

MOTIVATIONAL AND COMPETENCE-BASED ASPECTS OF GAMIFICATION ELEMENTS IN THE TRAINING OF FUTURE INFORMATICS TEACHERS

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Abstract. This study aims to examine the motivational and competence-based aspects of gamification in the training of future informatics teachers. The research adopts a quasi-experimental design and employs a mixed-methods approach, combining quantitative and qualitative data. The empirical stage involved 30 undergraduate students from Zhetysu University, enrolled in the educational programs “Informatics” and “Mathematics–Informatics,” who were divided into control and experimental groups.

The results demonstrate that the systematic integration of gamification elements into instructional design significantly increases students’ intrinsic motivation, engagement, and the development of pedagogical competences. Gamification is conceptualized not as a supplementary tool but as a pedagogical strategy that enhances the coherence and structure of the learning process. The teacher’s role is emphasized as a facilitator who aligns game mechanics with didactic objectives and supports motivation.

The scientific significance of the study lies in the development of a conceptual model that reveals the relationship between motivation and competence in gamified learning. The practical value is reflected in methodological recommendations for integrating gamification into teacher education curricula. The findings show that gamification contributes to the sustainable development of professional readiness, digital competences, and reflective practice, confirming its effectiveness as an element of teacher preparation.

Keywords: gamification, teacher education, intrinsic motivation, competence development, quasi-experiment, mixed-methods approach.

Introduction

The rapid digital transformation of education necessitates a reconsideration of traditional pedagogical approaches and the preparation of a new generation of teachers. In his 2025 Address to the Nation, President Kassym-Jomart Tokayev emphasized that large-scale digital modernization and the introduction of artificial intelligence impose fundamentally new requirements on the education system and on the preparation of teachers. He underlined that human capital must become the foundation of progress and that educators should be equipped to cultivate digital competences in students from an early stage.

Within this context, gamification, defined as the use of game-based elements and mechanics in educational environments, is regarded as a promising strategy for enhancing teacher preparation. Its potential lies not only in enriching the educational process but also in fostering students’ intrinsic motivation, thereby strengthening both methodological and digital competences. Well-designed gamified activities can support a broad range of learning objectives, ranging from critical thinking and algorithmic skills to professional reflection and decision-making under uncertainty.

At the same time, successful implementation requires alignment of gamification with the educational context, particularly in the preparation of future informatics teachers. Here, the intersection of technological competence, pedagogical literacy, and sustainable learning motivation becomes decisive. Despite increasing attention to gamification, comprehensive frameworks for its integration into teacher education remain underdeveloped. Methodological tools for designing gamified tasks in information and communication technology (ICT)-related disciplines and for assessing their influence on motivation and competence formation are particularly limited.

Consequently, the relevance of this research is determined by the need to investigate motivational and competence-based aspects of gamification in informatics teacher training. The novelty of the study lies in the development and justification of a model where gamification is conceptualized as a systemic pedagogical element that enhances both motivation and digital-pedagogical competences.

The purpose of the study is to identify the features of gamification in teacher training and to determine its influence on academic motivation and the development of professional-pedagogical competences.

Gamification is widely recognized in contemporary pedagogy as an effective means of enhancing both intrinsic motivation and active student engagement. For instance, Tokzhigitova N. et al. (2024) argue that the use of game mechanics in informatics courses fosters student interest and supports the development of sustainable learning strategies [1]. In their work, the authors emphasize that such practices do not only increase situational involvement, but also form a more stable interest in the subject, which is especially valuable in disciplines where abstract thinking and logical reasoning play a central role. In this sense, gamification becomes not just a method of stimulating activity, but also a way of building long-term learning trajectories.

Similarly, Aldabergenova A. et al. (2024) demonstrate that gamification elements strengthen the training of future informatics teachers by increasing participation and improving knowledge retention [2]. This study highlights that the introduction of points, badges, and ranking systems provides a structured framework that makes the learning process more transparent and meaningful for students. Consequently, the acquisition of content knowledge is accompanied by a rise in methodological awareness, which is crucial for prospective teachers who will later transmit these skills to their own pupils.

According to Kim E., Rothrock L., and Freivalds A. (2020), “gamification positively affects intrinsic and extrinsic motivation” in higher education settings [3]. The authors link this effect to the mechanisms of self-determination theory, stressing that gamified environments can simultaneously satisfy the needs for autonomy, competence, and relatedness. By aligning game design with these psychological needs, educators are able to maintain a balance between enjoyment and academic rigor.

In their systematic review, Dahalan F., Alias N. and Shaharom M. (2023) highlight that game-based methods are well aligned with contemporary students’ preferences for interactive and digitalized learning environments [4]. They also underline that modern learners expect dynamic formats that resemble the digital ecosystems they are accustomed to outside the classroom. Therefore, gamification in education acts as a bridge between academic requirements and students’ daily digital experiences, ensuring higher acceptance of pedagogical innovations.

Baltabayeva N. et al. (2024) stress that engaging with gamified resources in information and communication technology disciplines fosters self-regulation, reflective capacity, and decision-making skills [5]. The study notes that these skills are not isolated outcomes, but are interconnected: the ability to organize one’s own activity supports deeper reflection, while decision-making skills become more effective when students can monitor and regulate their own learning paths.

Moreover, Liu T. et al. (2023) found that online teacher-training programs that incorporate gamification methods enhance teacher motivation, increase adoption of interactive instructional strategies, and identify key challenges in using game elements in professional development settings [6]. These insights expand the applicability of gamification beyond undergraduate education, showing its potential in lifelong learning and continuous professional training for educators.

As shown by Bazarbayeva A. et al. (2024), collaborative open learning models enriched with gamification improve students’ instructional design and project literacy [7]. This indicates that gamification is not limited to individual motivation, but can also reinforce collective forms of knowledge building, which are increasingly demanded in the digital society. In a related study, Bekezhanova A. and Kurmanbekkyzy N. (2024) demonstrated that digital visualization tools integrated into gamified environments enhance engagement and facilitate the acquisition of transversal competences [8]. Their findings confirm that gamification contributes not only to subject-specific knowledge, but also to universal skills such as critical thinking, creativity, and communication.

Gómez-Carrasco C.J., Monteagudo-Fernández J. et al. (2020) emphasize that teacher-training programs using gamification and flipped-classroom strategies significantly enhance student motivation, perceived learning, and the development of teaching competences [9]. Likewise, Wu M.L., Zhou Y., and Lan Li (2023) found that a gamified online course significantly increases pre-service teachers' confidence in integrating technology, enhances their intention to adopt gamification, and boosts their motivation to explore emerging technologies in their future teaching practice [10]. Together, these studies demonstrate how gamification impacts both students' subjective perceptions of learning and their objective acquisition of professional competences.

According to Salgozha I. and Kassekeyeva A. (2022), the integration of gamification with active learning strategies supports the development of functional literacy, critical thinking, research, and communication skills [11]. Thus, gamification can be seen as a catalyst for broader educational reforms that seek to prepare teachers capable of cultivating twenty-first-century skills in their students. In their empirical study, Smiderle, R. et. al. (2020) found that “the gamification of education can enhance levels of students' engagement similar to what games can do, to improve their particular skills and optimize their learning” in a programming learning environment [12], while Li M. et al. (2023) show that gamification as a method effectively enhances learner engagement and improves learning outcomes even in fully digital or fully face-to-face settings, without relying on hybrid models [13].

In a more recent project, Tokzhigitova N. et al. (2025) revealed that gamified platforms can serve as innovative tools for hidden assessment of ICT competences and career guidance among Kazakhstani students, bridging formal instruction with professional trajectories [14]. This example demonstrates that gamification can fulfill not only motivational and didactic functions, but also diagnostic and career-oriented roles, thereby expanding its educational value. Furthermore, Shirokolobova A. (2022), in her systematic review, reinforces that gamification is highly effective in professional and technical education, underlining its cross-disciplinary relevance [15].

Despite the richness of existing studies, the analysis of the literature reveals a common limitation: most research tends to focus either on motivational or competence-based outcomes separately, without providing an integrated picture. Therefore, the present study seeks to address this gap by examining both aspects simultaneously, highlighting the interdependence between motivation and competence in the context of teacher education.

Despite this growing body of literature, there remains a significant shortage of empirical research that systematically addresses the dual impact of gamification on both motivation and competence development in teacher education.

Materials and methods

The study employed the following method:

1. Theoretical methods – comparative analysis of psychological, pedagogical, scientific-methodological, and specialized literature.
2. Sociological methods – semi-structured interviews, questionnaires, comparison, classification, and analysis of survey results.
3. Empirical methods – pedagogical quasi-experiment; statistical data processing and interpretation (t-test, Cohen's d, confidence intervals); Academic Motivation Scale (AMS) with Cronbach's alpha reliability; classroom observation; competence assessment; reflective observation; and follow-up interviews.

The quasi-experiment was conducted with 30 students of Zhetysu University, specializing in Informatics and Informatics – Mathematics (2nd, 3rd, 4th years). The students were divided into an experimental group, where gamification was systematically integrated, and a control group, which studied according to the traditional curriculum. Gamification elements were systematically embedded into the courses “Methods of teaching digital literacy in primary school” and “Methodology of teaching computer science in lower secondary school”. The integration was implemented across lectures, practical classes, and independent study, with the use of point

systems, leaderboards, quests, narrative tasks, team competitions, collaborative missions, and quizzes. The methodological framework included the following components:

1. **Integration into traditional formats** – lectures, practical classes, and independent study were enriched with point systems, leaderboards, quests, narrative tasks, team competitions, collaborative missions, and quizzes.

2. **Design principles** – coherence of instructional flow, progressive increase in task complexity, interdisciplinary integration of informatics and pedagogy, and provision of real-time feedback.

3. **Methodological conditions** – assessment of students' digital readiness, blended learning formats (offline combined with Code.org, Tynker, and Blockly), transparent evaluation criteria, and the instructor's role as a facilitator.

Research Stages

The study was organized in three stages, which provided systematic monitoring of the learning process and ensured reliable evaluation of outcomes. This structure allowed for the identification of students' initial characteristics, the implementation of a pedagogical intervention, and the validation of its effectiveness. The study was conducted in three sequential stages, as summarized in Table 1.

Table 1 – Stages of the research design

Stage	Main activities	Objective	Expected outcome
Diagnostic (Baseline)	Administration of AMS survey; classroom observation; assessment of methodological competences	Identification of baseline levels of motivation and pedagogical skills	Initial data on motivation and competence profiles
Formative (Intervention)	Implementation of gamified course; semi-structured interviews; reflective observation	Examination of the effects of gamification in real conditions	Evidence of increased motivation and competence development
Control (Post-assessment)	Re-administration of AMS; follow-up interviews; comparative statistical analysis	Validation of intervention effectiveness and measurement of impact	Statistically significant improvements in the experimental group compared to baseline

The diagnostic stage focused on recording the starting level of motivation and professional competences of future informatics teachers. The formative stage provided conditions for testing the gamified course in practice, with emphasis on students' engagement and methodological growth. The control stage allowed for comparing initial and final indicators in order to confirm the effectiveness of the applied approach and to identify measurable improvements in the experimental group.

Research Questions

RQ1: How does gamification affect intrinsic and extrinsic motivation of future informatics teachers?

RQ2: To what extent does gamification contribute to the development of methodological competences?

RQ3: What pedagogical and methodological conditions ensure the successful implementation of gamification in informatics teacher education?

RQ4: What barriers limit the effectiveness of gamified learning, and how can they be addressed?

Results and discussion

1. Quantitative Findings

To evaluate the effectiveness of gamification, the Academic Motivation Scale (AMS) was administered before and after the intervention. The reliability of the instrument was previously confirmed with Cronbach's alpha ($\alpha = 0.84$), which ensured the validity of motivational measures. The comparative results for intrinsic motivation, extrinsic motivation, and amotivation are presented in Table 2.

Table 2 – Comparative analysis of motivation domains ($M \pm SD$)

Domain	Control Group (n = 15)	Experimental Group (n = 15)	Mean Diff	t(df)	p	Cohen's d	95% CI
Intrinsic Motivation	3.6 $\pm$ 0.41	4.2 $\pm$ 0.39	+0.6	3.72(28)	<0.001	0.79	[0.28, 0.92]
Extrinsic Motivation	3.8 $\pm$ 0.36	4.1 $\pm$ 0.34	+0.3	2.15(28)	0.034	0.46	[0.02, 0.58]
Amotivation (lower = better)	2.9 $\pm$ 0.44	2.3 $\pm$ 0.37	-0.6	-3.95(28)	<0.001	0.82	[-0.91, -0.31]

The results indicate a statistically significant increase in intrinsic motivation accompanied by a notable reduction in amotivation among students in the experimental group. The large effect sizes (Cohen's $d > 0.7$) suggest that gamification had not only statistical but also practical significance. The total sample comprised 30 students from Zhetysu University, majoring in Informatics and Informatics–Mathematics. They were divided equally into an experimental group ($n = 15$) and a control group ($n = 15$).

A further comparison of students' active engagement, expressed in the proportion of high scores (4–5 points) on key AMS items, is presented in Table 3.

Table 3 – Percentage of students reporting high learning activity (4–5), %

Group	Pre-test	Post-test	Change
Experimental group	45.0 %	82.5 %	+37.5 %
Control group	44.0 %	46.0 %	+2.0 %

The proportion of highly motivated students almost doubled in the experimental group, while the control group showed only negligible improvement. This supports the argument that systematic gamification enhances sustained motivation and student engagement.

2. Competence Development

In addition to motivation, the study also examined competence-related outcomes across four domains: preparation of a short-term lesson plan, teamwork and collaboration, digital tool proficiency, and reflective practice. The results are summarized in Table 4.

Table 4 – Comparative analysis of competence domains ($M \pm SD$)

Competence Domain	Control Group (n = 15)	Experimental Group (n = 15)	Mean Diff	t(df)	p	Cohen's d	95% CI
Short-term Lesson Plan	3.2 $\pm$ 0.40	4.0 $\pm$ 0.38	+0.8	4.25(28)	<0.001	0.89	[0.42, 1.07]
Teamwork & Collaboration	3.5 $\pm$ 0.36	4.1 $\pm$ 0.35	+0.6	3.11(28)	0.002	0.66	[0.21, 0.88]

Competence Domain	Control Group (n = 15)	Experimental Group (n = 15)	Mean Diff	t(df)	p	Cohen's d	95% CI
Digital Tools Proficiency	3.6 ± 0.37	4.2 ± 0.34	+0.6	3.45(28)	0.001	0.72	[0.27, 0.93]
Reflective Practice	3.1 ± 0.42	3.9 ± 0.39	+0.8	4.02(28)	<0.001	0.83	[0.36, 1.02]

The experimental group significantly outperformed the control group in all four domains. The largest improvements were observed in preparation of a short-term lesson plan ($d = 0.89$) and reflective practice ($d = 0.83$), highlighting that gamification is particularly effective in strengthening methodological thinking, reflective capacity, and the ability to transfer pedagogical strategies into practice.

The conceptual model of gamification in teacher education was constructed on the basis of three key components: integration into traditional formats, design principles, and methodological conditions. These components reflect the systematic approach taken in embedding gamification into the curriculum and illustrate how its effects extend simultaneously to motivational and competence-based outcomes.

The findings of the quasi-experiment demonstrated that the intervention produced statistically significant improvements in both motivation and competence development. The Academic Motivation Scale (AMS) results confirmed increased intrinsic motivation and reduced amotivation ($p < 0.001$, Cohen's $d > 0.7$), while competence assessments indicated significant growth in lesson planning, teamwork, digital proficiency, and reflective practice (all $p < 0.01$). Based on these validated outcomes, a conceptual model of gamification in teacher education was constructed, illustrating how systematic integration of game-based elements simultaneously enhances motivation and competence formation.

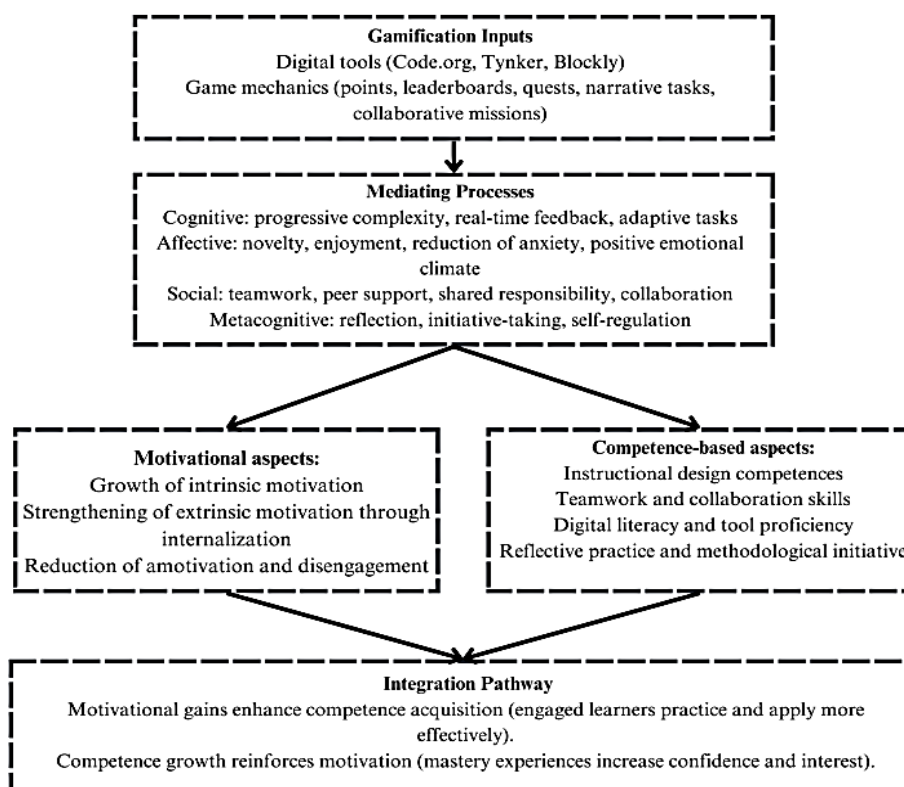


Figure 1 – Conceptual model of motivational and competence-based effects of gamification in informatics teacher education

As illustrated in Figure 1, integration into traditional formats meant that lectures, practical classes, and independent study were enriched with point systems, leaderboards, quests, narrative tasks, team competitions, collaborative missions, and quizzes. Design principles emphasized coherence of instructional flow, progressive increase in task complexity, interdisciplinary integration of informatics, and the provision of real-time feedback. Finally, methodological conditions involved diagnostics of students' digital readiness, blended formats that combined offline learning with Code.org, Tynker, and Blockly, transparent evaluation criteria, and the instructor's role as a facilitator. Together, these components demonstrate how gamification systematically supports both motivational aspects (increased intrinsic motivation, reduced amotivation) and competence-based outcomes (preparation of a short-term lesson plan, teamwork, digital literacy, and reflective practice) in the training of future informatics teachers.

Conclusion

This study has demonstrated that the systematic integration of gamification elements into the training of future informatics teachers exerts a substantial positive impact on academic motivation, student engagement, and the development of professional competences. The findings clearly indicate that when game mechanics are strategically embedded into the curriculum, they contribute not only to short-term increases in student activity, but also to more sustainable shifts in learning behavior, reflective capacity, and professional readiness.

The quasi-experimental mixed-methods design produced robust quantitative evidence of statistically significant improvements in intrinsic motivation and competence domains, while qualitative analysis revealed students' recognition of gamification as a pedagogically meaningful and professionally valuable approach. This combination of methods provided a holistic picture, allowing us to see not only numerical changes in motivation and skills but also the subjective experiences of students, which are equally important for interpreting the effectiveness of educational interventions.

The findings emphasize that the effectiveness of gamification depends not on fragmented or superficial application, but on its deliberate and systemic incorporation into instructional design. In other words, gamification should be understood not as an optional or decorative element, but as an integral pedagogical strategy that aligns with learning objectives and has the potential to transform educational interaction. In this process, the instructor plays a central role: successful facilitation requires alignment of game mechanics with educational objectives, adaptation to students' readiness levels, and maintaining a balance between playfulness and academic rigor. This highlights the dual responsibility of educators: on the one hand, to design and implement gamified activities, and on the other, to guide students' reflection on their own learning pathways.

At the same time, certain limitations were identified, including differences in teacher preparedness, variations in digital literacy levels, infrastructural constraints, and occasional perceptions of games as less serious learning formats. Acknowledging these limitations is essential, as it provides a realistic basis for further improvement of gamified models. For instance, additional teacher training, investment in digital infrastructure, and awareness campaigns may help overcome skepticism and broaden acceptance of gamification among both students and faculty. Despite these challenges, the overall evidence suggests that gamification should be regarded not merely as a motivational technique, but as a pedagogical technology that enhances methodological readiness, digital competence, and reflective practice.

By conceptualizing gamification as both a motivational driver and a competence-building tool, this study contributes to the theoretical understanding of the motivation-competence relationship in teacher education. The proposed conceptual model can be used as a framework for designing new courses and for revising existing curricula in higher education. It also serves as a foundation for future comparative studies across different cultural and disciplinary contexts, allowing researchers to test the universality and adaptability of gamified approaches. Its practical value lies in providing methodological guidelines for designing gamified courses, as well as directions for developing diagnostic instruments to assess the educational outcomes of gamified learning environments in higher education. Finally, this research underlines that gamification,

when thoughtfully integrated, may act as a catalyst for broader educational innovation, preparing teachers who are not only knowledgeable in their subject area but also skilled in fostering creativity, resilience, and digital literacy in their students.

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БОЛАШАҚ ИНФОРМАТИКА МҰҒАЛІМДЕРІН ДАЯРЛАУДАҒЫ ГЕЙМИФИКАЦИЯ ЭЛЕМЕНТТЕРІНІҢ МОТИВАЦИЯЛЫҚ ЖӘНЕ ҚҰЗЫРЕТТІЛІК АСПЕКТІЛЕРІ

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Андатпа. Бұл зерттеу болашақ информатика мұғалімдерін даярлаудағы геймификация элементтерінің мотивациялық және құзыреттілік аспектілерін қарастыруға бағытталған. Зерттеу квази–

эксперименттік дизайнға негізделген және сандық пен сапалық деректерді біріктіретін аралас әдістерді қолданады. Эмпирикалық кезеңде І. Жансүгіров атындағы Жетісу университетінің «Информатика» және «Математика–Информатика» білім беру бағдарламалары бойынша білім алатын 30 студент қатысты, олар өз араларында бақылау және эксперименттік топтарға бөлінді.

Зерттеу нәтижелері геймификация элементтерін оқу процесіне жүйелі енгізу студенттердің ішкі мотивациясын, қатысуын және әдістемелік құзыреттіліктерін айтарлықтай арттыратынын көрсетті. Мұндай тәсіл қосымша тетік ретінде емес, білім беру жүйесінің құрылымын және біртұтастығын нығайтатын негізгі педагогикалық стратегия ретінде қарастырылды. Сонымен қатар, оқытушының рөлі ойын механикаларын дидактикалық мақсаттармен ұштастыратын әрі студенттердің ынтасын қолдайтын модератор ретінде айқындалды.

Ғылыми тұрғыдан алғанда, жұмыс мотивация мен құзыреттілік арасындағы байланысты түсіндіретін тұжырымдамалық модельді ұсынады. Практикалық құндылығы – мұғалімдерді даярлау бағдарламаларына геймификацияны енгізу бойынша әдістемелік ұсыныстарды әзірлеуінде. Нәтижелер кәсіби даярлықты, цифрлық құзыреттілікті және рефлексивті тәжірибені дамытуға ықпал ететінін дәлелдейді, осылайша геймификация мұғалімдерді даярлаудың тиімді элементі болып табылатынын растайды.

Кілт сөздер: геймификация, мұғалімдерді даярлау, ішкі мотивация, құзыреттілікті дамыту, квази-эксперимент, аралас әдістер.

МОТИВАЦИОННЫЕ И КОМПЕТЕНТНОСТНЫЕ АСПЕКТЫ ЭЛЕМЕНТОВ ГЕЙМИФИКАЦИИ В ПОДГОТОВКЕ БУДУЩИХ УЧИТЕЛЕЙ ИНФОРМАТИКИ

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Аннотация. Данное исследование направлено на изучение мотивационных и компетентностных аспектов применения геймификации в подготовке будущих учителей информатики. Исследование основано на квази-экспериментальном дизайне и использует смешанный методологический подход, объединяющий количественные и качественные данные. В эмпирической части приняли участие 30 студентов Жетісуского университета, обучающихся по образовательным программам «Информатика» и «Математика–Информатика», которые были разделены на контрольную и экспериментальную группы.

Результаты показали, что системная интеграция элементов геймификации в учебный процесс существенно повышает внутреннюю мотивацию студентов, их вовлеченность и развитие методических компетенций. В данном контексте геймификация рассматривается не как вспомогательный инструмент, а как педагогическая стратегия, укрепляющая целостность и структуру образовательного процесса. Особое внимание уделяется роли преподавателя как модератора, который согласует игровые механики с дидактическими задачами и поддерживает мотивацию.

Научная значимость исследования заключается в разработке концептуальной модели, раскрывающей взаимосвязь между мотивацией и компетентностью в условиях геймифицированного обучения. Практическая ценность выражается в методических рекомендациях по внедрению геймификации в программы подготовки учителей. Полученные результаты подтверждают, что геймификация способствует развитию профессиональной готовности, цифровых компетенций и рефлексивной практики, выступая эффективным элементом педагогической подготовки.

Ключевые слова: геймификация, педагогическое образование, внутренняя мотивация, развитие компетенций, квази-эксперимент, смешанные методы.