

**MENTAL ENLIGHTENMENT SCIENTIFIC –
METHODOLOGICAL JOURNAL****MENTAL ENLIGHTENMENT SCIENTIFIC –
METHODOLOGICAL JOURNAL**<http://mentaljournal-jspu.uz/index.php/mesmj/index>**DEVELOPING FUTURE TEACHERS' SCIENTIFIC-RESEARCH COMPETENCIES
THROUGH A CREATIVE APPROACH: A STRUCTURAL MODEL AND ITS
EXPERIMENTAL VERIFICATION****Feruza Abulqosimovna Rakhmatova***Head of Pedagogical faculty of Jizzakh State pedagogical university**E-mail address: raxmatovaferuza01@gmail.com**Jizzakh, Uzbekistan***ABOUT ARTICLE**

Key words: scientific-research competence; future teachers; creative approach; pedagogical model; higher education; research skills; didactic conditions; pedagogical experiment; Student's t-test; Cohen's effect size; reflective activity; creative pedagogy.

Received: 20.09.26**Accepted:** 21.09.26**Published:** 22.09.26

Abstract: This article addresses the problem of developing future teachers' scientific-research competencies within the paradigm of a creative approach in higher pedagogical education. Drawing on international and national research on the formation of research competence in teacher training, the study proposes a four-component structural-functional model comprising motivational-need-based, cognitive-analytical, creative-search and reflective-responsible components, integrated into the educational process of pedagogical universities through a specially designed digital research platform, case-based and project tasks, and scientific seminar-trainings organised within a creative pedagogues' club. To verify the methodology, a three-stage pedagogical experiment (diagnostic, formative and final) was carried out with 606 future teachers of pedagogy and psychology from three higher education institutions of Uzbekistan, divided into an experimental group ($n = 306$) and a control group ($n = 300$). Data were analysed using Student's t-test (Welch variant) and Cohen's d effect size at the 95% confidence level. The results showed no statistically significant difference between the groups at the diagnostic stage ($t = 0.205$; $d = 0.017$), a statistically significant difference at the formative stage ($t = 5.896$; $d = 0.478$; relative

gain $\Delta\bar{X} = 9.62\%$), and a highly significant, practically large difference at the final stage ($t = 11.665$; $p < 0.01$; $d = 0.948$; $\Delta\bar{X} = 17.46\%$), a pattern consistently confirmed across all three institutions (relative gains of 17.29–17.65%). The findings demonstrate that a methodology grounded in the creative approach substantially and reliably improves future teachers' scientific-research competencies across cognitive, procedural and integrative-personal criteria, and it can therefore be recommended for wide implementation in teacher-training curricula and in-service professional development programmes.

Introduction. The globalisation and internationalisation of higher education have placed the development of students' research competencies at the centre of teacher-training reform. The UN World Declaration on Higher Education for the Twenty-First Century, UNESCO's programme documents on reforming and developing higher education, and the Bologna Declaration on the harmonisation of European higher-education standards all assign a prominent role to strengthening the research capacity of future specialists, including future teachers [17, 18]. In this context, leading research centres and universities — the Association for Educational Communications and Technology and the Massachusetts Institute of Technology in the United States, the Universities of Columbia, Sorbonne and Freiburg, the pedagogical university of Belfeld in Germany, a professional-development centre affiliated with the University of Manchester in the United Kingdom, Miyagi Pedagogical University in Japan, and Chung-Ang and Seoul National Universities in the Republic of Korea — have each contributed distinct organisational, technological and diagnostic solutions for developing the research competencies of future teachers.

Uzbekistan's own education reforms move in the same direction. The Development Strategy of New Uzbekistan and the Strategy "Uzbekistan – 2030" identify the wide-scale introduction of innovative activity and support for scientific research and innovative initiatives as a priority task [3, 13], while the Concept for the Development of the Higher Education System of the Republic of Uzbekistan until 2030 calls for strengthening the scientific and methodological basis on which competitive pedagogical personnel are trained [4]. National scholars have examined various facets of this problem — professional creativity, research methodology, and the diagnostic assessment of students' research potential — from several methodological angles [19–16], while scholars from the Commonwealth of Independent States

and beyond have developed the theory and practice of forming pedagogical research skills through activity-based, competence-based and person-centred approaches [1, 2, 5, 6, 8–10].

Despite this substantial body of work, two problems remain insufficiently resolved. First, existing models rarely integrate a specifically creative approach — one that treats problem-based, heuristic, project-based and reflective tasks as a coherent, sequentially organised system rather than as isolated instructional techniques. Second, few studies provide rigorous experimental verification, across several institutions and with an adequate sample, of the practical effect that such a methodology produces on measurable research-competence criteria. This article addresses both gaps. It presents (i) a structural-functional model for developing future teachers' scientific-research competencies on the basis of a creative approach, and (ii) the results of a three-stage pedagogical experiment, conducted with 606 students across three Uzbek pedagogical universities, that verifies the model's effectiveness using inferential statistics.

Materials and methods. The theoretical part of the study relied on a comparative-critical analysis of philosophical, sociological and psychological-pedagogical literature devoted to research-competence formation, together with a review of advanced pedagogical practice at higher education institutions. The proposed structural-functional model consists of four interrelated components: (1) a motivational-need-based component, which forms students' sustained interest in research activity and links their internal needs to external educational influences; (2) a cognitive-analytical component, which develops subject knowledge together with critical- and analytical-thinking skills; (3) a creative-search component, which trains students to reformulate practical problems as scientific problems, to advance and substantiate hypotheses, and to design non-standard solutions; and (4) a reflective-responsible component, which cultivates self-assessment, academic responsibility and rational time-management in research work. Each component is realised in practice through a dedicated digital research platform ("Researcher Students"), case-based assignments, project tasks, scientific seminar-trainings, and the extracurricular "Creative Pedagogues" club, which together operationalise the creative approach as a coherent didactic system rather than a set of disconnected techniques.

To verify the methodology empirically, a pedagogical experiment was organised in three stages — diagnostic, formative and final — at three higher education institutions of Uzbekistan: the National University of Uzbekistan for Pedagogy, Surkhandarya State Pedagogical Institute, and Jizzakh State Pedagogical University. The participants were 606 future teachers enrolled in Pedagogy–Psychology programmes, allocated to an experimental group ($n = 306$), which

studied under the creative-approach-based methodology, and a control group ($n = 300$), which continued under the traditional programme. Table 1 summarises the distribution of participants.

Institution	Experimental group, n	Control group, n	Total, n	Programme
National University of Uzbekistan for Pedagogy (NUUP)	~102	~100	~202	Pedagogy-Psychology
Surkhandarya State Pedagogical Institute (SSPI)	~102	~99	~201	Pedagogy-Psychology
Jizzakh State Pedagogical University (JSPU)	~102	~101	~203	Pedagogy-Psychology
Total	306	300	606	—

Students' level of research-competence development was assessed on a three-level ordinal scale (High, Medium, Low), converted into numerical scores of 5, 4 and 3 respectively to obtain an interval-type set of scores, and evaluated according to three criteria — cognitive, procedural, and integrative-personal. Because the sample sizes were sufficiently large ($n_e = 306$, $n_c = 300$), the Central Limit Theorem justified treating the sampling distribution of the mean score as approximately normal, which permitted the use of the parametric Student's *t*-test (Welch variant) for comparing group means; Cohen's *d* was additionally computed to capture the practical, and not merely statistical, magnitude of the observed differences. The null hypothesis (H_0) stated that there is no difference between the mean scores of the experimental and control groups; the alternative hypothesis (H_1) stated that the experimental group, taught under the proposed methodology, significantly outperforms the control group. The critical value was set at $t = 1.964$ for the overall sample ($df = 604$) and at approximately $t = 1.972$ for the institution-level comparisons, at the $p = 0.05$ significance level; effect sizes were interpreted following the conventional benchmarks of $d \approx 0.2$ (small), 0.5 (medium) and 0.8 (large).

Results and discussion. At the diagnostic stage, prior to the introduction of the methodology, the mean score of the experimental group ($\bar{X} = 3.742$) did not differ significantly from that of the control group ($\bar{X} = 3.730$): $t = 0.205$, well below the critical value of 1.964, and Cohen's $d = 0.017$, indicating a negligible difference. This confirmed that the two groups began the experiment from an equivalent starting position, which is a necessary precondition for attributing any subsequent divergence to the methodology rather than to pre-existing group differences.

At the formative stage, after the creative-approach-based methodology — including the research platform, case method, project tasks and scientific seminar-trainings — had been introduced in full in the experimental group, the mean score rose to $\bar{X} = 4.144$ against $\bar{X} = 3.780$ in the control group. The difference was statistically significant ($t = 5.896 > 1.964$), with a small-to-medium effect size ($d = 0.478$) and a relative gain of $\Delta\bar{X} = 9.62\%$, indicating an emerging positive, medium-term effect of the methodology.

At the final stage, the experimental group's mean score reached $\bar{X} = 4.487$, compared with $\bar{X} = 3.820$ in the control group. The share of students at the High level rose to 59.5% in the experimental group (against 18.7% in the control group), while the share at the Low level fell to 10.8% (against 36.7% in the control group). The difference between groups was highly significant ($t = 11.665$, $p < 0.01$), and Cohen's $d = 0.948$ indicated a large practical effect; the relative gain reached $\Delta\bar{X} = 17.46\%$. Table 2 summarises the three stages.

Stage	$\bar{X}$ (experimental)	$\bar{X}$ (control)	t-empirical	Cohen's d
Diagnostic	3.742	3.730	0.205 (< t crit. 1.964)	0.017
Formative	4.144	3.780	5.896 (> t crit. 1.964)	0.478
Final	4.487	3.820	11.665 ($p < 0.01$)	0.948

The pattern was consistent across all three institutions (Table 3): in every case the diagnostic stage showed no significant difference, while the final stage showed a large, statistically significant advantage for the experimental group, with relative gains ranging narrowly between 17.29% and 17.65%. This cross-institutional replication substantially strengthens confidence in the methodology's effectiveness, since the result cannot be attributed to the particularities of a single teaching context.

University	$\bar{X}$ experimenta l	$\bar{X}$ control	Cohen's d	Relative gain, $\Delta\bar{X}$
NUUP	4.500	3.837	0.949	17.29%
SSPI	4.500	3.832	0.956	17.45%
JSPU	4.462	3.792	0.933	17.65%
Overall	4.487	3.820	0.948	17.46%

A criterion-level analysis showed that the experimental group outperformed the control group on all three criteria by the final stage, with the largest gains recorded on the cognitive criterion (+0.687) and the procedural criterion (+0.667), and a slightly smaller but still

substantial gain on the integrative-personal criterion (+0.647). This pattern suggests that the creative-approach-based methodology develops future teachers' theoretical knowledge and practical research skills in a balanced way, rather than improving one dimension of competence at the expense of another.

These findings are consistent with, and extend, the international literature reviewed above. Where existing models — for example, the organisational-structural model developed at the University of Manchester's teacher-training centre, or the technology for developing research skills reported at Miyagi Pedagogical University — have generally targeted a single stage of research training, the model proposed here integrates motivational, cognitive, creative and reflective components into a single sequential system and, importantly, subjects that system to multi-site experimental verification with a substantial combined sample ($N = 606$). The reliability of the results is further supported by the initial statistical equivalence of the groups, the adequacy of the sample size, the joint use of statistical (t -test) and practical (Cohen's d) significance measures, and the replication of the effect across three independent institutions.

Conclusion. The study leads to four principal conclusions. First, the scientific-research competence of future teachers can be productively conceptualised through a four-component structural-functional model — motivational-need-based, cognitive-analytical, creative-search and reflective-responsible — that links learners' internal needs to external didactic influences within a single coherent system. Second, this model can be operationalised through a specific combination of tools — a dedicated digital research platform, case-based and project assignments, scientific seminar-trainings, and an extracurricular creative-pedagogues' club — which together constitute the practical didactic content of the creative approach. Third, a three-stage, multi-institution pedagogical experiment involving 606 future teachers demonstrated that this methodology produces a statistically significant and practically large improvement in research-competence indicators ($t = 11.665$, $p < 0.01$, Cohen's $d = 0.948$, relative gain of 17.46%), with the effect replicated consistently at three different universities. Fourth, the improvement is balanced across cognitive, procedural and integrative-personal criteria, indicating that the methodology develops future teachers' research competence as an integrated whole rather than as a set of isolated skills.

On this basis, it is recommended that higher education institutions preparing future teachers incorporate the creative-approach-based methodology and its four-component model into the working curricula and teaching-methodological complexes of relevant pedagogical disciplines, and that they extend the use of digital research platforms and creative-pedagogues' clubs as durable, low-cost instruments for sustaining students' interest in scientific-research

activity. Further research should examine the model's applicability across other fields of teacher training, its longer-term effects on graduates' actual research productivity, and the specific contribution of individual didactic tools within the overall methodology.

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