основы использования искусственного интеллекта в обучении иностранным языкам» и состояла из трёх классических этапов: констатирующего, преобразующего (формирующего) и контрольного.

В рамках исследования нами была разработана и экспериментально проверена модель формирования ИИ-компетентности будущих педагогов иностранного языка. В отличие от классической рамки ТРАСК, которая фиксирует когнитивный срез технологических и педагогических знаний (АИ-ТК, АИ-РК, АИ-СК), предлагаемая модель интегрирует психологический конструкт ТАИКС (Teacher AI Competence Self-efficacy) в качестве сквозного элемента.

Структура модели состоит из следующих компонентов:

1. Целевой блок: формирование готовности будущих педагогов иностранных языков к интеграции ИИ-технологий в профессиональную деятельность.

2. Содержательно-технологический блок: включает базовые знания согласно концепции ТРАСК-АИ по трём целевым компонентам: 1) промпт-инжиниринг (проектирование промптов) для работы с нейросетевыми моделями и специализированными сервисами для педагогов; 2) методика применения ИИ-симуляторов педагогических ситуаций; 3) автоматизированная оценка иноязычной речи;

3. Личностно-психологический блок (TAICS): уровень технологической самооэффективности, определяющий уверенность студента в преодолении технических сбоев и «галлюцинаций» ИИ.

4. Оценочно-рефлексивный блок: система оценки готовности будущих педагогов к интеграции ИИ-технологий на основе шести ключевых компонентов ИИ-компетентности: 1) технические навыки и промпт-инжиниринг – заключается в способности эффективно взаимодействовать с интерфейсами ИИ, грамотно формулировать, тестировать и модифицировать текстовые запросы (промпты) для больших языковых моделей (LLM) с целью получения точного дидактического материала; 2) аналитическое мышление и валидация данных включают в себя навыки критической оценки контента, сгенерированного нейросетью (умение выявлять фактологические ошибки, логические несоответствия и «галлюцинации» ИИ, а также проверять лингвистическую точность учебных текстов); 3) этическая ответственность и академическая честность отражают понимание правовых и осознание этических аспектов использования ИИ в образовании; 4) интеграция ИИ-технологий - умение органично встраивать инструменты ИИ в структуру урока иностранного языка; 5) профессиональная автономность - способность к самостоятельному освоению новых появляющихся ИИ-инструментов, независимость от конкретного программного интерфейса и готовность гибко адаптировать свою методическую систему под экспоненциальное развитие технологий; 6) педагогическая рефлексия - способность критически осмысливать собственный опыт взаимодействия с ИИ-технологиями, оценивать риски и преимущества автоматизации учебных процессов. Именно этот компонент в нашем исследовании измеряется качественным методом (рефлексивные эссе) и верифицируется через психолингвистический анализ LIWC (Linguistic Inquiry and Word Count – Лингвистическое исследование и подсчет слов), оценивающий когнитивную сложность и агентность через использованные местоимения в отчётах студентов. Схематическое представление модели представлено на Рисунке 1.

ПРАКТИКО-ОРИЕНТИРОВАННАЯ МОДЕЛЬ ФОРМИРОВАНИЯ ИИ-КОМПЕТЕНТНОСТИ БУДУЩИХ ПЕДАГОГОВ ИНОСТРАННОГО ЯЗЫКА		
ЦЕЛЕВОЙ БЛОК		
Цель: формирование готовности будущих педагогов иностранных языков к интеграции ИИ-технологий в профессиональную деятельность.		
СОДЕРЖАТЕЛЬНО-ТЕХНОЛОГИЧЕСКИЙ БЛОК		
Базовые знания согласно концепции TRASK-AI		
промпт-инжиниринг для работы с нейросетевыми моделями и специализированными сервисами для педагогов	методика применения ИИ-симуляторов педагогических ситуаций	автоматизированная оценка иноязычной речи
ЛИЧНОСТНО-ПСИХОЛОГИЧЕСКИЙ БЛОК		
Интеграция TAICS - технологической самооэффективности, определяющая уверенность студента в преодолении технических сбоев и «галлюцинаций» ИИ.		
<i>Принципы:</i> активное вовлечение студентов в процесс; организация социального взаимодействия; Принцип академической и этической прозрачности, принцип непрерывной рефлексии.		
<i>Методы:</i> интерактивные методы обучения, метод контекстного обучения, метод интерактивного промптинга, проектный метод, дискуссия.		
<i>ФОРМЫ ОБУЧЕНИЯ:</i> индивидуальная, парная, групповая		
ОЦЕНОЧНО-РЕФЛЕКСИВНЫЙ БЛОК		
<i>Компоненты:</i> технические навыки и промпт-инжиниринг; аналитическое мышление и валидация данных; этическая ответственность; интеграция ИИ-технологий; профессиональная автономность; педагогическая рефлексия		
<i>Уровни:</i> высокий, средний, низкий		
Повышение уровня готовности будущих педагогов иностранных языков к интеграции ИИ-технологий в профессиональную деятельность		

Рисунок 1. Практико-ориентированная модель формирования ИИ-компетентности будущих педагогов иностранного языка

Источник: составлено авторами.

Основное отличие данной модели от существующих подходов заключается в применении и интеграции самооэффективности (TAICS), высокий уровень которой выступает внутренним предиктором, который переводит теоретические декларативные знания студента об ИИ в

плоскость уверенной педагогической интеграции ИИ-технологий в своей будущей профессиональной деятельности. На констатирующем этапе был диагностирован начальный уровень ИИ-компетентности участников-студентов. Посредством теста и анкетирования проверялся уровень базовых знаний участников, а также их готовности к внедрению новых ИИ - инструментов в будущую профессиональную деятельность.

В рамках формирующего этапа внедрялась практико-ориентированная модель формирования ИИ-компетентности будущих педагогов иностранного языка, основанная на интеграции концептуальных положений TRACK-AI и компонента технологической самоэффективности (TAICS). Были обеспечены базовые технические условия для проведения экспериментального обучения: обеспечен доступ к языковым моделям, (ChatGPT, Gemini), специализированным ИИ-сервисам для педагогов (Twee, MagicSchool – обеспечивают автоматизацию рутинной работы педагогов по планированию учебного процесса, разработке и адаптации контента, составлению индивидуальной траектории или программы обучающихся), сервисам отработки и автоматической оценки иноязычной устной речи (ELSA Speak, CharacterAI, ElevenLabs) и текстовым ИИ-симуляторам на базе готовых платформ для отработки педагогических сценариев (School AI, раздел “Spaces”, MagicSchoolAI – инструменты категории “AI Colleague”, “Student Simulator”, в которых виртуальная среда строится за счёт глубокой симуляции тестовых диалогов, где ИИ берет на себя роль “ученика”, “родителя” или “директора/руководства школы”). Выбор инструментов был обусловлен их функционалом на проектировочном, реализационном и аналитическом этапах деятельности педагога, а также их доступностью и наличием интуитивно-понятного интерфейса.

В рамках работы с языковыми моделями будущие педагоги отрабатывали взаимодействие с нейросетями с применением методов Rhetorical prompting и метода промптов по модели 5E. Rhetorical prompting позволяет точно настроить в ответе ИИ на авторский запрос тональность, стиль, структуру и прагматику ответа. Промпт прописывается со строгим ограничением последовательного ввода роли и контекста (например, “Ты - эксперт в области STEM...”), целевой аудитории (“...разрабатывающий план для учеников 10 класса”). Прописываются отрицательные ограничения (Negative Constraints) - запреты ИИ использовать указанные паттерны.

Модель 5E строится на пятиступенчатом алгоритме: engagement (вовлечение), exploration (исследование), explanation (объяснение), elaboration (проработка), evaluation (оценка). Они представляют собой пять фаз, предписывающих ИИ пошагово генерировать контент учебного занятия. ИИ прописывается роль методиста и запрет на переход к следующему этапу, пока пользователь не утвердит предыдущий.

В ходе контрольного этапа была проведена повторная диагностика для выявления динамических сдвигов в уровне сформированности ИИ-компетентности будущих педагогов иностранного языка. Всего в эксперименте участвовали 84 студента 3-го курса ОП 6B01702 - «Иностранный язык: два иностранных языка» КарНИУ имени Е. А. Букетова). Формирование групп проводилось методом сплошного отбора существующих академических потоков. Экспериментальную группу (ЭГ) составили 42 студента и контрольную (КГ) – 42. Демографические характеристики выборки: средний возраст участников составил 19.4 лет ($SD = 0.68$), гендерный состав: 84.5% ($n = 71$) - лица женского пола, и 15.5% ($n = 13$) - лица мужского пола. Для верификации статистической сопоставимости групп до начала формирующего эксперимента было проведено входное тестирование по разработанной анкете на основе рамки компетенций ЮНЕСКО, адаптированной к специфике иноязычного образования. Структура анкеты предусматривала оценку шести компонентов ИИ-компетентности: технические навыки и промпт-инжиниринг, аналитическое мышление и валидация данных, этическая ответственность, интеграция ИИ-технологий, профессиональная автономность, педагогическая рефлексия. Сравнительный анализ с применением двухвыборочного t-критерия Стьюдента для независимых выборок показал отсутствие статистически значимых различий между ЭГ и КГ по общему уровню ИИ-

готовности: $t(82) = 0,342$, $p = 0,733$, 95% CI [-0.18, 0.26]. Это свидетельствует об исходной однородности и высокой статистической сопоставимости выборки.

Результаты и их обсуждение. Для оценки эффективности разработанной модели была изучена динамика всех шести заявленных компонентов ИИ-компетентности в ЭГ и КГ до и после эксперимента. Полные статистические маркеры, включая парный t-критерий Стьюдента, точные значения уровня значимости (p) и размер эффекта (d Коэна), систематизированы в Таблице 1.

Таблица 1. Сравнительный анализ показателей ИИ-компетентности до и после эксперимента

Компонент компетентности	Группа	До эксперимента (M $\pm$ SD*)	После эксперимента (M $\pm$ SD*)	Значение t-критерия	Уровень значимости (p)	Размер эффекта (d Коэна)
1. Технические навыки	ЭГ	2,81 $\pm$ 0,54	4,62 $\pm$ 0,38	17,51	<0,001	3,86 (очень высокий)
	КГ	2,85 $\pm$ 0,51	3,12 $\pm$ 0,49	2,64	0,012	0,54 (средний)
2. Аналитическое мышление	ЭГ	3,10 $\pm$ 0,48	4,45 $\pm$ 0,41	13,68	<0,001	3,02 (высокий)
	КГ	3,05 $\pm$ 0,46	3,21 $\pm$ 0,42	1,72	0,093	0,36 (низкий)
3. Этическая ответственность	ЭГ	3,24 $\pm$ 0,61	4,71 $\pm$ 0,32	14,12	<0,001	3,03 (высокий)
	КГ	3,20 $\pm$ 0,59	3,42 $\pm$ 0,51	1,81	0,078	0,39 (низкий)
4. Педагогическая интеграция	ЭГ	2,62 $\pm$ 0,50	4,58 $\pm$ 0,35	20,44	<0,001	4,52 (очень высокий)
	КГ	2,65 $\pm$ 0,48	2,98 $\pm$ 0,44	3,45	0,001	0,71 (средний)
5. Автономность обучения	ЭГ	3,02 $\pm$ 0,42	4,68 $\pm$ 0,31	19,85	0,001	4,49 (очень высокий)
	КГ	2,98 $\pm$ 0,45	3,15 $\pm$ 0,40	1,98	0,054	0,40 (низкий)
6. Педагогическая рефлексия	ЭГ	2,95 $\pm$ 0,47	4,52 $\pm$ 0,34	17,11	<0,001	3,81 (высокий)
	КГ	2,91 $\pm$ 0,50	3,08 $\pm$ 0,46	1,78	0,082	0,35 (низкий)
Общий показатель	ЭГ	2,96 $\pm$ 0,41	4,59 $\pm$ 0,28	22,34	<0,001	4,61 (очень высокий)
	КГ	2,94 $\pm$ 0,42	3,16 $\pm$ 0,38	2,51	0,016	0,53 (средний)

*M (Mean / Sample Mean) - выборочное среднее арифметическое значение, средний балл всей группы студентов по конкретному критерию. Вычисляется как сумма всех баллов студентов, деленная на их количество (n=42 в каждой группе).

*SD (Standard Deviation) - стандартное (среднеквадратическое) отклонение, показывает степень разброса данных вокруг среднего арифметического значения. Если SD отражает малое значение, это значит, что ответы студентов однородны, плотно сгруппированы вокруг среднего балла, и их уровень примерно одинаков. Если SD имеет большее значение, это указывает на сильную неоднородность группы: у кого-то баллы очень высокие, а у кого-то - очень низкие.

Источник: составлено авторами.

Для экспериментальной группы (ЭГ) общий показатель до эксперимента составлял: $2,96 \pm 0,41$, что показывает, что средний балл студентов ЭГ до начала обучения равен 2,96 (по 5-балльной шкале). При этом у большинства студентов (согласно правилу нормального распределения - около 68% выборки) индивидуальные баллы находились в диапазоне от $2,96 - 0,41$ до $2,96 + 0,41$, то есть в пределах от 2,55 до 3,37 баллов. Тот же показатель в ЭГ после эксперимента составил $4,59 \pm 0,28$, таким образом, средний балл качественно вырос до 4,59. Как мы видим, коэффициент разброса (SD) снизился с 0,41 до 0,28, что доказывает, что в результате обучения группа стала более однородной и обучение согласно модели, оказалось эффективным практически для всех студентов в группе, сгладив исходный разрыв.

Качественная составляющая исследования основывалась на контент-анализе рефлексивных отчётов студентов, подготовленных в процессе работы с ИИ-инструментами. Для более глубокого изучения когнитивных и эмоциональных аспектов педагогического опыта применялся программный комплекс LIWC. Данный инструмент использовался для определения того, как респонденты анализируют свои действия, а также степень их вовлеченности и характер взаимодействия в цифровой среде, что дало возможность преодолеть ограничения простой фиксации внешних результатов. В рамках данного подхода

были изучены внутренние процессы формирования профессиональных компетенций будущих педагогов. Исследовались изменения психолингвистических маркеров по трем целевым метакатегориям программы: «Когнитивные процессы» (Cognitive Processes), «Аналитическое мышление» (Analytic) и «Агентность/Автономность» (через фокус на местоимения первого лица I-words). Алгоритм работы включал лемматизацию (приведение слов к начальной форме) текстов отчетов, загрузку их в русскоязычный/английский модуль LIWC и последующий расчет процентной доли искомых категорий от общего объема словоупотреблений. Результаты контент-анализа до и после прохождения экспериментального курса представлены в Таблице 2.

Таблица 2. Изменение психолингвистических маркеров рефлексии в ЭГ по данным LIWC-анализа

Метакатегория LIWC	Ключевые текстовые маркеры (примеры слов)	До эксперимента (% от общего текста)	После эксперимента (% от общего текста)	Значение критерия (t)	Уровень значимости (p)	Интерпретация
Cognitive Processes (Когнитивная сложность)	<i>понимать, следовательно, потому что, адаптировать, критерий</i>	3,84 ±0,45%	7,62 ±0,51%	8,42	<0,001	Статистически значимый рост уровня глубины осознания опыта.
Analytic (Аналитичность речи)	Логические связи, структурирующие конструкции	42,10 (индекс)	64,85 (индекс)	9,15	<0,001	Смещение фокуса от эмоционального описания к системному анализу ИИ-инструментов.
I-words (Личная агентность)	<i>я, мой, меня, самостоятельно</i>	2,04 ±0,3%	4,91 ±0,39%	6,51	<0,01	Выраженная фиксация собственной автономности и ответственности за учебный результат.

Источник: составлено авторами.

На примере отчетов можно сказать, что качественный сдвиг иллюстрируется выдержками из отчетов. Если до эксперимента преобладали суждения: «Нам показали ИИ, это было интересно» (низкий показатель Analytic и Cognitive), то после эксперимента маркеры усложняются: «Я самостоятельно сконструировала промпт, потому что стандартные настройки выдавали галлюцинации; таким образом, мне пришлось изменить критерии проверки текста» (отражает высокий показатель LIWC по всем трем метрикам).

В ходе экспериментальной работы в учебный процесс были внедрены ИИ-инструменты для повышения уровня ИИ-компетентности. Так, для автоматизации разработки планов уроков, разноуровневых заданий и методических материалов были использованы и нейросети; сервисы распознавания речи были использованы с целью улучшения иноязычного произношения и отработки фонетических навыков участников, а также усвоения методики их применения на практике. Использование ИИ-тренажеров способствовало развитию навыков моделирования квазиреальных педагогических ситуаций, в ходе которых будущие учителя учились принимать решения в нестандартных условиях. Комплексный подход способствовал развитию у обучающихся основ ИИ-компетентности, критического и осознанного применения ИИ.

Сравнение полученных нами данных с результатами изученных исследований подтвердил, что методически обоснованное внедрение ИИ-технологий имеет положительный эффект на развитие автономности и формирование метакогнитивных навыков у будущих учителей иностранного языка [14-15]. Так, в экспериментальной группе наблюдалась более

выраженная положительная динамика роста автономности обучения по сравнению с контрольной группой (Рис.2).

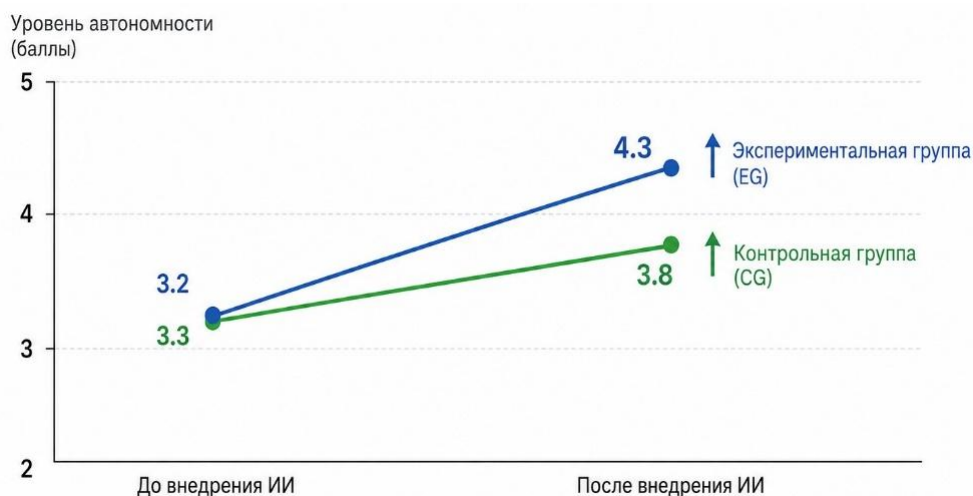


Рисунок 2. Влияние экспериментального обучения на динамику формирования уровня автономности участников

Источник: составлено авторами на основе анализа экспериментальных данных.

Полученные нами результаты позволяют предположить, что интеграция искусственного интеллекта в образовательную среду оказывает влияние как на формирование технологических навыков, так и на развитие когнитивных механизмов профессионального становления будущих педагогов. Взаимодействие с нейросетями и интеллектуальными системами приводит к тому, что обучающихся чаще анализируют свои действия. Студенты учатся переосмысливать педагогические решения и оценивать эффективность выбранных учебных стратегий. В результате этого процесса стимулируется развитие метакогнитивных способностей, в частности, навыки самоанализа и критический анализ приобретённого опыта.

Положительная динамика формирования ИИ-компетентности будущих учителей подтвердила эффективность предложенной модели. Рост показателей подтверждает, что внедрение систем искусственного интеллекта в учебный процесс формирует как операционально-технологические, так и навыки педагогической рефлексии и автономности. Полученные данные служат основой для реализации системной подготовки будущих учителей иностранных языков к работе в условиях цифровизации образования.

Выявленные закономерности во многом совпадают с результатами зарубежных исследований. При этом данные отражают также и специфику местной образовательной системы, где интеграция ИИ только начинает активно развиваться. Так, в международной образовательной практике искусственный интеллект часто рассматривают как инструмент индивидуализации обучения. Европейские учёные отмечают, что умные технологии помогают адаптировать учебный процесс под запросы конкретного обучающегося [16–17].

Развитие педагогической рефлексии при использовании ИИ технологий выступает отдельным и крайне важным аспектом использования интеллектуальных систем в образовательной практике. Интеллектуальные системы стимулируют обучающихся глубже осмысливать свой опыт уже на этапе их применения в виртуальных условиях, тогда как традиционные подходы фокусируются на развитии рефлексии преимущественно во время практики в школе. Кроме того, взаимодействие с ИИ в учебном процессе позволяет обеспечить быструю обратную связь, предоставляя новые возможности для самоанализа, что отражается в самой концепции расширенного интеллекта. Согласно данной концепции, технологии не заменяют человеческое мышление, а усиливают когнитивные возможности. ИИ здесь выступает фасилитатором, помогающим педагогу эффективнее решать профессиональные задачи.

Исследование подтвердило связь между ИИ-компетентностью и технологической самоэффективностью учителей. Студенты, уверенные в своих силах, меньше тревожились при работе с программами и охотнее внедряли инновации. Этот вывод коррелирует с положениями, выдвинутыми в цифровой психологии касательно того, что позитивное отношение к технологиям во многом определяет успех цифровизации [18-19].

Существуют и ограничения к использованию современных цифровых технологий в образовательной деятельности. Интенсивная работа с цифровыми ресурсами перегружает студентов, в случае нерациональной организации процесса обучения с использованием ИИ. Кроме того, сохраняется проблема слепого доверия к информации, сгенерированной нейросетями без ее критического осмысления. Сегодня осознанное использование искусственного интеллекта, в том числе критический подход к информации, сгенерированной нейросетями в различном формате, педагогической рефлексии, включая аспекты анализа достоверности данных и оценки этических аспектов работы с ИИ выступают обязательной составляющей ИИ-компетентности.

Заключение. Апробированная в рамках исследования практико-ориентированная модель формирования ИИ-компетентности будущих педагогов иностранного языка, основанная на интеграции концептуальных положений TRACK-AI и компонента технологической самоэффективности (TAICS), продемонстрировала высокую результативность, что подтверждается статистически значимыми изменениями исследуемых показателей. Полученные данные свидетельствуют о том, что системное использование искусственного интеллекта в образовательном процессе способствует не только освоению технических навыков, но и трансформации педагогического мышления, выражающейся в более осознанном и гибком подходе к проектированию и реализации учебной деятельности.

Использование в образовательной практике генеративных моделей и текстовых симуляторов позволило расширить спектр профессионально ориентированных учебных ситуаций и создать условия, приближённые к реальной педагогической деятельности. Это, в свою очередь, усилило практическую направленность подготовки и способствовало развитию у обучающихся готовности к принятию педагогических решений в условиях неопределённости и изменяющейся образовательной среды.

Практическая значимость исследования определяется возможностью внедрения предложенной модели и соответствующих методических решений в систему высшего педагогического образования Казахстана.

В целом, результаты проведённого эксперимента подтвердили, что технологии искусственного интеллекта выступают средством индивидуализации обучения и развития профессиональных компетенций будущих педагогов. Необходим переход от точечного и фрагментарного использования программ обучения к системной интеграции ИИ в педагогическое образование. Для этого нужны проверенные модели подготовки, учитывающие как технические, так и психологические нюансы взаимодействия человека с ИИ-технологиями.

Информация о финансировании. Статья подготовлена в рамках выполнения договора на грантовое финансирование проекта ИРН AP26104435 «Интеграция искусственного интеллекта в практику иноязычного образования: обзор, систематизация и механизмы внедрения ИИ-инструментов в профессиональную деятельность преподавателей высших учебных заведений».

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ТРАСК-АІ ЖӘНЕ TAICS ТЕХНОЛОГИЯЛЫҚ ӨЗІНДІК ТИІМДІЛІК ТӘСІЛДЕРІНЕ НЕГІЗДЕЛГЕН БОЛАШАҚ ШЕТЕЛ ТІЛІ МҰҒАЛІМДЕРІНІҢ ЖАСАНДЫ ИНТЕЛЛЕКТ ҚҰЗЫРЕТТІЛІГІН ДАМУ

Аңдатпа

Мақалада жаһандық цифрландыру жағдайында болашақ шетел тілі мұғалімдерінің ЖИ-құзыреттілігін қалыптастырудың өзекті мәселесі зерттеледі. Зерттеудің мақсаты мамандандырылған оқыту әдістері жүйесі арқылы жүзеге асырылатын Teacher AI Competence Self-efficacy (TAICS) технологиялық педагогикалық мазмұндық білім беру - Artificial Intelligence (Trask-AI) құрылымын және технологиялық өзіндік тиімділік компонентін интеграциялауға негізделген ЖИ құзыреттілігін қалыптастырудың моделін теориялық негіздеу және эксперименттік тексеру болып табылады.

Зерттеу әдістемесі аралас тәсілге (аралас әдістер) негізделген 84 студенттің тестілеу және сауалнамасын, сондай-ақ linguistic Inquiry and Word Count (Liwc) құралы арқылы рефлексиялық есептердің лингвистикалық мазмұнын талдауды қамтиды. Оқу процесі академиялық семестрде ұйымдастырылды оқу материалдарын жасау үшін генеративті тілдік модельдерді қолдана отырып оқытуды және нақты педагогикалық жағдайларды мәтіндік жасанды интеллект симуляторлары арқылы модельдеуді қамтиды. Оқыту үрдісін жүзеге асырудың техникалық шарттарына тілдік модельдерге, мұғалімдерге арналған мамандандырылған жасанды интеллект сервистеріне, шетел тіліндегі ауызша сөйлеуді жаттықтыру және бағалау сервистеріне және мәтіндік жасанды интеллект симуляторларына қол жеткізу кірді.

Ұсынылған модельдің тиімділігі эксперименталды түрде дәлелденді. Мақаланың тұжырымдары мақсатпен байланысты және ТРАСК-АІ+ТАICS моделімен бекітілген АІ құралдарының жүйелік интеграциясы болашақ шетел тілі мұғалімдерінің ЖИ-құзыреттілігін қалыптастыруға және олардың педагогикалық ойлауының сапалы түрде ықпал ететінін, және осылайша білім берудегі технологиялық алшақтықты жоятынын дәлелдейді.

Түйінді сөздер: жасанды интеллект, ЖИ - құзыреттілік, тілдік модельдер, мұғалімдерге арналған мамандандырылған жасанды интеллект сервистері, мәтіндік жасанды интеллект симуляторлары, технологиялық өзіндік тиімділік (TAICS), педагогикалық рефлексия.

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DEVELOPING PRE-SERVICE FOREIGN LANGUAGE TEACHERS' AI COMPETENCE ON TPACK-AI AND TAICS TECHNOLOGICAL SELF-EFFICIENCY APPROACHES

Abstract

This article examines the urgent issue of developing pre-service foreign language teachers' AI competence in the context of global digitalization. The aim of the study is to provide a theoretical justification and experimental validation of a model for developing AI competence, based on the integration of the Technological Pedagogical Content Knowledge – Artificial Intelligence (TPACK-AI) framework and the Teacher AI Competence Self-efficacy (TAICS) component, implemented through a system of specialized teaching methods.

The research methodology is based on a mixed-methods approach and includes testing and survey of 84 students, as well as linguistic content analysis of reflective reports using the Linguistic Inquiry and Word Count (LIWC) tool. The training process was organized over the course of an academic semester and involved learning using generative language models to create teaching materials and text AI simulators to model real-life pedagogical situations. The technical conditions for conducting the training included access to language models, specialized AI services for teachers, services for practicing and assessing foreign language oral speech, and AI text simulators.

The effectiveness of the proposed model has been experimentally proven. The conclusions of the article are consistent with the stated objective and demonstrate that the systematic integration of AI tools, supported by the TPACK-AI+TAICS model, enables pre-service foreign language teachers' AI competence development as well as a qualitative transformation of their pedagogical thinking, thereby helping to bridge the technological divide in education.

Keywords: artificial intelligence, AI competence, language models, specialized AI services for teachers, AI text simulators, technological self-efficacy (TAICS), pedagogical reflection.

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PEDAGOGICAL ANALYSIS OF TEACHING THE COURSE “ARTIFICIAL INTELLIGENCE IN CHEMISTRY” TO PROSPECTIVE CHEMISTRY TEACHERS

Abstract

This research paper examines the implementation and perceived outcomes of a practice-oriented course focusing on the application of artificial intelligence in the professional training of prospective chemistry teachers. The study, which took place during the 2025-26 academic year, involved 48 third-year undergraduate chemistry education students (n = 48) at a pedagogical university. The experimental work was carried out as part of the course «Using Artificial Intelligence in Chemistry Teaching» and was delivered exclusively through practical classes.

The research employed an exploratory one-group study, a questionnaire survey, an analysis of students' learning products, and qualitative methods. The findings indicated predominantly positive self-reported levels of students' digital, methodological, and professional skills. Quantitative results revealed a predominance of good and very good levels across most indicators, while qualitative analysis indicated of a reflective, pedagogically grounded approach to using artificial intelligence in chemistry teaching.

These results suggest the potential educational value and feasibility of integrating AI-oriented courses into the professional training of future chemistry teachers in the context of digital transformation in education.

Key words: artificial intelligence, chemistry education, prospective chemistry teachers, AI literacy, digital competence, technological pedagogical content knowledge (TPACK), professional training.

Introduction. The rapid digitalisation of education means that artificial intelligence (AI) is now one of the key factors in transforming higher teacher education. Modern AI technologies are being introduced into the educational process to provide personalised learning, automate routine pedagogical tasks, visualise complex concepts, and support learning analytics. AI is particularly relevant in chemistry education, where studying abstract, microscopic, and dynamic processes requires intelligent digital tools and models.

Current research shows that integrating AI into chemistry education can lead to a deeper understanding of learning materials, the development of research skills, and increased motivation among learners [1]. However, the effectiveness of AI applications depends heavily on the professional preparedness of teachers, particularly future chemistry teachers. Insufficient preparedness for the pedagogically sound use of AI can result in the formal, fragmented, or unethical use of these technologies in educational practice.

Scientific research pays special attention to training future chemistry teachers and developing their digital and AI competence. Empirical studies show that, while students of pedagogical specialities generally have a positive attitude towards the use of artificial intelligence in teaching, they demonstrate different levels of knowledge, practical experience, and confidence in using AI tools [2, 3]. However, there are also risks associated with a potential decline in critical thinking, reliance on AI systems, and the inadequate preparedness of future teachers to utilise these tools effectively.

In the context of the professional training of chemistry teachers, the concept of technological pedagogical content knowledge (TPACK) is of particular importance, as it considers the integration of subject content, pedagogy, and technology as a holistic process. Studies show that developing TPACK in future chemistry teachers is necessary for effectively implementing innovative

technologies, including AI, in a digitalised education system [4]. However, the development of TPACK in relation to AI remains insufficiently studied and systematised.

Additionally, analysis of the current state of pedagogical education reveals insufficient digital competence among future teachers, hindering the integration of AI technologies into teaching [5]. This highlights the need for the intentional design of educational disciplines that not only equip students with the technical skills to work with AI, but also provide them with a pedagogical understanding of its possibilities, limitations, and ethical implications.

Despite the growing interest in using artificial intelligence in chemistry education, there is still a scientific gap between AI's potential capabilities and the actual pedagogical readiness of future chemistry teachers to apply it. This gap highlights the importance of developing and implementing a special training course that fosters a comprehensive understanding of the pedagogically sound use of artificial intelligence in chemistry among students.

This study is relevant because of the need to modernise the professional training of future chemistry teachers in an era of the active implementation of artificial intelligence in educational practice. Including the discipline 'Using Artificial Intelligence in Chemistry' in pedagogical university curricula enables the intentional development of students' AI literacy, digital competence, and TPACK knowledge, ensuring they are prepared for effective and responsible pedagogical activities in digital educational environments.

This article aims to provide a theoretical justification and pedagogical analysis of teaching this discipline to third-year students on the «Chemistry» programme, as well as identify its role in developing the professional and digital competencies of future chemistry teachers.

The theoretical significance of the study lies in clarifying the pedagogical foundations for integrating artificial intelligence into the training of future chemistry teachers, as well as expanding scientific ideas about developing TPACK knowledge and AI competence in chemical education.

The study's practical significance lies in its potential to inform the development and enhancement of academic disciplines, teaching materials, and educational programmes at pedagogical universities, with the aim of fostering the pedagogical and ethical application of artificial intelligence in educational practice among future chemistry teachers.

Literature review.

The rapid development of artificial intelligence (AI), including generative models (GenAI), is shaping a new educational landscape. The ways in which information is retrieved, materials are prepared, and assessments are conducted are changing, as are the nature of learning tasks and classroom communication. In pedagogy, this shift is accompanied by the transition from sporadic use of digital tools to the systematic integration of AI as a means of personalising learning, supporting teachers, and developing learners' competencies.

AI is a transformative factor in education and pedagogical approaches.

In the Kazakhstani and regional discourse, it is considered not only a technological trend but also a basis for rethinking pedagogical approaches in higher education. This emphasises the need to shift the focus from reproductive learning to models in which students actively construct knowledge, solve practical problems, and use digital tools for analysis and decision-making. In this context, AI acts as a 'catalyst' for updating teaching methods and training content for future specialists, as well as strengthening the teacher's role as an educational environment designer and mentor [6].

At the same time, it is acknowledged that the implementation of AI in education necessitates the development of digital literacy and an understanding of associated risks, such as those relating to ethics, authenticity, academic integrity, and data security. Additionally, the development of regulatory mechanisms at the course/programme level is required. Review papers on AI in education emphasise that successful implementation depends not on the number of «tools», but on the correct methodological approach to their application and on teachers' readiness to manage learning activities in a digital environment [7].

Kazakh-language research on primary education emphasizes that the systematic use of digital technologies can increase the interactivity and visibility of learning materials, strengthen students' motivation, cognitive engagement, creativity, and critical thinking, and support more flexible

organization of the learning process [8]. At the same time, their educational effectiveness depends on teachers' digital competence and the methodologically sound integration of digital tools into classroom practice

AI in teaching chemistry: functional literacy and practice-oriented learning.

As a fundamental discipline, chemistry is oriented towards developing logical reasoning, analytical and critical thinking, and research skills, as well as a practical approach to learning. In the context of digital transformation, the development of functional literacy the ability to apply knowledge and skills in educational, professional, and everyday situations is particularly important. Tusupbekova & Orazbayeva's (2025) [9] research demonstrates that integrating AI into chemistry teaching expands the toolkit for developing functional literacy. AI can support the personalisation of learning, the automation of assessment, the visualisation of complex processes, the intellectual support of learning activities, and the simulation of realistic situations.

This approach is important because it shifts the focus from «knowledge for knowledge's sake» to the practical application of chemical concepts. Students learn to interpret data, explain phenomena, justify conclusions, analyse experimental results, and make evidence-based decisions. Here, AI and digital tools become an environment that can enhance the research and design component of learning, rather than a substitute for thinking.

Broader publications forecasting the future of chemical education emphasise the need to update educational content and methods to incorporate digital technologies and AI, as well as strengthening the practical element and interdisciplinarity. Such works generally convey the message that chemical education must address contemporary challenges by training specialists who can work with data, modelling, and modern digital environments while maintaining scientific rigor and experimental culture [10].

Linking AI research in chemistry and learning objectives: what matters for didactics.

Another area of interest is the discussion of how the application of AI to chemical research is changing the training requirements of students and future teachers. Berber et al. (2025) [11] argue that AI in chemical research inevitably affects teaching and learning and that it is necessary to educate students in the principles of AI, the limitations of algorithms, the interpretability of results, and the correct handling of data. Consequently, chemistry teaching should include tasks that do not simply provide students with answers but encourage them to verify correctness, compare results, draw reasoned conclusions, and grasp the limitations of numerical solutions.

This thesis highlights the importance of disciplines that promote the competent and ethical use of AI in teaching. A future chemistry teacher should know how to apply AI capabilities to didactic scenarios, including visualisation, simulations, analysis of experimental data, and preparation of teaching materials.

Competence of the future teacher in the digital age: from 'digital skills' to GenAI competences.

The readiness of teachers, especially future teachers, is a key condition for the effective integration of AI. Works on the didactics of the digital age note that the professional training of future chemistry teachers can no longer be conceived without modern digital technologies. The focus of education is shifting towards the development of digital literacy and skills, while the fundamental objective of knowledge, skill, and experience acquisition remains unchanged. The authors emphasise the need to integrate digital technologies into traditional learning, providing examples of tools that contribute to the development of general professional competencies, such as digital/virtual laboratories, video content creation, and the use of the university's digital learning environment.

But there are also rules: digital independent work needs teaching control and keeping up the quality of the content, and the choice of technology should be based on the learning goals and the features of the learning material [12].

The concept of GenAI competence emerges at the next level of discussion. Xia et al. (2025) [13] propose and validate the Generative Artificial Intelligence Competency Self-Efficacy Scale for Teachers and Researchers (GAICS-TR) in higher education. They emphasise that existing digital/AI competency frameworks often fail to consider the impact of GenAI on assessment and research activities sufficiently. The authors highlight the domains and dimensions of competence: a basic

understanding of GenAI and ethics; teaching with GenAI (student interaction, instructional design, and assessment); research with GenAI; and professional engagement. The scale itself is seen as a tool for diagnosing professional development needs and developing institutional policies. In terms of training future chemistry teachers, it is not enough to simply teach them how to 'use the tool'; it is also important to develop their ability to design learning tasks that promote academic integrity, data security, accurate assessment, and critical thinking.

Literature findings and identified research gap.

The analysis of sources enables us to identify several consistent themes:

- AI establishes a new context for higher education, necessitating a revision of pedagogical approaches, particularly in the training of future teachers [6, pp. 83-87; 7, p. 7; 8, pp. 79-84].
- In chemistry teaching, AI shows promise as a means of developing functional literacy through visualisation, modelling, analysis, and supporting learning activities [9, pp. 186-203].
- The development of AI in chemical research emphasises the importance of incorporating AI topics into teaching in a didactic manner [11, pp. 1445-1456].
- The key condition for effectiveness is teacher competence, ranging from digital skills and tool proficiency to comprehensive GenAI competence [12, pp. 222-226; 13, p. 12].

However, there is a practical deficit in the literature: while many works describe possibilities and general directions, comparatively few present modular, discipline-specific solutions for training future chemistry teachers where AI is integrated into the teaching process through clearly defined objectives, tasks, assessment methods, and criteria. Consequently, there is an urgent need to describe and validate real-life training courses and syllabuses for future chemistry teachers that aim to develop the skills needed to meaningfully apply AI in teaching scenarios.

The scientific novelty of this study lies in the development and empirical implementation of a discipline-specific, practice-oriented model for integrating artificial intelligence into the professional training of prospective chemistry teachers. Unlike studies that primarily examine general perceptions of AI or the use of individual digital tools, this study presents an integrated course design that combines chemistry content, AI-supported learning-product development, pedagogical reflection, and the evaluation of digital, methodological, and professional skills. The authors' contribution consists in specifying the course structure, practical lesson sequence, AI-supported tasks, and assessment indicators that can be adapted for chemistry teacher education.

Methods and materials

Organisation and basis of the study. The research was conducted during the 2025/26 academic year (first semester, fifth semester of study) at South Kazakhstan Pedagogical University, Faculty of Natural Sciences, Department of Chemistry.

The experiment was implemented within the framework of the «Use of artificial intelligence in teaching chemistry» discipline, which is studied by third-year students on the «6B01504 - Chemistry teacher training» educational programme.

This applied discipline was implemented exclusively in the format of practical classes due to its content and objectives, which are oriented towards forming the digital, methodological and professional competencies of future chemistry teachers.

Study participants. The experiment involved 3rd year students enrolled in the specified educational program. Classes were held in several academic groups. The distribution of the study participants by academic group and gender is presented in Table 1. The study followed a one-group design, and the participants were not divided into experimental and control groups.

Table 1. Characteristics of the study participants

Groups	Total number of students	female	male
1507-13A	19	4	15
1507-23	12	3	9
1507-33	17	2	15
Total	48	9	39

Source: developed by the author

All participants had previously studied subjects related to digital and information technologies in education, but they did not have special training in the use of artificial intelligence in chemistry education.

Characteristics of the discipline and format of lessons.

The discipline «Use of Artificial Intelligence in Chemistry Teaching» aims to develop the pedagogical skills of future chemistry teachers in the application of AI tools in the teaching process. This includes the development of teaching tasks, visualisation of chemical processes, creation of teaching videos, analysis and interpretation of experimental data, and design of interactive teaching methods.

All classes are conducted as practical sessions, during which students perform individual and group tasks using AI tools.

The following digital and AI tools were used during the practical exercises, which are summarised in Table 2.

Table 2. Digital and artificial intelligence tools used in the experiment

Tool	Developer and access	Function
ChatGPT	OpenAI; web version available during the first semester of 2025–2026	Generation of text explanations, lesson scenarios, and methodological comments
Gemini	Google; web version available during the first semester of 2025–2026	Preparation of alternative explanations and examples on chemistry topics
Grok	xAI; web version available during the first semester of 2025–2026	Generation of visual and video materials illustrating chemical processes
CapCut	ByteDance; application version available during the first semester of 2025–2026	Creation and editing of educational videos
Canva and other online services	Web-based platforms available during the first semester of 2025–2026	Support for visualization, presentation, and demonstration of results

Source: developed by the author

These tools were all used in one practical session or a series of interrelated sessions, thus ensuring the integrity of the training scenario.

Scenario of practical training sessions.

The practical lessons were based on a unified scenario, comprising the following stages:

- Formulation of a learning task on a specific chemistry topic.
- Selection of AI tools to solve the task.
- Development of a learning product (e.g., text, infographics, or video).
- Presentation and discussion of the results.
- Reflection on and methodological analysis of the possibility of applying the created product in school practice (table 3).

Table 3. Example of the structure of a practical lesson

Stage	Content of the activity	Tools used
Setting the task	Statement of the lesson's purpose and topic	Teacher
Designing	Developing a scenario for explaining the topic	ChatGPT, Gemini
Realization	Creating a video or visualization	CapCut, Grok
Performance	Demonstration of the results	Multimedia (Canva)
Analysis	Discussion and pedagogical assessment	Group discussion

Source: developed by the author

Videos as part of the experimental basis:

1. During practical classes, students developed educational videos reflecting the content of chemical topics and the methodology used to explain them, with the help of AI tools.

2. The videos were used exclusively for educational purposes and do not disclose the personal data of the students.

3. Examples of the videos are available via external links (Google Drive) and are intended to illustrate and support the experimental work.

Research methods.

The pedagogical experiment comprised three stages: preparatory, implementation, and diagnostic-analytical. The final assessment included a questionnaire and analysis of students' learning products, while no separate initial diagnostic assessment was conducted. The independent variable was the implementation of the practice-oriented AI course, and the dependent indicators were students' self-reported digital, methodological, and professional skills.

The research methods used in this study are systematically presented in Figure 1. They include pedagogical experimentation, observation of students' learning activities, analysis of learning products, comparative analysis of practical work results, and qualitative analysis of skills development.

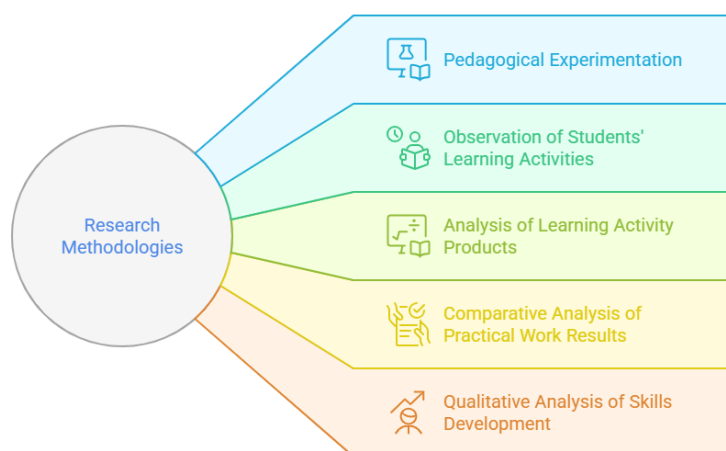


Figure 1. Research methodologies

Source: developed by the author

These research methods were chosen due to the specific objectives and the practice-oriented nature of the discipline. The pedagogical experiment, the leading method, allowed us to study the formation of professional and digital competencies in students in the real conditions of the educational process. This approach is in line with modern methods of analyzing the quality of educational products in higher education systems [14]. Observation and analysis of learning activity products provided a comprehensive review of practical lesson results, including student-developed videos, lesson scripts, and visual learning products. Qualitative analysis was employed to examine the role of digitalization in the development of general professional competencies in future chemistry teachers, with a particular focus on the practical application of digital tools and the reflection on learning experiences [12, p. 61-68].

The author-developed questionnaire was designed in accordance with the course learning outcomes and covered three dimensions: digital, methodological, and professional skills. As the questionnaire was used as an exploratory descriptive instrument, its psychometric validity and internal consistency were not independently tested.

This study is particularly interested in the work of Kolyada and Bugaeva (2019) [15], which considers artificial intelligence (AI) as a driving force for the innovative development of education even at an early stage of its development. The authors emphasize that introducing intelligent systems into the educational process requires technological readiness and a rethink of pedagogical approaches, teaching methods, and assessment of learning outcomes. Formulated before the widespread adoption of generative AI tools, this thesis confirms the relevance of applying qualitative research methods to analyze the pedagogical feasibility of using artificial intelligence in education and is fully aligned with the logic of the present study.

Statistical analysis. Due to the exploratory one-group design of the study and the absence of pre-test and control-group data, the quantitative findings were analysed using descriptive statistics. Frequencies and percentages were calculated for each response category, and the combined proportion of “good” and “very good” responses was used as a descriptive indicator of positive course outcomes. No inferential statistical tests were performed; therefore, the results are interpreted as descriptive evidence of students’ perceived skill levels after completing the course rather than as proof of statistically significant improvement or a causal effect of the course.

Results and discussion. To quantitatively assess the results of the pedagogical experiment, the distribution of students' responses to ten closed questions in the questionnaire was analyzed. Each question was evaluated on a four-point scale: «low» (0-49 points), «average» (50-64 points), «good» (65-84 points) and «very good» (85-100 points) (Appendix). This gradation enabled us to determine the level at which the learning material was mastered and the quality of the future chemistry teachers' professional and digital skills.

The generalized results of students' responses to each question are presented in Table 4.

Table 4. Distribution of students’ responses to closed questions by performance level (N = 48)

Question	Low (0-50)	Average (51-65)	Good (66-85)	Very good (86-100)	Quality (%)
Q1	4 (8.3%)	6 (12.5%)	22 (45.8%)	16 (33.3%)	79
Q2	3 (6.3%)	5 (10.4%)	24 (50.0%)	16 (33.3%)	83
Q3	5 (10.4%)	7 (14.6%)	20 (41.7%)	16 (33.3%)	75
Q4	2 (4.2%)	6 (12.5%)	23 (47.9%)	17 (35.4%)	83
Q5	4 (8.3%)	8 (16.7%)	21 (43.8%)	15 (31.3%)	75
Q6	3 (6.3%)	7 (14.6%)	22 (45.8%)	16 (33.3%)	79
Q7	2 (4.2%)	6 (12.5%)	24 (50.0%)	16 (33.3%)	83
Q8	5 (10.4%)	6 (12.5%)	21 (43.8%)	16 (33.3%)	77
Q9	4 (8.3%)	7 (14.6%)	22 (45.8%)	15 (31.3%)	77
Q10	3 (6.3%)	6 (12.5%)	23 (47.9%)	16 (33.3%)	81

Note: Q1–Q4 assess digital skills; Q5, Q6, and Q9 assess methodological skills; Q7, Q8, and Q10 assess professional skills. Quality (%) = Good + Very good.

Source: developed by the author

The generalized results of the students' responses presented in Table 4 are interpreted in Figure 2.

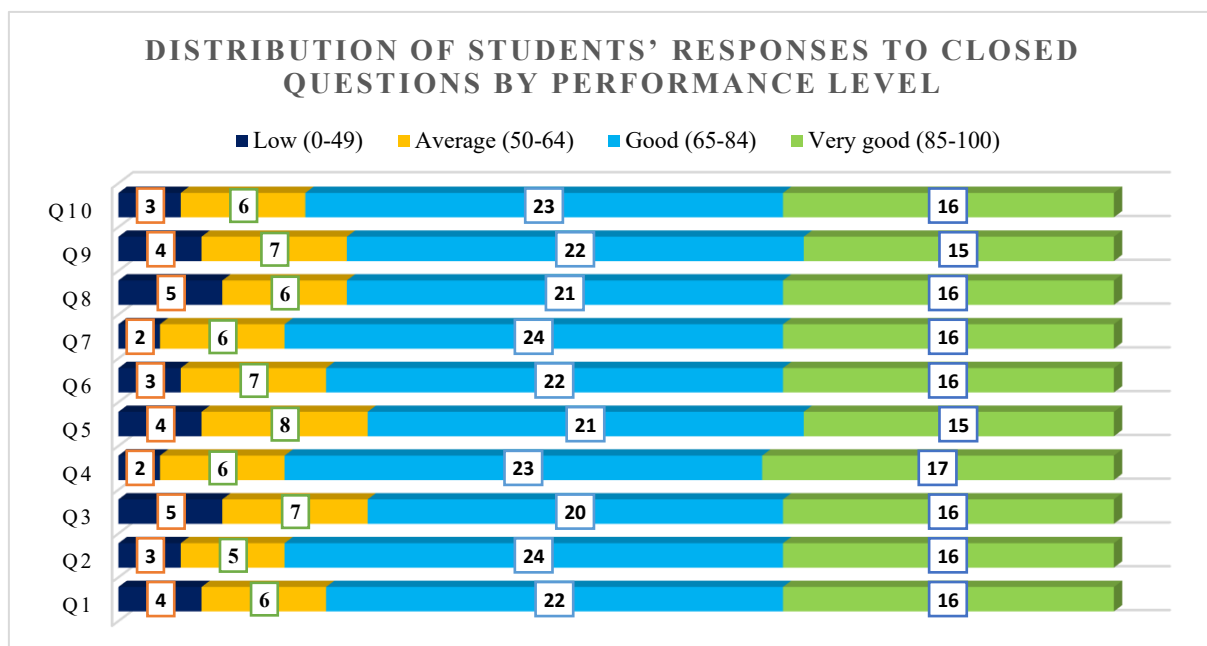


Figure 2. Distribution of students’ responses to closed questions by performance level

Source: developed by the author

As the data in Table 4 and Figure 2 show, the majority of responses to all questions in the questionnaire were at good or very good levels. On average, between 70% and 83% of students achieved a positive result in each indicator, indicating predominantly positive self-reported levels of digital, methodological, and professional skills by the end of the course. To identify differences in learning outcomes between study groups, a comparative analysis of student responses was conducted. The percentage of students who achieved good or very good grades was used as an overall indicator of the quality of education.

The percentage indicators of the quality of education for each study group are presented in Table 5.

Table 5. Comparative results of learning quality by academic groups (%)

Group	Low + Average (%)	Good + Very good (%)
1507-13A	26	74
1507-23	33	67
1507-33	24	76
Average	28	72

Source: developed by the author

Analysis of the data in Table 5 shows that, in all study groups, the proportion of students demonstrating a good or very good level exceeds the proportion demonstrating a low or average level. The percentage of positive results ranges from 67% to 76%, indicating the discipline's comparable effectiveness in different study groups.

Figure 3 provides a visual interpretation of the comparative results by group, clearly showing the differences and general trends in learning quality.

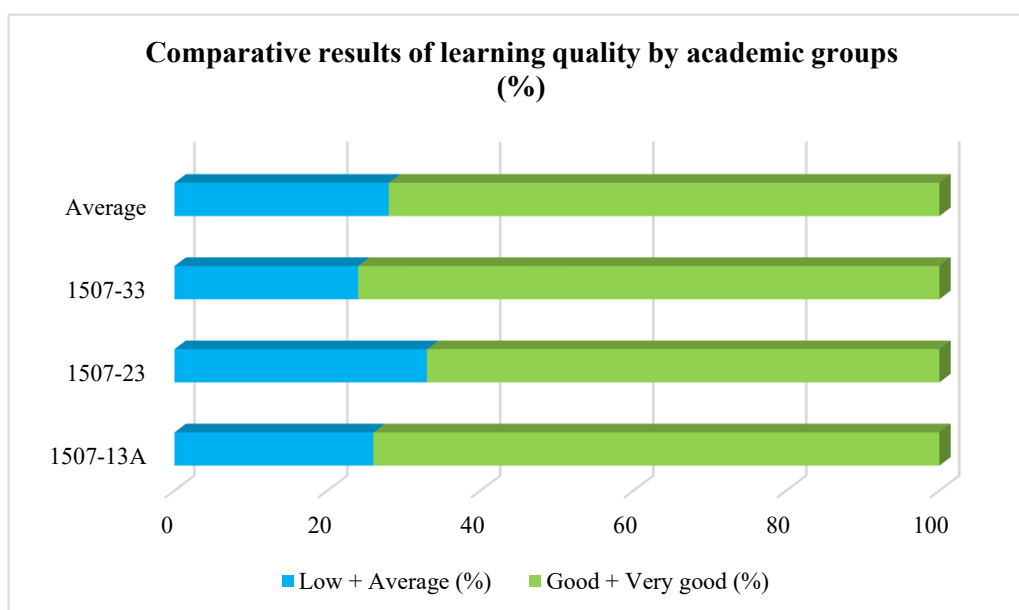


Figure 3. Comparative results of learning quality by academic groups (%)

Source: developed by the author

To ensure a comprehensive assessment of learning outcomes, the study was conducted using a questionnaire comprising both closed and open-ended questions. This combination enabled a combination of quantitative and qualitative approaches to analyze the effectiveness of the discipline.

The structure of the questionnaire and the distribution of question types are shown in Table 6.

Table 6. Structure of the questionnaire

Type of questions	Number	Purpose
Closed questions	10	Assessment of digital, methodological, and professional skills
Open questions	5	Qualitative analysis of students' learning experience
Total	15	Comprehensive evaluation of learning outcomes

Source: developed by the author

As illustrated in Table 6, closed questions enabled the quantitative assessment of skill development, while open questions facilitated the identification of individual perceptions of the course and its professional impact.

To gain a deeper understanding of the results of the pedagogical experiment, a qualitative analysis of students' responses to the open-ended questionnaire was conducted. This analysis included students' most typical and meaningful statements about the teaching process and its outcomes.

Examples of students' responses are presented in Table 7.

Table 7. Examples of students' responses to open-ended questions

Student	Key idea of the response
Student A	AI tools helped structure explanations of chemical concepts and lesson planning
Student B	Visualization improved understanding of abstract chemical processes
Student C	Creating videos enhanced confidence and pedagogical thinking
Student D	Emphasized the need for critical evaluation of AI-generated content
Student E	Course changed perception of digital tools in chemistry teaching

Source: developed by the author

Analysis of the statements shows that students recognize the pedagogical value of using artificial intelligence in chemistry teaching. They note that it develops methodological thinking, increases the visibility of teaching materials, and fosters a reflective attitude towards digital tools.

A summary analysis of the quantitative and qualitative data from the study was conducted to summarize the findings and formulate final conclusions.

Summary indicators of discipline effectiveness are presented in Table 8.

Table 8. Summary of learning outcomes

Indicator	Result
Students demonstrating good and very good levels	67-76%
Students requiring further development	24-33%
Overall effectiveness of the discipline	High

Source: developed by the author

The summarized data in Table 8 indicate that the implementation of the discipline «Using artificial Intelligence in Chemistry teaching» was associated with predominantly good and very good self-reported levels of students' professional and digital skills and may have potential value as an element of the professional training of future chemistry teachers.

The descriptive findings indicated that implementing the discipline 'Using Artificial Intelligence in Chemistry Teaching' in a practical was associated with predominantly positive self-reported levels of the digital, methodological, and professional skills of future chemistry teachers. Quantitative data indicate a high prevalence of good and very good levels for most evaluation indicators, with an average integral indicator of teaching quality (good + very good) of over 70%. This suggests that using artificial intelligence tools in practical classes may support students' perceived learning outcomes and the development of applied pedagogical skills.

These results are consistent with studies on the development of TPACK knowledge and the digital competence of future teachers. Bakazhanova et al. [4, pp. 40-51] therefore emphasize that the effectiveness of digital technologies in chemistry teacher training is determined by their methodologically sound integration into the teaching process rather than by the number of tools used. In our study, AI tools were used to solve specific didactic tasks, such as developing lesson scenarios, visualizing chemical processes, and creating training videos. This illustrates the relevance of the TPACK approach in the context of the digitalization of teacher education.

The results also correlate with international data on the perceptions and use of AI among future teachers. Iyamuremye et al. (2024) [1, p. 10] found that AI is most effectively used in chemistry education to visualize and analyze learning activities, with pedagogical readiness of learners remaining a key factor. Similar findings are presented in Harianti et al. [2, pp. 5-12], who note that practical work with AI increases future teachers' confidence and promotes the informed use of digital technologies in teaching.

Of particular note is the comparison of the present study's findings with those of earlier research papers. For instance, even before the widespread adoption of generative AI, Kolyada and Bugayeva [15, pp. 21-30] considered artificial intelligence to be a driving force in innovative educational development. They emphasized the importance of educators adopting a critical and methodologically sound approach to its use. The descriptive findings of the present study are consistent with these arguments and suggest that systematically including AI in pedagogical programs may contribute to the modernization of future chemistry teachers.

Recent international studies provide a broader context for interpreting the present findings. Ramnarain et al. [16] found that AI literacy, attitudes, perceived behavioral control, subjective norms, and perceived usefulness significantly influenced preservice science teachers' intentions to use GenAI in inquiry-based teaching, demonstrating that technical familiarity alone is insufficient without pedagogical readiness. Perceived usefulness, ease of use, and self-efficacy were also identified as significant predictors of preservice teachers' intentions to adopt GenAI after participation in a structured AI-integrated activity [17]. The systematic review by Ponomarenko et al. [18] further showed that initially limited AI knowledge and skills among preservice teachers could improve through targeted training and hands-on experience, although concerns related to academic integrity, data privacy, and fairness remained. In chemistry teacher education, Akaygun & Kilic [19] found that preservice teachers valued GenAI-generated visuals for their attractiveness and instructional potential but also identified scientific, pedagogical, and representational limitations, emphasizing the need for critical evaluation through PCK and TPACK perspectives. GenAI adoption among preservice chemistry teachers was additionally found to depend on performance and effort expectancy, social norms, facilitating conditions, and perceived behavioral control, with behavioral intention emerging as the strongest predictor of actual use [20]. Taken together, these studies support the practice-oriented focus of the present course while indicating that positive self-reported outcomes should be interpreted as perceived readiness rather than conclusive evidence of course effectiveness.

Several *limitations* should be considered when interpreting the findings. First, the study involved a relatively small sample of 48 students from a single pedagogical university, which limits the generalizability of the results. Second, the absence of a control group and pre- and post-course measurements prevents causal conclusions regarding the effectiveness of the discipline. Third, the quantitative analysis was based on aggregated self-reported responses and descriptive statistics; therefore, statistically significant changes or differences between groups could not be established. Future research should employ larger and more diverse samples, validated assessment instruments, control groups, and longitudinal or pre-test–post-test designs to evaluate changes in prospective chemistry teachers' AI-related competencies more rigorously.

Conclusion. During the research, the practice-oriented discipline «Using Artificial Intelligence in Chemistry Teaching», which aimed to develop the digital, methodological and professional skills of future chemistry teachers, was tested in practice. The descriptive results indicated that, after participating in the practical classes, students reported predominantly positive levels of digital,

methodological, and professional skills, a reflective attitude towards the use of digital technologies, and readiness to apply them pedagogically in school practice.

Quantitative and qualitative data from the study indicate predominantly positive self-reported levels in professional confidence, methodological thinking, and the visualization of teaching materials. Analysis of students' responses to open-ended questions suggested that the participating students generally perceived artificial intelligence not as a substitute for pedagogical activity, but as a tool to support and expand the didactic possibilities of chemistry teaching.

Consequently, the findings of this study suggest that further consideration may be given to incorporating disciplines centered on the practical application of artificial intelligence into the professional training program for prospective chemistry teachers. Implementing such courses would contribute to the modernization of pedagogical education in the context of digitalization and could be considered an effective way to update the content and methods of teaching at pedagogical universities.

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**БОЛАШАҚ ХИМИЯ МҰҒАЛІМДЕРІНЕ «ХИМИЯДАҒЫ ЖАСАНДЫ ИНТЕЛЛЕКТ»
КУРСЫН ОҚЫТУДЫҢ ПЕДАГОГИКАЛЫҚ ТАЛДАУЫ**

Аңдатпа

Мақалада болашақ химия мұғалімі мұғалімдерін кәсіби даярлауда жасанды интеллектті қолдануға бағытталған тәжірибеге бағдарланған курсты енгізу үдерісі мен білім алушылардың қабылдауына негізделген нәтижелері қарастырылады. Зерттеу 2025–2026 оқу жылында педагогикалық университеттің химия мұғалімдерін даярлау білім беру бағдарламасында оқитын үшінші курс студенттерінің қатысуымен жүргізілді ($n = 48$). Зерттеу жұмысы тек практикалық сабақтар форматында өткізілген «Химияны оқытуда жасанды интеллектті қолдану» курсы аясында жүзеге асырылды.

Зерттеуде бір топқа негізделген барлау сипатындағы зерттеу дизайны, сауалнама, студенттердің оқу әрекеті өнімдерін талдау және сапалық әдістер қолданылды. Нәтижелер студенттердің цифрлық, әдістемелік және кәсіби дағдыларын өзіндік бағалауы негізінен оң деңгейде болғанын көрсетті. Сандық нәтижелер көрсеткіштердің басым бөлігінде «жақсы» және «өте жақсы» деңгейлерінің басымдығын анықтаса, сапалық талдау химияны оқытуда жасанды интеллектті қолдануға рефлексивті және педагогикалық тұрғыдан негізделген тәсілдің қалыптасқанын көрсетті.

Алынған нәтижелер білім берудің цифрлық трансформациясы жағдайында жасанды интеллекті бағдарланған курстарды болашақ химия мұғалімдерін кәсіби даярлау жүйесіне кіріктірудің ықтимал білімдік құндылығы мен орындылығын көрсетеді.

Түйінді сөздер: жасанды интеллект, химиялық білім беру, болашақ химия мұғалімдері, жасанды интеллект сауаттылығы, цифрлық құзыреттілік, технологиялық-педагогикалық пәндік білім (TPACK), кәсіби даярлау.

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ПЕДАГОГИЧЕСКИЙ АНАЛИЗ ПРЕПОДАВАНИЯ КУРСА “ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В ХИМИИ” БУДУЩИМ УЧИТЕЛЯМ ХИМИИ

Аннотация

В статье рассматриваются процесс внедрения и воспринимаемые результаты практико-ориентированного курса, направленного на применение искусственного интеллекта в профессиональной подготовке будущих учителей химии. Исследование проводилось в 2025–2026 учебном году с участием 48 студентов третьего курса ($n = 48$), обучающихся по образовательной программе подготовки учителей химии в педагогическом университете. Работа осуществлялась в рамках курса «Использование искусственного интеллекта в обучении химии», реализованного исключительно в формате практических занятий.

В исследовании применялись одно-групповой разведочный дизайн, анкетирование, анализ продуктов учебной деятельности студентов и качественные методы. Результаты показали преимущественно положительные уровни самооценки цифровых, методических и профессиональных умений студентов. Количественные данные выявили преобладание уровней «хороший» и «очень хороший» по большинству показателей, а качественный анализ указал на формирование рефлексивного и педагогически обоснованного подхода к использованию искусственного интеллекта в обучении химии.

Полученные результаты свидетельствуют о потенциальной образовательной ценности и целесообразности интеграции курсов, ориентированных на искусственный интеллект, в систему профессиональной подготовки будущих учителей химии в условиях цифровой трансформации образования.

Ключевые слова: искусственный интеллект, химическое образование, будущие учителя химии, грамотность в области искусственного интеллекта, цифровая компетентность, технологическое педагогическое предметное знание (TPACK), профессиональная подготовка.

Appendix

A1. Closed questions (10 questions)

The answers were evaluated on a scale from 0 to 100 points and interpreted as follows:

0-49 – low level;

50-64 – average level;

65-84 is a good level;

85-100 is a very good level.

When analyzing the results, the indicators «good» and «very good» were considered as a positive result (100%).

Closed questions of the questionnaire

1. Evaluate your proficiency with AI tools (ChatGPT, Gemini) to prepare training materials.

2. How much has AI helped you better understand chemical processes and concepts?

3. Evaluate your chemical material visualization skills after completing the course.

4. How capable are you to create digital educational products (videos, visualizations, scripts) on your own?
5. How consciously do you choose AI tools depending on the learning task?
6. To what extent did the course help you understand the pedagogical possibilities of using AI in chemistry?
7. Evaluate your willingness to use AI when preparing school chemistry lessons.
8. To what extent has the use of AI contributed to the development of your critical thinking?
9. To what extent do you take into account the didactic purpose when using digital tools?
10. To what extent did the course affect your professional confidence as a future chemistry teacher?

A2. Open questions (5 questions)

1. Which AI tool has proved to be the most useful for you and why?
2. Describe how using AI has changed your understanding of chemistry teaching.
3. What difficulties have you encountered when working with AI tools?
4. To what extent do you think the materials you have created are applicable in school practice?
5. What professional and digital skills did you develop during the course?

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FORMATION OF GEOSPATIAL COMPETENCE IN 9TH GRADE STUDENTS: ECONOMIC GEOGRAPHY OF KAZAKHSTAN

Annotation

The economic geography section of the 9th-grade geography curriculum in Kazakhstan - industrial distribution, population dynamics, transport, agriculture, regional development - is spatial in nature but taught through descriptive, textbook-based methods. Students learn where phenomena are located but not how to reason about them spatially. This study develops and tests a methodology for forming geospatial competence through structured inquiry tasks embedded across the full course. A pedagogical experiment was conducted at the Republican Specialized School-Boarding for Gifted Children named after K. Baiseitova, Almaty (2024–2025) with 37 students: experimental group (n = 18) worked through purpose-designed geospatial tasks using Google My Maps, the electronic atlas of Kazakhstan, QGIS, and open data from stat.gov.kz; control group (n = 19) followed standard instruction. Geospatial competence was assessed at three points across three stages: localization, spatial correlation, and territorial analysis. Post-test results showed significant between-group differences (t = 5.9, p < 0.001, Cohen's d = 1.94, 95% CI [1.16, 2.73]): experimental group reached 76% of maximum score vs. 45% for controls. The widest gap was at Stage 3, independent territorial analysis: 64% vs. 22%, suggesting that within the conditions of this experiment conventional instruction developed map reading but was associated with only limited development of spatial reasoning. Findings offer geography teachers a curriculum-aligned task system covering all five sections of the 9th-grade course, tested in one specialised school and requiring replication in mainstream settings.

Keywords: geospatial competence, economic geography of Kazakhstan, spatial thinking, spatial reasoning, geospatial inquiry, secondary school, Kazakhstan.

Introduction. The economic geography section of Kazakhstan's 9th-grade geography curriculum - the fifth and final content block of the course - covers the distribution of industry, population, transport, and agriculture across the country's seventeen oblasts and three cities of republican significance. Unlike the preceding physical geography sections, this section is taught last and receives the fewest allocated hours, a structural constraint that shapes what instruction is realistically possible. This content is spatial by nature - yet most classrooms teach it through reading, note-taking, and textbook maps. Students learn *what* is where, but not *how to think* about why it is there, how it connects to other phenomena, or what the patterns reveal. The result is geographic knowledge without geographic reasoning.

This gap has a measurable dimension. Kazakhstan's Programme for International Student Assessment (PISA) 2022 results showed persistent weaknesses in applied reasoning tasks requiring students to interpret and analyze in real-world contexts [1]. Geography teachers surveyed across all regions of the country reported only moderate use of geospatial technologies in their lessons, with most relying on mobile applications rather than structured spatial inquiry; equipment costs, insufficient training, and time pressure were the primary barriers cited [2]. A parallel curriculum analysis of geography objectives for grades 7–11 confirmed that while geospatial competencies are implied in the learning goals, no explicit methodology exists for developing them systematically across a course.

Literature review. The National Research Council [3] defines spatial thinking as a structured cognitive capacity - the ability to represent, analyze, and reason about spatial relationships - and argues it must be taught explicitly rather than assumed to emerge from map use alone. Three terms are used throughout this article in a fixed sense. Spatial thinking denotes the general cognitive capacity described above. Spatial reasoning denotes its operational component, the relating of two or more spatial data layers and the derivation of a territorial explanation from them, and it is spatial reasoning that Stages 2 and 3 of the assessment address. Geospatial competence denotes the observable ability to carry out these operations on real geographic data using digital tools, and it is

this that the present study measures. Hickman [4] demonstrates that the capacity is both teachable and assessable: students who work through Geographic Information System (GIS)-based inquiry tasks show measurable gains in spatial reasoning that conventional map exercises do not produce. Gryl and Jekel [5] extend this to civic dimensions, arguing that the ability to read and critically use geographic information is a form of spatial citizenship that secondary schools have a specific responsibility to develop.

At Abai Kazakh National Pedagogical University, a research group has been building the methodological foundations for geospatial education in Kazakhstani schools since 2021, drawing on international frameworks for geospatial competence. Zwartjes and de Lázaro y Torres [6] identified the core components of geospatial thinking competence and defined ten spatial thinking competencies structured across complexity levels for secondary school students. Ussenov et al. [7] examined how geoinformation technologies can be used to develop students' geospatial thinking skills, providing a methodological basis directly applicable to grade 9–11 geography instruction. Kalkashev et al. [8] tested competency-based assessment models in natural science disciplines and found that criterion-referenced evaluation, when aligned with clearly defined skill stages, significantly improves student performance and engagement. Shakirova et al. [9] examined geography teacher preparation at Kazakh National Pedagogical University (KazNPU) and identified competency-oriented task design as the key variable distinguishing effective from ineffective technology integration.

International research shows the same pattern. Mašterová [10] reviewed 36 empirical studies on geospatial technology use in primary and secondary schools and found that inquiry-based approaches consistently produced gains in both digital literacy and geographic understanding - but only when teachers had received structured preparation. Lee [11] documented the integration of open data, big data visualization, and Artificial Intelligence (AI) tools into Korean high school geography, showing that students developed stronger spatial analysis skills when working with real territorial data than with textbook exercises. Bednarz and Kemp [12] established that spatial thinking develops incrementally through repeated practice - a single GIS lesson or one-off map activity produces no lasting competence.

The frameworks reviewed above share a structural feature that limits their applicability within a single school year. GI Learner distributes its ten competencies along a learning line spanning several grades of secondary education, with complexity levels assigned to each age group [6, pp. 45-47]; Hickman's levels likewise describe a progression measured over an extended period of sustained GIS work rather than a single course [4, pp. 143-145]. Both frameworks address the question of how spatial thinking matures across the whole of secondary education. Neither addresses the question facing a teacher at the start of grade 9: how to develop this competence within one course of five content sections, allocated fewer hours than any other block in the syllabus.

The methodology tested here departs from those frameworks in three respects. It compresses the progression into three stages rather than ten competencies, on the assumption that a scheme a teacher cannot hold in mind while planning will not survive a compressed timetable. It runs the progression horizontally rather than vertically: instead of one stage per year, all three stages recur inside each of the five content sections, so that a student meets localization, correlation and analysis five times over in different subject matter. And it ties tasks to sources a teacher can actually reach, the electronic atlas and the national statistics portal, rather than to datasets assembled for research purposes.

How far this constitutes a distinct model rather than an adaptation is a fair question, and the answer here is deliberately narrow. The cognitive progression is Hickman's, the stage descriptors stay close to the GI Learner line, and the contribution lies in the arrangement rather than in any new account of spatial thinking. What has not been tested before is whether such an arrangement produces measurable competence gains inside a single national curriculum course. Favier and Van der Schee [13] came closest, recording gains in relational thinking from GIS-based lessons at secondary level, but their intervention sat alongside the curriculum rather than being built into its content sequence.

Three points follow from this literature. Task design matters more than tool availability: a student who opens a map application and a student who maps regional GRP (Compare Gross Regional Product) disparities and explains them are doing different cognitive work. The 9th-grade economic

geography course is unusually well suited to spatial inquiry, since every section describes phenomena that only make sense spatially, yet delivery remains largely descriptive. And competence of this kind accumulates: single GIS lessons produce no lasting capacity, so the same analytical logic has to recur across the industry, population, transport and regional development units. This study develops and tests a methodology built on these three points.

Research Aim: to design and empirically validate a methodological approach to forming geospatial competence in 9th-grade students through the economic geography of Kazakhstan course.

Research Hypothesis: students taught through a systematically structured sequence of geospatial inquiry tasks embedded across all major sections of the economic geography course will show significantly greater geospatial competence development than students taught through conventional methods.

Practical significance: the study provides geography teachers with a concrete, curriculum-aligned system - specific task types, tools, and assessment criteria - for developing spatial analytical thinking in grade 9, rather than general recommendations about technology use.

Methods and materials. This study used a quasi-experimental design with a non-equivalent control group, combined with qualitative methods, to test whether a structured geospatial inquiry methodology produces measurable gains in 9th-grade students' geospatial competence during the economic geography of Kazakhstan course. The design is quasi-experimental rather than experimental because students could not be randomly allocated: they were already distributed into two intact parallel classes by the school before the study began, and breaking up existing classes was neither administratively possible nor pedagogically justified. Baseline equivalence was therefore established statistically rather than by randomization, and the limits this place on causal inference are set out below. The design combined quantitative pre- and post-testing with qualitative classroom observation and curriculum document analysis. Three methodological components are described below: research design and sample, instructional intervention, and assessment framework.

Research Design and Sample

The experiment ran across the full 2024–2025 academic year at the Republican Specialized School-Boarding for Gifted Children named after K. Baiseitova in Almaty. The school was selected on the basis of its stable digital infrastructure, availability of a dedicated computer classroom for geography lessons, and the qualification level of its geography teaching staff. The pre-test administered in September 2024, before any intervention, showed no significant difference in baseline geospatial competence between the experimental group (EG) and the control group (CG): EG mean score 11.4, standard deviation (SD) = 2.1; CG mean score 11.2, SD = 2.3; Student's t-test value $t = 0.28$ at 35 degrees of freedom (df), significance level $p = 0.78$. Both classes therefore entered the study at an equivalent starting level. The distribution of students across the two conditions is presented in Table 1. The two classes were parallel streams of the same intake year within a single specialized school, admitted through the same competitive selection procedure, following identical timetables and covering the same curriculum content over the same number of lesson hours. Both were taught by geography teachers with comparable formal qualifications. The study did not collect data on gender composition, prior academic attainment, learning motivation or baseline digital literacy, and these variables could not be controlled statistically - a limitation addressed in the Limitations section.

Table 1. Sample Distribution Across Conditions

School	Experimental group (n)	Control group (n)	Total
Republican Specialized School-Boarding for Gifted Children named after K. Baiseitova, Almaty	18	19	37
Total	18	19	37

Note: Non-random allocation by the school administration into intact parallel classes. Baseline equivalence established on pre-test scores ($t = 0.28$, $p = 0.78$, $df = 35$).

Source: compiled by the authors.

Control classes followed the standard curriculum: teacher explanation, textbook reading, conventional paper map exercises, and reproductive written tasks. Experimental classes covered identical curriculum content through a purpose-designed sequence of geospatial inquiry tasks using Google My Maps, the electronic atlas of Kazakhstan, basic Quantum Geographic Information System (QGIS) functions, and open regional statistical data from stat.gov.kz and the Bureau of National Statistics of Kazakhstan [14]. The experimental group teacher attended a one-day methodological workshop before the experiment began, covering task logic, assessment criteria, and technical use of the platforms. The control group teacher was briefed only on data collection procedures and continued established practice without any change to teaching methods. This asymmetry is inherent to the design: the intervention consists precisely of the task system and the preparation needed to deliver it, so the two conditions cannot be equalised on teacher preparation without eliminating the intervention itself.

Curriculum and Task Design

The 9th-grade economic geography of Kazakhstan course comprises five major content sections: industry, population and urbanization, transport infrastructure, agriculture, and regional development. The five sections were taught in the order set by the curriculum: industry from September to November, population and urbanization in December and January, transport in February, agriculture in March, and regional development in April and May. For each section, a set of four to six geospatial inquiry tasks were developed, graded by cognitive demand across three competency stages (Table 2).

Table 2. Geospatial Task Design Across Course Sections and Competency Stages

Course section	Stage 1 tasks (localization)	Stage 2 tasks (correlation)	Stage 3 tasks (analysis)	Tools used
Industry	Map mining enterprise locations using atlas data	Overlay industry map with population density; identify patterns	Explain Karaganda region's industrial-demographic profile; assess policy implications	Google My Maps, electronic atlas
Population & urbanization	Locate major cities and population centers	Compare urbanization rates across regions; identify north-south disparities	Analyze causes of depopulation in northern oblasts using economic and migration data	stat.gov.kz, thematic maps
Transport	Map railway and road networks	Correlate transport density with economic output by region	Evaluate transport accessibility gaps and their effect on regional development	QGIS basic, Google My Maps
Agriculture	Identify agricultural zones on climatic and soil maps	Link agricultural specialization to physical geography factors	Assess water resource constraints on agricultural development in southern regions	Electronic atlas, stat.gov.kz
Regional development	Locate Kazakhstan's economic regions	Compare Gross Regional Product (GRP) per capita across regions; rank by development indicators	Construct an evidence-based analysis of one region's development trajectory	stat.gov.kz, QGIS basic

Note: Tasks at each stage used real data not reproduced in the textbook. Stage 3 tasks required students to produce written spatial analyses of 150–200 words with map-based evidence.

Source: compiled by the authors.

The three stages differ in kind, not in difficulty: Stage 1 asks for retrieval, Stage 2 for relating two data layers, Stage 3 for an independent explanation defended with map evidence.

All instructional task materials were developed by the research team in collaboration with the participating teachers, reviewed for alignment with the grade 9 learning objectives set out in the standard curriculum in Geography approved by the Ministry of Education of Kazakhstan [15], and piloted in one non-participating class before the experiment began. Pilot feedback led to the revision of three Stage 3 instructional tasks whose data requirements exceeded the available classroom time.

These instructional tasks are distinct from the assessment items described below, which were developed and trialled separately.

Assessment Instruments

Geospatial competence was measured at three points: before instruction (pre-test, September 2024), after the industry and population sections (intermediate test, January 2025), and after the full course (post-test, May 2025). Each test consisted of 12 tasks, four per competency stage, built directly from the three-stage model: Stage 1 items required locating and extracting data from an unfamiliar thematic map, Stage 2 items required relating two data layers, Stage 3 items required a written territorial explanation supported by map evidence. The assessment items were developed and trialled separately from the instructional tasks. They were drafted by the research team, checked for alignment with the grade 9 learning objectives of the standard curriculum [15, Ch. 3], and trialled in one non-participating class, after which three Stage 3 items were reworked because their data requirements exceeded the time available within a single lesson. The task system and the assessment items were subsequently reviewed by the subject methodological association of the participating school (minutes No. 6, 16 March 2026), which confirmed their correspondence to the curriculum content and their suitability for classroom use. These procedures constitute content review and trialling, that is, approbation of the instrument in use. They are not psychometric validation, and the two should not be read as equivalent: expert judgement of content coverage says nothing about internal consistency, form equivalence or construct validity, none of which was tested here.

The three tests used parallel forms with matched cognitive demand but different geographic content, so that no student met the same territory twice. Form equivalence was established by design rather than by measurement: the three forms carry the same number of items at each stage, the same response format and the same scoring rubric, but differ in the regions and datasets used. No empirical check of form equivalence was carried out, and no internal consistency coefficient was computed for the instrument. This is a limitation of the study, and the competence scores reported below should be read as measurements made with an instrument whose psychometric properties have not been formally established. The overall design of the assessment instrument is summarized in Table 3.

Table 3. Assessment Design Summary

Parameter	Specification
Measurement points	3 (pre, intermediate, post)
Tasks per test	12 (4 per competency stage)
Maximum score	48 points
Data used	Unfamiliar maps and statistics not used in instruction
Test forms	Parallel (equivalent demand, different content)
Scoring	0–4 scale (five levels) per task
Inter-rater reliability	Cohen's $\kappa = 0.81$ on 20% subsample
Scorers	2 independent educators (20% subsample); lead researcher (remainder)

Source: compiled by the authors.

Note: κ - Cohen's kappa coefficient of inter-rater agreement.

Each task was scored on a five-level rubric from 0 to 4: 0 - no spatial reasoning evident; 1 - correct localization only, no relational thinking; 2 - partial spatial correlation, reasoning largely absent; 3 - spatial correlation identified but reasoning incomplete; 4 - full spatial analysis with an evidence-based conclusion. All responses were coded by number before scoring, so that scorers saw neither the student's name nor the class. Two geography educators not otherwise involved in the study independently scored a random 20% subsample; inter-rater agreement, measured by Cohen's kappa coefficient (κ), was strong ($\kappa = 0.81$), and the few discrepancies were settled by discussion. The remaining responses were scored by the lead researcher against the same rubric. The lead researcher designed the intervention, which raises the possibility of expectancy effects in scoring. Coding of the scripts removed direct identification, but Stage 3 responses to tasks built around Google My Maps or QGIS output could still betray group membership through their content, so blinding was incomplete

for that part of the instrument. The κ value covers a fifth of the material and does not extend to the rest.

In addition to test scores, teacher observation logs were maintained throughout the experiment. Teachers recorded instances of unprompted spatial reasoning in classroom discussion - cases where students independently connected economic data to geographic distribution without teacher direction. These logs provided qualitative evidence of competence development between formal measurement points and were analyzed thematically at the end of the year.

Data Analysis

Quantitative data were processed in Statistical Package for the Social Sciences (SPSS), version 26. Between-group differences at each of the three measurement points were tested with independent samples t-tests ($df = 35$). Effect sizes are reported as Cohen's d computed from the pooled standard deviation, with 0.2, 0.5 and 0.8 taken as thresholds for small, medium and large effects. Because the sample is small, every between-group difference is reported with a 95% confidence interval, both for the difference in means and for d . A sensitivity analysis indicates that with $n = 37$ and $\alpha = 0.05$ the design has 80% power to detect effects of $d = 0.94$ or larger; smaller differences would not have been reliably detected.

Change over the year was analyzed with a 2×3 mixed ANOVA (Analysis of Variance). Group entered as the between-subjects factor and measurement point as the within-subjects factor. The interaction term carries the weight of the analysis: a comparison of trajectories is what distinguishes gains produced by the intervention from gains both groups would have shown anyway over nine months of schooling. Development inside the experimental group was then examined with repeated measures ANOVA and pairwise comparisons between successive measurement points.

Observation logs were coded thematically in two cycles. The first cycle marked discrete instances of spatial reasoning; the second grouped them into patterns across content sections and competency stages.

Ethical Considerations

Because the participants were minors aged 14–15, consent was arranged before any data were collected. Written informed consent was obtained from the parents or legal guardians of all 37 students, and the students themselves were told what the study involved, what would be recorded, and that they could stop taking part at any point without it affecting their marks. The experiment ran with the permission of the administration of the Republican Specialized School-Boarding for Gifted Children named after K. Baiseitova and under the supervision of the Department of Geography and Ecology at Abai Kazakh National Pedagogical University, where the research is being carried out.

Students appear in the dataset by number only. No names were recorded, and the teacher observation logs were kept in the same coded form. Test scores served research purposes alone and were never entered into school assessment.

Control group students followed the full standard curriculum throughout and lost no instructional time. Once the post-test was complete, the task materials developed for the experimental group were handed over to the control group teacher.

Limitations

Five limitations apply to this study. First, the sample was drawn from a single specialized school in Almaty with stable technology infrastructure and a gifted student population; findings may not generalize directly to rural schools where equipment access and teacher preparation conditions differ substantially - a gap that Laiskhanov et al. [2, p. 6] identify as a persistent barrier in Kazakhstani geography education. Second, the experiment covered one academic year, which is sufficient to observe competence development across all five course sections but does not address whether gains are retained after the course ends. No delayed post-test was administered, so the durability of the measured effect is unknown, and the results speak only to competence at the point of course completion. A delayed measurement is planned for the same cohort in grade 10, using a fourth parallel form of the instrument, to establish whether the difference between the groups persists once the intervention has ceased. Third, while teachers in both conditions had comparable formal qualifications, individual instructional style and classroom management were not controlled

variables; teacher effect on outcomes cannot be fully separated from methodology effect with the current design. Fourth, several variables that could have shaped the outcome went unmeasured. Nothing was recorded on the students' motivation, their prior attainment in geography, or how confident they already were with digital mapping tools before the course started, which means none of these could be entered as covariates. Baseline equivalence rests on one indicator only - the September pre-test. Both classes were parallel streams of the same intake, selected through the same competitive admission procedure, so a large hidden gap between them is improbable; improbable, however, is not the same as ruled out. Anyone repeating this work would do well to collect these indicators in September alongside the pre-test, when it costs almost nothing to do so.

Fifth, the mixed ANOVA was reconstructed from the summary statistics in Table 4 together with the within-group repeated measures result, rather than computed from the individual score matrix. The between-subjects and interaction terms depend on the correlation between the three measurement points, which was recoverable for the experimental group but had to be assumed equivalent for the control group. A sensitivity analysis across the plausible range of that correlation, from 0.20 to 0.65, left the interaction significant at $p < 0.001$ at every value, with partial eta-squared (partial η^2) between 0.37 and 0.48. The substantive conclusion, that the two groups differ in trajectory and not only in level, therefore, holds across the whole range tested. The reported coefficients are nonetheless estimates rather than computed values and should be read as such.

Results and discussion. *Overall competence gains: experimental vs. control*

Pre-test scores confirmed baseline equivalence between the two groups. The EG ($n = 18$) scored a mean of 11.4 points out of 48 ($SD = 2.1$); the CG ($n = 19$) scored 11.2 points ($SD = 2.3$).

The difference was not statistically significant ($t = 0.28$, $p = 0.78$), confirming that both groups entered the study at the same competency level.

By the post-test the two groups had moved apart. The EG averaged 36.6 points out of 48 ($SD = 7.4$) against 21.6 for the CG ($SD = 8.0$), a difference of 15.0 points (95% confidence interval, CI [9.85, 20.15], $t = 5.9$, $p < 0.001$, $d = 1.94$, 95% CI [1.16, 2.73]). The gap was already open at the January measurement, taken after the industry and population sections: 24.6 points against 15.1, a difference of 9.5 points (95% CI [4.98, 14.02], $t = 4.3$, $p < 0.001$, $d = 1.40$, 95% CI [0.69, 2.12]). Growth in the EG therefore did not come in a late surge but built up across the course (Table 4). The confidence interval around the post-test effect size runs from 1.16 to 2.73, which is what a sample of 37 permits; the direction of the effect is firm, its exact magnitude much less so.

Table 4. Mean Test Scores by Group and Measurement Point

Measurement point	EG mean (SD)	CG mean (SD)	t-value	p-value	Cohen's d
Pre-test (Sept. 2024)	11.4 (2.1)	11.2 (2.3)	0.28	0.78	0.09
Intermediate test (Jan. 2025)	24.6 (6.5)	15.1 (7.0)	4.3	<0.001	1.40
Post-test (May 2025)	36.6 (7.4)	21.6 (8.0)	5.9	<0.001	1.94

Note: Independent samples t-tests, $df = 35$. Cohen's d computed from the pooled standard deviation. Confidence intervals for the between-group differences are given in the text.

Source: compiled by the authors based on test results of the experimental and control groups.

Competence stage distribution

The mixed ANOVA returned a significant group $\times$ time interaction (Fisher's F-test statistic, $F(2, 70) = 25.5$, $p < 0.001$, partial $\eta^2 = 0.42$). The groups differed not merely in level but in the shape of their development: the distance between them widened at every measurement point. Main effects were significant for time ($F(2, 70) = 144.4$, $p < 0.001$, partial $\eta^2 = 0.81$) and for group ($F(1, 35) = 27.0$, $p < 0.001$, partial $\eta^2 = 0.44$), but neither settles the question on its own. Both groups gained over nine months, and some of that gain belongs to ordinary schooling and to being a year older. The interaction is what separates the two sources. The breakdown of post-test performance by competency stage is presented in Table 5.

Table 5. Post-test Performance by Competency Stage

Competency stage	EG mean score / max (%)	CG mean score / max (%)	Between-group difference
Stage 1: localization	14.2 / 16 (89%)	11.5 / 16 (72%)	Moderate
Stage 2: spatial correlation	12.2 / 16 (76%)	6.6 / 16 (41%)	Large
Stage 3: territorial analysis	10.2 / 16 (64%)	3.5 / 16 (22%)	Very large
Total	36.6 / 48 (76%)	21.6 / 48 (45%)	Large

Source: compiled by the authors based on post-test results of the experimental and control groups.

This pattern has a clear interpretation. Conventional instruction - textbook reading, teacher explanation, paper map exercises - develops basic geographic literacy well enough. Students in the CG could locate and identify spatial phenomena on maps at a level approaching EG performance. What conventional instruction does not develop is the capacity to reason spatially: to hold two data layers simultaneously, identify the relationship between them, and construct an evidence-based territorial explanation. These are precisely the operations that Stage 2 and Stage 3 tasks required, and they are the operations that the experimental methodology was designed to build through repeated, cumulative practice across all five course sections.

Section-by-section analysis

Teacher observation logs allowed a more granular picture of where competence developed fastest in the EG. Unprompted spatial reasoning was recorded 84 times across the EG over the academic year, compared to 13 times in the CG. In the EG, instances were sparse during the industry section in the autumn term (10 recorded), grew through the population and urbanization section in December and January (20), and were densest in the regional development section in April and May (24). The transport and agriculture sections produced somewhat lower observation frequencies (16 and 14 instances respectively), which teachers attributed to greater difficulty in sourcing accessible real-data sets for these sections. The open statistics available through stat.gov.kz were richer for population and regional economic data than for transport network and agricultural productivity data, limiting the complexity of Stage 3 tasks in those sections. This is a methodological finding with practical implications: the availability and granularity of open regional data directly constrain the ceiling of spatial inquiry tasks that teachers can realistically assign.

Within-group development in the experimental group

Having established that the trajectories differ, the next question is how the experimental group moved between measurement points. Repeated measures ANOVA showed a significant rise in experimental group scores across the three measurement points ($F(2, 34) = 153.0$, $p < 0.001$, partial $\eta^2 = 0.90$). This coefficient should not be read as the share of competence produced by the methodology. Partial eta squared expresses the proportion of within-subject variance attributable to the time factor, and over nine months the time factor carries more than the intervention: a full year of general schooling, cognitive development at 14–15, and increasing familiarity with the test format all fall within it. Attribution of the gain to the methodology rests on the between-group comparison reported above, not on this figure.

Post-hoc comparisons showed significant gains between all three measurement points: pre-test to intermediate (mean gain 13.2 points, $p < 0.001$) and intermediate to post-test (mean gain 12.0 points, $p < 0.001$). The slightly larger gain in the first half of the year reflects the steeper initial learning curve when students are first introduced to spatial inquiry tasks - an observation consistent with Mašterová's [10, p. 47] finding that the early stages of geospatial technology integration require the most intensive teacher support. By the second half of the year, students in the EG were operating with greater autonomy, requiring less scaffolding for Stage 2 tasks and approaching Stage 3 work with more confidence.

The results are consistent with the research hypothesis: within the conditions of this experiment, systematic integration of geospatial inquiry tasks across all major sections of the 9th-grade economic

geography course was associated with significantly greater competence gains than conventional instruction, with a large effect size at post-test (Cohen's $d = 1.94$, 95% CI [1.16, 2.73], indicating that the experimental group's mean score exceeded the control group's mean by nearly two standard deviations). Because allocation was not random and motivational, digital and teacher-related factors were not controlled, this association cannot be read as a demonstrated causal effect of the methodology alone. Three findings warrant specific discussion.

First, the size of the between-group difference deserves comment, because $d = 1.94$ sits far above what interventions in geography education usually produce, and a value that large is more often a signal about design than about pedagogy. At least three factors inflate it here. The sample comes from a school that selects for academic ability, so the experimental students had the cognitive headroom to move a long way once the tasks demanded it, and a mainstream cohort would not start from the same position. The assessment also favours the intervention in a way that is hard to avoid: Stage 3 items ask for written territorial analysis with map evidence, which is exactly the operation experimental students rehearsed all year and control students never encountered in any form. Part of the gap therefore reflects familiarity with the task genre rather than spatial reasoning as such. Finally, the bulk of the scripts were scored by the researcher who designed the tasks, and Stage 3 answers are not fully anonymous in practice. None of this cancels the findings, which the widening interaction across three measurement points supports independently. It does mean the point estimate belongs to these conditions, and that the confidence interval, running from 1.16 to 2.73, is the more honest summary.

Second, the observation logs point towards transfer. Instances of unprompted spatial reasoning grew from ten in the industry section to twenty-four in the regional development section, which fits the idea that students carried the same cognitive moves from one economic theme to the next without being prompted. Bednarz and Kemp [12, p. 20] argue that spatial thinking becomes a stable disposition only after repeated practice across different content, and the pattern here is consistent with that. It is worth being clear about the weight this evidence can bear. The logs were kept by the teacher delivering the intervention, who knew what the study was testing, and no second observer checked the entries. A count of 84 against 13 is striking, but it comes from an unblinded observer, and the reading offered here is plausible rather than demonstrated.

Third, the data availability constraint identified in the transport and agriculture sections points to a problem no individual teacher can solve. The quality of spatial inquiry tasks is directly bounded by the granularity and accessibility of real regional data. Where open statistics are rich - population, GRP, urbanization - Stage 3 tasks can be genuinely demanding and analytically substantive. Where data are sparse or fragmented, task quality degrades. Laikhanov et al. [2, p. 7] identify infrastructure and cost as the main barriers to adopting geospatial technology in Kazakhstani schools. The present results add a barrier that survives after those are solved. The school studied here had the equipment, the trained staff and a dedicated computer classroom, and the ceiling on Stage 3 tasks still fell where the open statistics thinned out. Lee [11, pp. 4–6] describes Korean classrooms drawing on open data, big data visualisation and AI tools; the contrast is instructive, since the constraint there lies in what teachers can do with abundant data, and here in whether comparable data exist for a given theme at oblast level at all. A curated repository aligned to the school curriculum would address a problem that no amount of equipment purchasing reaches.

Conclusion. This study set out to answer a specific question: does a structured sequence of geospatial inquiry tasks embedded across all sections of the 9th-grade economic geography of Kazakhstan course develop students' geospatial competence more effectively than conventional instruction? Within the conditions of this experiment the results support an affirmative answer, with statistically significant between-group differences at both intermediate and final measurement points ($p < 0.001$) and a large effect size at post-test (Cohen's $d = 1.94$, 95% CI [1.16, 2.73]). The point estimate should be read with the reservations set out above: the sample was drawn from a school selecting for academic ability, the Stage 3 items matched the task genre rehearsed by the experimental group alone, and blinding at that stage was incomplete. The interval, rather than the point value, is the appropriate summary of the effect.

Three findings stand out. First, in the school studied, conventional instruction developed basic map reading adequately but was associated with markedly weaker spatial reasoning. The experimental methodology narrowed this gap without closing it: experimental students reached 64% of the maximum Stage 3 score. Whether the same pattern holds in mainstream schools remains open.

Second, the observation data point towards transfer across content domains, though on evidence weaker than the test scores and from an unblinded observer. Transfer remains a plausible reading of the pattern rather than a demonstrated result.

Third, the quality of spatial inquiry tasks is directly bounded by the availability of real regional data. A curated, curriculum-aligned open data repository for school geography in Kazakhstan would raise the ceiling of what geospatial instruction can achieve in practice.

The findings and the task system were presented to the subject methodological association of the participating school, which recommended the materials for continued use in grade 9 geography teaching (minutes No. 6, 16 March 2026). This constitutes practical uptake within the setting in which the methodology was developed, and it does not extend the evidential basis of the study beyond that setting.

Four directions follow for further work. The first is replication in mainstream schools outside Almaty, on a sample large enough to support randomised allocation. The second is psychometric validation of the diagnostic instrument: internal consistency, empirical equivalence of the parallel forms, and construct validity, none of which was established in the present study and all of which are prerequisites for using the instrument beyond this setting. The third is a delayed measurement after grade 9 to establish whether the gains hold. The fourth is teacher training models that let geography teachers build spatial inquiry tasks without specialised GIS expertise.

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Data availability. The anonymised test score data supporting the findings of this study are available from the corresponding author on reasonable request.

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9-СЫНЫП ОҚУШЫЛАРЫНЫҢ ГЕОКЕҢІСТІКТІК ҚҰЗЫРЕТТІЛІГІН ҚАЛЫПТАСТЫРУ: ҚАЗАҚСТАННЫҢ ЭКОНОМИКАЛЫҚ ГЕОГРАФИЯСЫ

Аңдатпа

Қазақстанның 9-сынып география курсына экономикалық география бөлімі - өнеркәсіптің орналасуы, халық динамикасы, көлік, ауыл шаруашылығы, аймақтық даму - табиғаты жағынан кеңістіктік сипатта, бірақ сипаттамалық, оқулыққа негізделген әдістермен оқытылады. Оқушылар құбылыстардың қайда орналасқанын біледі, бірақ оларды кеңістіктік тұрғыдан талдай алмайды. Бұл зерттеу курс бойынша құрылымдық геокеңістіктік сұраныс тапсырмалары арқылы геокеңістіктік құзыреттілікті қалыптастыру әдістемесін әзірлейді және тестілейді. Педагогикалық эксперимент Алматыдағы Қ.Байсейітова атындағы Республикалық мамандандырылған мектеп-интернатта (2024–2025) 37 оқушымен жүргізілді: эксперименттік топ (n = 18) Google My Maps, Қазақстанның электрондық атласы, QGIS және stat.gov.kz ашық деректерін пайдалана отырып арнайы геокеңістіктік тапсырмалар орындады; бақылау тобы (n = 19) стандартты оқытуды жалғастырды. Геокеңістіктік құзыреттілік үш кезеңде бағаланды: локализация, кеңістіктік корреляция және аумақтық талдау. Қорытынды тест нәтижелері топтар арасындағы маңызды айырмашылықтарды көрсетті (t = 5,9, p < 0,001, Cohen's d = 1,94, 95%

СА [1,16-2,73]): эксперименттік топ максималды балдың 76%-ына жетті, бақылау тобы - 45%-ға. Ең үлкен айырмашылық 3-кезеңде - дербес аумақтық талдауда: 64% пен 22%, бұл зерттеу жүргізілген жағдайда дәстүрлі оқыту картаны оқу дағдыларын дамытқанымен, кеңістіктік ойлауды дамытуда шектеулі болғанын болжауға негіз береді. Нәтижелер география мұғалімдеріне 9-сынып курсының барлық бес бөлімі бойынша геокеңістіктік құзыреттілікті дамытуға арналған бір мамандандырылған мектепте сынақтан өткен, жалпы білім беретін мектептерде қосымша тексеруді қажет ететін тапсырмалар жүйесін ұсынады.

Түйінді сөздер: геокеңістіктік құзыреттілік, Қазақстанның экономикалық географиясы, кеңістіктік ойлау, кеңістіктік пайымдау, геокеңістіктік зерттеу, орта мектеп, Қазақстан.

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ФОРМИРОВАНИЕ ГЕОПРОСТРАНСТВЕННОЙ КОМПЕТЕНТНОСТИ УЧАЩИХСЯ 9 КЛАССА: ЭКОНОМИЧЕСКАЯ ГЕОГРАФИЯ КАЗАХСТАНА

Аннотация

Раздел экономической географии в курсе географии 9 класса Казахстана - размещение промышленности, динамика населения, транспорт, сельское хозяйство, региональное развитие - пространствен по своей природе, однако преподаётся преимущественно описательными, учебниково-ориентированными методами. Учащиеся знают, где расположены те или иные явления, но не умеют рассуждать о них пространственно. Данное исследование разрабатывает и апробирует методику формирования геопространственной компетентности посредством структурированных задач пространственного исследования, встроенных во весь курс. Педагогический эксперимент проводился в Республиканской специализированной школе-интернате для одарённых детей имени К. Байсеитовой, г. Алматы (2024–2025) с участием 37 учащихся: экспериментальная группа (n = 18) выполняла специально разработанные геопространственные задания с использованием Google My Maps, электронного атласа Казахстана, QGIS и открытых данных stat.gov.kz; контрольная группа (n = 19) обучалась по стандартной программе. Геопространственная компетентность оценивалась в три этапа: локализация, пространственная корреляция и территориальный анализ. Результаты итогового теста выявили значимые межгрупповые различия ($t = 5,9$, $p < 0,001$, Cohen's $d = 1,94$, 95% ДИ [1,16-2,73]): экспериментальная группа достигла 76% от максимального балла против 45% у контрольной. Наибольший разрыв зафиксирован на этапе 3 - самостоятельного территориального анализа: 64% против 22%, что даёт основание полагать, что в условиях проведённого эксперимента традиционное обучение развивало навыки чтения карты, но обеспечивало лишь ограниченное развитие пространственного мышления. Результаты предоставляют учителям географии систему заданий по всем пяти разделам курса, апробированную в одной специализированной школе и требующую проверки в общеобразовательных школах.

Ключевые слова: геопространственная компетентность, экономическая география Казахстана, пространственное мышление, пространственное рассуждение, геопространственное исследование, средняя школа, Казахстан.

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MECHANISMS FOR QUANTITATIVE AND QUALITATIVE ASSESSMENT OF THE STUDY OF THE INCLUSIVE EDUCATIONAL ENVIRONMENT

Abstract

The article discusses the impact of the inclusive educational environment on professional formation and its scientific assessment in the process of training future teachers. The implementation of the principles of inclusive education in the modern education system imposes new requirements on the content of teaching staff training. However, in practice, the assessment of the inclusive educational environment is often limited to organizational or formal indicators, and its real impact on the professional training and educational practice of future teachers is not sufficiently studied. In this regard, there is a need for a comprehensive study of the inclusive educational environment as a pedagogical resource that contributes to the professional development of future teachers. The purpose of the study is to identify the role of the inclusive educational environment in the formation of professional competencies in the process of training future teachers and justify the possibilities of combining quantitative and qualitative approaches to its assessment.

In the course of the study, an analysis of the scientific literature was carried out to identify the theoretical foundations of the inclusive educational environment. At the empirical stage, a mixed methodological approach was used, survey and content analysis methods were used. This approach made it possible to comprehensively consider the views of future teachers regarding the inclusive environment, professional positions and the level of formation of skills used in inclusive practice. The results of the study showed that the inclusive educational environment has a positive impact on the formation of humanistic and personality-oriented professional positions of future teachers. At the same time, the data obtained revealed that although the level of value perception of the principles of inclusive education by future teachers is high, the formation of professional skills associated with their implementation in real pedagogical practice is uneven. There was a need for methodological support, especially in the areas of adaptation of the assessment of educational achievements, differentiation of educational tasks and planning of training taking into account the individual characteristics of students. The article substantiates that the combined use of quantitative and qualitative approaches to assessing the inclusive educational environment allows us to more fully characterize the professional training of future teachers. The results of the study can serve as a scientific and practical basis for determining the directions of development of an inclusive educational environment in the system of training teachers and improving the practice of inclusive education.

Key words: inclusive education, inclusive education environment, assessment mechanisms, quantitative and qualitative assessment, psychological and pedagogical support, future teacher, professional competencies.

Introduction. The implementation of inclusive principles in the modern education system is becoming an urgent problem not only at the level of general secondary education, but also in the educational environment of organizations of higher and (or) postgraduate education that train teaching staff. In the context of inclusive education, the professional training of the future teacher is characterized by the readiness of students to take into account the diverse learning characteristics, work with children with special educational needs, adapt teaching and create a safe, supportive educational environment. Therefore, an inclusive educational environment is considered as an important condition for the formation of professional competencies of future teachers.

The formation of an inclusive educational environment is not limited to ensuring material access. Its content includes pedagogical flexibility, psychological security, social support, the ability to participate equally in the educational process, as well as approaches to teaching and evaluation adapted to students with special educational needs. From this point of view, the inclusive environment should form not only the value position of the future teacher, but also the readiness for real professional activity.

In the scientific literature, the inclusive educational environment is characterized as a multifaceted phenomenon. In a number of studies, it is interpreted as a socio-pedagogical system that ensures equal participation of students and the reduction of barriers, while in other works, priority is given to psychological safety, a favorable microclimate and individualization of the educational process. Research in another area explains the effectiveness of an inclusive environment by adapting educational content, transforming teaching methods, and adapting evaluation mechanisms. Consequently, the inclusive educational environment is a comprehensive system based on the interconnection of physical, pedagogical, psychological and social components. However, the analysis of these studies showed that the assessment of an inclusive environment is often limited to either structural conditions or subjective opinions of participants. As a result, its real impact on the professional training of future teachers is not fully disclosed.

The development of inclusive education in the Republic of Kazakhstan is supported by international and national legal documents. The convention on the rights of the child, National Legislative Acts aimed at supporting children with special educational needs, as well as modern conceptual documents for the development of an inclusive policy affirm the need to ensure equal access and a supportive environment in the education system. At the same time, the current regulatory framework provides for the introduction of inclusive approaches in the practice of educational organizations, as well as bringing the professional training of teaching staff in line with these requirements. This increases the importance of adhering to the concepts and approaches enshrined in the legislation when assessing the training of future teachers.

Nevertheless, a number of contradictions remain in the issue of studying the inclusive educational environment in organizations of higher and (or) postgraduate education. On the one hand, an inclusive environment is recognized as an important resource that contributes to the professional formation of the future teacher. On the other hand, its assessment is often limited to formal indicators, and important qualitative aspects such as the learning experience of future teachers, professional reliability, learning adaptation and evaluation skills are not sufficiently taken into account. Hence the need to study the inclusive educational environment in the unity of quantitative and qualitative mechanisms.

The scientific problem of the study is related to determining by what indicators it is possible to comprehensively assess the impact of an inclusive educational environment in an organization of higher and (or) postgraduate education on the professional training of future teachers.

In accordance with this, the purpose of the article is to analyze the quantitative and qualitative assessment mechanisms used in the study of the inclusive educational environment in the process of training future teachers and characterize them as the basis of a comprehensive assessment model.

Research objectives:

- theoretical analysis of the essence and structural components of the inclusive education environment in the process of training future teachers;
- determination of the main indicators of professional training of future teachers in relation to work in an inclusive environment;
- description of the possibilities of quantitative and qualitative mechanisms used in assessing the inclusive educational environment;
- justification of directions for improving the inclusive educational environment based on the results of assessing the professional training of future teachers.

Research forecast: if the inclusive educational environment is considered as a unity of pedagogical, psychological and organizational conditions that contribute to the professional training of future teachers, and quantitative and qualitative mechanisms are used comprehensively in its assessment, then it will be possible to more clearly and substantively determine the level of readiness of future teachers for inclusive practice.

The specifics of the study is due to the focus on the Universal professional skills of future teachers. In this regard, the object of research was the educational environment in the process of training teachers and its influence on the professional training of future teachers. And defectologists and tutors were not included in this study, since the study was aimed not at assessing the professional

activities of special support specialists, but at assessing the basic professional training of a teacher in general, necessary to work in an inclusive class environment.

Thus, the study of the inclusive educational environment allows us to determine not only the value orientation of future teachers, but also their readiness for professional activities, such as adaptation of teaching, assessment of educational achievements, planning taking into account the characteristics of students and ensuring psychological safety. Therefore, a comprehensive assessment of the inclusive educational environment is an important prerequisite for improving the quality of teaching staff training and making scientifically based decisions aimed at developing inclusive practice.

The problem of inclusive education is considered in modern pedagogy on the basis of various theoretical positions. An analysis of scientific works shows that at least three main directions have been formed in the interpretation of inclusive education: the first, a direction that considers inclusion as a socio-pedagogical system aimed at equal participation and reducing educational barriers; the second, a direction that interprets the inclusive educational environment as a space for psychological security and favorable interaction; the third is a didactic direction that explains the effectiveness of an inclusive environment through the adaptation of educational content, methods and evaluation mechanisms.

In domestic studies, inclusive education is often characterized as a system aimed at ensuring equal participation of students, taking into account their individual characteristics and reducing barriers to the educational process. Shalgynbaeva K. K. and Ospanova B. K. explain inclusion as a complex phenomenon that takes into account the needs and characteristics of students, creates conditions for equal participation and requires adaptation of the educational environment [1]. Tusupova M. M. also takes a close position and connects the essence of inclusive education not only with the integration of students into one environment, but also with the flexibility of pedagogical decisions, Professional Responsibility and an inclusive culture [2]. What these two positions have in common is that inclusion is interpreted not only as an organizational decision, but as a system that changes the professional position of the pedagogue. At the same time, M.M. Tusupova's work pays more attention to the risks and difficulties of pedagogical activity, while K.K. Shalgynbaeva's and B.K. Ospanova's work emphasizes the value and organizational aspects of inclusion.

Kabdyrova A. A. and Kenzhebekova E. M. draw attention to the problem of interaction in the context of inclusive education [3]. The authors promote the professional position of the teacher, openness to partnership and the organization of the educational environment as a condition for successful learning and socialization. This conclusion suggests that in domestic studies, the content of inclusion is largely associated with the value training of the teacher and the culture of interaction between participants. However, in these works, the actual assessment indicators and criteria of the inclusive environment in the conditions of training future teachers are not sufficiently specified.

In foreign and Russian studies, the structure of the inclusive educational environment is considered in a more classified form. Bliznyuk O. A. and Senchenkov N. P., analyzing the relationship between the concepts of "inclusive educational environment" and "inclusive educational space", show that they are not balanced in content Terms [4]. The authors interpret the inclusive environment as a system of specially organized conditions. Here, conceptual concreteness is given priority, that is, inclusion is considered as an educational reality with specific structural characteristics, and not just an idea or principle. Such a position is more systematic in comparison with domestic works, however, it pays little attention to the analysis of the subjective experience of future teachers.

Kozyreva O. A. considers the inclusive educational environment as a socio-pedagogical problem and characterizes it as an environment that expands students' opportunities to participate in educational, cultural and social life [5]. This view reveals the nature of inclusion based on social justice. However, although the structural characteristics of the medium are given in O.A. Kozyreva's work, empirical mechanisms for assessing it are not clearly presented. In this sense, although these studies contribute to explaining the essence of the inclusive environment, they do not sufficiently reveal the evaluation model that directly relates it to the results of the teacher's training.

Studies that consider the inclusive educational environment from the point of view of psychological security deepen the content of this concept. Slyusareva E. S. characterizes the inclusive environment as a psychological and pedagogical reality in which security, convenience and accessibility are ensured, substantiating its structure through the spatial-material, psychodidactic and socio-psychological components [6]. This concept shows that an inclusive environment is not limited to physical access, it relies on learning motivation, freedom of choice, mutual respect between participants and recognition of the value of each student. The advantage of the model proposed by slyusareva is its multicomponence, however, it is not directly aimed at assessing the professional competencies of future teachers.

In works that consider the didactic and design aspects of inclusive education, the problem of adaptation of educational content comes to the fore. Kaimara P. sees inclusive education as a systemic reform that requires a redesign of educational content, teaching materials, digital tools and pedagogical technologies [7]. According to the authors, an effective inclusive environment should be based not on a standardized, but on content adapted to the individual learning characteristics of the student. This approach is important for teacher training, as it explains the professional training of the future teacher through meaningful adaptation and variable learning.

Debasu H. continues to analyze the design and management of an inclusive learning environment at the institutional level [8]. The authors indicate that the effectiveness of an inclusive environment depends on a psychologically safe climate, physical accessibility and a flexible curriculum. If the kaimara work is dominated by the redesign of educational content, the Debasu H. study shows stronger institutional management and organizational aspects of the educational environment. A comparison between these two directions shows that the interpretation of the inclusive environment is dominated by didactic logic, on the one hand, and institutional logic, on the other.

Bakhmat N. explains the socio-pedagogical potential of an inclusive environment, especially through socialization, communication and interaction [9]. The authors consider the professional training of a teacher as the main condition for inclusive practice. This conclusion echoes domestic research, since in both directions the importance of the personality of the teacher, his professional position and actions based on partnership is clearly expressed. And Grishaeva S. substantiates the inclusive educational environment as a prerequisite for high-quality inclusive education and introduces cultural-value, legal-regulatory, personnel-professional, pedagogical-methodological and institutional-organizational components into its structure [10]. The peculiarity of this model is that the inclusive environment is considered not only as a state of learning, but as a whole system of organization culture, management and professional development.

Comparison of the analyzed studies allows us to draw several conclusions. First of all, all authors recognize the inclusive educational environment as a multicomponent and adaptive system. Secondly, in domestic studies, the value and socio-pedagogical aspects of inclusion are considered priority, while in foreign and Russian works its structural, psychodidactic and institutional components are presented in a more classified form. Thirdly, although many works give a broad description of the inclusive environment, the mechanisms for its comprehensive assessment in terms of influencing the professional training of future teachers are not sufficiently clarified. The problem of assessing the impact of an inclusive environment on the Universal professional skills of future teachers, especially combining quantitative and qualitative indicators, has not been sufficiently studied.

Consequently, an analysis of the scientific literature shows that an important theoretical basis has been formed on the structure, principles and conditions of functioning of the inclusive educational environment. However, this basis often remains at the descriptive level and is not fully brought to the development of a comprehensive model for assessing the inclusive environment in the conditions of training future teachers. This gap forms the theoretical premise of the study and justifies the need to consider the inclusive educational environment in the unity of quantitative and qualitative assessment mechanisms.

An analysis of the scientific literature showed that the structure of the inclusive educational environment is a multicomponent phenomenon, however, the models of its comprehensive

assessment in terms of contributing to the professional training of future teachers are not sufficiently clarified. Taking into account this gap, the study proposes an author's conceptual model that considers the inclusive educational environment as a unity of four interrelated components that contribute to the professional formation of future teachers.

Inclusive education environment in the proposed model:

- value-security component;
- assessment adaptation component;
- component of adaptation of educational tasks;
- characterized by a component of individualization of planning and training.

The first component includes the principles of equal participation in the educational process, psychological safety, mutual respect and Prevention of discrimination. The second component describes the willingness to use individualization, consideration of Educational Progress and alternative assessment approaches in assessing educational achievements. The third component combines the skills of differentiating educational tasks according to the characteristics of students, changing the level of complexity and presenting the material in different formats. The fourth component reflects the ability to plan training taking into account the individual characteristics of students, adapt learning goals and diversify methods.

The peculiarity of this model lies in the fact that the inclusive educational environment is considered not only as an organizational or value environment, but also as a pedagogical resource that forms specific professional actions of the future teacher. In accordance with this, the study assessed the effectiveness of the inclusive education environment through the level of formation of the four listed components.

Methods and materials. The methodological basis of this work was a mixed research approach. The choice of a mixed approach was associated with the need to consider the impact of an inclusive educational environment on the professional training of future teachers from two angles: firstly, to quantify the level of manifestation of individual indicators of professional training; and secondly, to explain through the subjective experience of students how and why these indicators are formed. In accordance with this, the work considered quantitative and qualitative data of a complementary nature.

The study relied on systematic, competence-oriented and participant-oriented approaches. The systematic approach made it possible to consider the inclusive educational environment as a whole of interrelated pedagogical, psychological and organizational conditions. The competence-oriented approach served as the basis for assessing the readiness of future teachers for inclusive practice through specific professional actions. The participant-oriented approach was aimed at analyzing students' learning experience, professional confidence and understanding of the inclusive environment.

Research base and participants

Empirical work was carried out on the basis of an organization of higher and (or) postgraduate education that trains teaching staff. The selection was organized according to the target principle. The participants included students studying in pedagogical educational programs, who in the future are focused on pedagogical activity in organizations of general secondary education. Students of 2-3 courses were involved in the selection process. The total sample size was 60 students.

This type of selection was chosen in accordance with the purpose of the study, since the work was aimed at assessing the Universal professional training of not special support specialists, but precisely future general teachers in relation to work in an inclusive environment. For this reason, defectologists, tutors and specialists from the psychological and pedagogical support service were not included in the selection. This decision was made not to narrow down the object of study, but to clarify the unity of analysis: the work considered the impact of an inclusive educational environment on the overall training of a teacher.

At the same time, it should be noted that the purposefulness and small nature of the sample does not allow to generalize the results obtained directly to the entire set of students. Therefore, the

conclusions describe the trends within this sample and are not automatically distributed to all students.

Data collection tools

The data was collected using two tools: a structured questionnaire and an open-ended Question Block.

1. digital tool: survey

The questionnaire was developed as an author's tool for assessing the basic professional training of the future teacher in relation to working in inclusive class conditions. The content of the questionnaire was compiled on the basis of a review of the literature, regulatory documents on inclusive education and requirements for the professional activity of the future teacher. The tool consisted of four content blocks:

- skills of adaptation of assessment of educational achievements;
- skills of adaptation of educational tasks;
- training planning skills taking into account the individual characteristics of students;
- pedagogical principles aimed at ensuring equal participation and psychological security.

The answer to each statement in the questionnaire was set on a 5-point Likert scale:

- 1-completely disagree;
- 2 – often disagree;
- 3 – I can't give an exact answer / partially agree;
- 4-agree;
- 5-fully agree.

The average score was calculated individually for each statement and each block. To interpret the average indicators, the following criterion was used:

- 1.00-2.33-low level;
- 2.34-3.67-middle level;
- 3.68-5.00-high level.

The standard deviation (SD) was used to indicate the level of uniformity of responses: the lower the SD, the smaller the spread of participants' responses. And the percentages of "low", "medium", "high" were calculated by grouping the average score scored by each student in the corresponding block, in accordance with the above intervals. This approach allows you to clearly explain the value of points and percentages in tables.

2. a quality tool: a block of open questions

The qualitative component was used to complement and deepen quantitative results. If the digital data is "at what level? if the question "Why is the qualitative data formed in this way?"and" how does this manifest itself in professional practice? the main goal of the event was to reveal the following questions: To this end, at the end of the survey, students were asked questions in an open format.

The open questions were aimed at identifying the following aspects:

- how they perceive the learning experience in an inclusive environment;
- what professional difficulties you experience;
- how confident he feels in the assessment and adaptation of tasks;
- what prevents or supports the use of inclusive approaches in future pedagogical activities.

The qualitative component was not used to simply repeat quantitative measurements, but to identify the motivations behind them, practical difficulties, and professional reflection.

Validity and reliability of tools

The questionnaire was subjected to a preliminary examination in terms of content validity. The content of the tool was submitted for evaluation by 2 experts in the field of inclusive education, pedagogy and psychological and pedagogical support. Experts assessed the relevance of the survey conclusions to the purpose of the study, the degree of conceptual clarity and coverage of indicators of professional training. Based on Expert Opinions, a number of conclusions were clarified, stylistic and substantive corrections were made.

Data collection procedure

Data collection was carried out from January to May 2025. The purpose of the study was explained to students, and participation was organized on a voluntary basis. The survey was conducted in an offline / online format. It took an average of 20 minutes to fill it. All responses were processed anonymously.

Although quantitative and qualitative data were collected at the same stage, the analysis was carried out at two levels. First, the results of the survey were analyzed digitally, then the answers to open questions were considered through content analysis. Such a sequence made it possible to use qualitative data as a means of interpreting quantitative results.

Data processing and analysis

In the process of processing quantitative data, descriptive statistics were used. The average score (Mean), standard deviation (SD) and level distribution (%) were calculated for each statement and each content block. These indicators made it possible to characterize the general picture of the training of future teachers in relation to work in an inclusive environment.

Since the purpose of this work was not a statistical comparison of differences, but a description of the level of manifestation of professional training, the analysis was limited to descriptive statistics. This selection is also related to the size of the sample. Therefore, it is better to consider the obtained averages as a characteristic of the studied group, and not a population conclusion.

Qualitative data were processed by the method of content-thematic analysis. At first, open answers were read several times, and the initial semantic units were marked. Similar responses were later encoded and combined into the following thematic categories:

- subjective learning experience in an inclusive environment;
- a sense of professional confidence;
- preparation for the future application of inclusive approaches in practice;
- concepts and difficulties related to the evaluation and adaptation of tasks.

This approach to analysis allowed the qualitative material to perform not only descriptive, but also explanatory functions. That is, the qualitative part was used not only to confirm quantitative results, but also to reveal their causal and experimental aspects.

Methodological limitations

The work has several limitations. First, the sample size was limited to 60 students and was formed by the principle of targeted selection, so it is necessary to carefully distribute the results to a wider population. Secondly, the bulk of the data relies on responses of a self-assessment nature, while this does not completely exclude the likelihood of a socially acceptable response. Third, qualitative data was collected through open questions, so they are limited in nature compared to deep methods such as focus group, observation. Nevertheless, the applied mixed approach made it possible to comprehensively characterize the impact of the inclusive educational environment on the professional training of future teachers at the initial level.

Results and Discussion. The quantitative component of the study was aimed at determining the level of manifestation of universal professional skills of future teachers necessary for working in an inclusive environment. 60 students studying in pedagogical educational programs took part in the empirical stage. Therefore, it should be borne in mind that although the results obtained characterize general trends in the training of future teachers, their direct distribution to the entire set of students is limited.

The survey consisted of four content blocks:

- adaptation of the assessment of educational achievements;
- adaptation of educational tasks;
- planning of training taking into account the individual characteristics of students;
- pedagogical principles aimed at ensuring equal participation and psychological security.

All conclusions were evaluated on a 5-point Likert scale. The average score (Mean) given in the tables indicates the level of agreement with a particular statement, the standard deviation (SD) indicates the degree of dispersion of answers, and the percentage of low, middle, and high levels indicates the distribution of students' answers by level intervals. Thus, the data in the tables allows you to see not only the overall average, but also the structure of the answers.

1. indicators of adaptation of the assessment of educational achievements

The first block was aimed at determining the readiness of future teachers to adapt the assessment process to the characteristics of students. In this block, such indicators as the transformation of assessment criteria, taking into account the progress of the student and the use of alternative assessment methods were considered. The results of the survey on the adaptation of the assessment of educational achievements are shown in Table 1.

Table 1. The results of the survey on the adaptation of the assessment of educational achievements

Survey conclusion	Average score	Standard deviation	Low %	Middle %	High %
I believe that it is necessary not to be limited to one standard requirement in assessing students' academic achievements	3,62	0,71	15,0	51,7	33,3
I can adapt the evaluation criteria according to the individual characteristics of the students	3,41	0,69	20,0	55,0	25,0
When evaluating, I take into account the progress (progress) of the student	3,52	0,66	18,3	50,0	31,7
I am ready to use alternative assessment methods (oral, project, portfolio)	3,37	0,73	20,0	56,7	23,3

Source: developed by the authors.

The data of Table 1 showed that the indicators related to the adaptation of the assessment are mainly at the average level. The highest average score belonged to the statement "it is necessary not to limit yourself to just one standard requirement" (Mean = 3.62). This means that future educators understand that the assessment should not be limited to just one criterion. However, changing the assessment criteria based on the individual characteristics of students (Mean = 3.41) and using alternative assessment methods (Mean = 3.37) indicates that this understanding has not yet become a stable professional skill.

In other words, future educators recognize the importance of adapting the assessment, but there is uncertainty when it comes to implementing it in a specific pedagogical situation. The indicator of taking into account the student's progress in learning was also at the average level (Mean = 3.52). This result indicates that the idea of taking into account not only the final grade, but also the dynamics of learning is beginning to be accepted, but there is not enough methodological preparation for its systematic application.

These conclusions coincide with the results in the literature. For example, Kaimara P. and Debasu H. points out that in inclusive learning, evaluation approaches need to be revised along with content and teaching methods. At the same time, domestic studies also show that the value side of inclusion is perceived faster than practical tools. Our results support this trend: although inclusive assessment principles are accepted at a value level, the algorithms for their application are not sufficiently developed.

The data obtained on this block indicate the need to strengthen practical tasks on the transformation of assessment criteria, accounting for student progress, the use of alternative assessment formats, such as portfolio, project, oral response, in pedagogical training programs.

2. indicators of adaptation of training tasks

The second block concerned students' skills in adapting the content, volume, complexity and presentation format of tasks based on their characteristics. Indicators of adaptation of training tasks are shown in Table 2.

All indicators in this block are located between 3.23 and 3.38, indicating that the skills of adapting training tasks are also at an average level. The lowest result was recorded in the statement "it is not difficult for me to prepare tasks available to all students" (Mean = 3.23). That is, the development of an inclusive task is a relatively difficult professional task for future teachers.

Table 2. Results of a survey on the competence block of adaptation of training tasks

Survey conclusion	Average score	Standard deviation	Low %	Middle %	High %
I can compose tasks of different levels to achieve the same educational goal	3,29	0,74	25,0	48,3	26,7
I can change the volume or complexity of tasks depending on the capabilities of the student	3,34	0,71	21,7	53,3	25,0
I am ready to present one task in several formats (text, image, scheme)	3,38	0,70	23,3	51,7	25,0
It is not difficult for me to prepare tasks that are available to all students	3,23	0,73	23,3	53,3	23,4

Source: developed by the authors.

The indicators "drawing up tasks of different levels to achieve the same educational goal" and "changing the volume or complexity of tasks" are also not high. This indicates that future teachers understand the essence of differentiated and adapted learning, but are not ready for its systematic use at the design stage. Although the willingness to present the same task in several formats is slightly higher (Mean = 3.38), this figure has not reached a stable professional level either.

This result is combined with the studies analyzed in the literature review. Kaimara P. emphasizes the importance of redesigning content and teaching materials in inclusive education, Debasu H. attributes this to institutional and methodological support. Our results also reflect the same problem: although the adaptation of tasks is recognized at the level of an individual approach, there is not enough clear methodological base for its implementation.

At the same time, the low level of these indicators in comparison with the first block suggests that task construction and differentiation is a more complex activity than changing assessment approaches. Therefore, in order to strengthen the readiness to work in an inclusive environment, it is necessary not only to give students a theoretical understanding, but also to compile differentiated tasks, present educational material in several formats and present practical cases on the application of the principles of universal design.

3. Planning of training taking into account the individual characteristics of students

The third block was devoted to assessing the readiness of future teachers to plan lesson structure, learning goals and teaching methods in accordance with the specifics of the inclusive class. The results of the survey on training planning taking into account the individual characteristics of students are shown in Table 3.

Table 3. Results of a survey on training planning taking into account the individual characteristics of students

Survey conclusion	Average score	Standard deviation	Low %	Middle %	High %
When planning a lesson, I take into account the different learning rates of students	3,71	0,63	13,3	55,0	31,7
I can adapt my learning goals to the capabilities of my students	3,65	0,66	15,0	53,3	31,7
I am ready to use several teaching methods in parallel in the lesson	3,74	0,61	11,7	55,0	33,3
Lesson planning for working in an inclusive classroom is clear to me	3,66	0,65	13,3	56,7	30,0

Source: developed by the authors.

The results in the third block were slightly higher than in the previous two blocks: the indicators ranged from 3.65 to 3.74. This suggests that future teachers have a much better understanding of the principles of inclusive planning. The highest result was related to the preparation for the parallel use

of several teaching methods (Mean = 3.74). Consequently, students adopt the idea of transforming teaching methods.

At the same time, the indicators of adaptation of educational goals (Mean = 3.65) and clarity of the lesson plan for the inclusive class (Mean = 3.66) showed that the training in this area is still incomplete. That is, there is an understanding at the planning level, but the difficulty remains in transforming it into clear documentary and methodological solutions.

This result coincides with E.S. Slyusareva's conclusions about the psychodidactic component. The author writes in an inclusive environment "how do we teach? the question "what is it?" is of particular importance. In our study, the indicators related to the same question were slightly higher than in the assessment and adaptation of tasks, however, it is too early to call them permanent professional skills. At the same time, Grishaeva S. notes that the effectiveness of an inclusive environment depends on the integrated adaptation of the curriculum, methods and organizational mechanisms. Our results support this view: inclusive planning occupies an important place in the professional training of future teachers, but it requires support with methodological exercises and model lesson plans.

Therefore, the data obtained on this block prove the need for targeted training of students in the direction of creating an inclusive lesson, adapting the purpose of training, coordinating methods and individualizing the structure of the lesson.

4. Pedagogical principles aimed at equal participation and psychological safety

The fourth block was devoted to the assessment of value and relational orientations in an inclusive environment. Such positions as the safety of each student, prevention of discrimination, mutual respect and support for dialogue were considered here. The results of the survey on pedagogical positions aimed at equal participation and psychological safety are shown in Table 4.

Table 4. The results of the survey on pedagogical positions focused on equal participation and psychological safety

Survey conclusion	Average score	Standard deviation	Low %	Middle %	High %
I believe that all students should feel safe in the classroom	4,32	0,52	3,3	31,7	65,0
I believe that it is the teacher's duty to prevent discrimination in an inclusive environment	4,18	0,54	5,0	35,0	60,0
I can build a respectful relationship between students	4,06	0,57	8,3	41,7	50,0
I believe that it is important to listen to the opinion of each student	3,92	0,59	10,0	38,3	51,7

Source: developed by the authors.

The fourth block showed the highest results compared to other blocks. The average score for all conclusions was in the range of 3.92–4.32. The highest score was determined in relation to the statement "all students should feel safe" (Mean = 4.32). This means that future teachers perceive psychological security as the main condition for an inclusive environment.

The high indicator that it is the teacher's responsibility to prevent discrimination (Mean = 4.18) also indicates a good acceptance of the value foundations of inclusive education. The indicators of forming a respectful relationship between students and listening to the opinion of each student were also at a high level. However, the share of mid-level responses is not small here, so it is impossible to say that these positions are fully stable.

This result coincides with domestic and Foreign Studies. Shalgynbaeva K.K. and Ospanova B.K., Kabdyrova A.A. and Kenzhebekova E.A. demonstrate the importance of equal participation, interaction and creating a receptive environment in inclusive education. Slyusareva E.S. and Zubchenko O.M. substantiates that psychological security forms the core of an inclusive environment. Our study also empirically supports these conclusions: future teachers have better mastered the humanistic and value foundations of inclusive education than practical skills.

This situation shows one important pattern: value perception and professional and methodological training are not formed at the same pace. The faster the ideas of psychological security and equal participation are adopted, the longer and more purposeful the components of action, such as adaptation of assessment, task and planning, require.

A comparison of the results obtained on four blocks showed that there is a certain inequality in the training of future teachers. The highest rates were observed in positions related to equal participation and psychological security. And the lowest indicators were recorded in the areas of adaptation of educational tasks and adaptation of assessments. Training planning indicators are located between these two levels.

This structure means that the value component of inclusive training is much better formed than the action component. In other words, future teachers understand why an inclusive approach is needed, but have not fully mastered how to implement it in the classroom. Such a result echoes the phenomenon of "the gap between value harmony and practical training", which is often found in inclusive research.

The qualitative component was implemented by considering the answers to open questions on the basis of content-thematic analysis. This analysis focused on complementing the quantitative results and explaining the reasons behind them. As a result of the differentiation of open answers, four main thematic categories were identified:

- learning experience in an inclusive environment;
- a sense of professional confidence;
- preparation for the future application of inclusive approaches in practice;
- difficulties with the assessment and adaptation of tasks.

In the first category, the majority of students described the inclusive environment as a supportive and receptive environment. In the answers, such substantive phrases as "moderate perception of diversity", "listening to each other", "free expression of one's opinion", "participation without fear" were often found. These data explain the high rates in the fourth block: psychological security and equal participation are first established as a value that is felt in the daily learning experience.

In the second category, many students noted that studying in an inclusive environment gradually increased their professional confidence. In some responses, it was noted that at the initial stage there was uncertainty about working with children with special educational needs, and during the study, this fear was somewhat reduced. Therefore, an inclusive environment contributes to changing not only the attitude of the future teacher, but also his professional sense of self.

The third category concerned the preparation for the use of inclusive approaches in future practice. Here, the majority of students rated inclusive approaches as necessary and useful. However, in their answers, it became clear that examples, algorithms, and practical instructions are needed to apply these approaches clearly. This coincides with quantitative results: there is value training, but the means of action are not enough.

The fourth category revealed the difficulties associated with the assessment and adaptation of tasks. The most frequent substantive units in the open responses were: "ignorance of how to simplify the task," "the difficulty of preparing a common and accessible option for everyone," "it is difficult to combine fairness and individualization in the assessment," "there is little practical example." These data explain the decrease in averages in the first and second blocks and clarify the weak points of the respondents.

The main result of qualitative data is that future teachers support the idea of an inclusive environment, consider it important for their future work, but need specific methodological tools in adapting assessments, tasks and planning. Thus, the qualitative component made it possible not only to simply repeat the quantitative results, but also to explain why they were exactly the same.

The results show that the impact of an inclusive educational environment on the professional training of future teachers is manifested at two levels. At the first level, this influence is of a value nature: students value such principles as psychological security, prevention of discrimination, and equal participation. At the second level, this influence is associated with methodological training:

indicators remain at the average level in the areas of adaptation of assessments, differentiation of tasks and individualization of training.

This difference can be explained by several factors. First, value and legal aspects are often given in the educational content on inclusive education, and practical tools are sometimes insufficiently covered. Secondly, future teachers master the assessment and adaptation of the task in real lesson conditions only through experience. Third, the action part of inclusive training requires reflection, model tasks, case analysis, and practice-related training.

From this point of view, the results of the study complement the conclusions expressed in the literature. If in previous works the structure, principles and psychological significance of the inclusive environment were more broadly described, then in this work the inequality in its influence on the specific professional skills of future teachers was empirically demonstrated. That is, an inclusive environment is more productive in the formation of value orientations, and for the formation of methodological skills, additional organized training mechanisms are needed.

Thus, the mutual coincidence of quantitative and qualitative results increases the consistency of research conclusions. The inclusive educational environment has a positive impact on the formation of a humanistic and personality-oriented professional position of future teachers. However, its assessment should not be limited only to the level of attitude and attitude. In order for an inclusive environment to be truly productive, students also need to be armed with action skills, such as adapting assessments, differentiating tasks, individualizing lesson structures, and modifying methods.

Conclusion. The conducted study made it possible to empirically characterize the influence of the inclusive educational environment on the formation of professional competencies in the process of training future teachers. The results of the study, based on the analysis of quantitative and qualitative data, revealed a number of features of the level of professional training and attitudes of future teachers in relation to the inclusive environment.

The results of the quantitative analysis showed that the pedagogical positions of future teachers regarding equal participation and ensuring psychological safety were formed at a relatively high level. This indicates that the humanistic and personality-oriented principles of inclusive education are successfully mastered in the context of Higher Education.

It was established that professional skills of practical orientation, such as adaptation of assessment, differentiation of educational tasks and planning of training taking into account the individual characteristics of students, are formed at the middle level. This indicates that future teachers have a general understanding of the principles of inclusive education, but insufficient experience in applying them in specific pedagogical situations.

The results of the qualitative analysis showed that students evaluate the inclusive educational environment as a supportive and receptive environment. At the same time, the answers of students showed that methodological difficulties remain in the issues of assessment and adaptation of tasks. These qualitative data coincide with the formation of practical skills at the middle level, which is observed in quantitative results.

In general, the results showed that the inclusive educational environment has a positive impact on the formation of value orientations of future teachers, but for the development of practical professional skills, specially organized methodological support is needed. Therefore, the systematic introduction of practical cases, model situations and reflexive tasks on the adaptation of assessments, differentiation of educational tasks and individualization of training is important in the training programs of teachers.

At the same time, the study has a number of limitations. First of all, empirical data were based on the survey responses of 60 students, therefore, the results obtained characterize trends within a particular educational organization, and their direct generalization to all pedagogical students is limited. Secondly, since the study relied on self-assessment data, the participants' responses reflect their subjective opinions.

A promising direction in the upcoming research is to conduct comparative studies involving students studying in various educational programs in order to more widely study the impact of an inclusive educational environment on the professional training of future teachers, as well as

supplement the survey results with additional data such as materials of pedagogical practice, lesson plans or portfolio analysis.

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ИНКЛЮЗИВТІ БІЛІМ БЕРУ ОРТАСЫН ЗЕРТТЕУДІ САНДЫҚ ЖӘНЕ САПАЛЫҚ БАҒАЛАУ ТЕТІКТЕРІ

Аңдатпа

Мақалада инклюзивті білім беру ортасының кәсіби қалыптасуына әсері және болашақ мұғалімдерді даярлау процесінде оның ғылыми бағасы қарастырылады. Қазіргі білім беру жүйесінде инклюзивті білім беру принциптерін енгізу педагогикалық кадрларды даярлау мазмұнына жаңа талаптар қояды. Алайда, іс жүзінде инклюзивті білім беру ортасын бағалау көбінесе ұйымдастырушылық немесе формальды көрсеткіштермен шектеледі, оның болашақ мұғалімдердің кәсіби дайындығы мен оқу практикасына нақты әсері жеткілікті түрде зерттелмеген. Осыған байланысты болашақ мұғалімдердің біліктілігін арттыруға ықпал ететін педагогикалық ресурс ретінде инклюзивті білім беру ортасын жан-жақты зерделеу қажеттілігі туындайды. Зерттеудің мақсаты – болашақ мұғалімдерді даярлау процесінде кәсіби құзыреттілікті қалыптастырудағы инклюзивті білім беру ортасының ролін анықтау және оны бағалаудың сандық және сапалық тәсілдерін біріктіру мүмкіндіктерін негіздеу.

Зерттеу барысында инклюзивті білім беру ортасының теориялық негіздерін анықтау мақсатында ғылыми әдебиеттерге талдау жүргізілді. Эмпирикалық кезеңде аралас әдіснамалық тәсіл қолданылды, зерттеу және мазмұнды талдау әдістері қолданылды. Бұл тәсіл болашақ мұғалімдердің инклюзивті ортаға, кәсіби ұстанымдарға және инклюзивті практикада қолданылатын дағдылардың қалыптасу деңгейіне қатысты көзқарастарын жан-жақты қарастыруға мүмкіндік берді. Зерттеу нәтижелері инклюзивті білім беру ортасы болашақ мұғалімдердің гуманистік және тұлғалық-бағдарлы кәсіби ұстанымдарының қалыптасуына оң әсер ететіндігін көрсетті. Сонымен бірге, алынған мәліметтер болашақ мұғалімдердің инклюзивті білім беру принциптерін құндылықты қабылдау деңгейі жоғары болғанымен, оларды нақты педагогикалық практикада жүзеге асырумен байланысты кәсіби дағдылардың қалыптасуы біркелкі еместігін көрсетті. Әдістемелік қолдау қажет болды, әсіресе оқу жетістіктерін бағалауды бейімдеу, оқу міндеттерін саралау және оқушылардың жеке ерекшеліктерін ескере отырып оқытуды жоспарлау салаларында. Мақалада инклюзивті білім беру ортасын бағалаудың сандық және сапалық тәсілдерін бірлесіп қолдану болашақ мұғалімдердің кәсіби дайындығын неғұрлым толық сипаттауға мүмкіндік беретіндігі негізделген. Зерттеу нәтижелері мұғалімдерді даярлау жүйесіндегі инклюзивті білім беру ортасын дамыту бағыттарын анықтауға және инклюзивті білім беру тәжірибесін жетілдіруге ғылыми-практикалық негіз бола алады.

Түйін сөздер: инклюзивті білім беру, инклюзивті білім беру ортасы, бағалау тетіктері, сандық және сапалық бағалау, психологиялық-педагогикалық қолдау, болашақ мұғалім, кәсіби құзыреттіліктер.

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МЕХАНИЗМЫ КОЛИЧЕСТВЕННОЙ И КАЧЕСТВЕННОЙ ОЦЕНКИ ИССЛЕДОВАНИЯ ИНКЛЮЗИВНОЙ ОБРАЗОВАТЕЛЬНОЙ СРЕДЫ

Аннотация.

В статье рассматривается влияние инклюзивной образовательной среды на профессиональное становление будущих педагогов в процессе их подготовки, а также научная оценка данного влияния. Реализация принципов инклюзивного образования в современной системе образования предъявляет новые требования к содержанию подготовки педагогических кадров. Однако на практике оценка инклюзивной образовательной среды часто ограничивается организационными или формальными показателями и недостаточно изучается ее реальное влияние на профессиональную подготовку будущих педагогов и их учебный опыт. В связи с этим возникает необходимость комплексного изучения инклюзивной образовательной среды как педагогического ресурса, способствующего профессиональному развитию будущих педагогов. Цель исследования – выявить роль инклюзивной образовательной среды в формировании профессиональных компетенций будущих педагогов в процессе их подготовки и обосновать возможности сочетания количественного и качественного подходов к ее оценке. В ходе исследования был проведен анализ научной литературы для определения теоретических основ инклюзивной образовательной среды. На эмпирическом этапе применялся смешанный методологический подход, включающий методы анкетирования и содержательного анализа. Такой подход позволил комплексно рассмотреть взгляды будущих педагогов на инклюзивную среду, профессиональные позиции и уровень сформированности навыков, применяемых в инклюзивной практике. Результаты исследования показали, что инклюзивная образовательная среда положительно способствует формированию гуманистической и личностно-ориентированной профессиональной позиции будущих педагогов. Также полученные данные показали, что, хотя уровень ценностного восприятия будущими педагогами принципов инклюзивного образования высок, формирование профессиональных навыков, связанных с их реализацией в конкретной педагогической практике, неоднородно. Особенно отмечена потребность в методической поддержке в направлениях адаптации оценки учебных достижений, дифференциации учебных заданий и планирования обучения с учетом индивидуальных особенностей обучающихся. В статье обосновывается, что сочетание количественного и качественного подходов к оценке инклюзивной образовательной среды позволяет наиболее полно охарактеризовать профессиональную подготовку будущих педагогов. Результаты исследования могут служить научно-практической основой для определения направлений развития инклюзивной образовательной среды в системе подготовки педагогических кадров и совершенствования практики инклюзивного образования.

Ключевые слова: инклюзивное образование, инклюзивная образовательная среда, механизмы оценки, количественная и качественная оценка, психолого-педагогическое сопровождение, будущий педагог, профессиональные компетенции.

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PERCEPTIONS OF ARTIFICIAL EMOTIONAL INTELLIGENCE (AEI) AMONG TEACHERS IN KAZAKHSTAN

Abstract

The current study investigates teachers' perceptions and acceptance of Artificial Emotional Intelligence (AEI) in teacher education. It particularly focuses on the role of demographic and professional patterns, drawing on data from a sample of 1.100 educators collected across Kazakhstan. The study employed a quantitative research design, including descriptive statistics, reliability analysis, group comparisons, and multiple regression analysis.

The study results demonstrate a generally high level of AEI acceptance among teachers ($M = 4.37$), particularly regarding its potential to enhance emotional assessment and support in professional development. The AEI scale itself revealed a strong internal consistency (Cronbach's $\alpha = 0.923$), confirming the reliability of the measurement. However, comparatively lower levels of trust in AI-generated results suggest a gap between positive attitudes and full confidence in the technology.

The findings suggest that teachers' attitudes toward AEI are generally consistent across participating groups. In turn, it challenges traditional assumptions about the extent to which demographic attributes may influence technology adoption in education. In addition, the observed gap between acceptance and trust shows the need to address ethical issues. The current study contributes to research in an emerging field of AI in education by emphasizing the role of contextual and trust-related factors in shaping perceptions of emotionally intelligent technologies.

Keywords: AEI acceptance, AEI perceptions, artificial emotional intelligence, AI tools, Kazakhstan, professional development, teacher education.

Introduction. Today's world is experiencing dramatic shifts due to the development of machine learning systems. There is no doubt that one of them is Artificial Intelligence (AI), which, according to the Cambridge Dictionary, is "the use of computer programs that have some of the qualities of the human mind, such as the ability to understand language, recognise pictures, and learn from experience" [1]. With its emergence, AI provokes the reconfiguration of many other fields, including emotional intelligence. Therefore, AI systems are becoming highly embedded within educational platforms to maintain emotional awareness and psychological resilience [2]. However, Schuller & Schuller [3] highlight that the development of AI still lacks creativity from emotional and social perspectives. In this sense, current educational landscapes are shifting from traditional, "one-size-fits-all" training to personalised, data-driven professional development. International studies [4], [5], [6] reveal that while AI is widely used across various educational dimensions, its role in teacher training still remains emerging. In this sense, emotional and psychological aspects of learning are known to affect motivation, engagement, self-regulation, and academic performance [7], [8]. Therefore, emotional intelligence is a critical component in teacher education that influences overall classroom management [4, p. 117], [5, p. 7], [9], student engagement [10], and teacher well-being [11], [12].

In this sense, according to the literature, emotional intelligence (EI) is a significant capability of a person to "understand and respond to feelings, both in oneself and others" [13], while artificial intelligence is a "technique of creating computer systems that can perform tasks that require human intelligence" [14]. Although AI has been criticised for its inability to understand emotions, ethics, and morality, this led to the merger of the two disciplines of AI and EI, which created a new path for

the AEI in 1995 [14, p. 1]. However, different concepts and definitions exist related to the merger of artificial and emotional intelligence. In this sense, according to Kambur [15], emotional AI is the capability of AI systems to detect and interpret human emotions.

However, traditional approaches to evaluating emotional intelligence tend to rely more on self-report measurement [16], often undermining other methods that enable more dynamic and longitudinal assessments. In this sense, AEI is assumed to be a transformative tool for assessing learners' emotional intelligence by providing data-driven, evidence-based fundamentals [17]. There are AI-driven systems that are capable of analysing facial expressions, vocal tone, gaze direction, EEG (Electroencephalography) signals, and written input to infer emotional states with increasing precision [18], [19], [20]. These technologies are becoming significant since they enable adaptive learning experiences, providing real-time feedback and tailored interventions that align with a learner's emotional needs [21], [22].

Regardless of its potential benefits, Vistorte et al. [17, p. 2] acknowledge potential ethical risks while integrating AI in a learning environment. Particularly, data privacy and protection, transparency, and cyber threats remain significant implications for research.

In the Kazakhstani context, ongoing educational reforms and the government's intention to become an AI Hub [23] might imply the acceleration of innovative technologies in educational settings. However, there is limited research that evaluates stakeholders' perceptions of AI adoption for emotional intelligence, including teachers. In this sense, understanding teachers' acceptance of AEI is important for informing effective educational policies. The current study attempts to fill the knowledge and evidence gap by analyzing the perceptions of teachers on AEI.

Therefore, this study aims to examine teachers' perceptions and acceptance of Artificial Emotional Intelligence (AEI) in professional development and to assess whether demographic and professional characteristics influence these perceptions.

The study addresses the following three research questions:

1. What is the overall level of teachers' acceptance of AEI in teacher training?
2. Do demographic characteristics (gender, age, and education level) significantly influence teachers' perceptions of AEI?
3. Do professional characteristics (teaching experience, qualification category, school location, salary range) affect AEI acceptance?

Methods and Materials. The study employed a quantitative, cross-sectional study to identify relationships between teachers' demographic and professional characteristics and their perception of AEI.

Sampling. The current study adopted a purposive volunteer sampling design (Jupp, 2006). In-service secondary school teachers were invited to participate via an online survey link across Kazakhstan. Although the sampling strategy was purposive, targeting these individuals, their participation ultimately relied on the willingness of respondents that align with the features of a volunteer sample framework (Jupp, 2006). Participants were recruited voluntarily and included teachers of various age groups and levels of professional experience, ensuring sufficient data variability to address the research objectives. The final sampling size included 1,100 teachers, with a high concentration of respondents from Turkestan (58.7%) and Ulytau (15.3%) regions. Thus, while the sample provides sufficient variability, it does not claim national representativeness.

The research instrument is a structured, multidimensional questionnaire consisting of 50 items (variables) (appendix), categorized into four primary thematic blocks. Block I (Questions 1 to 10) covered socio-demographic background; Block II (Questions 11 to 40) included the Hall Emotional Intelligence Test; Block III (Questions 41 to 44) covered professional development; and Block IV (Questions 45 to 50) addressed perceptions of artificial emotional intelligence (AEI) in teacher education. The survey was administered via the Google Forms platform. Participation was voluntary and anonymous, and the average time to complete the questionnaire was 20-25 minutes.

Statistical processing of data was carried out using the R programming 4.6.0 software and included the calculation of descriptive statistics, Welch t-test, One-way ANOVA (Analysis of Variance), and Multiple linear regression analysis.

The study was conducted in accordance with international and national ethical standards, including the principles of the Kazakhstan Code of Ethics for Research in Education [24] and received confirmation from IRB of Astana IT University. Respondents received informed consent, whereas confidentiality and voluntary participation were ensured. The survey was designed to be bilingual (Kazakh and Russian) to ensure accessibility and clarity for a diverse cohort of educators in Kazakhstan.

Results and Discussion.

Descriptive findings for demographic and professional items

The study involved 1.100 educators, of whom 17.4% were men ($n = 191$) and 82.6% were women ($n = 909$). The participants' ages varied from 20 to older cohorts. In particular, those aged 20-30 years old composed 14.0% ($n = 154$), 30-40 years old 29.5% ($n = 324$), 40-50 years old 31.3% ($n = 344$), and 50 years old and older 25.3% ($n = 278$).

Regarding the educational level, the majority possessed a bachelor's degree - 84% (923 people), suggesting a highly standardized professional environment. This was followed by 10% of Master's degree holders, while teachers with vocational education (5.5%) and PhD holders (1%) remained the smallest portion.

The teaching experience of participants is remarkably well-balanced. While the novice teachers (<5) represented 14%, 5-9 years experienced were 12%, 10-14 year experienced were 17%, 15-19 and 20-24 year experienced were 14%, 25-30 year experienced were 11%, and the most experienced (30<) teachers composed 17% of the sampling.

Geographically, the majority of participants work in rural areas 74.7% ($n = 822$), and 25.3% of teachers ($n = 278$) work in urban schools. The vast majority of participants are from the Turkestan 58.7% ($n = 646$) and Ulytau regions 15.3% ($n = 168$), Shymkent city 9.5% ($n = 105$). Among other regions, Pavlodar region 2.6% ($n = 29$), North Kazakhstan region 3.0% ($n = 33$), East Kazakhstan region 3.4% ($n = 38$), Karaganda region 2.4% ($n = 26$), Kostanay region 2.9% ($n = 32$), Abay region 0.8% ($n = 9$), Astana city 0.9% ($n = 10$), Almaty city 0.2% ($n = 2$), Aktobe region and Zhetysu region 0.1% ($n = 1$).

The professional qualification category was characterized by a high level of expertise, with over 75% of the group holding advanced designations such as Teacher Expert (29%), Teacher Moderator (27%), or Teacher Researcher (22%). Standard Teachers make up a smaller portion at 18%, while those at the very beginning of their journey Teacher trainees account for just 1.8%, indicating a workforce that is heavily weighted toward experienced, senior-level practitioners rather than entry-level staff.

By the type of educational organization, the majority of participants reported working in public schools, 96.9% ($n = 1065$), and lyceums and gymnasiums, 3.1% ($n = 35$).

Regarding salary distribution, the majority (40%) receive 200.000-300.000 Kazakhstani tenge. Slightly more than one-fifth (22%) receive the lowest salary, between 100.000 and 200.000 tenge, while about one-third (28%) receive 300.000-400.000 tenge. The smallest share of participants (6.5%) reported the highest salary of more than 400.000 tenge, whereas 3.5% preferred not to answer.

Descriptive findings for AEI

Overall, the reliability analysis showed that the AEI scale has excellent internal consistency (Cronbach's $\alpha = 0.923$), indicating that the items (Questions 45-50) consistently measure the same underlying construct, which is the perception of AEI in teacher training. These items were rated using a six-point Likert scale, ranging from 1 ("Strongly disagree") to 6 ("Strongly agree"), with no neutral midpoint. Table 1 presents descriptive statistics (mean and standard deviation). Overall, the results indicate moderately high acceptance, with some variability in responses.

Items 45–50 were rated using a six-point Likert scale ranging from 1 ("Strongly disagree") to 6 ("Strongly agree"), with no neutral midpoint.

The first item, 'Support for innovative technologies in assessing teachers' emotional intelligence' was the most strongly supported item (Mean = 4.52 (highest), SD = 1.51). This implies that the survey respondents strongly support technological innovation for assessing their emotional intelligence.

For the second item, ‘Familiarity with emotional artificial intelligence’ (Mean = 4.49, SD = 1.46), results showed that respondents overall illustrate familiarity about AI tools, suggesting that AI tools are not entirely new to them. Still, the SD indicates uneven levels of awareness across participants.

Table 1. Descriptive Statistics for Artificial Emotional Intelligence Acceptance Items

#	Item	Mean	SD
1	Support for innovative technologies in assessing teachers' emotional intelligence	4.52	1.51
2	Familiarity with emotional artificial intelligence	4.49	1.46
3	Emotional AI enables a deeper assessment of future teachers' emotional stability.	4.33	1.51
4	Emotional AI can improve the professional preparation of future teachers	4.40	1.50
5	Emotional AI can help prevent professional burnout among teachers	4.30	1.50
6	Trust in the results of data obtained through emotional artificial intelligence	4.15	1.52
7	Composite Emotional AI acceptance score	4.37	1.28

Source: Compiled by the authors

The third item findings showed that Emotional AI enables a deeper assessment of future teachers' emotional stability (Mean = 4.33, SD = 1.51). Participants generally believe Emotional AI can provide more nuanced insights into emotional stability, though opinions vary.

The fourth item results showed that participants overall agree that ‘Emotional AI can improve the professional preparation of future teachers’ (Mean = 4.40, SD = 1.50).

The results for the fifth item showed that respondents believe that ‘Emotional AI can help prevent professional burnout among teachers’, though slightly less strongly than for training improvement (Mean = 4.30, SD = 1.50).

The sixth item, although still positive, was the least endorsed item among the six questions related to AEI perceptions among teachers (Mean = 4.15 (lowest), SD = 1.52). This suggests that teachers show some skepticism or caution towards the AI-generated data on emotional intelligence.

The seventh item, which shows the composite Emotional AI acceptance score (M = 4.37, SD = 1.28), suggests that, on average, respondents agree with the use of Emotional AI in teacher preparation.

To sum up, the findings demonstrate an overall positive perception of Emotional AI among respondents (M = 4.37). The highest level of agreement pertained to the support of innovative technologies (M = 4.52) in assessing EI, while trust in AI-generated results demonstrated comparatively lower agreement (M = 4.15). Despite overall favorable attitudes, the relatively high standard deviations indicate variability in perceptions, suggesting that while Emotional AI is widely accepted, users remain less confident when it comes to fully trusting its results.

Model findings

This section summarizes the results of inferential statistical tests examining whether different demographic and professional characteristics are associated with teachers’ AEI acceptance. The group differences were first examined using independent-samples t-tests and one-way ANOVA (Table 2). This was followed by a multiple linear regression model that included all predictors simultaneously. The key takeaway is that the overall regression model was not statistically significant, three individual regression coefficients were statistically significant after controlling for the remaining variables.

Table 2. Summary of Group Comparisons and Regression Analysis

#	predictor	test	statistic	p value	interpretation
1	Gender	Welch t-test	t(259.78) = -0.03	.978	Not significant
2	Age	One-way ANOVA	F(3, 1097) = 2.36	.070	Trend-level only
3	Education level	One-way ANOVA	F(4, 1096) = 1.99	.095	Trend-level only
4	Teaching experience	One-way ANOVA	F(6, 1094) = 1.97	.067	Trend-level only

#	predictor	test	statistic	p_value	interpretation
5	School location	Welch t-test	$t(536.22) = 0.10$	.924	Not significant
6	Salary range	One-way ANOVA	$F(5, 1095) = 1.82$	.105	Not significant
7	Subject group	One-way ANOVA	$F(8, 1092) = 1.74$	.085	Trend-level only
8	Institution type	One-way ANOVA	$F(7, 1093) = 1.58$	.138	Not significant
9	Qualification category	One-way ANOVA	$F(8, 1092) = 1.12$	.345	Not significant
10	Full regression model	Multiple linear regression	$F(43, 1056) = 1.34$	.075	Model not significant

Source: Compiled by the authors

As demonstrated in Table 2, the t (t -statistic) is used in t -tests to compare the means of two groups (e.g., male and female, urban and rural), while the F (F -statistic) is used in ANOVA and regression to assess differences among multiple groups or the overall model fit. In both cases, larger values indicate stronger differences or effects, but statistical significance is determined by the p (p -value), which reflects the probability that the observed results occurred by chance. Typically, $p < .05$ indicates statistical significance, $p < .10$ suggests a trend, and $p \geq .05$ indicates non-significance.

A multiple linear regression (Table 3) examined the association between demographic and professional characteristics and teachers' AEI acceptance. The regression model was not statistically significant, $F(43, 1056) = 1.34$, $p = .075$, explaining 5.2% of the variance in AEI acceptance ($R^2 = .052$, adjusted $R^2 = .013$). Variables including gender, age, education level, teaching experience, school location, salary range, and qualification categories were not statistically significant ($p > .05$) after controlling for the remaining variables. However, teachers in social sciences ($B = 0.89$, $p = .042$) and in Arts ($B = 0.45$, $p = .041$) and respondents employed in institutions classified as "Other" ($B = 0.61$, $SE = 0.295$, $p = .039$) showed significantly higher AEI acceptance than those in the reference groups.

Table 3. Multiple Linear Regression Predicting Teachers' Emotional AI Acceptance

Predictor	Reference Category	Significant Comparisons (B, 95% Ci)	Overall p-value
Gender	Female	None	.879
Age	20–30 years	None	.069
Education level	Secondary	None	.052
Teaching experience	<5 years	None	.275
School location	Rural	None	.576
Salary range	100–200k KZT	None	.366
Subject group	STEM/ Natural Sciences	Arts/Technology: B = 0.45 (0.02, 0.89); Social Sciences: B = 0.89 (0.14, 1.63)	.050
Institution type	General Secondary School	Other: B = 0.61 (0.03, 1.19)	.399
Qualification category	Administrative/Other Professional Role	None	.791

Source: Compiled by the authors

Overall, the findings suggest that although three individual categories exhibited statistically significant positive associations with teachers' AEI acceptance, the overall regression model was not significant explaining a small proportion of the variance. Therefore, other factors than demographic and professional characteristics may play a decisive role in shaping teachers' AEI acceptance.

It is important to note that only nine predictors were included in the regression model (Table 4). However, because these nine predictors were categorical variables with multiple levels, they were entered as factors using R's default treatment (or dummy) coding. The first category served as the reference group (Table 3).

Consequently, in this model, the nine predictors were expanded into 43 regression parameters (dummy variables), explaining the numerator degrees of freedom reported for the overall model, $F(43,1056)$.

Table 4. Coding of Categorical Predictors Included in the Regression Model

#	Predictor	Number of Categories	Dummy Variables
1	Gender	2	1
2	Age	4	3
3	Education level	5	4
4	Teaching experience	7	6
5	School location	2	1
6	Salary	6	5
7	Subject group	9	8
8	Institution type	8	7
9	Qualification category	9	8

Source: Compiled by the authors

Since the model included multi-level categorical predictors, multicollinearity among the predictors was evaluated using Generalized Variance Inflation Factor (GVIF) (Table 5).

Table 5. Generalized Variance Inflation Factor results

#	Predictor	Adjusted Gvif
1	Gender	1.20
2	Age	1.40
3	Education level	1.11
4	Teaching experience	1.23
5	School location	1.12
6	Salary range	1.10
7	Subject	1.06
8	Institution type	1.15
9	Qualification category	1.18

Source: Compiled by the authors

As shown in Table 5, adjusted GVIF values ranged from 1.06 to 1.40 well below commonly accepted thresholds (< 5). This means that multicollinearity showed no evidence of problematic collinearity among the nine predictors.

Overall, while a few predictors in this dataset show significant tendencies (p-value between .05 and .10), signaling possible weak relationships, but these are not robust enough to draw conclusions. Relatively, the full regression model is not significant ($p = .134$), explaining 5.2% of the variance in AEI acceptance ($R^2 = .052$, adjusted $R^2 = .013$). This indicates that all demographic and professional items combined do not meaningfully explain variation in the AEI perception (dependent variable). These could be important findings, which mean that overall AEI perception is not substantially driven by demographic and professional characteristics but by other individual and structural features. To sum up, the inferential analysis revealed no statistically significant differences across demographic and professional variables towards the dependent variable, perceptions of AEI. While age, teaching experience, and subject group demonstrated trend-level associations ($p < .10$), these effects were not robust. Furthermore, the overall regression model was not significant ($F(43, 1056) = 1.34$, $p = .075$), indicating that the included predictors do not meaningfully explain variation in the dependent variable. These findings suggest that the observed attitudes are relatively consistent across different teacher groups.

The findings of this study reveal a consistently positive perception of Artificial Emotional Intelligence (AEI) among teachers, with a relatively high overall acceptance score ($M = 4.37$). Concurring with international literature [5, p. 5], [17, p. 2], the study findings show that teachers

generally welcomed the use of AEI technologies. Therefore, the high level of support for innovative technologies, particularly in assessing emotional intelligence, may reflect an increasing recognition of the role of digital tools in enhancing pedagogical practices across the country. It is important to note that statistically significant differences across most demographic and professional characteristics were relatively homogeneous. This potentially could be explained by a centralized structure of the national education since the results had consistent expectations and practices across almost all variables [25]. Moreover, Kazakhstan has recently implemented nationwide strategies aimed at digitalization of the education sector, including AI-initiatives, expanding digital tools, and professional development [26]. While these initiatives may contribute to consistent positive perceptions of AEI among teachers in Kazakhstan, future studies should consider more accurate selection of participants across all regions to ensure generalized results.

In addition, the fact that many teachers already have access to various AI platforms may reduce, for instance, the gender gap in AEI acceptance. Many education practitioners may already have experienced perceived usefulness through their regular interaction with generative AI tools [27]. This, in turn, may have contributed to the homogeneous results observed in this study.

Nevertheless, the study results indicate a notable gap between acceptance and trust among the participants. This is revealed by the results, where trust in AI-generated results was comparatively lower among teachers, despite their high support for the use of AEI. This divergence suggests that although educators are willing to engage with AI-based tools, they may still hold reservations regarding the accuracy, transparency, and ethical implications of such technologies [14, p. 12]. This aligns with broader concerns in the literature on AI in education, where trust is often identified as a critical factor influencing adoption and sustained use [28].

One of the most important findings of this study is the absence of statistically significant differences across demographic and professional variables. Factors such as gender, age, education level, teaching experience, and school context did not significantly predict teachers' perceptions of AEI. This challenges common assumptions in technology adoption research, which often emphasize the role of individual characteristics in shaping attitudes toward innovation.

Conclusion. This study examined teachers' perceptions of Artificial Emotional Intelligence (AEI) by exploring whether demographic and professional factors might be associated with these perceptions. The findings demonstrate that teachers possess generally positive attitudes toward AEI to enhance emotional assessment and professional preparation.

Nevertheless, the study results revealed a gap between acceptance and trust since teachers had cautious attitudes toward the reliability of AI-generated results. Therefore, despite its successful adoption and positive attitudes shown by participants, AEI's application needs to consider its ethical usage.

Importantly, the absence of statistically significant differences across demographic and professional variables shows that AEI perceptions are relatively consistent among participants. Therefore, this may question the application of traditional assumptions about technology adoption, suggesting that attitudes toward AEI may be shaped by institutional or broader contexts rather than by individual characteristics.

The current study contributes to an emerging field of research on AI in education pointing out to the need to explore issues of transparency, ethics, and trainings beyond demographic attributes. Practically, policymakers, researchers, and educational institutions may consider prioritizing building trust in AEI systems by ensuring particularly ethical challenges while integrating AEI in the process. Further implications may explore underlying reasons for consistent perceptions towards AEI and investigate how teachers' lived experiences with AI shape their attitudes over time.

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ҚАЗАҚСТАНДАҒЫ МҰҒАЛІМДЕРДІҢ ЖАСАНДЫ ЭМОЦИОНАЛДЫ ИНТЕЛЛЕКТКЕ (ЖЭИ) ҚАТЫСТЫ ҚАБЫЛДАУЛАРЫ

Аңдатпа

Бұл зерттеу Жасанды Эмоционалды Интеллекттің (ЖЭИ) мұғалімдерді оқытудағы демографиялық және кәсіби сипаттамаларды негізге ала отырып, олардың ЖЭИ қабылдауын зерттейді. Қазақстандағы 1100 педагогтың арасынан алынған деректерге сүйене отырып, зерттеуде сипаттамалық статистика, сенімділік талдауы, топтық салыстырулар және көптік регрессиялық талдауды қамтитын сандық зерттеу дизайны қолданылады.

Зерттеу нәтижелері мұғалімдер арасында ЖЭИ-ді қабылдаудың жалпы жоғары деңгейін көрсетеді ($M = 4.37$), әсіресе оның эмоционалды бағалауды жақсарту және кәсіби дамуды қолдау әлеуетіне қатысты. ЖЭИ шкаласы жоғары ішкі сәйкестікті көрсетті (Cronbach's $\alpha = 0.923$), бұл өлшеудің сенімділігін растайды. Дегенмен, ЖЭИ жасаған нәтижелерге деген сенімнің салыстырмалы түрде төмен деңгейі оң көзқарастар мен технологияға толық сенімділік арасындағы алшақтықты көрсетеді.

Зерттеу нәтижелері мұғалімдердің ЖЭИ-ге деген көзқарасы әртүрлі топтарда салыстырмалы түрде тұрақты екенін көрсетеді, бұл технологияны енгізуге демографиялық әсер ету туралы дәстүрлі болжамдарға күмән келтіреді. Сонымен қатар, қабылдау мен сенім арасындағы байқалған алшақтық ашықтыққа, сенімділікке және этикалық пайдалануға қатысты мәселелерді шешудің маңыздылығын көрсетеді. Бұл зерттеу эмоционалды интеллектуалды технологияларды қабылдауды қалыптастырудағы контекстік және сенімге байланысты факторлардың ролін атап өту арқылы білім берудегі жасанды интеллект бойынша зерттеулердің дамуына үлес қосады.

Түйінді сөздер: ЖЭИ қабылдау, ЖЭИ туралы түсініктер, жасанды эмоциялық интеллект, жасанды интеллект құралдары, Қазақстан, кәсіби даму, мұғалімдерді оқыту.

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ВОСПРИЯТИЕ ИСКУССТВЕННОГО ЭМОЦИОНАЛЬНОГО ИНТЕЛЛЕКТА (ИЭИ) СРЕДИ УЧИТЕЛЕЙ В КАЗАХСТАНЕ

Аннотация

В данном исследовании изучается восприятие и принятие учителями искусственного эмоционального интеллекта (ИЭИ) в педагогическом образовании, с особым вниманием к роли демографических и профессиональных характеристик. На основе данных выборки из 1100 педагогов Казахстана использовался количественный метод исследования, включавший описательную статистику, анализ надежности, сравнение групп и множественный регрессионный анализ.

Количественные результаты данного исследования показали, в целом, высокий уровень принятия ИЭИ учителями. Это было особенно выражено в отношении его потенциала для улучшения эмоциональной оценки и поддержки профессионального развития. Сама шкала ИЭИ продемонстрировала высокую внутреннюю согласованность (Cronbach's $\alpha = 0.923$), что в свою очередь подтверждает надежность измерения. Тем не менее, сравнительно низкий уровень доверия к результатам, полученное с помощью ИИ, указывает на наличие разрыва между положительным отношением и высокой уверенностью использования ИЭИ.

Результаты также показали, что отношение респондентов к ИИ несет относительно согласованный характер, ставя под сомнения влияние каких-либо профессиональных или демографических факторов на внедрение технологии. Кроме того, существующий разрыв между принятием ИЭИ и доверием, в свою очередь указывает на важность вопросов о прозрачности, надежности и этичным интегрированием ИЭИ в сфере образования. Результаты и интерпретация данного исследования вносит вклад в развивающуюся область исследований по ИЭИ в образовании, подчеркивая важную роль контекстуальных и структурных факторов.

Ключевые слова: принятие ИЭИ, восприятие ИЭИ, искусственный эмоциональный интеллект, инструменты ИИ, Казахстан, профессиональное развитие, педагогическое образование.

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COMPARING AN ARTIFICIAL INTELLIGENCE-BASED ADAPTIVE APPLICATION AND A GAMIFIED APPLICATION FOR MOBILE ENGLISH LEARNING AMONG UNIVERSITY STUDENTS IN KAZAKHSTAN

Annotation

Mobile applications have become a central tool for learning English as a foreign language. Two designs now dominate the market, gamification and artificial-intelligence-based adaptive learning, yet they are seldom compared directly, especially in Kazakhstan and among the future foreign-language teachers who will shape its national language education. This study compared a gamified application, Duolingo, with an artificial-intelligence-based adaptive application developed in Kazakhstan, Oki/Aleem, over a four-week intervention. A two-group quasi-experimental design was used. In total, 120 undergraduate students in a foreign-language teacher-training programme worked with one of the two applications, and 115 were matched across a pre-test and a post-test. Achievement was measured with parallel twenty-item forms administered before and after the intervention. A weekly form tracked how the applications were used, and three open-ended questions were coded thematically. Scores rose markedly in both groups over the month. Once pre-test scores were entered as a covariate, the analysis of covariance showed no advantage for either application. Weekly practice was sustained in both groups and increased toward the end of the intervention. The open-ended responses revealed a clear contrast. Duolingo was valued for its game-like motivation, whereas Oki/Aleem was valued for its adaptivity, feedback and local relevance. The two applications therefore produced similar learning gains through different mechanisms, which reframes the choice between them as a question of purpose rather than of effectiveness. The findings support building direct, comparative experience of gamified and adaptive applications into foreign-language teacher preparation in Kazakhstan.

Keywords: artificial intelligence, English as a foreign language, gamification, Duolingo, Oki/Aleem, mobile-assisted language learning, foreign-language teacher preparation.

Introduction. Mobile applications have moved to the centre of how people learn English as a foreign language. Smartphones are now widely available and allow learners to study at almost any time and place, and mobile-assisted language learning has grown from a marginal practice into a mainstream one, supported by a large and still-expanding body of research [1]. For many learners, a language application is no longer a supplement to the classroom but the primary space for everyday practice [2].

Two design philosophies have come to dominate this field. The first is gamification, which uses points, badges, streaks, levels and daily goals to keep learners returning to the application. Its best-known representative is the global application Duolingo. The second is artificial-intelligence-based adaptive learning, in which the application analyses a learner's performance and adjusts tasks, feedback and difficulty to the individual. This approach underpins a newer generation of artificial-intelligence tutors. Both promise stronger motivation and measurable language gains, but they pursue these outcomes through very different mechanisms, and it is not obvious that they bring learners to the same result.

The question is especially salient in Kazakhstan. Under the national digitalisation agenda, the digitalisation of higher education has become a policy priority, and the preparation of future foreign-language teachers increasingly assumes that graduates will be competent users and designers of such tools [3]. A locally developed adaptive application, Oki/Aleem, has begun to compete with Duolingo for the attention of Kazakhstani learners, which adds cultural and curricular relevance to the

comparison. Teachers and students thus face a practical choice between a gamified and an adaptive application, yet they have little direct evidence on which to base it.

The present study addresses this gap. For four weeks, undergraduate students in a foreign-language teacher-training programme worked with either Duolingo or Oki/Aleem. We tracked their achievement gains and their weekly use of the applications, and we asked the students what each tool was like to work with. By pairing an objective achievement test with learners' own accounts, the study speaks both to the measurable effects of the two designs and to the reasons learners value them.

Literature review. Reviews of the mobile-assisted language learning literature generally report positive effects on language learning, but they also caution against reading those effects too confidently. The largest meta-analysis to date is that of Burston and Giannakou [1, p. 160], who pooled experimental studies published between 1994 and 2019. The overall effect sizes are large, approximately 0.72 in between-group designs and 1.16 in within-group designs, yet the authors warn that these values should be interpreted with caution because of clear publication bias and very high heterogeneity [1, pp. 161-162]. The same synthesis shows that vocabulary is by far the most frequently targeted learning focus, accounting for roughly a third of all reported outcomes, while advanced learners are rarely studied [1, p. 159]. Longitudinal evidence indicates that sustained mobile practice can shift learners' attitudes and self-regulation in a positive direction over time [2, p. 8]. The field therefore appears effective but uneven, with short interventions, small samples and non-standardised tests recurring as weaknesses.

Gamification, understood as the use of game-design elements such as points and rewards in non-game settings, has been introduced into foreign-language teaching to address the motivational problem at the heart of self-directed study [4]. Meta-analytic evidence is broadly favourable. In a meta-analysis of South Korean research, Lee and Baek reported a medium effect of gamification on English proficiency, with a standardised mean difference of about 0.52 [5]. This average conceals a moderator effect. The gain was largest in primary school, whereas at university level it was small and not statistically significant [5, p. 11]. A further caveat recurs across the reviews. Technology-based study is self-directed, so keeping learners engaged is a problem in its own right, and the features intended to motivate can also distract [6].

Duolingo, the application used by one group in this study, is the most heavily researched gamified platform. One study assessed 245 learners who had used Duolingo as their only learning tool and had completed its beginner content at level A2 of the Common European Framework of Reference for Languages (CEFR), using a standardised proficiency test [7]. On average these learners reached Intermediate High in both reading and listening, one sublevel of the American Council on the Teaching of Foreign Languages (ACTFL) scale above the expected course outcome [7, p. 263]. A natural experiment with several hundred learners showed that the regularity of practice and engagement with the curriculum predicted gains more dependably than the number of minutes spent in the application [8]. Comparative studies indicate that Duolingo can match classroom instruction. Beginner learners of French improved to a similar degree whether they studied in class, through Duolingo alone or through both combined, the single exception being one pragmatic measure on which the combined condition outperformed the other two [9]. What this literature rarely does is compare Duolingo with an adaptive, artificial-intelligence-based alternative rather than with classroom instruction or with itself.

The adaptive-learning approach rests on a different premise, namely that learning is most effective when content, difficulty and feedback are tailored to the individual in real time. Experiments testing this premise are only now appearing. One pre-test/post-test control-group study found that learners taught with adaptive artificial-intelligence-based instruction handled difficult grammatical structures better than those taught conventionally, although the sample was small ($n = 60$) [10]. Achievement is not the whole story. Corrective and motivational feedback generated by artificial intelligence has been associated with higher engagement, enjoyment and motivation [11]. Systematic reviews nevertheless note that the evidence base is still young and uneven. Reviewing studies published between 2017 and 2023, one review concluded that the integration of artificial intelligence into English teaching remains at an early stage and that rigorous evidence on its effects is limited

[12]. Adaptivity and rich feedback are therefore plausible strengths of an application such as Oki/Aleem, but they have seldom been tested directly against a gamified competitor.

The Kazakhstani setting matters as well. The national digitalisation policy has produced a wave of research on technology in higher education. These studies report that digital interventions can strengthen students' professional and cognitive skills, but they also expose gaps in infrastructure and in teacher readiness [13]. In teacher preparation specifically, a mixed-methods study of Kazakhstani teacher-training programmes showed that digital learning environments improve future English teachers' language proficiency, pedagogical skill and technological fluency [3, p. 284], while problems of access and of integrating technology into the curriculum remain unresolved [3, p. 285]. Since the digital competence of future language teachers is now treated as a core professional requirement, this cohort is a particularly relevant group in which to study how different application designs work in practice.

Across these strands the same gap recurs. The literature compares applications with classroom instruction [9, p. 22], or reviews a single application type, gamified or adaptive, on its own. It rarely places a gamified application and an adaptive application alongside each other within the same learner population, under comparable conditions, with the same prescribed dose and outcome measures. Head-to-head comparisons of this kind are rare, and we found almost none from Central Asia or Kazakhstan. A locally built application such as Oki/Aleem is, for practical purposes, invisible in the international evidence base. Future foreign-language teachers, the cohort on which the region's long-term language education depends, are also under-represented. The present study was designed to address this gap.

The aim and objectives of the study. The aim of this study is to compare the effects of a gamified mobile application (Duolingo) and an artificial-intelligence-based adaptive mobile application (Oki/Aleem) on the English achievement, application use and perceptions of undergraduate learners of English in a Kazakhstani teacher-training programme over a four-week intervention. The specific objectives are: (1) to measure and compare English achievement gains in the two groups; (2) to describe how consistently each group used its assigned application; (3) to examine, through learners' own accounts, how they perceived the usefulness, difficulties and relative suitability of the two applications; and (4) to consider what these findings imply for the use of gamified and adaptive applications in English learning and in foreign-language teacher preparation in Kazakhstan.

These objectives were addressed through four research questions and four hypotheses (H). RQ1: after a four-week intervention, do learners in the two groups differ in their English achievement gains? (H1: both groups will improve significantly from pre-test to post-test; H2: the two groups will differ in post-test performance after pre-test scores are controlled.) RQ2: how consistently did learners in the two groups use their assigned application? RQ3: how did learners perceive the usefulness, difficulties and relative suitability of the two applications for learning English in Kazakhstan? (H3: the Oki/Aleem group will emphasise adaptivity and feedback more than the Duolingo group; H4: the Duolingo group will emphasise gamified engagement more than the Oki/Aleem group.) RQ4: what difficulties did learners report during weekly use and in their open-ended responses?

Methods and Materials. The design was a two-group pretest-posttest quasi-experiment with an added qualitative strand, so that the test results and the students' own comments could be read alongside each other. Over four weeks, two groups of undergraduates practiced with different mobile applications. Group A used Duolingo, a largely gamified application, and Group B used Oki/Aleem, an artificial-intelligence-based adaptive application developed in Kazakhstan. Participation was voluntary and the groups were not formed through random assignment, so the design is best understood as a non-equivalent-groups quasi-experiment. For this reason we examined, and report in the Results, whether the two groups were comparable before the intervention began. The primary and only objective outcome was the English achievement test. The perception scales had also been planned as outcomes, but their internal consistency proved too weak (see Results), so learners' experiences of the two applications are described from the open-ended answers instead. After giving informed consent, students were assigned in order of registration, alternating between the groups,

with the first eligible student allocated to Group A and the next to Group B, until both groups reached 60. Because no individual randomisation was carried out, the study is treated as quasi-experimental. Alternating allocation is systematic rather than random, and registration order could in principle correlate with characteristics such as eagerness or prior proficiency; alternation, however, distributes any such ordering trend evenly across the two conditions, and the baseline equivalence of the groups was verified empirically before the intervention.

The study was carried out at O. Zhanibekov South Kazakhstan Pedagogical University in Shymkent, Kazakhstan, with undergraduates of the programme 6B01703 “Foreign Language: Two Foreign Languages”, which prepares future teachers of foreign languages. Students from the first, second and third years took part on a voluntary basis, giving a total of 120 participants split evenly between the two groups (60 in each). Of these, 115 could be matched across the pre- and post-tests through their self-generated codes (57 in Group A and 58 in Group B); the remaining five participants were excluded from the paired analyses because the codes they had entered at pre-test and post-test did not correspond.

The sample leaned toward the lower undergraduate years, with 68 first-year, 33 second-year and 19 third-year students, and toward intermediate proficiency. On a self-report basis, 81 students placed themselves at level B1, 26 at B2 and 13 at C1, and none reported an A-level. Because proficiency was self-reported rather than tested, we did not treat it as an objective baseline and used the pre-test score for all group comparisons. Age and gender were not recorded, a limitation discussed below.

Students were recruited through their regular English classes and were informed about the purpose and duration of the study, the comparison of two mobile applications, and the pre-test, weekly monitoring form and post-test. Taking part was voluntary. Students who agreed signed an electronic consent form online, and nobody who declined proceeded to the pre-test or the pre-survey. Eligibility criteria were straightforward: at least 18 years of age, enrolment at undergraduate level, studying English as a foreign language, ownership of a smartphone with internet access, and willingness to remain in the study for all four weeks. Several kinds of data were removed before analysis: records of anyone under 18 or without consent, records with a missing pre-test or post-test, records of students who never used their assigned application, and duplicates.

Ethical approval came from O. Zhanibekov South Kazakhstan Pedagogical University, which classified the study as a minimal-risk educational intervention. Before the pre-test and pre-survey, every participant signed an electronic consent form. Students were told in plain terms what the study was about, what the four weeks would involve and how the testing would work. They also knew that participation was voluntary, that their answers were anonymous and confidential, and that they could leave at any moment without consequences for their coursework. No personal identifiers were collected. The four-to-six-character codes that students created themselves were used only to link their pre-test, weekly monitoring and post-test responses. The files were password-protected and accessible to the research team only, and nothing is reported here below the aggregate level.

Intervention and procedure. The timeline was straightforward. On 25-26 April 2026 students sat the pre-test and completed the pre-survey. From 27 April to 23 May they practised with their assigned application, and on 25-26 May they took the post-test and the post-survey. To keep the workload equal in both conditions, the instructions were identical: 15-20 minutes of practice a day, on at least five days a week, together with weekly evidence of use in the form of a screenshot or a progress record. The teacher’s role was limited to technical help. No teaching and no additional content were provided, so that any difference between the groups would derive from the applications themselves. Throughout the four weeks students continued their regular timetable, in which English was taught in two 50-minute lessons per week, and the application practice was assigned as part of their independent study workload. Both groups used the publicly available versions of the applications current during the intervention period (April–May 2026).

Access to the paid application was controlled so that cost would not separate the two groups during the study. All 60 students in Group B received one month of free access to Oki/Aleem and none of them paid anything during the study. The access ran for exactly the intervention period and covered the lessons, practice activities, feedback and progress-tracking features on which the study

relied. Even though access was free, some Group B participants still commented on subscription cost in their open-ended answers, which we read as a general perception of the application rather than as a barrier they had experienced. Every Friday students completed a short adherence form, and four weeks of these forms produced 480 weekly records.

English achievement test. Achievement in English was measured with a 20-item multiple-choice test, given in two parallel forms, one before the intervention and one after it. The items were developed by the research team to assess general English achievement at approximately the intermediate level. Each form contained six vocabulary items, six grammar items, five reading-comprehension items and three items on application-based language use; each item had four options and was scored 1 or 0, which put the ceiling at 20 points. The two forms used different item wording but an identical structure: the same number of items per language aspect was kept in both forms, and comparable difficulty was sought by matching the grammatical and lexical complexity of the items and the length of the reading passages across the forms. Parallel rather than identical forms were chosen deliberately, in order to limit the practice effect of encountering the same items twice. The forms did not undergo separate piloting or formal expert validation, a point acknowledged among the limitations; their functioning was therefore examined directly through internal-consistency analysis. Internal consistency was estimated with the Kuder-Richardson formula 20 (KR-20), the special case of coefficient alpha for dichotomously scored items [14]. On the post-test it reached an acceptable level (KR-20 = .731), whereas on the pre-test it was lower (KR-20 = .506). The pre-test scores therefore carry more measurement error, which we take into account when interpreting the gains.

The pre-survey gathered background information together with three five-point Likert scales, ranging from 1 (strongly disagree) to 5 (strongly agree), on initial motivation, digital readiness and attitude toward application-based learning, with four items each. These three scales showed poor internal consistency, with Cronbach's alpha values of .12, -.18 and -.01, so they were not used as composite measures, and baseline equivalence between the groups was established from the objective pre-test score instead. The post-survey had three parts. The first consisted of single questions on how often students had used the application, how much time they had spent and whether they had submitted weekly evidence. The second comprised seven self-constructed five-point scales intended to capture perceived learning gains, perceived adaptivity, gamified engagement, feedback quality, satisfaction, cognitive load and concerns, and intention to continue. The third consisted of three open-ended questions on the most useful feature, the main difficulty, and which application the student considered more suitable for learning English in Kazakhstan.

Cronbach's alpha [14, p. 299] for the seven perception scales was inadequate in every case, running from -.16 to .46. Even after the weakest item was dropped from each scale, no value climbed past the usual .70 threshold; the best we obtained was .51. These scales were therefore not analysed as composite measures and no scale-level conclusions were drawn from them; this outcome is reported as an instrument-validation finding and discussed among the limitations. Where individual items are mentioned, they are treated descriptively only.

Weekly monitoring. Each week a short form recorded how many days the application had been used, the average daily time, the skill the student had practised most, and one difficulty experienced that week. The original weekly records did not contain the participant code, and codes were reconstructed only for technical alignment of the files. For this reason, the weekly data are analysed at the group-by-week level, and no claims are made about individual learning trajectories or about links between an individual's usage and their achievement.

The quantitative data were analysed with descriptive statistics followed by a small set of inferential tests. Baseline equivalence between the groups was checked with a Welch's independent-samples t-test on the pre-test score. Change from pre-test to post-test was tested with paired-samples t-tests for the whole sample and within each group, and gain scores are reported with 95% confidence intervals – a precaution taken because the modest reliability of the pre-test inflates the uncertainty of change scores, and the difference between groups on the post-test, after adjusting for pre-test performance, was tested with a one-way analysis of covariance using the pre-test score as the covariate; the homogeneity of regression slopes was checked beforehand by testing the pre-test $\times$

group interaction. Effect sizes were reported as Cohen's d for the between-group comparison and as the standardised mean change for the paired comparisons. Reliability was estimated with the Kuder-Richardson formula 20 for the achievement test and Cronbach's α for the Likert scales, and the significance level was set at .05. Analyses were carried out in Python using the pandas, SciPy and statsmodels libraries. The three open-ended questions were analysed through inductive thematic analysis [15]: the responses were read repeatedly, coded for recurring ideas and grouped into themes, which were then tabulated by group and illustrated with representative quotations before being integrated with the quantitative results. The coding was carried out by the research team without an independent second coder, given the brevity and largely low-inference nature of the answers, single-coder inductive coding was judged acceptable for this exploratory strand, and the absence of double-coding and inter-rater agreement statistics is acknowledged among the limitations.

Results and discussion. Baseline comparability of the two groups. Because the groups were not formed by random assignment, we first checked whether they were comparable before the intervention. On the pre-test, the Duolingo group ($M = 12.68$, $SD = 3.15$; here and below M denotes the mean and SD the standard deviation) and the Oki/Aleem group ($M = 12.64$, $SD = 2.83$) performed almost identically, and the difference was not statistically significant, $t(113) = -0.12$, $p = .903$, $d = -0.02$ (t – t -test statistic, p – significance level, d – Cohen's d effect size). In other words, the two groups began at an equivalent level of English achievement, and their gains can be compared on that footing.

English achievement gains. Both groups improved markedly from the pre-test to the post-test. In the matched sample as a whole ($n = 115$), the mean score rose from 12.66 ($SD = 2.98$) to 15.63 ($SD = 3.32$), a large and highly significant gain of 2.97 points, 95% CI [2.65, 3.28] (CI – Confidence Interval), $t(114) = 18.58$, $p < .001$, standardised mean change 1.73. Each group showed the same pattern. Duolingo users gained 2.81 points, 95% CI [2.34, 3.28], and Oki/Aleem users 3.12, 95% CI [2.69, 3.55], in both cases at $p < .001$. These results support H1, which predicted significant improvement in both conditions. The corresponding indicators are presented in Table 1.

Table 1. Pre-test to post-test English achievement by group (matched sample).

Group	n	Pre-test M (SD)	Post-test M (SD)	Gain	t	p	d
Whole sample	115	12.66 (2.98)	15.63 (3.32)	+2.97	18.58	<.001	1.73
A: Duolingo	57	12.68 (3.15)	15.49 (3.50)	+2.81	11.92	<.001	1.58
B: Oki/Aleem	58	12.64 (2.83)	15.76 (3.16)	+3.12	14.45	<.001	1.90

Source: Compiled by the authors. Note: n – number of participants; M – mean; SD – standard deviation; t – t -test statistic; p – significance level; d – standardised mean change (paired-samples effect size).

To test whether the applications differed in their effect, we ran an analysis of covariance on the post-test scores with the pre-test score as the covariate. The assumption of homogeneity of regression slopes was met, as the pre-test $\times$ group interaction was not significant, $F(1, 111) = 0.00$, $p = .991$. The covariate strongly predicted post-test performance, $F(1, 112) = 315.03$, $p < .001$, partial $\eta^2 = .74$ ($b = 0.96$, where b denotes the unstandardised regression coefficient), whereas the effect of group was small and not significant, $F(1, 112) = 0.95$, $p = .332$, partial $\eta^2 = .008$, $b = 0.31$ in favour of Oki/Aleem, 95% CI [-0.32, 0.94]. After adjusting for pre-test performance, the estimated post-test means were 15.47 for Duolingo and 15.78 for Oki/Aleem. A difference between the applications was thus not detected in this sample, and H2, which anticipated one, was not supported.

Application use during the intervention. The weekly monitoring records, analysed at the group-by-week level, show that students in both groups used their application regularly and to a similar degree. On average, the Duolingo group practiced on 3.85 days per week ($SD = 1.16$) and the Oki/Aleem group on 3.69 days ($SD = 1.20$). Engagement was not flat across the month. In both groups the number of practice days climbed steadily from the first week to the fourth, which suggests that students settled into a routine rather than losing interest. The weekly distribution is shown in Table 2.

Table 2. Mean number of practice days per week, by group and week.

Group	Week 1	Week 2	Week 3	Week 4
A: Duolingo	2.63	3.62	4.37	4.78
B: Oki/Aleem	2.43	3.37	4.20	4.75

Source: Compiled by the authors.

Daily time on task was substantial in both conditions, and the reported skill focus was spread fairly evenly across vocabulary, grammar, listening, speaking and mixed practice. The post-survey pointed in the same direction. Most students reported using their application five days a week, if not daily, and nearly all reported submitting weekly evidence every week or almost every week. Adherence was therefore steady in both groups, which matters because it means that the similar achievement gains cannot be explained by unequal practice.

Reliability of the instruments. The achievement test itself behaved reasonably: KR-20 was .731 on the post-test, which is acceptable, but only .506 on the pre-test. The self-report scales did not perform well. The seven post-intervention perception scales returned Cronbach's alpha values between $-.16$ and $.46$, all below the $.70$ threshold, and removing the weakest item lifted the best value only to $.51$; the three pre-survey scales were no better ($.12$, $-.18$ and $-.01$). The items inside each scale simply did not hang together, so no scale could be trusted as a composite score; when examining how the two applications were perceived, we therefore turned to the open-ended answers instead of the ratings.

Learners' perceptions of the two applications. The three open-ended questions were analysed thematically, and the themes were tabulated by group. Themes were identified through inductive coding of the responses, and the reported frequencies are indicative. Although both applications produced similar measured gains, students described their value in very different terms. Asked about the most useful feature, Duolingo users wrote overwhelmingly about game-like motivation, including points, badges, leagues, streaks and reminders. Oki/Aleem users pointed instead to feedback and adaptivity, mentioning clear corrections, an artificial intelligence tutor they could question, speaking and pronunciation practice, lessons tuned to their level, and locally relevant content such as Kazakh cultural topics.

The difficulties students reported corresponded to these strengths. Duolingo users most often complained that the gamified design could become distracting or even stressful. Some wrote about pursuing points instead of learning, others about feeling pressured by the competition, and repetitive content and advertisements were also mentioned. With Oki/Aleem the complaints were mostly practical. Students mentioned the subscription price as a general concern, although access was free during the study, together with occasional technical glitches and the absence of any social or competitive dimension. On the question of suitability, Oki/Aleem was most often recommended for serious, exam-oriented study and for its local and cultural relevance, while Duolingo was praised for being enjoyable, motivating and easy to fit into daily life. A number of students concluded that the two tools are complementary. These patterns support H3 and H4. Duolingo was experienced primarily as a gamified, motivational tool and Oki/Aleem as an adaptive, feedback-rich and locally grounded one.

This study compared a gamified application (Duolingo) and an artificial-intelligence-based adaptive application (Oki/Aleem) within a single four-week intervention among Kazakhstani learners of English who are training to become foreign-language teachers. Three main findings emerged. Both groups improved substantially in English achievement, and once baseline scores were taken into account there was no significant difference between them. Both groups used their application consistently, and their practice increased across the four weeks. Although the measured gains were similar, the two applications were valued for very different reasons.

The first finding, a substantial improvement in both groups, supports H1. It is consistent with the wider literature, which indicates that mobile practice is associated with measurable language gains [1, p. 160]. For Duolingo there is direct evidence that completing its courses raises reading and listening proficiency [7, p. 263], and for adaptive instruction there is evidence of gains on difficult grammatical structures [10, p. 226]. The absence of a control group means that the gains cannot be attributed to the applications alone. Ordinary coursework and a testing effect almost certainly contributed, and the lower reliability of the pre-test adds noise to the change scores, so the effect should be read with the caution that meta-analysts have urged for this field [1, pp. 161-162]. The second finding is more informative. After controlling for pre-test performance, the two applications produced statistically indistinguishable outcomes, so H2 was not supported. This convergence mirrors comparative work in which Duolingo and classroom instruction brought beginners to similar levels [9, pp. 22-23], and it extends that pattern to a comparison of a gamified application with an adaptive one. It is also consistent with review evidence indicating that the effectiveness of gamified tools in foreign language learning is mixed rather than uniformly positive [6, p. 12], and that at university level the gamification effect is small and not statistically significant [5, p. 11]. Two different mechanisms, motivation through game design and personalisation through adaptive feedback, appear to produce comparable outcomes over a short intervention.

In answer to RQ2, learners in both groups practiced on a similar number of days each week, and in both groups practice rose steadily rather than declining. This is notable, since maintaining engagement in self-directed mobile study is a recognised difficulty [6, p. 2]. It is also in line with the finding that gains follow the regularity of practice more closely than the time invested [8, p. 24]. Because adherence was comparable, the similar achievement gains are easier to interpret. The groups did not differ in how much they practised, only in what they valued.

The qualitative analysis supported H3 and H4. Duolingo users described its value in terms of game-like motivation, which is the mechanism that the gamification literature associates with higher engagement and, through it, achievement [5, p. 8]. The same learners named the corresponding drawback, that of pursuing points rather than learning, a tension that reviewers of gamified learning have identified [6, p. 11]. Oki/Aleem users placed adaptivity and feedback first. These are the strengths that the literature attributes to artificial-intelligence tools, namely personalised, feedback-rich interaction that supports engagement, enjoyment and motivation [11, p. 6], although the evidence base as a whole remains young [12, p. 9]. The locally grounded content that several Oki/Aleem users valued corresponds to a recurring theme in Kazakhstani research, where relevance to the national context is treated as an asset of digital learning environments [3, p. 284]. Read together with the achievement data, these accounts suggest that, while no difference in test-score gains was detected between the two applications, they were experienced as serving different purposes. Duolingo functioned as a motivational, habit-forming tool and Oki/Aleem as a focused, adaptive tutor, and several learners concluded that the two are complementary.

A methodological finding requires separate comment. The self-constructed perception scales failed to reach acceptable internal consistency, even after a careful re-administration that produced the full range of responses, and were therefore set aside in favour of the open-ended data. Short, self-made Likert scales of three or four items are common in application-evaluation studies, yet their reliability is rarely scrutinised, and acquiescent responding can undermine it. As survey data are increasingly produced under conditions of inattentive or assisted responding, reporting reliability transparently and setting unreliable scales aside is part of responsible practice. In the present case the open-ended data recovered the distinction that the scales had been designed to capture.

Our participants were future foreign-language teachers, which gives the findings a second layer of meaning. For learning, they indicate that the choice between a gamified and an adaptive application is less a contest over effectiveness than a decision about purpose, since no advantage for either application was detected in this sample, and the two can be combined. For teacher preparation, the study underlines why digital competence belongs at the centre of foreign-language teacher education in Kazakhstan. Future teachers who have themselves compared a gamified and an adaptive

application are better placed to make informed pedagogical choices, a competence that research on Kazakhstani teacher training argues should be deliberately cultivated [3, p. 284].

Limitations. These conclusions come with several qualifications. The design was quasi-experimental. The groups were made up of volunteers, were not formed at random and came from a single university, so the findings may not generalise, even though the two groups were equivalent on the objective pre-test. Without a non-application control group, the gains cannot be attributed to the applications alone, and a four-week window can capture only short-term effects. Proficiency levels were self-reported, and the reliability of the pre-test was only modest; the test forms were developed by the research team without separate piloting or formal expert validation. The perception scales failed and had to be dropped. The open-ended answers, informative as they were, cannot be verified for provenance in the way an objective test can, and they were coded without an independent second coder. The weekly monitoring files contained no genuine participant codes, which confined that analysis to the group level. Age and gender were not collected. Future work should use larger, multi-institution samples, a control condition, longer interventions, validated instruments and properly linked process data.

Conclusion. Over four weeks, students using the gamified application (Duolingo) and the artificial-intelligence-based adaptive application (Oki/Aleem) showed significant gains in English achievement, and once baseline scores were controlled the gains were of similar size. Practice in both groups was steady and increased as the month progressed. The applications differed in how they were experienced. Learners saw Duolingo as a motivational, habit-forming tool, and Oki/Aleem as an adaptive tutor with detailed feedback and local relevance. The perception scales did not reach acceptable reliability and were set aside, and the students' own written accounts therefore provided the sounder basis for interpreting perceptions. For English learning, the practical question is therefore not which type of application works better – no difference between them was detected in this sample – but what a learner wants from it. For foreign-language teacher preparation in Kazakhstan, the implication is that future teachers should be given the opportunity to work with such tools alongside each other and to build their digital competence from that direct experience. Larger, longer and controlled studies with validated instruments are needed to confirm and extend these conclusions.

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ҚАЗАҚСТАНДАҒЫ УНИВЕРСИТЕТ СТУДЕНТТЕРІНІҢ МОБИЛЬДІ АҒЫЛШЫН ТІЛІН ҮЙРЕНУІНДЕГІ ЖАСАНДЫ ИНТЕЛЛЕКТ НЕГІЗІНДЕГІ БЕЙІМДЕЛГІШ ҚОСЫМША МЕН ГЕЙМИФИКАЦИЯЛАНҒАН ҚОСЫМШАНЫ САЛЫСТЫРУ

Аңдатпа

Мобильді қосымшалар ағылшын тілін шет тілі ретінде үйренудің негізгі құралына айналды. Ал, нарықта екі тәсіл басым: геймификация және жасанды интеллект негізіндегі бейімделмелі оқыту. Бұл тәсілдерді тікелей салыстыратын зерттеулер сирек кездеседі, әсіресе Қазақстан жағдайында және елдің тілдік білім беру жүйесіне маман даярлау аясында болашақ шетел тілі мұғалімдерін даярлау саласында. Бұл зерттеуде геймификацияланған Duolingo қосымшасы мен Қазақстанда жасанды интеллект технологиялары негізінде әзірленген бейімделмелі Oki/Aleem қосымшасының тиімділігі төрт апталық кезең ішінде салыстырылды. Екі топтық квазиэксперименттік дизайн қолданылды: шетел тілі мұғалімдерін даярлау бағдарламасының 120 студенті екі қосымшаның бірімен жұмыс істеді; 115 студенттің деректері алдын ала және қорытынды тест нәтижелері бойынша сәйкестендірілді. Оқу жетістіктері зерттеу кезеңіне дейін және одан кейін өткізілген, 20 тапсырмадан тұратын параллель тестілер арқылы өлшенді; қосымшаларды пайдалану апталық сауалнама арқылы қадағаланды, ал үш ашық сұраққа берілген жауаптар тақырыптық тұрғыда талданды. Екі топ та бір ай ішінде көрсеткіштері айтарлықтай өсті; алдын ала тестілеу нәтижелерін ковариата ретінде ескере отырып жүргізілген ковариациялық талдау қосымшалардың тиімділігі арасында статистикалық маңызды айырмашылық анықталмады. Апта сайынғы оқу белсенділігі екі топта да сақталып, зерттеу кезеңінің соңына қарай өсті. Ашық сұрақтарға берілген жауаптарды талдау қатысушылардың зерттелген қосымшаларды қабылдауындағы айырмашылықтарды көрсетті: Duolingo ойын элементтері арқылы ынталандыруы, ал Oki/Aleem бейімделгіштігімен, кері байланысымен және жергілікті мазмұнымен бағаланды. Осылайша, екі қосымша әртүрлі механизмдерді қолданғанына қарамастан салыстырмалы оқу нәтижелерін көрсетті, бұл олардың арасындағы таңдауды тиімділік емес, білім беру

мақсаттары тұрғысынан қарастыруға мүмкіндік береді. Алынған нәтижелер Қазақстандағы шетел тілі мұғалімдерін даярлау бағдарламаларына геймификацияланған және бейімделмелі білім беру қосымшаларын салыстырмалы пайдалану тәжірибесін енгізудің орындылығын растайды.

Түйінді сөздер: жасанды интеллект, ағылшын тілі шет тілі ретінде, геймификация, Duolingo, Oki/Aleem, мобильді тіл үйрену, шетел тілі мұғалімдерін даярлау.

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СРАВНЕНИЕ АДАПТИВНОГО ПРИЛОЖЕНИЯ НА ОСНОВЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА И ГЕЙМИФИЦИРОВАННОГО ПРИЛОЖЕНИЯ ДЛЯ МОБИЛЬНОГО ИЗУЧЕНИЯ АНГЛИЙСКОГО ЯЗЫКА СРЕДИ СТУДЕНТОВ УНИВЕРСИТЕТОВ КАЗАХСТАНА

Аннотация

Мобильные приложения стали центральным инструментом изучения английского языка как иностранного; на рынке доминируют два подхода – геймификация и адаптивное обучение на основе искусственного интеллекта. Прямые сравнительные исследования этих подходов встречаются редко, особенно в контексте Казахстана и подготовки будущих учителей иностранных языков для системы национального языкового образования. В настоящем исследовании сравнивалась эффективность геймифицированного приложения Duolingo и адаптивного приложения Oki/Aleem, разработанного в Казахстане на основе технологий искусственного интеллекта, в течение четырехнедельного периода. Использован квазиэкспериментальный дизайн с двумя группами: 120 студентов программы подготовки учителей иностранных языков работали с одним из двух приложений; данные 115 студентов сопоставлены по результатам пре- и посттеста. Учебные достижения измерялись с помощью параллельных тестов, состоявших из 20 заданий, которые проводились до и после вмешательства; еженедельная анкета использовалась для мониторинга использования приложений, а ответы на три открытых вопроса подвергались тематическому анализу. Обе группы значительно улучшили результаты в течение месяца; ковариационный анализ, выполненный с учетом результатов предварительного тестирования в качестве ковариаты, не выявил статистически значимых различий в эффективности между приложениями. Интенсивность еженедельной практики сохранялась в обеих группах и возрастала к концу периода вмешательства. Анализ ответов на открытые вопросы продемонстрировал различия в восприятии участниками исследуемых приложений. Duolingo ценился за игровую мотивацию, Oki/Aleem – за адаптивность, обратную связь и локальную релевантность. Таким образом, оба приложения обеспечили сопоставимые результаты обучения, несмотря на использование различных механизмов, что позволяет рассматривать выбор между ними скорее как вопрос образовательных целей, чем эффективности. Полученные результаты подтверждают целесообразность включения в программы подготовки учителей иностранных языков в Казахстане практики сравнительного использования геймифицированных и адаптивных образовательных приложений.

Ключевые слова: искусственный интеллект, английский язык как иностранный, геймификация, Duolingo, Oki/Aleem, мобильное изучение языка, подготовка учителей иностранных языков.

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FACTORS ASSOCIATED WITH DIGITAL TECHNOLOGY INTEGRATION IN MATHEMATICS EDUCATION IN THE CONTEXT OF CALCULUS TEACHING

Abstract

Digital technologies have become increasingly common in mathematics education, but their use in calculus varies across educational settings. This study examines the factors associated with digital technology integration in mathematics education using calculus teaching as the specific context of the study. The study involved 176 participants, including 36 mathematics educators and 140 learners, and the survey data were analyzed using descriptive statistics, principal component analysis (PCA), and analysis of variance (ANOVA). The PCA identified five exploratory components explaining 35.52% of the total variance, with statistically significant differences found for three of them. These components reflected professional and institutional characteristics, perceptions of mathematical content and instructional decisions, and professional development and methodological support. Generally, it was found that digital tools were positively perceived in terms of representing mathematical concepts and simplifying abstract ideas. At the same time, their reported use varied across educational contexts, suggesting that access to technology alone does not determine how it is incorporated into calculus teaching and learning. The results point to the importance of educational and professional factors when considering the role of digital technologies in mathematics education.

Keywords: calculus education, digital technology integration, mathematics education, digital competence, professional development, digital tools, differential and integral calculus, student engagement.

Introduction. The growing use of digital technologies has changed the way mathematical ideas can be presented and explored in the classroom. Graphing applications, Computer Algebra Systems, and interactive environments make it possible to work with mathematical concepts through symbolic, numerical, and graphical representations rather than relying on calculations alone. This is particularly useful in differential and integral calculus, where understanding often requires students to connect different representations of limits, derivatives, and integrals. Making these connections can be difficult, especially during the transition from school mathematics to the more formal reasoning expected at university level [1, 2].

Digital tools can support this process by allowing learners to visualize changes, experiment with mathematical relationships, and examine the same problem from different perspectives. At the same time, the presence of technology in an educational setting does not guarantee that it will become part of everyday mathematics teaching. The way digital resources are used may depend on many factors, including experience with technology, confidence in using it for mathematical tasks, and the conditions available within a particular educational environment.

The relevance of this study is linked to a practical issue: the growing availability of digital technologies does not necessarily translate into their regular and meaningful use in mathematics education. This gap becomes especially important in calculus, where digital tools can provide additional ways of working with concepts that are difficult to represent using traditional approaches alone. The availability of technology is just one aspect of the issue, however. Factors such as education and experience, digital skills and environments play an important role in technology adoption.

The situation is especially significant in Kazakhstan, as digitalization is one of the main directions of the educational development. While the access to technology has increased among many educational institutions, conditions for their application differ greatly. The differences in infrastructure, digital competence, education, and experience may be associated with differences in the extent to which technology is used for teaching purposes.

The aim of this study is to describe perceptions of digital technology use in calculus education and to explore patterns in mathematics educators' responses concerning technology integration. The study considers educators' and learners' perceptions and reported use of digital technologies, examines the component structure of educator responses, and explores differences in component scores across empirically derived educator profiles. Given the cross-sectional design and exploratory nature of the analysis, the results are interpreted in terms of associations and group differences rather than causal effects.

Literature Review. The use of technology in mathematics education is closely connected with the idea that mathematical understanding develops through active engagement rather than through the passive reception of information. From a constructivist perspective, learners build new knowledge by relating unfamiliar ideas to what they already know and by testing these connections through exploration and reflection. Digital environments can support this process in ways that are difficult to reproduce with static materials. Computer Algebra Systems, interactive graphs, and simulations allow learners to change parameters, observe the results, and move between different representations of the same mathematical idea [3, 4].

The educational value of such tools, however, cannot be separated from users' ability to work with them. Digital literacy has therefore become increasingly relevant to mathematics education. Evidence from Kazakhstan suggests that the development of students' digital skills is shaped not only by what is available at school. Joshkun et al. (2024), using data collected between 2016 and 2022, found that access to the Internet at home had a stronger relationship with schoolchildren's digital skills than access to technology at school [5]. This points to an important distinction between access and actual competence: providing digital resources is necessary, but it does not ensure that learners will be equally prepared to use them for educational purposes.

This distinction is especially important in calculus. Learning calculus involves working with concepts that can be expressed symbolically, numerically, and graphically, and understanding the connections between these forms is often difficult for students. Research in calculus education has repeatedly documented problems with limits, derivatives, and integrals, particularly when students are expected to move beyond procedural differential and integral calculation and explain the underlying mathematical relationships [2, p.4]. These difficulties can become more pronounced during the transition to university, where formal definitions, abstract reasoning, and mathematical proof take a more prominent role [6].

Several theoretical approaches help explain why these difficulties persist. Vinner's (2002) distinction between concept image and concept definition shows how a learner's intuitive understanding of a mathematical idea may differ from its formal definition [7]. Tall and Vinner (1981) further showed that learners' concept images may not fully correspond to formal mathematical definitions [8]. Although these approaches describe mathematical understanding from different perspectives, they point to a common problem in calculus learning: successful performance with procedures does not necessarily mean that the underlying concepts are well understood.

Digital technologies are particularly relevant in this context because they allow students to approach the same calculus concept in more than one form. Graphing environments can show how a function changes as its parameters vary, while Computer Algebra Systems can support experimentation with symbolic expressions and calculations. Dynamic representations can also make relationships between symbolic and graphical forms more visible [4, p.93]. The contribution of technology is therefore not limited to making calculations faster. Its educational value lies partly in creating opportunities to explore mathematical relationships that are difficult to see when concepts are presented only through formulas and static diagrams.

Evidence accumulated over several decades generally supports the use of technology in mathematics education, although the size and nature of its effects vary. Young (2017), in a second-order meta-analysis covering approximately 30 years of research, reported a moderate positive effect of technology-enhanced instruction on mathematical achievement [9]. Technologies that supported computation and interactive exploration were among the approaches associated with positive outcomes. At the same time, the review raised questions about whether short-term gains in performance necessarily translate into lasting improvements in mathematical reasoning and conceptual understanding. This distinction is important because the educational value of technology depends on what students actually do with it rather than simply on whether a digital tool is present.

For this reason, research has increasingly shifted from asking whether technology is useful to examining how it is incorporated into teaching. Drijvers (2015) argues that the effectiveness of digital tools depends on the relationship between the technology itself, the mathematical task, and the way instruction is organized. A tool with strong technical capabilities may contribute little if it is poorly connected to the learning objective or used only as an additional means of performing routine calculations [10]. The competence and experience of educators are therefore important parts of the integration process.

Digital technologies have also expanded beyond instruction into other areas of mathematics education. Computer Adaptive Testing, for example, allows assessment tasks to be adjusted to individual performance and provides a different approach to differentiated assessment. Internet-based technologies have likewise been used to support criteria-based assessment and more timely feedback [11]. These developments illustrate that digitalization can affect not only how mathematical content is presented but also how learning is monitored and supported.

The question of integration is particularly relevant in Kazakhstan, where schools and educational institutions have experienced substantial digital development. Yet greater availability of digital resources does not imply that they are used in the same way across contexts. Joshkun et al. (2024) demonstrate the importance of conditions outside school for the development of digital competence, while recent research on calculus education in Kazakhstan has identified differences associated with educational and professional characteristics [5, p. 2]. Sabyrkhanova et al. (2026), for example, reported variation in the difficulties identified in calculus learning according to teachers' experience and qualification level [1, p. 39]. Other studies have similarly emphasized the importance of professional preparation and institutional conditions for the effective use of technology in education.

Taken together, previous studies provide substantial evidence for the educational possibilities of digital technologies, including their use in mathematics and calculus. What remains less clear is why these possibilities translate into regular practice in some educational settings but not in others. Studies often concentrate either on the learning effects of a particular digital tool or on general attitudes toward technology, while the factors associated with different patterns of technology integration receive less attention.

Although prior research has documented the potential of digital tools for visualization, multiple representations, and mathematical exploration, three limitations remain. First, much of the literature evaluates particular tools or learning outcomes rather than examining professional, instructional, and institutional characteristics together. Second, evidence specifically concerning calculus education in Kazakhstan remains limited. Third, studies rarely compare educators' and learners' perceptions while also exploring heterogeneity within the educator group. The present study addresses this descriptive and contextual gap; it does not claim to validate a general measurement model or establish causal determinants of technology adoption.

Accordingly, the study addresses the following research questions:

RQ1. What patterns characterize educators' and learners' perceptions of digital technology use in calculus education?

RQ2. What underlying dimensions can be identified in educators' responses concerning digital technology integration in calculus education?

RQ3. How do the identified dimensions vary across empirically derived educator profiles?

The study's scientific novelty is contextual and exploratory. It provides evidence from Kazakhstan that combines educator–learner descriptive comparisons with an exploratory analysis of educator response patterns in calculus education. Its contribution is the identification of candidate professional, instructional, and support-related dimensions for subsequent validation in a larger educator sample. The retained components are therefore treated as provisional empirical patterns rather than established latent constructs.

Methods and Materials. The data for this study were collected as part of a broader dissertation study entitled “Innovative Forms and Methods for Preparing Future Mathematics Teachers to Teach Differential and Integral Calculus.” The survey developed for the research covered two main areas. The first examined difficulties encountered in the teaching and learning of calculus and was analyzed in an earlier publication [1, p. 38]. The second focused specifically on digital technologies, including their use in calculus education, difficulties associated with their integration, and the support needed for their effective use. The present article focuses exclusively on the second area of the survey, which was not examined in the previous publication, and analyzes patterns of digital technology integration in calculus education.

The survey included 176 respondents: 36 mathematics educators and 140 learners studying calculus or introductory calculus. Separate questionnaires were used for educators and learners. The educator questionnaire consisted of 20 numbered items and covered educational and professional characteristics, perceptions of the content and difficulties of teaching calculus, the use of digital technologies, perceived benefits and challenges of technology integration, previous technology-related training, and professional development and support needs. The learner questionnaire addressed corresponding aspects from the learners' perspective, including difficulties in learning calculus, the use of digital technologies in mathematics lessons, and their perceived influence on engagement and motivation. The questionnaires included closed, multiple-response, and open-ended items, with several closed questions using three response categories (“agree,” “partially agree,” and “disagree”). The questionnaires were developed by the authors in Kazakh and Russian and were presented bilingually within the same Google Form, allowing respondents to read each item in either language. Participation in the survey was voluntary. The questionnaires were completed anonymously through Google Forms, and the collected data were analyzed and reported only in aggregated form. The present study focuses on the items related to digital technology integration, while the results concerning difficulties in teaching and learning calculus were analyzed in the previous publication. The educational and professional characteristics of the mathematics educators are presented in Table 1.

Table 1. Educational and professional characteristics of the mathematics educators

Education, %		Years of Experience, %		Qualification Category, %		Language of Instruction, %	
Bachelor	36	Less than 1 year	11.5	Pedagogue	33	Kazakh	78
Master	64	1–5 years	33	Pedagogue-Moderator	20	Russian	22
		5–10 years	8	Pedagogue-Expert	25		
		10–15 years	22	Pedagogue-Researcher	22		
		15–20 years	14				
		More than 20	11.5				

Source: compiled by the authors.

Data processing and statistical analysis were carried out in Jupyter Notebook. Survey responses were coded numerically, and categorical variables were converted into dummy variables where required. Descriptive statistics were used to summarize the responses. The distributions of the variables were examined before further analysis. Variables included in the multivariate analysis were standardized to place them on a comparable scale. Descriptive comparisons of perceptions of digital technology use included both educators and learners. The subsequent multivariate analysis of

professional and educational characteristics was conducted for the educator subsample ($n = 36$), because variables such as teaching experience, educational background, and qualification category were applicable only to educators.

Principal component analysis (PCA) was used as an exploratory dimension-reduction technique for the educator subsample ($n = 36$). PCA was performed on standardized variables, and component scores were retained for subsequent exploratory analysis. The retained components were interpreted from the variables with the strongest loadings. Three educator profiles were then derived empirically from the PCA component-score space. One-way analysis of variance (ANOVA) was used to describe differences in PC1–PC5 scores across these three profiles. Because the profiles were created from the same component scores that were subsequently compared by ANOVA, these tests are circular and descriptive rather than independent confirmatory tests. Accordingly, they are not interpreted as independent evidence of differences associated with specific professional or educational characteristics.

Results and Discussion. The descriptive comparison indicated different reported experiences of digital technology use. Approximately 50% of educators selected occasional use, compared with slightly more than 20% of learners. These percentages describe responses to corresponding items in two separate questionnaires; the groups were not pooled in PCA or ANOVA, and no inferential test of the educator–learner difference was conducted. Approximately 47% of educators and 45% of learners reported perceived improvement in learning outcomes (fig. 1). The similarity is descriptive and should not be interpreted as statistical equivalence.

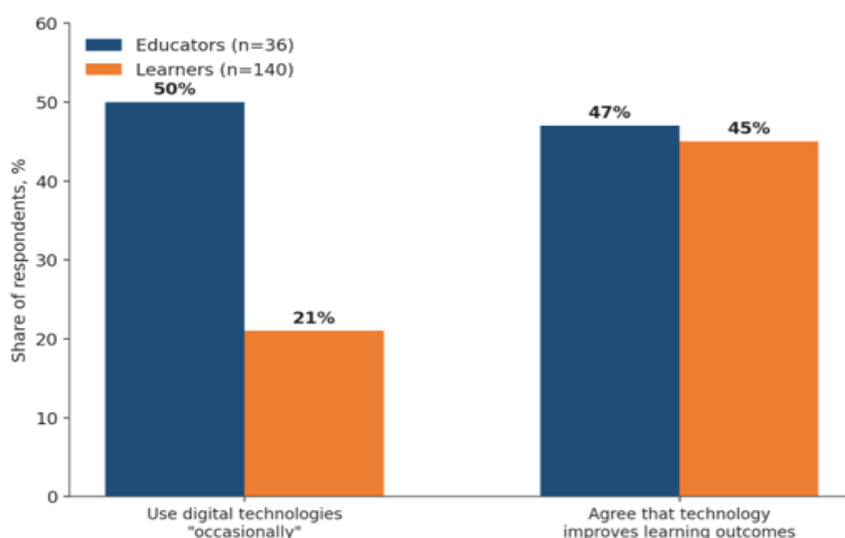


Figure 1. Comparison of educators' and learners' perceptions

Source: compiled by the authors.

The educator responses also revealed a difference between positive perceptions of digital technologies and the frequency of their actual use. While 69.4% of educators agreed that digital tools facilitate the learning of calculus topics and a further 27.8% partially agreed, only 16.7% reported using digital technologies daily and 22.2% weekly, whereas 50.0% used them only occasionally. Previous technology-related training was also limited, with 22.2% of educators reporting that they had received such training. The most frequently reported barriers included technical problems, limited access to technology, the cost of digital content and resources, insufficient training, and a lack of methodological guidance. At the same time, visualization and increased student engagement were among the most frequently reported benefits of using digital technologies.

PCA of the educator data retained five components that together explained 35.52% of total variance: PC1, 9.52%; PC2, 7.86%; PC3, 6.81%; PC4, 5.83%; and PC5, 5.50% (fig. 2). The low cumulative variance and small educator sample mean that the components should be interpreted as exploratory patterns rather than as a stable or comprehensive latent structure. A one-way ANOVA

then compared the three score-derived profiles ($n = 20, 12$, and 4). The omnibus results were PC1, $F(2, 33) = 50.14$, $p < .001$, $\eta^2 = .752$; PC2, $F(2, 33) = 20.69$, $p < .001$, $\eta^2 = .556$; PC3, $F(2, 33) = 0.02$, $p = .980$, $\eta^2 = .001$; PC4, $F(2, 33) = 5.84$, $p = .0068$, $\eta^2 = .261$; and PC5, $F(2, 33) = 0.96$, $p = .393$, $\eta^2 = .055$ (table 2). Levene's tests were non-significant (all $p > .69$). The significant tests indicate differences in component scores between the empirically derived profiles; they do not show that PC1, PC2, or PC4 are more influential. Moreover, because profile membership was derived from the same component scores, the ANOVA results are interpreted as descriptive rather than confirmatory.

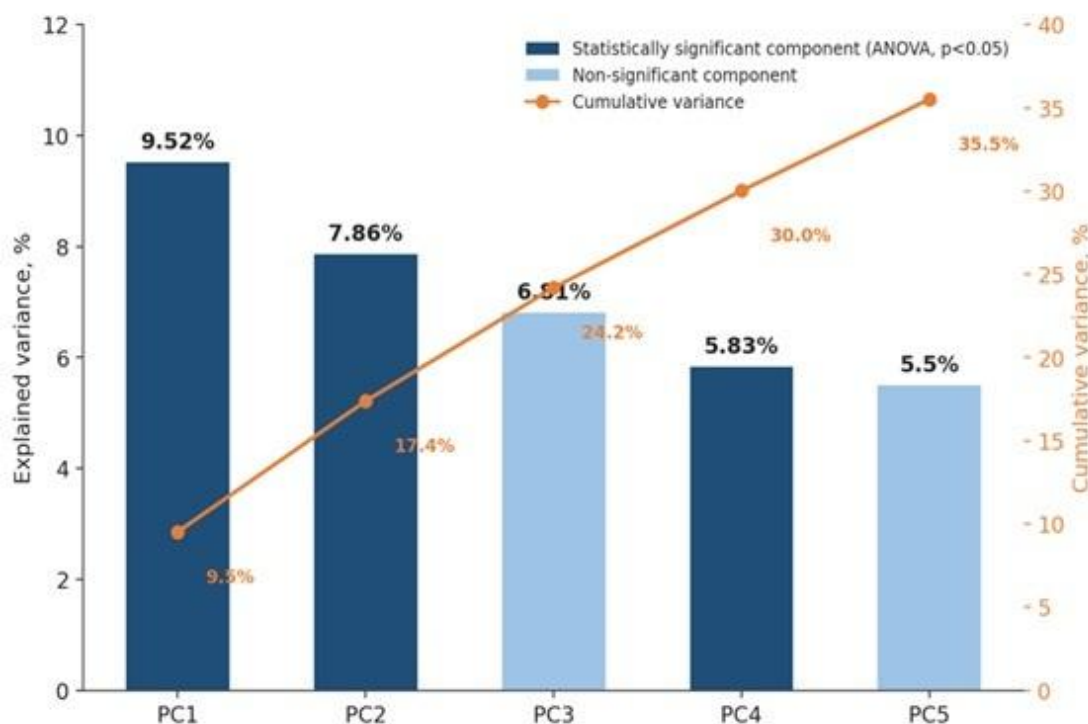


Figure 2. Variance explained by five principal components (PCA). Total 35.52%
Source: compiled by the authors.

Table 2. Variance explained by the five principal components

Component	F	p	η^2
PC1	F(2,33)=50.14	< .001	.752
PC2	F(2,33)=20.69	< .001	.556
PC3	F(2,33)=0.02	.980	.001
PC4	F(2,33)=5.84	.0068	.261
PC5	F(2,33)=0.96	.393	.055

Source: compiled by the authors.

Note: F is the ANOVA test statistic representing the ratio of between-group to within-group variation. The p-value indicates the statistical significance of the observed group differences, with $p < .05$ considered statistically significant. η^2 (eta squared) represents the effect size and indicates the proportion of variance in component scores associated with differences between the three educator profiles.

The first principal component (PC1) represented a professional and institutional dimension of technology integration. The major contributors to the component included variables related to teaching experience, educational background, and school type. Rather than implying that technology use depends on any particular variable, the findings indicate that digital technology integration occurs within a broader context involving educators' professional characteristics and institutional

environment. The component therefore reflects an association between professional and institutional characteristics and patterns of technology integration rather than the effect of any individual characteristic.

The second principal component (PC2) was shown to reflect the connection between the curriculum contents, perceived conceptual complexity, and instructional decisions. Respondents expressed divergent opinions on the question of the right grade level for the introduction of advanced calculus topics, including differential equations. In addition, digital technologies were uniformly evaluated as useful in facilitating the elaboration of difficult mathematical materials. These results suggest that the perceived educational value of technology is related not only to the technology itself but also to the complexity of the educational content. This suggests that interactive visualization may be particularly relevant when educators work with conceptually demanding mathematical content.

PC4 reflected a pattern related to instructional support and professional development. Respondents emphasized seminars, workshops, online training courses, methodological guidance, and digital mathematics software such as GeoGebra, Desmos, and Wolfram Alpha as valuable resources for improving teaching practice and increasing student engagement. Although the statistical effect associated with PC4 was less pronounced than those observed for PC1 and PC2, this component highlights an association between technology integration and opportunities for continuous professional learning that support educators' technological and pedagogical competence.

Taken together, the three statistically significant components suggest that digital technology integration in calculus education is a multidimensional phenomenon associated with professional, instructional, and contextual characteristics rather than with technology availability alone. PC1 reflects associations with educators' professional characteristics and institutional environment, PC2 connects technology integration with perceptions of mathematical content and instructional decisions, and PC4 highlights the role of professional development and methodological support.

These findings are broadly consistent with previous research on technology integration in mathematics education. The educational value of digital technologies depends on how effectively they are embedded within mathematical tasks and classroom practice, while Fitriati (2019) emphasized the importance of teachers' technological and pedagogical competence [4, p. 97]. The present study extends these perspectives by identifying an exploratory pattern in which educators' professional and institutional characteristics are associated with technology integration.

The interpretation of PC2 further supports previous evidence suggesting that digital technologies are particularly beneficial when learners are required to connect symbolic, graphical, and numerical representations of mathematical concepts. Earlier studies have reported similar advantages for teaching derivatives, integrals, and other abstract calculus topics [3, p. 145]. The present findings reinforce this conclusion by showing that perceptions of curriculum complexity and decisions regarding the appropriate educational level for introducing advanced topics form part of the same underlying dimension. This suggests that the pedagogical role assigned to digital technologies is closely related to the nature of the mathematical content being taught.

The pattern represented by PC4 is also related to professional development and methodological support. Opportunities to participate in workshops, methodological training, and collaborative learning activities may support educators' capacity to integrate technology effectively into mathematics instruction. This interpretation is consistent with studies highlighting the contribution of dynamic visualization tools and interactive digital learning environments to both teacher practice and student learning [4, p. 96].

The findings should also be interpreted within the broader educational context of Kazakhstan. Joshkun et al. (2024) demonstrated that students' digital competence is influenced not only by technological resources available in schools but also by their digital experiences beyond formal education [5, p. 15]. This perspective provides additional context for the differences observed between educators' and learners' perceptions in the present study and supports the conclusion that access to technology alone is insufficient to explain meaningful technology integration. Instead, meaningful integration appears to be associated with institutional support, professional expertise, curriculum characteristics, and learners' broader digital environment.

Overall, the findings suggest that digital technology integration in calculus education is associated with broader professional, instructional, and contextual patterns identified in educators' responses. These results shift the discussion beyond technology availability alone and highlight the importance of considering the educational context in which digital technologies are used. Such a perspective may inform the design of professional development programmes and methodological support aimed at promoting meaningful uses of digital technologies in mathematics education.

Limitations. The study has several limitations. First, although the survey included 176 respondents, the multivariate analysis was conducted only on the educator subsample ($n = 36$). The small educator sample limits the generalizability and stability of the exploratory PCA results. In addition, one of the three empirically derived educator profiles included only four participants. The findings should therefore be interpreted cautiously and examined further in larger and more diverse educator samples.

Second, self-reported questionnaire data was used in this study. The data offered insight into the participants' perceptions and experiences on the topic, but this may not precisely reflect classroom practices. By combining self-reported data with classroom observation, interview, or learning analytics, one can obtain much richer insights into the practical application of digital technologies in calculus instruction.

Third, the study employed a cross-sectional research design. Consequently, the identified relationships should be interpreted as associations rather than causal effects. Longitudinal studies would enable researchers to examine how teachers' professional development, institutional support, and technology integration evolve over time.

Finally, the present research focused on identifying broad patterns associated with digital technology integration rather than evaluating the effectiveness of specific digital tools or instructional approaches. Future studies could investigate how particular technologies, such as dynamic mathematics software, computer algebra systems, or artificial intelligence-supported learning environments, influence students' conceptual understanding, problem-solving skills, and long-term learning outcomes.

In addition, the five retained principal components explained 35.52% of the total variance. Consequently, a substantial proportion of variability remained outside the retained solution, and the component structure should be regarded as exploratory.

Regardless of these limitations, the present study contributes to the expanding body of research on technology integration in the teaching of mathematics. The findings suggest that technology use in calculus instruction is associated with a combination of professional, pedagogical, and contextual characteristics rather than with access to technology alone. The findings may inform the development of professional development programmes and methodological support for digital technology integration in mathematics education.

Conclusion. The study examined factors associated with digital technology integration in calculus education. The findings suggest that technology integration is related to a combination of professional, instructional, and contextual characteristics rather than to the availability of digital resources alone. The exploratory PCA identified dimensions involving educators' professional and institutional characteristics, perceptions of mathematical content and instructional decisions, as well as professional development and methodological support. The descriptive results further showed that educators generally perceived digital technologies positively, although their reported frequency of use and previous technology-related training varied considerably.

The findings show that the integration of digital technologies into calculus education should be considered in relation to the conditions in which teaching and learning take place. Providing digital tools is important, but their meaningful use should also be considered in relation to educators' professional preparation, the mathematical content being taught, and the methodological support available to teachers. The results therefore support the inclusion of a dedicated digital technology component in the course "Innovative Approaches to Teaching Differential and Integral Calculus," with particular attention to the use of digital resources for visualization and the teaching of conceptually demanding topics.

Further research could examine these relationships using larger and more diverse samples and investigate how particular approaches to technology integration affect students' conceptual understanding and mathematical reasoning over time.

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МАТЕМАТИКАЛЫҚ АНАЛИЗДІ ОҚЫТУ КОНТЕКСТІНДЕ МАТЕМАТИКАЛЫҚ БІЛІМ БЕРУГЕ ЦИФРЛЫҚ ТЕХНОЛОГИЯЛАРДЫ КІРІКТІРУ ФАКТОРЛАРЫ

Аннотация

Зерттеудің мақсаты математикалық анализді оқыту мысалында математикалық білім беруге цифрлық технологияларды кіріктіру факторларын анықтау болып табылады. Зерттеуде 176 респонденттің сауалнама деректері пайдаланылды, олардың 36-сы математика пәнінің оқытушылары, ал 140-ы математикалық анализді немесе оның негіздерін оқып жүрген білім алушылар. Деректерді талдау барысында негізгі компоненттер әдісі (PCA) мен дисперсиялық талдау (ANOVA) пайдаланылды. PCA нәтижесінде жалпы дисперсияның 35,52%-ын түсіндіретін бес компонент анықталып, олардың үшеуі бойынша статистикалық мәнді айырмашылықтар байқалды. Анықталған компоненттер оқытушылардың кәсіби және институционалдық сипаттамаларын, математикалық мазмұнды қабылдау мен оқытуды ұйымдастыру ерекшеліктерін, сондай-ақ кәсіби даму мен әдістемелік қолдауды қамтиды. Цифрлық құралдар математикалық ұғымдарды көрсету және абстрактілі идеяларды түсіндіру тұрғысынан жалпы оң бағаланғанымен, оларды қолдану деңгейі білім беру жағдайларына қарай ерекшеленеді. Алынған нәтижелер цифрлық технологияларды тиімді кіріктіру тек цифрлық ресурстардың болуымен ғана емес, оларды қолданудың кәсіби, әдістемелік және білім беру жағдайларымен де байланысты екенін көрсетеді. Зерттеу нәтижелерін математикалық білім беру саласында әдістемелік материалдар мен оқытушылардың кәсіби даму бағдарламаларын әзірлеуде пайдалануға болады.

Түйінді сөздер: математикалық анализді оқыту, цифрлық технологияларды кіріктіру, математикалық білім беру, цифрлық құзыреттілік, кәсіби даму, цифрлық құралдар, дифференциалдық және интегралдық есептеулер, білім алушылардың белсенділігі.

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ФАКТОРЫ ИНТЕГРАЦИИ ЦИФРОВЫХ ТЕХНОЛОГИЙ В МАТЕМАТИЧЕСКОЕ ОБРАЗОВАНИЕ В КОНТЕКСТЕ ПРЕПОДАВАНИЯ МАТЕМАТИЧЕСКОГО АНАЛИЗА

Аннотация

Цель исследования заключается в выявлении факторов интеграции цифровых технологий в математическое образование на примере преподавания математического анализа. В исследовании использованы данные анкетирования 176 респондентов, в том числе 36 преподавателей математики и 140 обучающихся, изучающих математический анализ или его основы. Для анализа данных применялись метод главных компонент (PCA) и дисперсионный анализ (ANOVA). В результате PCA было выделено пять компонентов исследовательского характера, объясняющих 35,52% общей дисперсии, для трех из которых были выявлены статистически значимые различия. Выделенные компоненты отражают профессиональные и институциональные характеристики, восприятие содержания математического материала и особенности организации обучения, а также профессиональное развитие и методическую поддержку преподавателей. Цифровые инструменты в целом положительно оцениваются с точки зрения представления математических понятий и объяснения абстрактных идей, однако интенсивность их использования различается в зависимости от образовательного контекста. Полученные данные свидетельствуют о том, что эффективная интеграция цифровых технологий связана не только от наличия цифровых ресурсов, но и от профессиональных, методических и образовательных условий их применения. Результаты исследования могут быть использованы при разработке методических материалов и программ профессионального развития преподавателей в области математического образования.

Ключевые слова: обучение математическому анализу, интеграция цифровых технологий, математическое образование, цифровая компетентность, профессиональное развитие, цифровые инструменты, дифференциальное и интегральное исчисление, вовлеченность обучающихся.

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ФОРМИРОВАНИЕ НАВЫКОВ МОДЕЛИРОВАНИЯ РЕШЕНИЯ ОЛИМПИАДНЫХ ЗАДАЧ НА ОСНОВЕ ЧАСТИЧНО-ПОИСКОВОГО МЕТОДА

Аннотация

В статье рассматривается формирование у учащихся 10 класса навыка построения модели решения олимпиадной математической задачи. В исследованиях по решению нестандартных задач чаще оценивается общий результат, тогда как выбор метода, планирование, проверка условий и полнота доказательства рассматриваются отдельно значительно реже. Цель исследования состояла в том, чтобы проследить изменения этих компонентов при систематическом использовании частично-поискового метода и формирующего оценивания. Исследование проводилось в формате Action Research в одной группе из 24 учащихся 10 класса в течение 2024–2025 учебного года. Были использованы входная и итоговая диагностика, анализ письменных решений, анкеты, полуструктурированные интервью, педагогическое наблюдение и диагностическая рубрика из пяти показателей. В ходе циклов применялись каркас решения, задания с различной степенью поддержки, парная взаимопроверка, групповое восстановление алгоритмов и формирующая обратная связь. Средний балл по рубрике увеличился с 6,4 до 11,9 из 15. Доля учащихся, способных обосновать выбор метода, выросла с 29 до 71%, а доля учащихся, проверяющих условия применимости и случай равенства, с 17 до 63%. Полное доказательство на итоговом этапе представили 58% учащихся против 21% на старте. Анализ письменных работ и наблюдений показал, что быстрее всего менялись выбор метода и план решения, тогда как завершение строгого доказательства оставалось наиболее трудным компонентом. Полученные данные описывают положительную динамику в данной группе. Из-за отсутствия контрольной группы они не рассматриваются как доказательство того, что изменения вызваны только использованным педагогическим подходом.

Ключевые слова: Action Research, олимпиадная математика, частично-поисковый метод, модель решения, математическое рассуждение, формирующее оценивание, неравенства.

Введение. Олимпиадная подготовка по математике требует не только знания отдельных методов, но и умения организовать ход решения. Учащемуся необходимо понять структуру условия, наметить возможные пути, выбрать подходящий метод, проверить ограничения и довести рассуждение до полного доказательства. Эта логика согласуется с классической схемой Дж. Пойа, где решение строится через понимание задачи, составление плана, его выполнение и последующую проверку [1]. А. Шёнфельд показывает, что существенную роль играет также самоконтроль учащегося в процессе решения. Важны оценка выбранной стратегии и своевременное решение о ее продолжении или смене [2].

Современные исследования дополняют эту картину. Систематический обзор работ о доказательстве в школьной и университетской математике показывает, что больше внимания уделяется взаимодействию учащегося с математическим содержанием. Исследований, в которых одновременно рассматриваются действия учителя, деятельность учащихся и качество доказательства, заметно меньше [3]. В исследовании одаренных учащихся показано, что использование представлений и моделей может сочетаться с трудностями при переходе к строгой математической записи [4]. Обзор программ для математически одаренных школьников выделяет сложные и открытые задачи, сотрудничество учащихся и активную поддержку учителя как характерные элементы такой подготовки [5].

При этом в доступных исследованиях сравнительно редко прослеживается, как меняются отдельные действия учащегося в процессе олимпиадного решения. Общий результат часто оценивается как единое целое. В таком случае трудно определить, возникает ли основная проблема при анализе условия, выборе метода, планировании, проверке условий или оформлении доказательства. В настоящей работе эти составляющие рассматриваются

отдельно. Такой подход позволяет точнее связать наблюдаемые затруднения с конкретными способами педагогической поддержки.

Исходная проблема была выявлена в ходе олимпиадной подготовки учащихся 10 класса. Письменные работы показывали, что при знании отдельных методов учащиеся нередко начинали решение с бессистемных преобразований. Метод часто выбирался по внешнему сходству, условия его применения не проверялись, а доказательство оставалось незавершенным. Под моделью решения в статье понимается осознанная последовательность взаимосвязанных действий. В нее входят анализ структуры и ограничений задачи, выбор и обоснование метода, планирование шагов, контроль условий применимости и случая равенства, а также завершение связного доказательства. Такое понимание опирается на эвристическую логику решения [1, с. 5–14; 2, с. 15–26] и современные исследования математического доказательства [3, с. 47–49; 4, с. 14].

В качестве методической основы был выбран частично-поисковый метод. Учитель не сообщал готовый алгоритм, а направлял поиск с помощью вопросов, подсказок и обратной связи. Такой вариант отличается от полностью самостоятельного открытия без поддержки. Метаанализ Л. Альфиери с соавторами показывает, что управляемый поиск, сопровождаемый подсказками и объяснениями, дает более надежные результаты, чем обучение без такой поддержки [6]. Исследования по математическому образованию также связывают вопросы, направленные на планирование и самоконтроль, с улучшением организации решения [7]. Поэтому самостоятельный поиск сочетался с ясными критериями качества и постепенным уменьшением помощи учителя.

Цель исследования — разработать и апробировать систему обучения олимпиадной математике, направленную на развитие у учащихся 10 класса навыка построения модели решения средствами частично-поискового метода.

Исследовательский вопрос был сформулирован следующим образом: Какие изменения наблюдаются в анализе структуры задачи, выборе метода, планировании, проверке условий и полноте доказательства при систематическом использовании частично-поисковых заданий и формирующего оценивания, а также какие элементы организации работы связаны с этими изменениями по данным наблюдений и письменных работ?

Гипотеза исследования состояла в том, что систематическое использование частично-поисковых заданий, в которых учащийся сначала продумывает и проверяет ход решения, будет сопровождаться более осознанным выбором метода и более полным доказательством. Ожидалось также уменьшение числа бессистемных преобразований и более внимательная проверка условий применимости. Вместе с тем формат Action Research не позволяет установить, что все изменения вызваны только одним педагогическим фактором. Поэтому результаты рассматриваются как динамика конкретной учебной группы.

Методы и материалы. Исследование было проведено в формате Action Research, предполагающем последовательные циклы планирования, действия, наблюдения и рефлексии [8]. Оно проводилось в течение 2024–2025 учебного года в группе из 24 учащихся 10 класса, посещавших элективный курс по олимпиадной математике. Выборка носила целевой характер. Учитель одновременно выполнял роль исследователя, что соответствует логике Action Research, но требует учитывать возможность субъективности при наблюдении и оценивании.

Объект исследования — процесс обучения математике учащихся 10 класса в условиях олимпиадной подготовки. Предмет исследования — развитие навыка построения модели решения математической задачи средствами частично-поискового метода. При анализе рассматривались письменные решения и зафиксированные эпизоды учебной деятельности, которые можно было соотнести с показателями диагностической рубрики.

Материалами исследования выступили письменные решения учащихся, диагностические работы, анкеты, результаты полуструктурированных интервью, листы наблюдения, постеры групповой работы, портфолио решений и рефлексивные записи учителя. Материалы авторской программы «Schola Mathematicorum» использовались как источник задач и как

организационная основа занятий. Сама программа не рассматривалась как отдельный объект проверки эффективности в данной статье.

Дизайн исследования включал диагностический этап и три последовательных цикла. Каждый цикл строился по логике планирования, действия, наблюдения и рефлексии. После анализа письменных работ и наблюдений уточнялись способы поддержки, которые использовались на следующем этапе. Общий дизайн исследования представлен в таблице 1.

Таблица 1. Дизайн исследования

Цикл	Сроки	Основная задача	Инструменты
Диагностический этап	сентябрь 2024 г.	Выявить типичные затруднения учащихся при решении нестандартных задач	Входная работа, анкета, анализ письменных решений, наблюдение
Цикл 1	октябрь-ноябрь 2024 г.	Ввести каркас модели решения и минимальный стандарт доказательства	Частично-поисковые задания, карточки-подсказки, лист наблюдения
Цикл 2	декабрь 2024 г. – февраль 2025 г.	Усилить перенос способа решения на новые темы через парную и групповую работу	Постеры, взаимооценивание, протокол урока, мини-интервью
Цикл 3	март-апрель 2025 г.	Систематизировать результативные методические решения и проверить перенос модели решения на задачи разных типов	Итоговая диагностика, портфолио решений, аналитическая матрица, рефлексивные записи

Источник: разработано автором.

Для научного обоснования используемых приемов было определено, какое учебное действие поддерживает каждый из них. Каркас решения помогал вынести планирование и самоконтроль в явную форму. Карточки-подсказки направляли самостоятельный поиск, не заменяя его готовым алгоритмом. Диагностическая рубрика и чек-листы задавали понятные требования к доказательству. Парная и групповая работа использовалась для обсуждения выбора метода и обнаружения логических пропусков. Теоретические основания этих решений представлены в таблице 2.

Таблица 2. Теоретико-методическое обоснование педагогического вмешательства

Компонент	Теоретическое основание	Функция в модели решения
Каркас решения и предварительная фиксация идеи	Планирование, самоконтроль и оценка хода решения [2, с. 15–26; 7, с. 569–572]	Помогает перейти от случайных преобразований к анализу структуры и последовательному плану.
Частично-поисковые задания и карточки-подсказки	Управляемое открытие и педагогическая поддержка [6, с. 11–12]	Сохраняют самостоятельный поиск и ограничивают непродуктивные ходы. Поддерживают обоснованный выбор метода.
Диагностическая рубрика и чек-листы	Формирующее оценивание и явные критерии качества [9–12]	Помогают проверять условия применимости, случай равенства и полноту вывода.
Парные роли «аналитик» и «эксперт»	Взаимооценивание и совместный контроль [11, с. 13–31; 13]	Помогают проговаривать критерии, проверять обоснование метода и замечать логические пропуски.
Групповое восстановление алгоритма и письменная рефлексия	Обобщение способа решения и перенос [1, с. 5–14; 2, с. 15–26]	Помогают выделить общую структуру метода и применить ее в измененной задаче.

Источник: разработано автором.

Для фиксации динамики была разработана диагностическая рубрика «Построение модели решения». Пять показателей были выбраны с учетом этапов решения задачи [1, с. 5–14; 2, с. 15–26] и требований к математическому обоснованию [3, с. 47–49; 4, с. 14].

К ним относятся анализ структуры задачи, выбор метода, план решения, контроль условий применимости и случая равенства, полнота доказательства. Каждый показатель оценивался от 0 до 3 баллов. Максимальный суммарный результат составлял 15 баллов. Результат в 2–3 балла по отдельному показателю рассматривался как достаточный или высокий уровень.

Критерии рубрики были связаны с принятой в исследовании моделью решения и описывали наблюдаемые признаки письменной работы. Такой подход соответствует рекомендациям по использованию аналитических рубрик для оценки сложной учебной деятельности [9, с. 138–140; 10, с. 343–345, 360–363].

Вместе с тем отдельная проверка валидности и надежности рубрики в рамках данного исследования не проводилась. Работы не оценивались независимо двумя экспертами, поэтому согласованность оценок разных экспертов не рассчитывалась. Это ограничение учитывается при интерпретации результатов. Рубрика использовалась прежде всего как диагностический и формирующий инструмент для данной учебной группы. Критерии диагностической рубрики представлены в таблице 3.

Таблица 3. Диагностическая рубрика «Построение модели решения»

Показатель	0 баллов	1 балл	2 балла	3 балла
Анализ структуры задачи	Не выделяет существенные признаки	Видит отдельные признаки	Частично выделяет ключевые признаки	Точно выделяет структуру и ограничения
Выбор метода	Выбор отсутствует или случаен	Метод выбран по внешнему сходству	Метод в целом уместен, но не обоснован	Метод выбран и обоснован
План решения	Начинает с бессистемных действий	Есть отдельные шаги	План намечен, но неполон	Представлена четкая последовательность шагов
Контроль условий и равенства	Условия не проверяются	Проверка фрагментарна	Контролирует часть условий; случай равенства рассмотрен неполно	Полностью проверяет условия применимости и случай равенства
Полнота доказательства	Решение обрывается	Вывод частичный	Доказательство почти завершено	Доказательство полное и связанное

Источник: разработано автором.

Количественный анализ проводился по четырем срезам: на старте, после первого и второго циклов и на итоговом этапе. Для каждого среза рассчитывались средний суммарный балл и число учащихся, получивших 2–3 балла по каждому показателю. Дополнительно определялось изменение доли учащихся от стартовой к итоговой диагностике. Статистические критерии значимости не применялись. Исследование было организовано как Action Research одной учебной группы, а не как эксперимент с контрольной выборкой. Поэтому количественные данные использовались для описания изменений внутри этой группы. Отсутствие контрольной группы не позволяет отделить влияние частично-поискового метода от повторной практики и других факторов учебного процесса. По этой причине различия не интерпретировались как причинный эффект. Качественный анализ включал сопоставление письменных решений, ответов в анкетах и интервью, наблюдений и рефлексивных записей на разных этапах. Сведения из разных источников сравнивались между собой. Это позволяло проверить, подтверждается ли изменение числовых показателей изменениями в структуре рассуждения. Формирующая обратная связь использовалась для корректировки последующей работы учащихся [11, с. 13–31; 12, с. 124–153].

Результаты и их обсуждение. Входная диагностика включала шесть заданий разных типов. В нее вошли нестандартное преобразование, неравенство, сравнение чисел, задача с функциональным подходом, задание на делимость и краткое доказательство в геометрической конфигурации. Цель диагностики состояла не в проверке полного предметного охвата, а в выявлении того, как учащийся организует решение в новой ситуации. На рисунке 1 показана доля учащихся, достигших 2–3 баллов по каждому показателю.



Рисунок 1. Доля учащихся на достаточном и высоком уровнях по показателям стартовой диагностики
Источник: разработано автором.

Средний балл на стартовом этапе составил 6,4 из 15, или 42,7% от максимально возможного результата. Наиболее слабым был контроль условий применимости и случая равенства. В 19 из 24 работ этот компонент отсутствовал либо выполнялся формально. В 16 работах решение начиналось с преобразований без предварительной идеи, а в 15 метод выбирался по внешнему признаку. Например, при наличии квадратных корней учащиеся нередко сразу переходили к возведению в квадрат, даже если такой шаг усложнял дальнейшее доказательство. Доля учащихся, успешно выделявших структуру задачи, составляла 42%, тогда как условия применимости полноценно контролировали 17%. Это показывает, что частичного понимания условия еще было недостаточно для построения последовательного решения.

Анкетирование подтвердило результаты письменной диагностики. Семнадцать из 24 учащихся назвали главным затруднением непонимание того, с чего начинать решение. Пятнадцать отметили, что знают отдельные методы, но затрудняются выбрать подходящий. Только 5 учащихся могли уверенно объяснить, почему выбранный способ применим. Сходство ответов в анкетах и результатов письменных работ позволяет предположить, что проблема была связана не только с запасом методов, но и с организацией самого хода решения.

Поэтому формирующая работа была направлена не на простое увеличение числа известных приемов, а на последовательность действий от анализа структуры задачи к выбору метода, планированию, проверке условий и завершению доказательства. Та же последовательность использовалась при анализе изменений в последующих циклах.

Цикл 1: переход от бессистемных преобразований к каркасу решения

На первом формирующем цикле учащимся предлагалось проговаривать каркас решения до начала вычислений. Его задача состояла в том, чтобы сделать планирование и проверку хода решения явными. Учащиеся последовательно отвечали на пять вопросов.

1. Что дано и какие ограничения существенны?
2. Какие структурные признаки видны в условии?

3. Какие методы потенциально применимы?
4. Какой метод выбран и почему?
5. Где может достигаться равенство или в чем состоит условие корректности?

В первом цикле было проведено шесть занятий по алгебраическим методам. Использовались фронтальные частично-поисковые обсуждения, парная работа, карточки-подсказки и короткие письменные рефлексии. До начала вычислительных преобразований учащиеся должны были кратко записать основную идею. Это позволяло обращать внимание не только на правильность ответа, но и на организацию поиска.

Промежуточный анализ письменных работ после четырех занятий показал положительную динамику. На входной диагностике только 4 из 24 учащихся начинали решение с формулировки идеи или плана. К концу первого цикла таких работ стало 11. Средний балл по рубрике увеличился с 6,4 до 8,2 из 15. Наиболее заметные изменения наблюдались в анализе структуры задачи и выборе метода. По наблюдениям учителя, каркас вопросов помогал учащимся реже начинать со случайных преобразований и давал общий язык для обсуждения решения.

Вместе с тем первый цикл выявил ограничение. Каркас работал лучше в задачах, близких к тем, которые уже разбирались на занятиях, и не всегда помогал распознать метод в измененной формулировке. Стало понятно, что одних направляющих вопросов недостаточно. Учащимся требовалось сравнивать разные способы, проверять решения друг друга и самостоятельно восстанавливать общий алгоритм. Это определило содержание второго цикла.

Цикл 2: перенос способа и групповое восстановление алгоритма

Во втором цикле была усилена парная и групповая работа. В паре использовались роли «аналитик» и «эксперт». Аналитик формулировал существенные признаки задачи, идею и план решения. Эксперт проверял применимость метода, случай равенства и полноту вывода. В групповых заданиях учащимся предлагалось не только решить задачу, но и найти возможный альтернативный метод, указать места, где легко допустить логическую ошибку, и восстановить общий алгоритм для задач данного типа.

Наиболее показательным стал урок по теме «Метод отделяющей касательной при доказательстве неравенств». Он позволил проверить, переносят ли учащиеся общий способ рассуждения в новую ситуацию. Работа начиналась со сравнения через третью величину, затем учащиеся переходили к выбору функции и точки касания. После этого требовалось перевести графическое представление в строгое аналитическое доказательство.

На этапе обсуждения 20 из 24 учащихся корректно сформулировали принцип сравнения через третью величину. В групповых постерах 17 учащихся зафиксировали полный алгоритм метода. В 14 индивидуальных работах решение начиналось с выбора функции и точки касания. На стартовом этапе сопоставимый уровень предварительного планирования наблюдался в 6 работах. Эти данные показывают, что учащиеся стали чаще сначала выбирать математический объект и способ решения, а уже затем выполнять преобразования.

Одновременно сохранялись трудности. Только 10 учащихся самостоятельно довели решение до полного доказательства без подсказки на последнем шаге. Наиболее сложным оказался переход от графической идеи к строгой системе аналитических неравенств и проверке необходимых условий. После этого в обратной связи больше внимания уделялось не только нахождению идеи, но и обоснованию каждого перехода.

После второго цикла средний балл по рубрике составил 10,3 из 15. Быстрее всего менялись показатели, связанные с выбором метода и планом решения. Полнота доказательства улучшалась медленнее. Это различие стало важным результатом исследования, поскольку общий рост балла скрывал неодинаковую динамику отдельных компонентов.

Цикл 3: систематизация результатов в структуре авторской программы

На третьем цикле проверялось, сохраняется ли выработанная последовательность действий при смене предметного содержания. Для анализа использовались решения по многочленам, сравнениям по модулю, геометрическим доказательствам, комбинаторным и игровым задачам. Одновременно результативные приемы систематизировались в структуре

авторской программы. При этом основным предметом статьи оставалась динамика действий учащихся, а не оценка программы как целостного курса.

Итоговая диагностика включала задания, сопоставимые по типу со стартовой работой, но требовала большей самостоятельности. Учащиеся должны были обозначить выбранную стратегию, обосновать применимость метода, проверить ограничения и завершить доказательство. Материалы программы использовались как учебная среда для этой проверки. Полученные результаты не рассматриваются как отдельное доказательство эффективности всей программы.

Результаты трех циклов были использованы для уточнения «Schola Mathematicorum». В программу вошли те приемы, которые в наблюдениях и письменных работах помогали сделать ход решения более последовательным. Тем самым программа стала практическим продолжением исследования, но не его основным объектом.

Итоговая динамика результатов. На рисунке 2 представлено изменение доли учащихся, достигших достаточного и высокого уровня по каждому показателю на четырех этапах. График используется для описания повторных измерений внутри одной группы. Различия не рассматриваются как статистически доказанный причинный эффект.

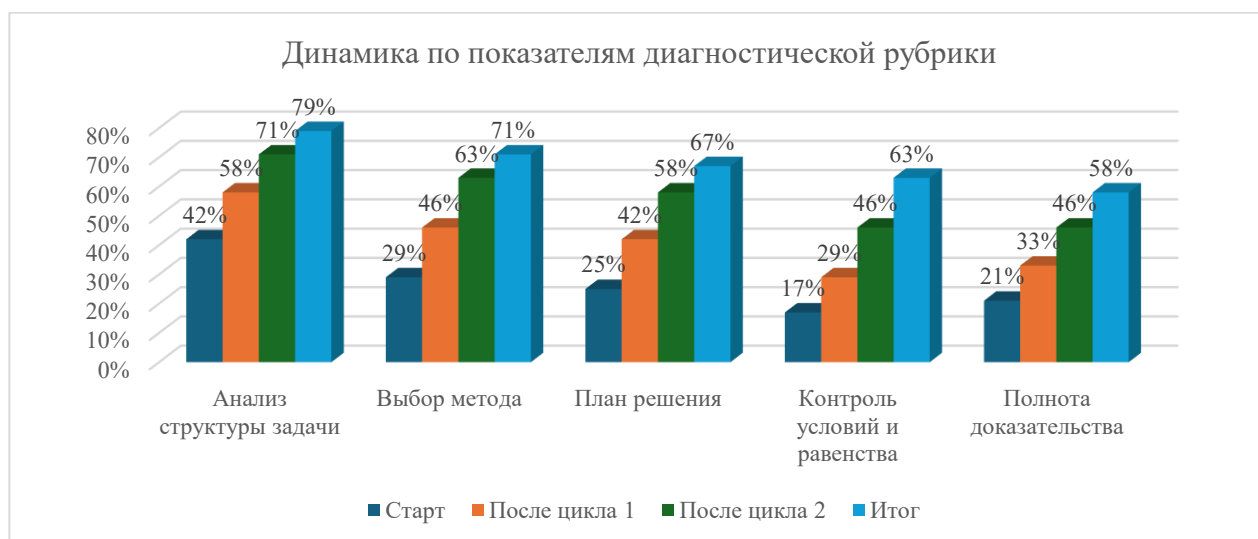


Рисунок 2. Динамика доли учащихся на достаточном и высоком уровнях по показателям рубрики
Источник: разработано автором.

Средний балл увеличился с 6,4 до 11,9 из 15, то есть на 5,5 балла. Доля от максимального результата возросла с 42,7 до 79,3%. По отдельным показателям прирост составил от 37 до 46 процентных пунктов (таблица 4). Число решений без предварительной идеи сократилось с 16 до 5. Число учащихся, способных обосновать применимость выбранного метода, выросло с 5 до 17. Количество работ без проверки условий или случая равенства уменьшилось с 19 до 8. Наибольший прирост наблюдался по контролю условий и составил 46 процентных пунктов. При этом полнота доказательства оставалась самым низким итоговым показателем и достигла 58%. Следовательно, отдельные составляющие навыка развивались с разной скоростью.

Таблица 4. Динамика показателей диагностической рубрики, n (%)

Показатель	Старт	После цикла 1	После цикла 2	Итог	Изменение от старта
Анализ структуры задачи	10 (42)	14 (58)	17 (71)	19 (79)	+37 п.п.
Выбор метода	7 (29)	11 (46)	15 (63)	17 (71)	+42 п.п.
План решения	6 (25)	10 (42)	14 (58)	16 (67)	+42 п.п.
Контроль условий и случая равенства	4 (17)	7 (29)	11 (46)	15 (63)	+46 п.п.
Полнота доказательства	5 (21)	8 (33)	11 (46)	14 (58)	+37 п.п.

Показатель	Старт	После цикла 1	После цикла 2	Итог	Изменение от старта
Средний балл по рубрике	6,4	8,2	10,3	11,9	+5,5 балла

Примечание. Для пяти показателей приведены число учащихся и округленная доля; результат в 2–3 балла соответствует достаточному и высокому уровням; п.п. — процентные пункты.

Источник: разработано автором.

Качественный анализ письменных решений также показал изменения в структуре рассуждения. На старте учащиеся чаще фиксировали первое доступное преобразование. В итоговых работах чаще появлялись выделение существенного признака и краткий план. Выбор метода стал чаще сопровождаться объяснением его применимости. Проверка ограничений и случая равенства стала отдельным шагом решения. Вместе с тем встречались работы, в которых верная идея по-прежнему не доводилась до связного доказательства.

Рефлексия по итогам циклов помогает объяснить наблюдаемую динамику. В первом цикле каркас вопросов прежде всего упорядочил планирование, но перенос на новые формулировки оставался ограниченным. Во втором цикле роль «эксперта» сделала логические пропуски предметом совместного обсуждения. В финальной анкете 18 из 24 учащихся отметили, что теперь чаще начинают с поиска структуры задачи. Шестнадцать учащихся указали, что экспертная роль помогает замечать пропуски в собственных решениях. Пятнадцать назвали полезным формат, в котором нужно восстановить общий алгоритм метода. Эти ответы согласуются с наблюдениями и письменными работами, хотя сами по себе не являются отдельным доказательством эффективности.

Сопоставление полученных результатов с исследованиями позволяет уточнить их смысл. В данной группе выбор метода и планирование улучшались быстрее, чем полнота доказательства. Это согласуется с работами, где отмечается, что использование представлений и аргументов может опережать способность оформить их в строгую доказательную форму [3, с. 47–49; 4, с. 14].

Каркас вопросов сделал планирование, проверку хода решения и итоговую оценку более явными для учащихся. Однако результаты первого цикла показали, что такая опора сама по себе не обеспечивает перенос на новую задачу. Более заметные изменения наблюдались после того, как учащиеся начали сравнивать способы решения, обсуждать ошибки и восстанавливать общий алгоритм. Такое объяснение согласуется с исследованиями управляемого открытия и самоконтроля в процессе математического решения [2, с. 15–26; 6, с. 11–12; 7, с. 569–572].

Диагностическая рубрика задавала понятные критерии качества решения, а роли «аналитик» и «эксперт» переносили эти критерии в парное обсуждение. Исследования по формирующему оцениванию, использованию рубрик и взаимооцениванию показывают, что такие приемы могут поддерживать саморегуляцию и качество учебной работы [9, с. 138–140; 10, с. 360–363; 11, с. 13–31; 12, с. 124–153; 13, с. 484–486].

В нашем исследовании несколько приемов применялись одновременно. Поэтому определить отдельный вклад каждого из них невозможно.

Научный вклад работы состоит в том, что модель олимпиадного решения представлена через пять отдельно наблюдаемых компонентов. Это анализ структуры задачи, выбор метода, планирование, контроль условий и полнота доказательства. Такое разделение позволило увидеть, что положительная динамика по этим компонентам шла неравномерно. Выбор метода и планирование менялись быстрее, тогда как завершение строгого доказательства оставалось более устойчивым затруднением. Этот вывод получен в условиях одной учебной группы и требует проверки на других выборах.

Полученные результаты были использованы при уточнении авторской программы «Schola Mathematicorum». В модули были включены коллективный старт на распознавание структуры задачи, чек-листы минимального стандарта доказательства, парная взаимопроверка и задания на восстановление алгоритма. Эти решения представляют практическое применение результатов исследования и не рассматриваются как самостоятельное доказательство эффективности программы в целом.

Заклучение. Проведенное исследование показало положительную динамику навыка построения модели решения в изученной группе. Учащиеся стали чаще выделять структуру задачи, обосновывать выбор метода, планировать шаги и проверять условия применимости. Средний результат увеличился с 6,4 до 11,9 из 15. Вместе с тем эти изменения следует рассматривать как результат, полученный в конкретной педагогической практике, а не как причинно доказанный эффект одного метода.

Сопоставление циклов показало различную роль использованных приемов. Каркас вопросов прежде всего помогал учащимся начинать с плана, а парная проверка помогала замечать логические пропуски и возвращаться к критериям доказательства. Наиболее устойчивой трудностью осталось завершение строгого аналитического вывода. На итоговом этапе достаточного или высокого уровня по этому показателю достигли 58% учащихся.

Научная новизна исследования заключается в представлении навыка построения модели решения через пять наблюдаемых показателей. К ним относятся анализ структуры задачи, выбор метода, планирование решения, контроль условий применимости и полнота доказательства. Кроме того, показано, что эти компоненты могут изменяться с разной скоростью. Практическая значимость связана с разработанными приемами работы, которые можно использовать в элективных курсах по олимпиадной математике. К ним относятся каркас решения, диагностическая рубрика, чек-листы, парная взаимопроверка и задания на восстановление алгоритма.

Полученные выводы были использованы для совершенствования авторской программы «Schola Mathematicorum». В рамках настоящей статьи программа выступала средой проведения занятий и способом практического применения результатов. Основное внимание сохранялось на изменениях в математическом рассуждении учащихся.

Исследование имеет несколько ограничений. Оно проводилось в одной группе из 24 учащихся без контрольной выборки. Учитель одновременно выполнял роль исследователя. Оценивание работ не проводилось независимо несколькими экспертами, поэтому согласованность оценок разных экспертов не рассчитывалась. Статистические критерии значимости также не применялись. Кроме того, несколько методических приемов использовались одновременно, а повторная диагностика спустя длительное время не проводилась. В дальнейшем целесообразно включить несколько групп и образовательных площадок, организовать независимое оценивание работ двумя экспертами, провести статистический анализ индивидуальных парных данных и предусмотреть отсроченную диагностику переноса навыка.

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ЖАРТЫЛАЙ ІЗДЕНІСТІК ӘДІСІ НЕГІЗІНДЕ ОЛИМПИАДАЛЫҚ ЕСЕПТЕРДІ ШЕШУДІ МОДЕЛЬДЕУ ДАҒДЫЛАРЫН ҚАЛЫПТАСТЫРУ

Аңдатпа

Мақалада 10-сынып оқушыларының олимпиадалық математикалық есепті шешу моделін құру дағдысын қалыптастыру мәселесі қарастырылады. Қазіргі зерттеулерде есептің жалпы нәтижесі жиі бағаланады, ал әдісті таңдау, шешімді жоспарлау, қолдану шарттарын тексеру және дәлелдеуді аяқтау сияқты әрекеттердің өзгерісі жеке қарастырылатын жұмыстар аз. Зерттеудің мақсаты — жартылай ізденістік әдіс пен қалыптастырушы бағалауды жүйелі қолдану барысында осы әрекеттердің қалай өзгеретінін анықтау. Зерттеу 2024–2025 оқу жылында 10-сыныптың 24 оқушысынан тұратын бір топта Action Research форматында жүргізілді. Бастапқы және қорытынды диагностика, жазбаша жұмыстарды талдау, сауалнама, жартылай құрылымдалған сұхбат, педагогикалық бақылау және бес көрсеткіштен тұратын диагностикалық рубрика қолданылды. Зерттеу циклдерінде шешу қаңқасы, түрлі деңгейдегі көмек беретін тапсырмалар, жұптық өзара тексеру, алгоритмді топпен қалпына келтіру және қалыптастырушы кері байланыс пайдаланылды. Рубрика бойынша орташа балл 15 балдың 6,4-інен 11,9-ына дейін өсті. Әдісті таңдауын негіздей алатын оқушылар үлесі 29%-дан 71%-ға, қолдану шарттары мен теңдік жағдайын тексеретіндер 17%-дан 63%-ға артты. Толық дәлелдеу көрсеткіші 21%-дан 58%-ға дейін өсті. Жазбаша жұмыстарды талдау әдісті таңдау мен жоспарлау тезірек жақсарғанын, ал қатаң дәлелдеуді аяқтау ең күрделі бөлік болып қалғанын көрсетті. Нәтижелер осы топтағы оң өзгерісті сипаттайды, бірақ бақылау тобы болмағандықтан оларды тек қолданылған әдістің себептік әсері ретінде түсіндіруге болмайды.

Түйінді сөздер: Action Research, олимпиадалық математика, жартылай ізденістік әдіс, шешу моделі, математикалық пайымдау, қалыптастырушы бағалау, теңсіздіктер.

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FORMATION OF SKILLS IN MODELING OLYMPIAD PROBLEM SOLVING BASED ON THE PARTIAL SEARCH METHOD

Annotation

The article examines the development of Grade 10 students' skill in constructing a solution model for olympiad mathematics problems. Existing research often reports overall problem-solving success, while changes in method selection, planning, checking conditions, and completing a proof are less often examined separately. The study aimed to trace changes in these components during systematic use of the partial-search method and formative assessment. The study was conducted as Action Research with one group of 24 Grade 10 students during the 2024–2025 academic year. Data were collected through initial and final diagnostic tasks, written solutions, questionnaires, semi-structured interviews, classroom observation, and a five-indicator diagnostic rubric. The research cycles used a solution framework, tasks with varying degrees of support, peer checking, group reconstruction of solution algorithms, and formative feedback. The mean rubric score increased from 6.4 to 11.9 out of 15. The proportion of students able to justify method

selection rose from 29% to 71%, while the proportion checking conditions of applicability and equality cases rose from 17% to 63%. The proportion presenting a complete proof increased from 21% to 58%. Analysis of written work showed that method selection and planning improved more quickly than the completion of a rigorous proof. The findings describe positive changes within this group, but the absence of a control group does not allow the changes to be attributed solely to the pedagogical approach.

Keywords: Action Research, olympiad mathematics, partial-search method, solution model, mathematical reasoning, formative assessment, inequalities.

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ПРОЕКТИРОВАНИЕ ПЕРСОНИФИЦИРОВАННОЙ ПРОГРАММЫ ПРОФЕССИОНАЛЬНОГО РАЗВИТИЯ ПЕДАГОГОВ НА ОСНОВЕ ЦЕЛЕПОЛАГАНИЯ

Аннотация

Статья посвящена исследованию подходов и технологий к определению целей профессионального развития педагогов в посткурсовой период. Четкое целеполагание играет ключевую роль в обеспечении осознанного профессионального развития, которое направляется самим педагогом. В статье предлагается инновационное решение определения целей профессионального развития в посткурсовой период в виде мобильного конфигурируемого набора, который позволяет проектировать персонифицированную программу профессионального развития педагогов. В ходе исследования был проведен опрос 21 681 педагогов с целью определения их образовательных потребностей, их осознанного отношения к профессиональному развитию в посткурсовой период. 61% респондентов сообщили об отсутствии у них четкого представления о том, как они намерены развиваться в профессиональном плане в ближайшем будущем. У 28% педагогов формулировки цели профессионального развития носят весьма отвлеченный характер. 10% педагогов в качестве целей профессионального развития в посткурсовой период определили результаты, указав либо продукт деятельности, либо ступень карьерного роста, либо задачи по обучению предмету. Лишь у незначительной части участников опроса (1%) цели связаны с профессиональными компетенциями. Значимость результатов связана с обоснованием инновационного решения проблем проектирования персонифицированной программы профессионального развития на основе определения ее конкретных, достижимых целей в виде патентоспособной полезной модели мобильного конфигурируемого набора. Его применимость в качестве самостоятельно моделируемого конструктора за счет персонифицированной визуальной конфигурации элементов набора показывает перспективность использования при появлении новых требований к квалификации и компетенциям педагогов, новых ресурсов и форм профессионального развития.

Ключевые слова: хьютогика, непрерывное профессиональное развитие педагогов, агентность, посткурсовой период, цель профессионального развития педагогов, персонифицированная программа профессионального развития педагога, полезная модель, мобильный конфигурируемый набор.

Введение. Профессиональное развитие педагогов основывается на интеграции нескольких подходов, которые взаимодополняют друг друга. Это андрогогика, рефлексивное обучение, социальное взаимодействие и хьютогика (самоопределенное обучение). Сочетание этих подходов обеспечивает системное развитие педагогов и готовит их к адаптации в условиях изменяющихся образовательных и технологических реалий [1-6].

Хьютогика значительно расширяет подходы, ориентированные на взрослых, и подчеркивает рост автономии и самоопределения в профессиональном развитии, предоставляя педагогам самостоятельно разрабатывать индивидуальные образовательные траектории, адаптируя их к постоянно меняющимся условиям образовательной среды, профессиональным задачам и личным интересам [4, с.95]. Процесс профессионального развития становится непрерывным, а сам педагог выступает как инициатор изменений и полноправный партнер создания гибкой, адаптивной системы обучения, способной быстро реагировать на вызовы времени.

Обзор литературы позволяет выделить среди механизмов, обеспечивающих эффективное непрерывное профессиональное развитие педагогов, такую группу как постановка и

согласование целей [7], [8]. Учителям рекомендуется ставить личные цели для профессионального роста, уделяя особое внимание самодисциплине и мотивации, которые имеют решающее значение для постоянного совершенствования [9]. Цели профессионального развития рассматриваются исследователями как предполагаемое изменение поведения [10], как начальный этап планирования их собственного обучения [11]. Стратегическое планирование должно соответствовать индивидуальным потребностям педагогов и требованиям системы образования, обеспечивая направленность и заинтересованность в непрерывном развитии [12]. Swikla (2007) считает, что четко определенные цели учителей на конкретный период времени влияют на успешность профессионального развития, что, в свою очередь, влияет на улучшение успеваемости учащихся [13].

Исследователи сходятся во мнении, что определение четких и достижимых целей профессионального развития имеют существенное значение для его эффективности. Постановка целей побуждает педагогов к направленным и осознанным действиям по изучению практики своего преподавания и планирования персонального пути к обучению и совершенствованию [14]. Понимание своих целей и соответствие их образовательной системе влияют на преданность и увлеченность своей профессией [15] и могут различаться на разных этапах профессиональной жизни учителей и в разных образовательных контекстах [16].

Изучение проблем формирования профессиональных компетенций учителей в части целеполагания позволило сделать выводы о целесообразности организации специальной подготовки по навыкам целеполагания как будущих учителей, так и работающих учителей в рамках повышения квалификации, с использованием метода SMART (постановка «умных» целей) [17].

Мы исходим из того, что для устойчивости профессионального роста важными являются автономия, осмысленность и личная значимость образовательного процесса [2, с.14]. Педагоги будут мотивированы, если профессиональное развитие связано с их жизненными или профессиональными целями.

Worth, J. и Van den Brande, J. определили, что автономия педагогов наиболее слабо проявляется в определении целей профессионального развития и в значительной степени связана с удовлетворенностью своей работой [18]. Следовательно, повышение автономии учителей в отношении целей их профессионального развития имеет наибольший потенциал для повышения удовлетворенности работой учителей и их приверженности профессии.

Автономию учителей Worth, J. и Van den Brande, J. трактуют согласно теории самоопределения (Deci и Ryan, 2008) и представляют как способность принимать обоснованные решения и/или действовать независимо. Понятие «автономия» (autonomy) аналогично, хотя и не идентично, понятию «агентность» (agency), используемое в научной литературе. Агентность как концепт подразумевает наличие в личности определенной свободы, ориентации на будущее через целеполагание, способности выстраивать несколько траекторий для достижения своих целей, при этом обладание реалистичным пониманием багажа ресурсов и имеющихся ограничений (на основе Emirbayer и Mische, 1998).

Непрерывное профессиональное развитие педагогов (НППР) предполагает, что постановка ясных, достижимых целей относится не только к программам формального обучения на курсах или семинарах, но и в период после обучения. Краткосрочное повышение квалификации должно стать стимулом определения целей профессионального развития, а содержательные элементы деятельности педагогов после курсов необходимо направить на развитие агентности в условиях, когда известные способы достижения цели являются неэффективными и нужно проектировать новую систему действий на основе сформулированного самим педагогом образовательного запроса.

Согласно Martin Karlberg, НППР в большинстве стран диктуется национальными или региональными реформами, что нивелирует идею мотивированного и личностного НППР, сводя роль учителя к исполнению идей, спускаемых «сверху» [19].

Следовательно, необходим переход от линейной модели повышения квалификации «государство – руководство – учитель» к персонифицированной модели НППР, где учитель

находится в центре профессионального развития, становясь активным субъектом своего обучения, и действует из личной идеи служить идеалу, моральной цели [20], [21].

Мы рассматриваем учителей как активных агентов, направляющих собственное развитие в рамках своей профессиональной деятельности, при этом отправной точкой становится умение педагогов четко представлять, как они намерены совершенствовать свою практику и развиваться как профессионалы в ближайшем будущем.

Цель исследования

В нашем исследовании мы предположили, что агентность учителей связана с тем, как они определяют цели своего профессионального развития после обучения на курсах или семинарах. Это сформулировано в наших исследовательских вопросах:

1. Как постановка целей профессионального развития учителей связана с их текущими профессиональными интересами?

2. Как учителя проектируют путь своего профессионального развития?

Методы и материалы. Исследование умения педагогов определять цели профессионального развития сопровождается определением уровня осознанного отношения педагогов к профессиональному развитию в посткурсовой период и предложением новых решений.

В 2024 году с целью изучения потребностей в области профессионального развития в посткурсовой период был проведен опрос руководителей и учителей школ Казахстана, в котором приняли участие 21 681 педагогов из всех областей Казахстана. Исследование является масштабным и охватывает педагогов различных квалификационных категорий, разного стажа работы [22].

В числе вопросов, важных для понимания уровня осознанного отношения педагогов к профессиональному развитию в посткурсовой период, был вопрос о целях профессионального развития. Респондентам предлагалось указать цель своего профессионального развития, в случае ее отсутствия нужно было написать, что не имеется. Значительная часть учителей (61%) сообщила об отсутствии у них четкого представления о том, как они намерены развиваться в профессиональном плане в ближайшем будущем. У большинства оставшихся 28% педагогов формулировки цели профессионального развития носят весьма общий характер: формирование разносторонней личности; повышение компетенции, повышение качества знаний; непрерывное обучение; совершенствование профессионального мастерства; саморазвитие; улучшение результатов обучения и пр. Как показывают результаты опроса, отсутствие целей профессионального развития или их нечеткость не связана с уровнем квалификационной категории, так как такие ответы предоставили и педагоги с высокой квалификационной категорией.

10% педагогов в качестве целей профессионального развития в посткурсовой период определили конкретные результаты, указав либо продукт деятельности (создание авторской программы обучения предмету, подготовка методических рекомендаций, пособий), либо ступень карьерного роста (успешно сдать квалификационный экзамен, получить более высокую квалификационную категорию, стать заместителем директора или директором школы), либо задачи по обучению предмету (развитие речевых навыков учеников, использование графических органайзеров на уроке, применение разноуровневых заданий). Лишь у незначительной части участников опроса (1%) цели связаны с профессиональными компетенциями: создавать инклюзивную среду обучения, владеть методами оценивания при планировании и проведении урока, применять информационные технологии в учебном процессе для расширения возможностей обучения, владеть способами предоставления обратной связи для поддержки и развития обучающихся.

Следующим этапом исследования стала разработка полезной модели «Мобильный конфигурируемый набор», которая предназначена для моделирования непрерывного профессионального развития педагогов. Полезная модель включена в Государственный реестр полезных моделей Республики Казахстан, на нее получен патент, выданный

Национальным институтом интеллектуальной собственности Министерства юстиции Республики Казахстан [23].

Использование набора возможно как перед завершением курса в обучающей организации, так и в посткурсовой период в условиях организации образования, где работает педагог. Применение набора обеспечивает проектирование персонифицированной программы профессионального развития и визуализацию процесса ее проектирования.

Мобильный конфигурируемый набор включает магнитную доску, кейс с 4 комплектами магнитных карточек для проектирования программы профессионального развития. Каждый из 4 комплектов включает 20 шт. магнитных карточек.

Магнитные карточки систематизированы в зависимости от содержания:

Комплект 1 – карточки с описанием профессиональных компетенций.

Комплект 2 – карточки с описанием форм профессионального развития.

Комплект 3 – карточки с описанием ресурсов профессионального развития.

Комплект 4 – карточки с описанием практических результатов профессионального развития.

Структура каждой карточки включает ее название (1), цифровой код (2), визуальный образ названия карточки (3), цветовую маркировку (4), описание (5) и рекомендации (6) (рис.1).



Рисунок 1. Структура карточки

Источник: разработано авторами

Цветовая маркировка и визуальный образ повышают оперативность и эффективность работы с карточками.

При разработке карточек с описанием профессиональных компетенций мы ориентировались на профессиональные стандарты для педагогов организаций образования, которые являются навигатором профессионального развития педагогов и применяется для управления изменениями и адаптации содержания собственной педагогической деятельности [24].

Набор используется следующим образом. Педагог изучает описание карточек, затем самостоятельно или при поддержке наставника/методиста, отбирает из них те, которые будут определять программу его профессионального развития: профессиональные компетенции, требующие формирования или развития, необходимые для этого ресурсы и формы, ожидаемые практические результаты. Затем педагог визуализирует программу

профессионального развития на магнитной доске при помощи магнитных карточек. В зависимости от профессиональных дефицитов и профессиональных потребностей отдельных педагогов программа для каждого из них будет иметь персонифицированную конфигурацию.

Особенность данного набора состоит в том, что он является мобильным, гибким и удобным инструментом проектирования профессионального развития после курсового обучения, визуально рассматривать разные варианты ее траектории. Кроме того, по мере реализации программы ее конфигурация может меняться, дополняться.

Еще одной особенностью набора является то, что комплекты карточек возможно изменять в соответствии с новыми требованиями к квалификации и компетенциям педагогов, появлением новых ресурсов и форм профессионального развития.

«Мобильный конфигурируемый набор» был апробирован в процессе экспериментальной работы по проектированию персонифицированной программы профессионального развития. Результаты апробации изучены посредством контент-анализа.

Результаты и их обсуждение. Традиционно при определении пути индивидуального профессионального развития используются конструкторы [25], [26] и ресурсные карты [27]. Эти инструменты позволяют оказать помощь педагогу, обеспечивая разную степень самостоятельности его действий. Для проектирования отдельных компонентов индивидуального образовательного маршрута педагог может использовать варианты фраз из конструктора «как образцы при формулировании задач предстоящей деятельности, образовательных задач, форм предъявления результатов» [25, с.6]. Или онлайн-конструктор сам формулирует цель профессионального развития, после того как педагог проанализирует свой предыдущий опыт и определит проблему, решение которой позволит ему профессионально расти. Но технически педагог может не проводить предлагаемый анализ, а сделать интуитивный выбор наиболее подходящих вариантов из имеющихся.

Полезная модель «Мобильный конфигурируемый набор» не предоставляет педагогу готовых образцов или шаблонов, что отвечает содержанию понятия «агентность» и позволяет педагогу действовать как активному субъекту.

Экспериментальная работа была организована в два этапа.

На первом этапе к экспериментальной работе было привлечено 72 педагога – слушателей курсов повышения квалификации. Набор использовался для организации взаимодействия слушателей в малых группах количеством 4-5 человек. Такая форма работы имитировала работу творческой группы, в которой опытные и начинающие педагоги разного уровня квалификации выявляют имеющиеся трудности в профессиональной деятельности каждого и совместно обсуждают возможные траектории профессионального развития и их результаты. Положительное влияние на профессиональное развитие педагога подобных групп подтверждается опытом Lesson study [28] или Teacher Activity Groups [29].

Алгоритм работы на первом этапе включал ряд действий.

Сначала проводилась фронтальная беседа со всей группой о назначении посткурсового периода. Слушатели делились опытом развития профессиональной компетентности после обучения на курсах. Акцент делался на цели профессионального развития: осознается ли педагогом необходимость постановки, формулируется ли им, каким образом формулируется, что является отправной точкой для постановки.

Затем слушатели формулировали цель профессионального развития с учетом содержания обучения на курсе повышения квалификации: как полученные знания, умения, навыки и компетенции будут применяться в практической деятельности и для достижения каких результатов. Результаты изучения целей показывают, что 98,6% педагогов сформулировали цель профессионального развития обобщенно.

Чтобы организовать работу в малой группе, объяснялись состав набора и его назначение. Потом каждая малая группа получала набор карточек и изучала его состав: какие карточки к какому комплекту относятся, какие компетенции, формы, ресурсы и продукты профессионального развития вошли в каждый комплект.

Следующее действие предполагало выбор одного члена группы для выстраивания персонифицированной программы профессионального развития. Педагоги действовали интуитивно, не имея четкого алгоритма. Чтобы определить кандидата для работы, они действовали по-разному. Некоторые группы сначала обсуждали те цели профессионального развития, которые они сформулировали, чтобы выбрать соответствующую каким-то их представлениям цель. Другие – искали педагога, который проявил бы инициативу и сам решил выступить в роли объекта. Третьи – определяли педагога, который не имел достаточно опыта, и действовали по принципу командного наставничества (Peer group mentoring, [30]). Четвертые – не выбирали конкретного педагога, а работали с образом условного педагога.

Проектирование персонифицированной программы профессионального развития начиналось с выбора одной или нескольких профессиональных компетенций, предлагаемых мобильным конфигурируемым набором. Она становилась целью профессионального развития. Ее выбор группами также осуществлялся не всегда осознанно. Группы руководствовались различными представлениями. Наблюдения за высказываниями педагогов позволили собрать несколько вариантов:

- привлекательность, ценность, любопытство: «Интересная компетенция! Давайте возьмем ее»;
- недостаток, дефицит, потребность: «Вот этой компетенции мне не хватает. Выберем ее для работы»;
- обязательность, требование, правило: «Эта компетенция связана с требованиями к той квалификационной категории, которую я хочу получить. Поэтому возьму ее для работы».
- развитие, совершенствование, профессионализм: «Эта компетенция является ожидаемым результатом нашего обучения на курсах. Продолжу после курсов работу над ее развитием».

Выбор профессиональных компетенций обуславливал предпочтение форм, ресурсов и продуктов профессионального развития. Спроектированная персонифицированная программа профессионального развития затем презентовалась всей группе с объяснениями сделанного выбора.

Пример представлен в таблице 1.

Таблица 1. Связь профессиональных компетенций с формами, ресурсами и продуктами профессионального развития

Категория	Описание
компетенции	– разработка продуктов педагогической деятельности; – самосознание, самоэффективность; – предметная компетентность
формы профессионального развития	– конференции; – курсы повышения квалификации; – конкурсы
ресурсы профессионального развития	– системно-методический комплекс (СМК); – сайт Национального научно-практического центра развития специального и инклюзивного образования; – платформы для пробного тестирования (ОЗП): testter.kz/nkt, test-online.kz/nkt_predmet.html, nqt.kz/ru/ozp-nkt-test, nqt-test.online; – онлайн-платформа по развитию soft skills (4brain.ru); – образовательный канал «Өрлеу»
продукты профессионального развития	– успешная сдача ОЗП; – повышение квалификационной категории; – разработка дидактических материалов (сборники заданий, разработки уроков (занятий, мероприятий), рабочие тетради, тренажеры)

Источник: разработано авторами

Заключительным действием на первом этапе была рефлексия. Снова фронтально проводилась беседа:

- Помог ли набор осмыслить перспективы своего профессионального развития?
- Как вы теперь сформулируете цель профессионального развития?
- Что является самым важным при определении траектории профессионального развития?
- Как можно использовать набор в работе с педагогами?

Педагоги положительно оценивали влияние набора на осмысление дальнейшего профессионального развития. Они указывали на то, что четко сформулированные компетенции с описанием, точно названные формы, ресурсы и продукты профессионального развития позволяют легко подобрать необходимые варианты и выстроить траекторию.

Педагоги связывали возможные способы использования набора для работы наставника с молодыми педагогами, администрации с педагогами или педагогами самостоятельно для определения необходимых действий в получении желаемой квалификационной категории.

После рефлексии педагоги корректировали ранее сформулированную цель, включив в ее содержание конкретные компетенции. Анализ целей показал, что после использования набора цель профессионального развития с указанием определенных компетенций смогли конкретизировать только 33,3% педагогов.

Например, после вводной беседы педагог записала такую цель профессионального развития: «получение знаний, умений, навыков через использование ИИ в работе», а после использования набора конкретизировала: «развитие компетенции исследования собственной практики по использованию изученных на курсах цифровых ресурсов».

Поэтому была принята решение продолжить экспериментальную апробацию полезной модели в индивидуальной работе со слушателями. Эта работа стала содержанием второго этапа экспериментальной работы. В нем приняли участие 12 педагогов.

Алгоритм работы остался прежним: вводная беседа фронтально – объяснение назначения набора – выстраивание пути профессионального развития – презентация – рефлексия. Но были внесены три изменения.

Первое – чтобы действия педагогов были осознанными, во вводной беседе сразу проводился анализ возможных источников целей профессионального развития. Слушатели подводились с помощью открытых вопросов к тому, что в качестве таковых могут выступать недостатки, дефициты, западающие зоны или интересы, потребности, карьерные устремления. Тем не менее, тенденция в формулировке целей профессионального развития сохранилась та же, что и на первом этапе: 83,3% педагогов формулировали цель профессионального развития обобщенно. Например, «профессиональный рост для конкурентоспособности», «улучшение в области преподаваемых предметов для повышения своего педагогического мастерства».

Второе – после объяснения особенностей полезной модели и изучения карточек набора слушатели сразу приступали к проектированию персонифицированной программы профессионального развития.

Третье – на этапе рефлексии слушатели работали индивидуально. Им предлагалось так же откорректировать ранее сформулированную цель профессионального развития и ответить на три вопроса в полуструктурированном интервью:

1. Как использование полезной модели повлияло на формулировку цели профессионального развития?
2. Как можно использовать полезную модель в профессиональной деятельности педагога?
3. О чем заставила задуматься полезная модель?

При ответе на первый вопрос педагоги указывали на возможность:

- а) определить алгоритм профессионального развития. Например, «я вычленила важные этапы и систематизировала шаги к дальнейшему достижению результатов»;
- б) выделить профессиональный дефицит. Например, «набор помог структурировать в голове понятия, помог выявить проблемную зону и правильно сформулировать цель»;

с) выстроить модель профессионального развития. Например, «правильно построить структуру, понять значение определенных формулировок, пути наблюдения и сконструировать свою модель для дальнейшего преодоления трудностей или решений».

Способы использования полезной модели расширились за счет упоминания конкретных направлений работы: самообразование, самоанализ, консультирование, коучинг, повышение квалификации, разработка планов развития организаций образования.

Ответы на третий вопрос указывают, что полезная модель помогла педагогам понять, что цель профессионального развития формулируется ими неконкретно, что есть множество вариантов для выстраивания профессиональной траектории развития и что подобный набор помогает это сделать быстро и просто. Хорошим подтверждением этому может стать ответ педагога «Меня данный набор навел на мысль о том, что как же неточно мы формулируем цели, не видим каких-то проблем и как, оказывается, легко это можно сделать, имея в арсенале такой инструмент, а еще о том, что можно было бы его дополнить».

91,7% педагогам после самостоятельной работы с полезной моделью удалось конкретизировать цель профессионального развития.

Контент-анализ целей профессионального развития первого и второго этапа экспериментальной работы до использования набора показал, что при формулировке цели:

- 35,7% педагогов ориентировались на использование новых технологий (без уточнения, каких именно). Например, «внедрение полученных знаний и методик в учебный процесс с целью повышения качества преподавания, мотивации учащихся и развития их исследовательских навыков», «использовать инновационные педагогические технологии и цифровые ресурсы для повышения мотивации обучающихся».

- 17,6% педагогов обращались к повышению профессионального уровня (совершенствование профессиональной компетентности, улучшение профессиональных навыков). Например, «оставаться профессионалом, быть в тренде, знать обо всех нововведениях в своей специальности, вести уроки на высоком уровне», «постоянное повышение педагогического мастерства через обмен опытом»;

- 17,6% педагогов упоминали изучение нового. Например, «узнать новое, набраться опыта у коллег, [найти] новые знакомства и общение», «научиться новому, получить необходимые мне знания для дальнейшего профессионального развития. Пошла на курсы для того, чтобы получить возможность более эффективно и грамотно преподавать свой предмет»;

- 15,5% педагогов предполагали применение на практике полученных в процессе прохождения курса повышения квалификации знаний. Например, слушатели курсов повышения квалификации по образовательной программе «Робототехника и STEM-образование» формулировали цели: «применять технологию STEM-образования в преподавании предметов география и биология», «использование STEM при работе с учащимися по химии на уроках и во внеурочной деятельности»; слушатели курсов повышения квалификации по образовательной программе «Развитие рецептивных и продуктивных навыков в преподавании и обучении английскому языку» – «применение искусственного интеллекта и новых методов обучения для развития интереса и повышения качества знаний учащихся на уроках английского языка», «развитие речевых навыков учеников с учетом применения искусственного интеллекта»;

- 4,8% педагогов планировали повышение эффективности процесса обучения/урока. Например, «повышение качества уроков английского языка и мотивации учащихся с использованием новейших цифровых технологий»; «повысить эффективность учебного процесса через интеграцию современных EdTech-инструментов, создание интерактивных заданий и развитие коммуникативных навыков учащихся, адаптируя обучение к индивидуальным потребностям и интересам детей».

Цели профессионального развития 8,3% педагогов являются очень узкими и касаются отдельных действий. Например, «готовить задания для учащихся более интересными и познавательными», «повысить квалификационную категорию».

После применения полезной модели цели профессионального развития 45,2% педагогов сформулировали цель профессионального развития ясно и детально:

- 8,3% педагогов указали на развитие компетенции по разработке цифрового контента;
- 7,1% педагогов выбрали развитие компетенции по разработке продуктов педагогической деятельности;
- 6% педагогов ориентировались на развитие компетенции по исследованию собственной практики;
- 3,6% педагогов заинтересованы в развитии креативности.

13,1% педагогов нацелены на развитие таких компетенций, как эмоциональный интеллект, эмпатия, аналитические навыки, коммуникативные навыки.

У 54,8% педагогов в содержании цели профессионального развития остались «внедрение в практику изученного на курсах», «совершенствовании профессиональной компетентности», «развитие профессиональных навыков», «повышение квалификации».

7% педагогов по итогам второго этапа конкретизировать цель не смогли и ответ не предоставили.

Результаты экспериментальной работы показали, что значительная часть педагогов имеет трудности с четким определением цели профессионального развития. Поддержка педагогов и их обучение определению цели профессионального развития позволяет решить эту проблему. Поддержка в период обучения на курсах повышения квалификации может осуществляться преподавателем или тренером, а в посткурсовой период в организации, где работает педагог – наставником, коллегой, методистом, администрацией. Обучение определению цели профессионального развития может быть организовано на курсах повышения квалификации с использованием полезной модели.

Экспериментальная работа подтверждает, что «Мобильный конфигурируемый набор» эффективно помогает конкретизировать цель профессионального развития педагога и выстроить его персонифицированный путь. Для этого работу с полезной моделью необходимо проводить индивидуально, когда педагог самостоятельно проектирует собственную траекторию профессионального развития, или при поддержке наставника, помогающего в проектировании персонифицированной программы.

Заключение. Концепция непрерывного профессионального развития требует новых подходов и инновационных решений для развития агентности педагогов в посткурсовой период. Важнейшим условием повышения умения педагогов направлять собственное развитие в рамках своей профессиональной деятельности является четкое определение ее целей.

Разработанная полезная модель «Мобильный конфигурируемый набор» может обеспечить значительное преимущество для осознанного подхода педагогов к вопросу проектирования персонифицированной программы профессионального развития и выбора ее целей. При апробации набора 91,7% педагогам удалось конкретизировать цель профессионального развития. Проведение экспериментальной работы способствует накоплению эмпирического материала для исследования взаимосвязи целеполагания и агентности педагога, осмысленности его деятельности и личной значимости образовательного процесса.

Перспективы дальнейшего исследования:

- Изучение влияния целей профессионального развития, определенных с использованием «Мобильного конфигурируемого набора», на эффективность деятельности педагога в посткурсовой период.
- Расширение комплектов карточек с учетом специфики профессиональной деятельности педагогов (например, для педагогов специального образования, дополнительного образования) для создания персонализированных образовательных маршрутов.

Таким образом, предлагаемое решение на основе конфигурируемого набора вносит вклад в развитие эффективной системы НППП, предлагая масштабируемый и практический

инструмент для создания персонифицированной программы профессионального развития педагога.

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МАҚСАТТЫ АНЫҚТАУ НЕГІЗІНДЕ ПЕДАГОГТЕРДІҢ КӘСІБИ ДАМУЫНЫҢ ДЕРБЕСТЕНДІРІЛГЕН БАҒДАРЛАМАСЫН ҚҰРАСТЫРУ

Аңдатпа

Бұл мақала курстан кейінгі кезеңде мұғалімдердің кәсіби даму мақсаттарын қою тәсілдері мен әдістерін қарастырады. Айқын мақсат қою мұғалімнің өзін-өзі басқаруымен жүзеге асырылатын ақпаратқа негізделген кәсіби дамуды қамтамасыз етуде маңызды рөл атқарады. Мақала курстан кейінгі кезеңде кәсіби даму мақсаттарын қою үшін мұғалімдерге арналған дараланған кәсіби даму бағдарламаларын жобалауға мүмкіндік беретін мобильді, бапталатын құралдар жинағы түріндегі инновациялық шешімді ұсынады. Зерттеу аясында 21 681 мұғалім арасында сауалнама жүргізіліп, олардың білім алу қажеттіліктері мен курстан кейінгі кезеңдегі кәсіби дамуға қатысты хабардар көзқарастары анықталды. Жауап бергендердің 61 пайызы жақын болашақта кәсіби тұрғыдан қалай дамитыны жөнінде нақты идеялары жоқ екенін хабарлады. Мұғалімдердің 28 пайызы үшін кәсіби даму мақсаттарының формулировкасы біршама абстрактты. Педагогтердің 10 пайызы курстан кейінгі кәсіби даму мақсаттарын нәтиже тұрғысынан анықтап, өз жұмысының өнімін, мансаптық өсу сатысын немесе пәндік оқыту мақсаттарын нақтылады. Сауалнамаға қатысқандардың тек 1 пайызы ғана кәсіби құзыреттерге байланысты мақсаттар қойған. Осы нәтижелердің маңыздылығы – дербестендірілген кәсіби даму бағдарламасын жобалау кезінде туындайтын қиындықтарды шешудің инновациялық шешімін негіздеуге мүмкіндік беруінде, яғни оның нақты, қолжетімді мақсаттарын мобильді, бапталатын құралдар жинағының патенттелетін пайдалы модель түрінде анықтауға негізделуінде. Жиынтық элементтерінің дараланған визуалды конфигурациясы арқасында оны өзін-өзі модельдеу құралы ретінде қолдану мүмкіндігі мұғалімдердің біліктілігі мен құзыреттеріне қойылатын жаңа талаптар, сондай-ақ жаңа ресурстар мен кәсіби даму формалары пайда болған кезде оны пайдалану әлеуетін көрсетеді.

Түйінді сөздер: хьютогика, педагогтердің үздіксіз кәсіби дамуы, агенттік, курстан кейінгі кезең, педагогтердің кәсіби дамуының мақсаты, педагогтің дербестендірілген кәсіби даму бағдарламасы, пайдалы модель, мобильді конфигурацияланатын жиынтық.

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DESIGNING A TAILORED PROFESSIONAL DEVELOPMENT PROGRAMME FOR TEACHERS BASED ON GOAL-SETTING

Annotation

This article examines approaches and technologies for setting professional development goals for educators during the post-course period. Clear goal-setting plays a key role in ensuring informed professional development that is self-directed by the educator. The article proposes an innovative solution for setting professional development goals during the post-course period in the form of a mobile, configurable toolkit that enables the design of personalized professional development programs for teachers. As part of the study, a survey of 21,681 teachers was conducted to identify their educational needs and their conscious attitude toward professional development during the post-course period. Sixty-one percent of respondents reported that they did not have a clear idea of how they intended to develop professionally in the near future. For 28% of teachers, the wording of their professional development goals is quite abstract. 10% of teachers defined their post-course professional development goals in terms of outcomes, specifying either a product of their work, a career advancement level, or subject-specific teaching objectives. Only a small proportion of survey participants (1%) cited professional competencies as their goals. The significance of these results lies in their justification of an innovative solution to the challenges of designing a personalized professional development program based on defining its specific, achievable goals in the form of a patentable utility model for a mobile, configurable toolkit. Its applicability as a self-configurable toolkit, made possible by the personalized visual configuration of the kit's elements, demonstrates its potential for use as new requirements for educators' qualifications and competencies emerge, along with new resources and forms of professional development.

Keywords: Heutagogy, Continuous professional development of teachers, Agency, Post-course period, Professional development goals of teachers, Personalized teacher professional development program, Utility model, Mobile configurable set.

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