QUBAHAN ACADEMIC JOURNAL
VOL. 6, NO. 3, July 2026
https://doi.org/10.48161/qaj.v6n3a2439

The Role of Research Activity in the Formation of the Methodological Culture of Future Teachers of Primary Education

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ABSTRACT: This study examined the role of research activity in the development of the methodological culture of master's students preparing to become primary education teachers. In this study, methodological culture was operationalised as a composite of methodological knowledge, analytical–reflective skills, and evidence-informed justification of pedagogical decisions. The research used a quasi-experimental two-site nonequivalent-groups design within a sequential explanatory mixed-methods framework, with two measurement points (T0–T1) and without a no-treatment control group. The sample included 120 master's students from two Kazakhstani universities: Abai Kazakh National Pedagogical University (n = 55) and Zh. A. Tashenov University (n = 65). The intervention consisted of a 16-week research activity programme embedded in coursework and supported by tutoring, seminars on data visualisation, academic writing, and research ethics. Quantitative change was assessed using a 25-item diagnostic test (0–100; Cronbach's α = 0.84). In the Abai sample, scores increased from 44.2 to 65.4 (Δ = 21.2, $p < .001$, $d_z = 1.57$); in the Tashenov sample, scores increased from 32.6 to 52.1 (Δ = 19.5, $p < .001$, $d_z = 1.30$). Baseline-adjusted ANCOVA showed a significant site effect at post-test, $F(1,117) = 62.5$, $p < .001$, $\eta p^2 = 0.35$, with an adjusted mean difference of 10.2 points in favour of the Abai sample. Qualitative data from interviews, reflective essays, and observation protocols were used to explain the mechanisms of change and implementation conditions. The results suggest that systematic research activity, when supported by explicit quality criteria and mentoring, is associated with stronger evidence-informed reasoning, more confident data interpretation, and greater reflective regulation of professional decisions.

Keywords: Methodological culture, Research activity, Teacher education, Master's students, Evidence-informed practice, Mixed methods, Kazakhstan.

I. INTRODUCTION

Contemporary schools increasingly expect teachers not only to master instructional methods, but also to justify pedagogical decisions, verify their effectiveness, and adjust practice on the basis of data. Digitalization, growing diversity in learners' educational needs, and heightened attention to the quality of

primary education create situations in which ready-made recipes are insufficient [1, 2]. In this context, the methodological culture of the future teacher becomes especially valuable: the ability to frame a pedagogical problem as an inquiry task, formulate questions, select methods for gathering evidence, interpret results, and translate conclusions into well-grounded actions. For primary school teachers, this is particularly critical, since this stage lays the foundations for learning motivation, reading, writing, and thinking, and mistakes in choosing approaches may have long-term consequences. Despite the widely acknowledged importance of methodological culture, it is often developed in teacher preparation in a fragmented manner. In many master's programmes, the research component is concentrated in separate courses and in the completion of a final project, while day-to-day academic work remains largely reproductive: learning theory, completing standard assignments, and engaging in limited reflection on practice. This creates a contradiction. On the one hand, master's graduates are expected to be ready for evidence-informed and reflective pedagogical decision-making; on the other, the logic of inquiry is not always embedded in the regular learning trajectory and is not supported by systematic mentorship and data-analysis tools [1–5].

In Kazakhstan, this problem is particularly visible because training conditions across universities differ in access to research resources, academic support, and inquiry-based learning practices. At the same time, master's study is a key stage of professional socialization, when future teachers form stable views of pedagogy as a field in which decisions should be argued and verifiable. If an inquiry stance does not become part of everyday learning, it remains an add-on rather than an internal principle of professional thinking. This points to three research gaps. First, methodological culture in master's-level primary teacher education is still rarely examined as a measurable and developable system of methodological knowledge, analytical skills, reflection, and evidence-informed justification rather than as a declarative characteristic. Second, there is limited empirical evidence on the effects of systematically integrating research activity into the learning process through mini-studies, data work, reflective practices, and tutoring. Third, it remains insufficiently clear which institutional and psychological factors support or hinder students' engagement in research practices [4, 6, 7]. Against this background, the present study examines the role of research activity in the development of the methodological culture of future primary education teachers at the master's level and substantiates a practice-oriented model for its integration into the educational programme.

Despite the growing prominence of research-based teacher education, a key contradiction remains insufficiently resolved in literature. At the declarative level, teacher education programmes increasingly endorse Research-Based Teacher Education (RBTE) and evidence-informed practice as normative principles. At the operational level, however, future teachers are still often trained to reproduce methodological terminology rather than to enact an inquiry stance in authentic pedagogical decision-making. This contradiction is especially visible at the master's level, where students are expected to justify pedagogical choices with evidence, yet research activity often remains course-bound and weakly integrated into the routine logic of professional preparation. Accordingly, the present study does not test a closed theory; rather, it examines a practice-oriented model in which research activity functions as a mechanism for the development of methodological culture under real programme conditions. Beyond Kazakhstan, the study contributes to the broader discussion of how RBTE can be translated from a curricular declaration into an operational inquiry-oriented mode of teacher preparation [8–11].

The aim of the study is to determine the role of research activity in shaping the methodological culture of master's students in teacher education programmes (Primary Education track) and to substantiate a model for integrating research practices into their professional preparation. The objectives of the study are to (1) clarify the content of the concept of the methodological culture of the future primary school teacher at the master's level and identify its key components; (2) describe formats for integrating research activity into master's students' learning process (mini-studies, project- and inquiry-based tasks, work with data, reflective practices) and the role of tutoring support; (3) design and implement a semester-long research activity programme embedded in master's-level coursework; (4) empirically assess change in components of master's students' methodological culture based on diagnostic testing (T0–T1) and qualitative materials; (5)

identify barriers and enabling conditions for master's students' engagement in research practices across different university contexts and formulate recommendations for teacher education institutions.

Research questions of this work are addressed as:

- Q1: Which components of the methodological culture of future primary education teachers are key at the master's level, and how do they manifest in master's students' learning activities?
- Q2: Which formats of research activity (mini-studies, project- and inquiry-based tasks, work with data, reflective practices, tutoring support) are most productive for developing master's students' methodological culture?
- Q3: Is systematic integration of research activity into the learning process associated with statistically and pedagogically meaningful change in master's students' methodological knowledge and analytical–reflective skills (T0–T1) in comparable university contexts?
- Q4: Which barriers (organizational, resource-related, psychological, methodological) most substantially hinder master's students' engagement in research practices, and which solutions help minimize them?
- Q5: What model of integrating research activity can be considered practice-oriented and transferable for master's programmes preparing primary education teachers?

The scientific novelty of the study lies in conceptualizing the methodological culture of the future primary school teacher as an operationalizable system of components, the development of which is linked to specific formats of master's students' research activity (mini-studies, project- and inquiry-based tasks, work with data, reflective practices, and tutoring support). The study proposes a transferable model for integrating research practices into the regular learning process of master's programmes and offers a testable empirical logic: which components of methodological culture change most markedly and under what conditions (including across different institutional contexts).

II. RELATED WORK

In teacher education, methodological culture is increasingly understood not as a set of knowledge about methods, but as a teacher's professional capacity to justify pedagogical decisions by drawing on theory, data, and reflective scrutiny of one's own practices. In the international agenda, this logic aligns with the frameworks of RBTE and Evidence-Informed Practice (EIP): future teachers are expected not only to become acquainted with research, but to develop an inquiry-oriented way of thinking and learn how to translate evidence into decisions for a specific classroom. Yet this translation remains problematic. The presence of research courses in a curriculum does not, by itself, guarantee either a stable inquiry stance or competence in the use of data, and difficulties in implementing evidence are documented both in teacher preparation and in professional practice [1, 2].

1. RBTE AS AN UMBRELLA FRAMEWORK AND THE PROBLEM OF HETEROGENEOUS IMPLEMENTATION

RBTE encompasses a wide range of practices from reading and discussing research to conducting one's own mini-studies and participating in research communities. Empirical studies show that students interpret research preparation in different ways, and this heterogeneity is linked to how teacher educators conceptualize and enact RBTE [8, 9]. In some programmes, RBTE is treated as a formal academic requirement with limited relevance to future work; in others, it is framed as a resource for professional autonomy and a deeper understanding of teaching [8]. Similar conclusions emerge from qualitative studies of students' experiences: the meaning of RBTE begins to cohere only when scholarly ideas become tools for analyzing real pedagogical situations and are reinforced through practices of discussion, argumentation, and decision-making, rather than remaining a separate theoretical block [11]. Otherwise, a persistent tension arises between an image of teaching as a predominantly practical profession and the expectation of research rationality embedded in preparation [10].

It is also noted that even when student research is included, its effects may be short-term if conditions for continuing research activity are not in place. For example, analyses of factors shaping student research in

teacher education indicate that teacher educators and students often differ in how they perceive the goals and outcomes of this work; a lack of time, a supportive environment, and clear practical value frequently leads to discontinuation of research practices once a course ends [4]. Importantly, barriers to the adoption of evidence-informed practice manifest in different ways and require targeted organizational and didactic solutions rather than universal, generic measures [2]. This is especially salient at the master's level, where a shift is expected from mastering academic theory to the capacity to design, test, and justify pedagogical decisions; accordingly, research activity needs to be embedded in regular learning routines rather than organized as a one-off project.

2. OPERATIONALISING METHODOLOGICAL CULTURE: FROM DECLARATION TO COMPONENTS

Moving to an empirical analysis of methodological culture requires operationalization through observable components. A systematic review of future teachers' research competence emphasizes its multi-component nature: methodological knowledge (design logic, data collection and analysis), information-analytical skills (searching for and evaluating sources), epistemic beliefs (what counts as evidence and how the quality of knowledge is assessed), and a motivational value component (readiness to use research as a resource for professional decision-making) [3].

In terms of methodological culture, this implies that teaching research techniques is insufficient; what is needed is the development of inquiry-oriented thinking as a professionally stable way of understanding problems, selecting indicators, evaluating the quality of evidence, and recognizing the limits of one's conclusions. Recent shifts are associated with heightened attention to evidence-informed reasoning—the capacity to analyze pedagogical problems on the basis of theory and data and to justify the link between evidence, context, and the chosen action. Evidence-informed reasoning has been shown to be associated with attitudes, subjective norms, and self-efficacy: with higher self-efficacy and more positive attitudes, future teachers more often use scholarly ideas to interpret learning situations rather than relying on intuitive explanations [12]. At the same time, intervention studies indicate that the quality of evidence-informed reasoning can be purposefully developed through structured feedback and training in argumentation; in particular, peer feedback has demonstrated potential as a mechanism for improving evidence-informed reasoning [13]. This is fundamental for methodological culture: it is expressed not in the declaration "I use research," but in the capacity to justify a pedagogical choice, demonstrate the relevance of evidence, and take contextual constraints into account.

3. ACCEPTANCE OF RESEARCH AND THE EVALUATION OF EVIDENCE AS A BOTTLENECK

One of the key barriers remains trust in research and its acceptance as a resource relevant to practice. Teachers assess the applicability of research through filters of contextual relevance, clarity of conclusions, and consistency with professional experience [14]. Among future teachers, this often appears as skepticism toward scientific knowledge as something distant from classroom realities and depends on how research is integrated into teacher preparation [15]. This is consistent with European evidence showing that future teachers can improve their criteria for evaluating evidence claims, but such progress requires didactically structured work with evidence quality and justification rules [16]. Accordingly, methodological culture should include not only the ability to conduct research, but also the capacity to evaluate evidence, compare alternative explanations, and make decisions under uncertainty.

4. INQUIRY STANCE AND PRACTICUM: HOW AN INQUIRY STANCE BECOMES SUSTAINABLE

At the level of educational design, a productive framework is the development of an inquiry stance, understood as a stable inquiry-oriented orientation toward practice. In teacher education, this includes formulating pedagogical questions, collecting and interpreting data, and using evidence to improve practice; it is strengthened not only by individual tasks, but also by shared programme expectations and mentoring [5]. Similar conclusions are reported in studies of inquiry-based practicum, which show that such formats can reshape future teachers' understanding of what research in the profession means and how it relates to teaching [17]. For master's-level study, this suggests that an inquiry stance develops not through a single

research project, but when research actions become a regular part of analyzing pedagogical tasks and reflecting on practice. Digital and blended formats may support this process when they include step-by-step tasks, examples, quality criteria, and links to pedagogical cases [18]. At the same time, without systematic integration into practice and teacher-educator support, such elements tend to remain isolated and do not develop into a stable methodological culture.

5. THE ROLE OF INSTITUTIONAL CONTEXT AND PROGRAMME CONDITIONS

The literature also emphasizes the importance of organizational and cultural conditions. At the level of schools and systems, an innovative climate and organizational support for research use are critical: a supportive culture and conditions for applying research are associated with attitudes toward evidence-informed practice [19]. Broader syntheses underline that challenges in research use are systemic and are rarely resolved by a single methodological measure; sustainable conditions, intermediaries, time, and clear implementation mechanisms are needed [7]. In teacher education, this is complemented by evidence that there are facilitating factors for translating research into practice, and these should be deliberately designed at the level of the preparation programme [6]. Therefore, master's students' research activity needs to be part of the programme logic: clear goals, tutoring support, quality criteria, links to the analysis of pedagogical cases, and assessment that genuinely reflects the value of evidence-informed thinking.

6. SYNTHESIS AND THE RESEARCH GAP: POSITIONING THE PRESENT STUDY

Taken together, contemporary studies point to several deficits that shape the research gap in understanding the methodological culture of future primary education teachers. First, a gap persists between RBTE/EIP declarations and actual skills in evidence-informed reasoning and the evaluation of evidence; this gap is sustained both by individual dispositions and by institutional conditions of preparation [1, 12, 16]. Second, despite recognition of the multi-component nature of methodological culture, there remains a shortage of empirical studies that link specific formats of master's students' research activity (mini-studies, work with data, reflective practices, peer feedback, tutoring support) to changes in particular components within a single operational logic [3, 5, 13]. Third, conditions for sustainability are insufficiently clarified: which programme and organisational solutions ensure that research practices are incorporated into professional thinking rather than remaining limited to course reporting [4, 6, 7]. Finally, institutional variability is a salient issue for Kazakhstan: comparable teacher education programmes may be delivered under conditions of differing resources and mentoring practices, making between-context comparison an important source of insight into the factors that strengthen or constrain the development of methodological culture. Although the study is situated in the Kazakhstani context, its broader contribution lies in showing how research-based teacher education can be translated from a curricular principle into an operational model of inquiry-oriented professional preparation at master's level.

Table 1. Conceptual positioning of the study.

Construct	Main focus	Unit of analysis	What it contributes	Main limitation in prior literature	Relevance for the present study
Research-based teacher education (RBTE)	Integration of research into teacher preparation	Programme/curriculum	Frames research as part of teacher education	Often implemented heterogeneously and sometimes remains declarative	Provides the overarching programme-level framework
Evidence-informed practice (EIP)	Use of evidence in pedagogical decision-making	Professional decision/action	Links research and data to instructional choice	Translation from evidence to action is often weak or inconsistent	Clarifies the decision-oriented dimension of

					methodological culture
Inquiry stance	Stable inquiry-oriented way of engaging with practice	Professional habit/ disposition	Explains how questioning, data use, and reflection become routine	Often described conceptually rather than operationalized empirically	Helps explain the process logic of change in students' professional thinking
Methodological culture	Integrated system of methodological knowledge, analytical skills, reflection, and evidence-based justification	Composite professional capacity	Serves as the focal construct of the study	Often treated broadly and measured inconsistently	Functions as the main outcome operationalized in this study

As shown in Table 1, the present study does not treat these constructs as interchangeable. Rather, RBTE provides the programme framework, EIP clarifies the logic of evidence-based pedagogical choice, inquiry stance explains the processual development of inquiry-oriented thinking, and methodological culture functions as the focal composite outcome assessed in this research. The relationships between these constructs are reflected in the analytical structure of the study and operationalized through the research design rather than presented as a separate formal model. The present study is positioned within this field. It treats master's students' research activity as a mechanism for developing methodological culture, employs a sequential explanatory mixed-methods design, and compares change across two university contexts in order to document measurable outcomes and clarify the conditions and mechanisms that support them. Although much of the literature originates from European contexts, the conceptual framework and findings are applicable to broader international discussions on research-based teacher education.

III. MATERIAL AND METHOD

1. RESEARCH DESIGN

The study was conducted as a quasi-experimental two-site comparison (nonequivalent groups design) within an explanatory sequential mixed-methods framework. The object of the study was master's students enrolled in teacher education programmes. The design included a diagnostic stage (T0), an intervention stage (a 16-week research activity programme implemented in both universities according to shared standards), and a follow-up stage (T1) to assess change in methodological culture. The quantitative component captured change and enabled comparisons between the university samples with baseline adjustment, while the qualitative component was used to explain the mechanisms and conditions underlying the observed change. Because the study did not include random assignment or a no-treatment control group, the findings are interpreted as evidence of change under programme conditions rather than as proof of a strictly causal effect.

2. THEORETICAL AND METHODOLOGICAL FOUNDATIONS

The theoretical framework draws on the constructivist tradition of learning [20, 21] and the concept of reflective professional practice [22], as well as approaches to inquiry-based learning as a basis for developing pedagogical thinking. In this study, methodological culture is conceptualized as a developable system of knowledge, skills, and reflective actions expressed in problem formulation, hypothesis generation, method selection, data interpretation, and the justification of conclusions.

3. PARTICIPANTS AND RESEARCH CONTEXT

Participants were master's students in teacher education programmes from two comparable universities: Abai Kazakh National Pedagogical University (n = 55) and Zh. A. Tashenov University (n = 65), with a total sample of N = 120. The sample represented the full accessible population of master's students enrolled in the two participating programmes during the study period rather than a selectively recruited subgroup. Given the cohort-based nature of the intervention and the institutional organization of the programme, the study was designed around naturally existing academic groups. Accordingly, the sample size should be understood as determined by programme availability under real educational conditions. Group allocation was determined by the institutional site and was not random; accordingly, the study is treated as a nonequivalent groups design. At the diagnostic stage (T0), baseline indicators of methodological culture and basic learning characteristics were recorded. Subsequent between-site inferences were based on within-sample change analyses and baseline-adjusted models (with T0 as a covariate). A formal a priori power analysis was not conducted, as the study relied on the full accessible population under real educational conditions.

4. PROCEDURE AND STAGES OF IMPLEMENTATION

The study comprised three stages. At the diagnostic stage (T0), baseline assessment included a diagnostic test of methodological preparation and a questionnaire capturing attitudes toward research skills and the perceived importance of methodological knowledge. To identify barriers and enabling conditions for engagement in research activity, semi-structured interviews were conducted (n = 60), followed by in-depth interviews with a subsample (n = 12) and interviews with tutors/mentors (n = 5). During the intervention stage, a 16-week research activity programme was implemented. At the follow-up stage (T1), post-test assessment was conducted using the same principles, ensuring measurement comparability and allowing evaluation of change across the two university contexts. Integration of quantitative and qualitative data was carried out within the explanatory sequential mixed-methods design at the interpretation stage: (1) baseline results (T0) were used to refine the focus of interviews and formulate probing questions about barriers, and (2) thematic findings from interviews were compared with T0–T1 change and between-site differences to clarify the mechanisms of the observed effect and the contextual conditions under which it manifested.

5. DESCRIPTIONS OF THE INTERVENTION PROGRAMME

The programme integrated research activity into master's-level coursework over one semester (16 weeks). Master's students conducted mini-studies by completing a full cycle of a learning-oriented research project: problem formulation and specification of research questions (RQs)/hypotheses, design planning, data collection (survey/observation), processing and analysis, interpretation, and presentation of results (report, presentation). The programme was supported through tutoring and seminars on data visualization, academic writing, and research ethics. Implementation across the two universities followed shared standards (a common schedule and syllabus plan, mandatory artefacts, and unified assessment criteria); adherence to the stages was monitored using checklists and mentoring logs. The core structure of the programme was the same on both sites; however, mentoring support was not identical in all practical respects. The main differences concerned the continuity of tutor contact, the density of feedback, and the availability of consultation outside scheduled sessions. These differences were treated as part of implementation conditions rather than as separately manipulated variables. Thus, standardization concerned the programme framework and assessment logic, whereas implementation differences referred to how this shared structure was enacted in everyday academic interaction.

6. INSTRUMENTS AND DATA SOURCES

The main quantitative instrument was a diagnostic test administered at T0 and T1 to assess methodological concepts and research skills, including hypothesis formulation, variables, logic of analysis, and interpretation. Internal consistency was acceptable (Cronbach's α = 0.84). Content validity was supported through expert review of item alignment with the target components, and the final 25-item version

was scored on a 0–100 scale. The same item set, scoring rules, and administration procedure were used in both university sites to ensure procedural comparability; formal multi-group measurement invariance testing was beyond the scope of the study and is acknowledged as a limitation. Additional quantitative data were obtained from a questionnaire on the perceived importance of methodological knowledge and research skills at T0. Qualitative data included reflective essays, interviews, and instructors' observation protocols. To improve transparency and reproducibility, the diagnostic test blueprint and the case-evaluation rubric are provided as supplementary materials.

Quantitative inferences were based on continuous test scores and did not require dichotomization. For descriptive baseline profiling only, the T0 distribution was additionally classified by quartiles: the upper quartile was treated as a conditionally satisfactory level, whereas values below P75 were interpreted as indicating a need for further development. These percentages were used only descriptively and not for hypothesis testing. High recognition of the importance of methodological preparation was defined as endorsement of the upper response categories on the questionnaire. For the case analysis, levels of integration of the research approach were assigned with a rubric ranging from formal to systemic, using a dominance rule whereby the highest level supported by the available evidence was recorded.

7. DATA PROCESSING AND ANALYSIS

Quantitative data were analyzed in IBM SPSS Statistics. Within-sample change (T0–T1) was assessed using paired t-tests separately for each university sample. Between-site comparison was conducted using ANCOVA with T1 as the dependent variable, university site as the factor, and T0 as the covariate. Adjusted means, 95% confidence intervals, and effect size (ηp^2) were reported. ANCOVA assumptions were checked through visual inspection of residual distributions, Levene's test, and the interaction between site and pre-test score; no violations were identified. Effect sizes were interpreted using conventional thresholds for Cohen's d and ηp^2, and Cronbach's α values ≥ 0.70 were treated as acceptable. To assess the transfer of research actions into pedagogical practice, an additional analysis was conducted on 40 anonymized cases produced during the programme and containing a full set of artefacts (plan/design, instrument, dataset, analysis, interpretation, and conclusions). Each case was rated with a rubric reflecting levels of methodological integration (formal, fragmentary, situational, systemic), quality of data-based justification, and reflection on limitations. The final expert score was computed as an aggregated rubric-based rating and used as an additional practice-oriented outcome for triangulation with test-score changes. Qualitative data were analyzed using thematic content analysis guided by a codebook. Transparency was supported through an audit trail, and interpretive robustness through source triangulation and partial double-coding with discrepancies resolved through discussion.

8. ETHICAL AND ORGANISATIONAL CONDITIONS

The study was classified as minimal risk and was conducted within the educational process. Informed consent was obtained from all participants; data were anonymized, and access to materials was restricted to the research team in accordance with the universities' internal regulations.

IV. RESULTS AND DISCUSSION

1. BASELINE (T0): INITIAL LEVEL OF METHODOLOGICAL CULTURE AND THE PROFILE OF DIFFICULTIES

The Results section follows sequential explanatory logic: it first presents quantitative change from T0 to T1 and a baseline-adjusted comparison of post-test outcomes between sites, then reports qualitative findings explaining the mechanisms and conditions of the observed change and finally analyses the transfer of research actions into pedagogical practice through levels of integration and expert-rated cases. Baseline assessment included 120 master's students from two university sites: Abai Kazakh National Pedagogical University (n = 55) and Zh. A. Tashenov University (n = 65). At T0, the study used (a) a diagnostic test of

methodological knowledge and research skills (0–100) and (b) a questionnaire on the perceived importance of methodological knowledge and research skills. The results indicated a generally low-to-medium initial level of methodological preparation: about 28% of participants demonstrated relatively confident mastery of basic concepts and research procedures, whereas the majority showed substantial gaps in planning, analysis, and data interpretation (Figure 1). To clarify the sources of these difficulties, semi-structured interviews were conducted with 60 master's students (30 from each university). The interviews showed a typical baseline pattern: despite high recognition of the importance of methodological preparation (about 85%), more than half of participants reported low confidence in their own abilities and a need for mentoring and organizational support in research tasks. Because site allocation was not random, baseline differences were taken into account in between-site comparisons through ANCOVA, and interpretation relied on the combination of within-sample change and adjusted estimates (Table 2).

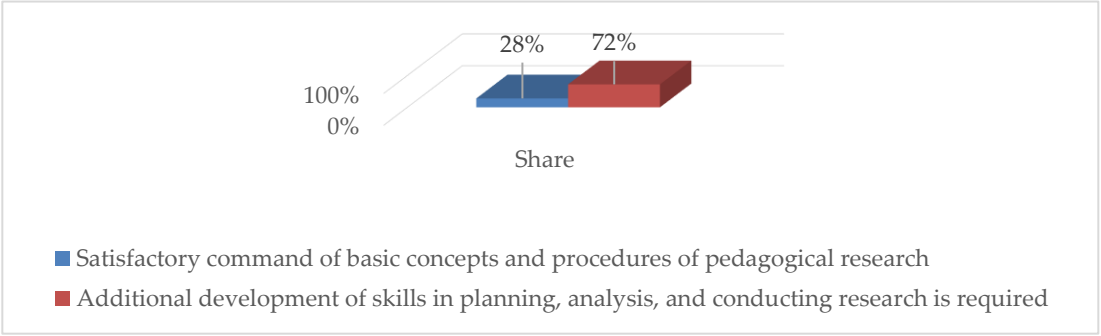

FIGURE 1. Distribution of master's students' baseline methodological preparation based on the initial assessment (N = 120).

Differences between the university samples were observed at the pre-test stage (Table 2), which is typical for a nonequivalent groups design; therefore, subsequent comparisons relied on change over time and baseline-adjusted models (ANCOVA).

Table 2. Baseline pre-test (T0) scores by group (0–100).

Group	n	Pre-test M	SD
Abai sample	55	44.2	11.7
Tashenov sample	65	32.6	10.9

Thus, the initial assessment captured not isolated gaps but a systemic mismatch between recognizing the importance of research competencies and being ready to apply basic methodological actions (problem/hypothesis formulation, work with variables, selection of analytic procedures, and justification of conclusions). This profile provided the empirical basis for the intervention stage: the logic of the programme was designed as a response to the identified deficits and to the expressed need for support, allowing subsequent change to be interpreted not "in a vacuum" but relative to a clearly described starting point. This diagnostic profile limited command of basic methodological actions despite high perceived importance was taken into account when designing the modular research activity programme: its stages and expected artefacts were structured to translate methodological knowledge into practical actions.

Interview data indicated that barriers to engagement in research practices fell into four groups: (a) organizational barriers (time constraints and a dense academic schedule), (b) resource-related barriers (limited access to examples, data, and analytic tools), (c) psychological barriers (low self-efficacy and fear of making mistakes when working with data), and (d) methodological barriers (unclear quality criteria for

research steps and difficulties in operationalizing variables). These barriers were considered when interpreting change and when analyzing the conditions under which the programme produced more pronounced improvements.

2. CHANGE IN DIAGNOSTIC TEST SCORES (T0–T1) ACROSS THE TWO UNIVERSITY SAMPLES

Following the 16-week research activity programme, both university samples showed a statistically significant increase in diagnostic test scores. In the Abai Kazakh National Pedagogical University sample (n = 55), the mean score increased from 44.2 ± 11.7 to 65.4 ± 10.3, Δ = +21.2 (95% CI [17.54; 24.86]), t(54) = 11.62, p < .001, d_z = 1.57 (95% CI [1.17; 1.96]). In the Zh. A. Tashenov University sample (n = 65), the mean increased from 32.6 ± 10.9 to 52.1 ± 9.8, Δ = +19.5 (95% CI [15.78; 23.22]), t(64) = 10.48, p < .001, d_z = 1.30 (95% CI [0.97; 1.62]). Thus, both sites demonstrated marked positive change in methodological knowledge and research skills (Table 4; Figure 2). Importantly, this improvement reflects not only greater familiarity with terminology, but also more confident formulation of research questions and hypotheses, selection of data-collection approaches, and justified interpretation of results. In this sense, methodological knowledge became a more functional tool for pedagogical decision-making. To complement the analysis of mean change, the score distribution was also summarized descriptively across broad performance bands at T0 and T1.

Table 3. Descriptive distribution of diagnostic test scores across performance bands at T0 and T1.

Score band (0–100)	Abai T0, n (%)	Abai T1, n (%)	Tashenov T0, n (%)	Tashenov T1, n (%)
0–39	18 (32.7)	4 (7.3)	34 (52.3)	10 (15.4)
40–59	27 (49.1)	16 (29.1)	24 (36.9)	28 (43.1)
60–79	10 (18.2)	29 (52.7)	7 (10.8)	24 (36.9)
80–100	0 (0.0)	6 (10.9)	0 (0.0)	3 (4.6)

Note. The table is intended as a descriptive complement to the analysis of mean change. Performance bands are used here only to illustrate shifts in score distribution from lower to higher ranges and were not used as the basis for inferential testing.

The descriptive distribution confirms that the observed improvement was not limited to a shift in average values: in both sites, the share of students in the lower score bands decreased, while the proportion in the 60–79 and 80–100 ranges increased by T1 (see Table 3).

3. BETWEEN-SITE DIFFERENCES IN POST-PROGRAMME OUTCOMES WITH BASELINE ADJUSTMENT (ANCOVA)

To ensure a valid between-site comparison of post-programme outcomes, an ANCOVA model was estimated with baseline control (T0): the dependent variable was the post-test (T1), the factor was the university site, and the covariate was the pre-test (T0). The model was computed on complete cases (n = 120); isolated missing values were handled via listwise deletion. Adjusted post-test differences and their 95% confidence intervals are reported directly in the text; therefore, a separate graphical representation was not considered necessary. Missingness was minimal and limited to isolated item-level absences rather than systematic dropout patterns. Given the very small proportion of missing data and the use of baseline-adjusted complete-case comparison, listwise deletion was considered methodologically acceptable and unlikely to materially affect the overall pattern of results. After controlling for T0, a statistically significant site effect was observed: $F(1, 117) = 62.5$, $p < .001$, $\eta p^2 = 0.35$ (Cohen's $f = 0.73$). The adjusted mean difference was $\Delta\_adj = 10.2$ (95% CI [8.1; 12.3]) in favor of Abai Kazakh National Pedagogical University. Because the intervention programme was implemented in both university contexts according to shared standards, the between-site difference is interpreted as a difference in implementation conditions and institutional context under the same programme logic, rather than a comparison of intervention vs no intervention. This result is consistent with the within-sample change from T0 to T1 and indicates that, even under shared programme

standards, post-test outcomes differ depending on the institutional context and implementation conditions (Table 4; Figure 2).

Table 4. Comparison of methodological knowledge before and after the intervention stage (M±SD), 2023–2024.

University	Before the intervention stage (M±SD)	After the intervention stage (M±SD)	Difference	t-value	p-value
Abai Kazakh National Pedagogical University	44.2 ± 11.7	65.4 ± 10.3	+21.2	11.62	< 0.001
Zh. Tashenov University	32.6 ± 10.9	52.1 ± 9.8	+19.5	10.48	< 0.001

Note. Statistically significant within-group change was observed in both groups ($p < .001$).

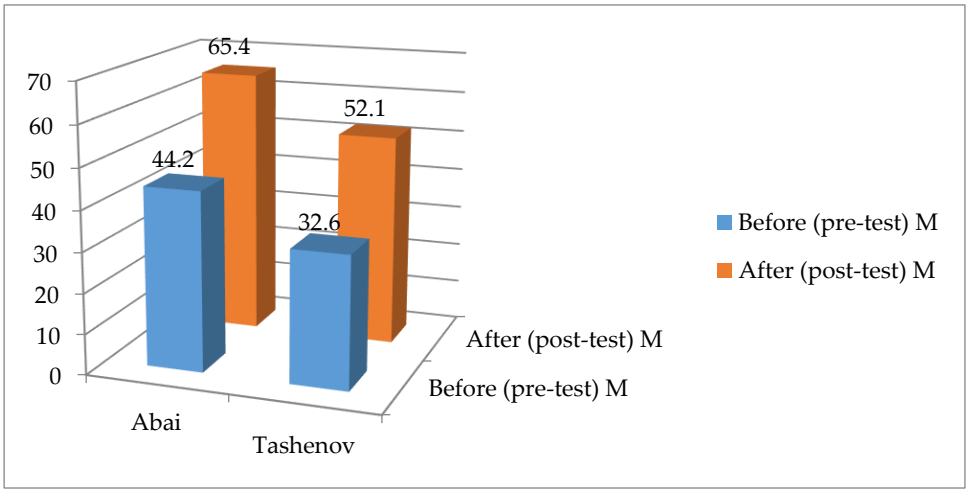

FIGURE 2. Change in mean methodological knowledge test scores before and after the intervention stage (by group).

4. DEVELOPMENT OF CRITICAL THINKING AND ANALYTICAL SKILLS IN FUTURE TEACHERS

The development of methodological culture was reflected not only in higher test scores, but also in strengthened cognitive and reflective skills, including analyzing pedagogical situations, checking the grounds for conclusions, and making sense of one's own decisions. Coding followed a unified codebook; a subset of materials was double-coded by a second researcher and discrepancies were resolved through discussion, which increased the stability of the category structure. To document qualitative change, master's students' reflective essays and semi-structured interviews were analyzed. Thematic coding was conducted using the same codebook with documentation of analytic decisions (audit trail), and interpretive robustness was supported through triangulation of sources (interviews, essays, observation protocols).

The qualitative analysis identified three stable areas of change: (1) analytical thinking (identifying situation components and causal links), (2) critical engagement with information (checking the strength and vulnerabilities of arguments), and (3) self-assessment and reflection (evaluating the quality of one's own inquiry logic and improving it). Representative statements are presented in Table 5. In response to Q2, the qualitative findings suggest that the most productive formats for developing methodological culture were those that (1) required completion of a full mini-study cycle, (2) provided external quality criteria and artefact requirements, and (3) were supported by feedback through tutoring and peer review. Participants most

frequently pointed to the combination of "full cycle + quality criteria + feedback" as the condition that helps translate methodological knowledge into action rather than leaving it at the level of terminology.

Table 5. Examples of master's student's statements reflecting the development of critical and analytical thinking.

Category	Example statement
Analytical thinking	Previously, I accepted a method 'as is,' but now I assess whether it fits a particular learning situation and look for alternatives.
Critical engagement	When we analyzed articles, I started to notice that some authors make generalizations without a sufficient sample.
Self-assessment and reflection	While working on the project, I realized that I had previously paid little attention to the logic of formulating goals and hypotheses.

Note. The excerpts are illustrative passages from interviews and reflective records. All quotations were anonymized; in the working database, each quotation is coded as Pxx-UNI (e.g., P07-ABAI; P19-TASH).

5. INTEGRATION OF METHODOLOGICAL CULTURE INTO PEDAGOGICAL PRACTICE

To assess the practical transfer of methodological skills, four levels of integration of the research approach into pedagogical activity were distinguished: formal, fragmentary, situational, and systemic. Based on 40 completed learning-oriented mini-studies containing a full set of artefacts, an example matrix was compiled, and pedagogical outcomes were evaluated by experts on a 5-point scale. Cases were rated using a rubric with pre-specified criteria, and the final score was calculated as the mean across criteria. A subset of 12 cases was independently evaluated by two experts, with exact agreement on the integration-level category reaching 86%. Because this check was conducted as a practical agreement procedure, formal chance-corrected coefficients such as Cohen's kappa or ICC were not calculated and are acknowledged as a limitation. The experts were independent specialists in pedagogical research methodology and primary education teaching practice who were not involved in the intervention; disagreements were resolved through discussion until consensus was reached. The highest ratings were associated with the systemic and situational levels, where students not only used isolated tools but also interpreted data, adjusted pedagogical decisions, and built lesson logic on an empirical basis (Table 6 and Figure 3).

Table 6. Cases of integrating methodological culture into practice and expert-rated outcomes (n = 40).

No.	Integration type	Brief description	Approaches applied	Pedagogical outcome	Expert rating (1–5)
1	Systemic	"World Around Us" lesson adapted based on a diagnosis of text comprehension among "struggling readers"	Sample analysis, educational testing, evidence-based goal setting	Increased motivation and topic understanding	4.9
2	Situational	Mathematics lesson using backward design based on a parent survey about learners' difficulties	Questionnaire interpretation, flexible planning	Individualization, improved achievement	4.7
3	Fragmentary	Self-assessment after a Russian language exercise (drawing on motivation research)	Ready-made techniques, partial data interpretation	Weak change, localized effect	3.8
4	Formal	Mentioning a "hypothesis" without actual inquiry or outcome analysis	Formal use of terminology	No methodological effect	2.5

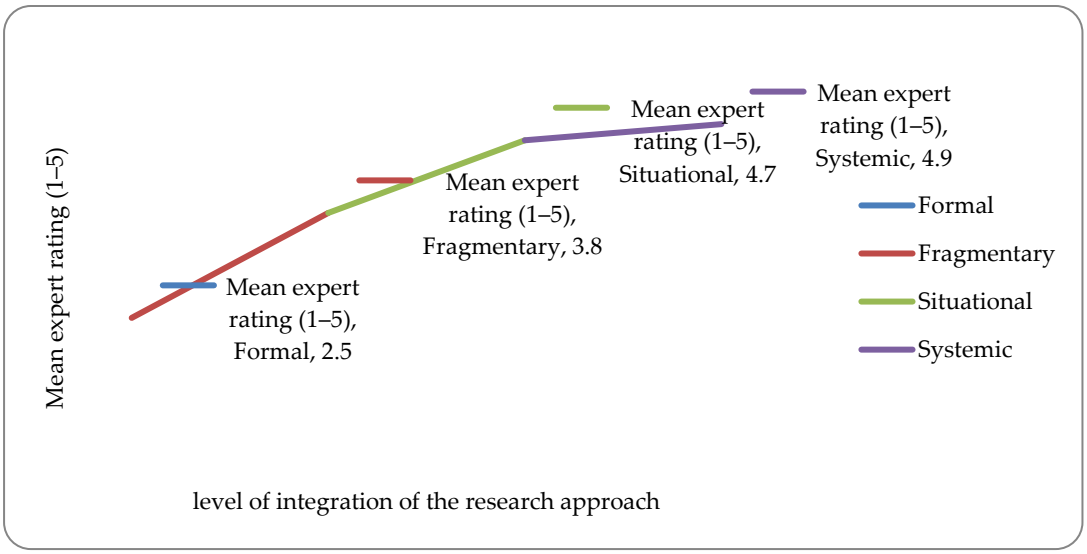

FIGURE 3. Relationship between the level of methodological integration and the quality of the pedagogical decision (expert rating).

Within-site changes from T0 to T1 reflect the effect of the embedded research programme implemented in both university contexts. Between-site differences in baseline-adjusted post-test outcomes should be interpreted as differences in implementation conditions and institutional context (mentorship, academic environment, resource support) under shared programme requirements, rather than as a comparison of "intervention vs no intervention." Overall, the results indicate: (a) statistically significant positive change in methodological knowledge and skills in both university samples following the semester-long programme (Q3), (b) between-site differences in post-test outcomes after controlling for baseline, pointing to the role of institutional context and implementation conditions (Q4), and (c) practical transferability of the developed actions—from a formal level to situational and systemic micro-studies that support pedagogical decisions (Q5). Considering quantitative and qualitative evidence together supports interpreting the observed gains as reflecting not only the acquisition of terminology, but also the development of evidence-informed reasoning and reflective regulation of professional actions.

V. DISCUSSION

The findings allow research activity to be viewed not as an optional add-on to master's training, but as a functional mechanism associated with the development of the methodological culture of future primary education teachers. It should be emphasized that the study design did not involve randomization and did not include a no-intervention control group: the intervention programme was implemented in both university contexts. Accordingly, within-site change from T0 to T1 should be interpreted as evidence of meaningful educational change under programme conditions, whereas between-site differences are more appropriately read as baseline-adjusted variation that may reflect differences in implementation conditions rather than the direct effect of a measured contextual variable. Within the logic of the research questions (Q1–Q5), the key conclusion is that methodological culture emerges as a system of interrelated components methodological knowledge, analytical–reflective skills, and the practice of evidence-informed justification of pedagogical decisions and develops more strongly when research actions become a regular part of the learning routine rather than an episodic requirement linked to final assessment. This conclusion aligns with research-based teacher education and evidence-informed practice, where the critical issue is not the presence

of a separate "research course," but systematic work with inquiry logic from question formulation and indicator selection to data interpretation and the justification of pedagogical decisions [1, 2].

The quantitative findings demonstrate a sustained positive change following the 16-week integrated programme: test scores increased in both university samples, and this change was statistically significant within each context (T0–T1). Because the study employs a nonequivalent groups design and baseline differences between sites were present, between-context inferences require cautious interpretation. At the same time, combining within-sample change with baseline-adjusted comparison (ANCOVA with pre-test control) provides a more robust evidential basis than a single-channel analysis. The literature suggests that RBTE approaches may be experienced by students either as a formal academic requirement or as a resource for professional autonomy; this variability may depend on how research preparation is interpreted and enacted in practice [8, 9].

The observed between-site difference should be interpreted cautiously. Because the study used a nonequivalent two-site design without randomization or a no-treatment control group, the findings do not allow strict causal interpretation. The higher post-test outcomes in one site are more appropriately read as baseline-adjusted differences that may reflect variation in implementation conditions, including mentoring continuity, feedback density, and access to academic support, rather than the direct effect of a measured contextual variable. After controlling for baseline, ANCOVA indicates a significant divergence in post-test outcomes in favor of the Abai Kazakh National Pedagogical University sample under shared programme implementation standards. This observation is central to interpreting Q3 and Q4 and suggests that the development of methodological culture depends not only on the set of learning tasks, but also on the institutional conditions under which they are carried out availability of mentorship, continuity of tutoring support, the culture of academic discussion, and the norms of evidence operating within the learning environment. Evidence shows that even when RBTE elements are formally similar, students may demonstrate different educational outcomes if mentoring practices, quality criteria, and the extent to which research actions are embedded in daily learning routines differ [8, 9].

Quantitative and qualitative findings were integrated using a joint display linking key statistical results with corresponding qualitative evidence; the full table is provided in the supplementary materials (Supplementary File Table S3). First, the data indicate a shift from reproductive acceptance of teaching methods toward analytical appraisal of their fit and an active search for alternatives. In evidence-informed practice terms, this shift corresponds to the development of evidence-informed reasoning as a professional habit of linking data, context, and pedagogical action. Prior work has shown that evidence-informed reasoning among future teachers is associated with attitudes, subjective norms, and self-efficacy: with higher self-efficacy, students more often use scholarly ideas and data to interpret pedagogical situations rather than relying on intuitive explanations [12]. Second, the materials reveal growth in critical reading and in evaluating the quality of argumentation, including identifying weaknesses in the evidential basis. This aligns with a line of research showing that criteria for evaluating evidence claims can change qualitatively over the course of training, but this development requires didactically organized practice in analysis, discussion, and the application of evidence-quality criteria [16]. Third, reflection on one's own research decisions becomes more pronounced from goal and hypothesis formulation to the logic of analysis and the interpretation of results. This effect is consistent with the argument that the meaning of research preparation is shaped not by theory alone, but by repeated situations of argumentation, choice, and justification of decisions grounded in authentic educational cases [11].

Table 7. Main qualitative themes and their frequency.

Theme	Brief description	Frequency of coded segments (n)	Interpretive meaning
Analytical appraisal of methods	Shift from reproductive acceptance of teaching methods toward comparison, selection, and evaluation of fit	34	Indicates growth in methodological reasoning
Critical engagement with evidence	Increased attention to argument quality, evidential adequacy, and weaknesses in justification	29	Reflects stronger evidence evaluation skills
Reflection on research decisions	More explicit reflection on goals, hypotheses, analysis logic, and interpretation of results	26	Shows development of reflective regulation
Support through structured inquiry formats	References to the value of full mini-study cycle, explicit criteria, and systematic feedback	31	Identifies the main mechanisms supporting change

The distribution of coded segments suggests that qualitative change was concentrated not in a single isolated skill, but across analytical reasoning, evidence evaluation, reflective regulation, and structured support mechanisms (see Table 7). With respect to Q2, the data indicate that the most productive formats are those that simultaneously require completion of a full mini-study cycle, provide explicit quality criteria and artefacts, and ensure systematic feedback through tutoring and peer review. Prior research likewise shows that feedback strengthens evidence-informed reasoning by helping students refine criteria of evidential adequacy and correct inquiry logic [13]. At the same time, research requirements may be perceived as external academic demands if their practical value is unclear and adequate support is absent [10]. Thus, the effectiveness of specific formats depends not only on their presence, but also on whether they lower the entry threshold for research actions and make them a supported routine. The barrier landscape (Q4) is multi-layered.

At the psychological level, students may recognize the importance of methodological knowledge while lacking confidence in performing key research actions without support. This is consistent with evidence that the acceptance of research as a practical resource depends on contextual relevance, clarity of conclusions, and consistency with professional experience [14], as well as with skepticism toward scientific knowledge as distant from classroom realities [15]. At the organizational level, between-site differences under shared programme standards point to the role of time, mentoring access, data-work infrastructure, and academic communication. Research use is rarely strengthened by a single methodological measure; rather, it depends on sustained conditions, intermediaries, time, and clear implementation mechanisms [7], as well as a supportive culture for evidence-informed practice [19]. Accordingly, a transferable model of integrating research activity should include not only modules and tasks, but also minimum organizational conditions for implementation.

The response to Q5 (a transferable integration model) is strengthened by evidence of practical transferability of research actions through levels of integration into pedagogical practice and their association with the quality of pedagogical outcomes as judged by experts. The strongest effects are linked to the situational and systemic levels, where a master's student does not stop at terminology or isolated tools, but constructs pedagogical decisions through data interpretation, subsequent adjustment of actions, and reflection on limitations. This result aligns with the inquiry stance framework as a stable inquiry-oriented orientation: it develops when research actions become regular, jointly shared practices supported by programme requirements and mentoring [5]. Similarly, studies of inquiry-based practicum show that practicum organized around forms of inquiry reshapes students' understanding of the "research ↔

teaching" connection and encourages more deliberate use of data in decisions [17]. In the present study, the matrix of integration levels provides an applied language for describing an inquiry stance from formal use of terms to a systemic linkage between data, decisions, and reflection. Practical implications can be stated as follows. A transferable model for master's-level teacher education programmes should include: (a) baseline diagnostics that document the "recognized importance self-efficacy" gap, (b) repeated full-cycle mini-studies, (c) mandatory artefacts and quality criteria for evidence, (d) tutoring support and structured feedback, and (e) transfer scenarios into school practice with assessment of the level of integration of the research approach. Such a model simultaneously lowers entry barriers (Q4) and makes research rationality an internal principle of professional thinking rather than an external academic add-on. This may help address the sustainability problem of RBTE effects after individual courses end and underscores the need to design facilitating conditions at the programme level [4, 6].

Interpretive limitations follow directly from the study design. First, the nonequivalent groups design and baseline pre-test differences limit the strength of causal claims even when baseline-adjusted models are used. Second, the study did not include a longitudinal follow-up stage; therefore, no direct conclusions can be drawn about the durability or long-term sustainability of the observed changes beyond the immediate post-programme period. Third, although the diagnostic test was aligned with the content and logic of the intervention programme, which supports content validity, this may also increase the risk of curriculum proximity bias, whereby post-test gains partly reflect familiarity with task formats and conceptual framing rather than fully independent transfer of methodological competence. Fourth, inter-rater agreement for the expert evaluation of cases was reported as exact percentage agreement only; formal chance-corrected reliability coefficients were not estimated and should be incorporated in future studies. Fifth, a formal sensitivity analysis to test whether the quantitative pattern was influenced by extreme observations was not conducted. At the same time, the combination of within-sample change, ANCOVA with T0 control, and qualitative explanation of mechanisms strengthens the robustness of the conclusions and reduces the risk of single-source interpretation. Future research would benefit from including a larger number of sites, measuring implementation parameters more precisely (for example, the intensity of tutoring support and the format of peer feedback), tracking the durability of transfer over a longer time horizon, complementing percentage agreement with chance-corrected coefficients such as Cohen's kappa or ICC, and using designs that allow comparison of the contributions of individual programme components in order to clarify causal mechanisms more precisely.

VI. CONCLUSION

The study shows that research activity embedded in the regular master's-level learning process functions not as an "add-on" to training, but as a mechanism for developing the methodological culture of future primary school teachers. At baseline, a typical gap was observed: despite high reported importance of methodological skills, most master's students demonstrated low-to-medium readiness to apply basic research actions (problem/hypothesis formulation, work with variables, selection of analytic procedures, and justification of conclusions). Overall, the findings suggest that systematic research activity, when embedded in master's-level preparation and supported by explicit quality criteria and mentoring, is associated with stronger methodological reasoning, more confident data interpretation, and more reflective pedagogical decision-making. Given the quasi-experimental two-site design, these results should be interpreted as evidence of meaningful educational change under programme conditions rather than as definitive proof of causality.

Funding Statement

This research received no external funding.

Author Contributions

K. Alimova: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft. G. Zhapbarova: Methodology, Validation, Formal Analysis, Writing – Review & Editing. A. Kosshygulova: Investigation, Data Curation, Resources, Writing – Review & Editing. Z. Abdullaeva: Validation, Visualization, Writing – Review & Editing. S. Nurzhanova: Supervision, Project Administration, Conceptualization, Validation, Writing – Review & Editing, Final Approval of the Manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data are available from the authors upon request.

Acknowledgment

The authors thank the master's students and tutors at Abai Kazakh National Pedagogical University for their participation and support during data collection.

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