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STACKABLE DEGREE IN MASTER'S PROGRAMS: EVALUATION OF OUTCOMES AND IMPLEMENTATION PROSPECTS

Abstract

In the context of education digitalization and the growing demand for personalized learning trajectories, the Stackable Degree model is considered a promising format for master's education, providing flexibility, modularity, and recognition of micro-credentials within the structure of formal education. The study aims to evaluate the effectiveness of implementing this model in the training of master's students in pedagogical fields. Analysis of international experience (USA, UK, Australia, Singapore, Kazakhstan) and experimental results demonstrated that the stackable structure enhances academic performance, develops meta-competencies (self-management, digital literacy, collaboration), and increases learners' professional mobility. Institutional effects are reflected in the formation of a digital infrastructure for recognizing micro-achievements, improving credit transfer procedures, and increasing student and employer satisfaction. The model has proven its potential for integrating formal and non-formal education and for fostering the sustainable development of the micro-credential system in master's programs.

Keywords: Stackable Degree, master's program, micro-credentials, flexible learning trajectories, digital transformation, professional mobility.

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МАГИСТРАТУРАДАҒЫ STACKABLE DEGREE: НӘТИЖЕЛЕРДІ БАҒАЛАУ ЖӘНЕ ЕНГІЗУ ПЕРСПЕКТИВАЛАРЫ

Аңдатпа

Білім берудің цифрлануы мен жеке білім алу траекторияларына сұраныстың артуы жағдайында Stackable Degree моделі формалды білім беру құрылымында икемділік, модульдік және микробіліктіліктерді мойындауды қамтамасыз ететін магистратураның болашағы зор форматы ретінде қарастырылады. Зерттеудің мақсаты – педагогикалық бағыттағы магистранттарды даярлауда аталған модельді енгізудің тиімділігін бағалау. Халықаралық тәжірибені (АҚШ, Ұлыбритания, Австралия, Сингапур, Қазақстан) және эксперименттік апробация нәтижелерін талдау стек модельдің академиялық үлгерімді арттыруға, метакомпетенцияларды (өзін-өзі ұйымдастыру, цифрлық сауаттылық, бірлескен жұмыс) дамытуға және білім алушылардың кәсіби ұтқырлығын жоғарылатуға ықпал ететінін көрсетті. Институционалдық әсерлер микрожетістіктерді танудың цифрлық инфрақұрылымын қалыптастыруда, кредиттерді қайта есептеу рәсімдерін жетілдіруде және студенттер мен жұмыс берушілердің қанағаттану деңгейін арттыруда байқалды. Модель ресми және бейресми білім беруді интеграциялаудың, сондай-ақ магистратура деңгейінде микробіліктілік жүйесін орнықты дамытудың әлеуетін дәлелдеді.

Түйін сөздер: Stackable Degree, магистратура, микробіліктіліктер, икемді білім траекториялары, цифрлық трансформация, кәсіби ұтқырлық.

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STACKABLE DEGREE В МАГИСТРАТУРЕ: ОЦЕНКА РЕЗУЛЬТАТОВ И ПЕРСПЕКТИВЫ ВНЕДРЕНИЯ

Аннотация

В условиях цифровизации и растущего запроса на персонализированные образовательные траектории модель Stackable Degree выступает перспективным форматом магистратуры, обеспечивающим гибкость, модульность и признание микроквалификаций в структуре формального образования. Исследование направлено на оценку эффективности внедрения данной модели в подготовке магистрантов педагогических направлений. Анализ международного опыта (США, Великобритания, Австралия, Сингапур, Казахстан) и результаты экспериментальной апробации показали, что стекуемая структура способствует росту академической успеваемости, развитию метакомпетенций (самоорганизация, цифровая грамотность, коллаборация) и повышению профессиональной мобильности обучающихся. Институциональные эффекты выражаются в формировании цифровой инфраструктуры признания микродостижений, совершенствовании процедур перезачёта и повышении удовлетворённости студентов и работодателей. Модель доказала потенциал для интеграции формального и неформального образования и устойчивого развития системы микроквалификаций в магистратуре.

Ключевые слова: Stackable Degree, магистратура, микроквалификации, гибкие образовательные траектории, цифровая трансформация, профессиональная мобильность.

Introduction. In the context of the rapid development of digital technologies and the transformation of the educational environment, traditional models of master's training are undergoing profound change. The transition from linear academic trajectories to flexible, modular learning formats has become a key response of universities to the demands of the digital economy, which requires continuous upskilling and the individualization of learning pathways.

One of the most promising approaches is the Stackable Degree model — a system of progressive accumulation of micro-credentials based on the principles of modularity, transparency, and academic interoperability.

The institutionalization of this model in master's programs implies not only the technical integration of micro-credits into program structures but also a deep reconfiguration of the university's managerial, regulatory, and pedagogical mechanisms. Stackable Degree requires a new logic of curriculum design, where micro-courses become fully recognized components of the academic architecture, ensuring horizontal mobility, cross-disciplinarity, and international comparability of qualifications.

At the same time, evaluating the effectiveness of this model—both at the level of academic outcomes and institutional impact—becomes a key direction for further research. The main indicators of effectiveness include:

- the growth of academic and professional mobility among master's students;
- the enhancement of competency development and meta-skills;
- expanded opportunities for personalized learning;
- improved employability and employer satisfaction;
- the integration of micro-credentials into national and international qualification frameworks.

A comprehensive assessment of the effectiveness of the Stackable Degree model in master's education requires a combination of quantitative and qualitative methods: analysis of academic achievement, competency dynamics, and learner engagement. This approach makes it possible not only to identify the direct outcomes of implementation but also to determine the institutional barriers affecting the model's sustainability and scalability.

Thus, the implementation and evaluation of the effectiveness of the Stackable Degree model in master's programs are viewed not as one-time innovative initiatives but as a strategic process of restructuring academic institutions toward greater flexibility, digitalization, and openness. As a result, a new paradigm of master's education is emerging, in which micro-credentials become not an addition but the core element of a personalized and sustainable system for training the next generation of professionals.

Basic provisions. The relevance of the study is determined by the need to develop and test a Stackable Degree model for master's students in pedagogical fields, integrating formal and non-formal learning. This model is considered an effective tool for the professional development of future educators, providing opportunities to acquire additional, narrowly specialized but highly demanded competencies within the framework of master's programs.

In recent years, the Stackable Degree model has become one of the key directions in the modernization of master's education, ensuring flexibility, modularity, and personalization of learning trajectories. It reflects the global trend in higher education toward a micro-credential ecosystem, where each component of the program represents an independent module forming a set of professional competencies recognized within formal education.

Research by Vasilev (2024) confirms that the introduction of stackable programs and micro-credentials in professional and higher education systems enhances graduates' competitiveness by enabling a rapid response to changes in the professional environment. The scholar emphasizes that the principles of modularity, flexibility, and practice-oriented design embedded in the concept of the Stackable Degree ensure its effectiveness in preparing specialists in dynamically evolving sectors [1].

A similar position is held by Díaz and Lim, who note that the modern master's degree model should move away from rigidly structured academic programs toward flexible and adaptive forms of learning. According to them, stackable educational pathways allow for the creation of individualized competence packages that combine academic rigor with practical orientation, thereby enhancing accessibility, motivation, and graduate employability [2].

Studies by Dinan-Thompson, Bajema, and Cowden focus on the role of micro-credentials in teacher education and confirm that short-term stackable programs effectively address gaps in teachers' professional competencies. The authors emphasize that integrating the Stackable Degree model into master's programs fosters the development of new competencies related to digitalization, inclusion, and interdisciplinarity in the educational process [3].

Thus, the analysis of scholarly sources demonstrates that the Stackable Degree model in master's education represents a promising direction for the development of higher education, oriented toward the creation of flexible and personalized learning trajectories.

Particularly significant in the context of Stackable Degree development in master's programs are studies devoted to the application of micro-credentials and stackable programs in professionally oriented fields. For example, De Rosa, Bianco, and Pallonetto examine the introduction of micro-credentials in the renewable energy sector, demonstrating their potential as an effective mechanism for continuous

professional learning and the sustainable development of specialist competencies [4]. This approach confirms the importance of embedding stackable educational modules into master's programs to ensure a dynamic link between academic and professional learning.

A systematic analysis conducted by Tamoliune, Greenspon, and Tereseviciene reveals the potential of micro-credentials for developing key competencies across various professional fields, emphasizing the need for their adaptation to specific industries and practical tasks. The authors note that the effectiveness of stackable programs directly depends on their applied orientation and close alignment with real labor market demands [5].

From the perspective of interaction among diverse stakeholders — universities, students, and employers — the issue of micro-credential implementation is analyzed by Jain, Mogaji, and Sharma [6]. The researchers emphasize that the success of Stackable Degree model implementation is determined by the degree of alignment among stakeholder interests and the establishment of an ecosystem of recognition for micro-credentials within the labor market.

From a theoretical standpoint, the works of Kayyali [7] are particularly significant, as they propose a conceptual classification of micro-credentials as integral components of stackable educational systems. Similarly, Rosenberg and Clayton [8] focus on the applied aspects of designing and implementing micro-programs, highlighting the necessity of developing standardized frameworks for the structure and content of stackable courses in master's programs.

The study by Schutte [9] draws attention to the dual nature of micro-credentials in higher education: on one hand, they enhance the flexibility and adaptability of master's programs; on the other, they require a reconsideration of traditional university models and mechanisms for ensuring academic quality.

Materials and Methods. This study is devoted to analyzing the effectiveness and prospects of implementing the Stackable Degree model within the structure of master's programs in pedagogical fields. The purpose of the research was to assess the educational and institutional outcomes of applying the stackable model, as well as to identify the factors that determine its sustainable development in the context of higher education.

To achieve this goal, a mixed methodological approach (Mixed Methods Research) was employed, integrating both quantitative and qualitative methods of analysis. This design provided a comprehensive examination of the Stackable Degree phenomenon — from measuring academic and competency-based effects to analyzing the perception, motivation, and readiness of educational stakeholders for new modular learning formats.

Research Stages

The study included two main stages:

1. Theoretical and analytical stage — analysis of international and national experience in implementing micro-credentials and modular programs, identification of the principles of institutionalizing the Stackable Degree model in master's programs, and development of a conceptual model for integrating micro-credentials.

2. Experimental stage — pilot testing of the model in a real educational environment, collection and analysis of empirical data, and assessment of the dynamics of professional competencies among master's students before and after participation in micro-credential programs.

The formulated hypothesis stated that the implementation and institutionalization of the Stackable Degree model in master's programs — based on the integration of formal and non-formal education — enhance the flexibility of individual learning trajectories, promote the personalization of professional training, and expand opportunities for academic and professional mobility of students.

Research Base

The experimental part of the study was conducted at Abai Kazakh National Pedagogical University. A total of 100 master's students in pedagogical fields participated in the experiment.

Data Collection Methods

To evaluate the effectiveness of the model, the following methods were applied: questionnaires, expert evaluations, participants' self-assessment, and diagnostics of professional competencies before and after completing the courses.

Data Analysis Methods

Data processing included:

- Statistical analysis (calculation of means, medians, and standard deviations) — to quantitatively assess changes in the level of competencies;
- SWOT analysis — to identify internal and external factors affecting the institutionalization of the Stackable Degree model;
- Content analysis of feedback and expert reports — to interpret qualitative data and determine the factors contributing to the model's success.

Ethical Considerations

All participants were informed about the aims and objectives of the experiment. The study was conducted in accordance with international ethical standards, ensuring voluntary participation, anonymity, and confidentiality of data.

Experimental Design

The study employed a quasi-experimental longitudinal "pre–post" design with a control group, aimed at assessing the effectiveness and institutional prerequisites for implementing the Stackable Degree model in master's programs.

The experimental group consisted of 52 master's students ($M = 23.7 \pm 2.1$ years) who participated in a pilot stackable program integrating micro-credentials and formal courses into a unified academic trajectory.

The control group included 48 students with comparable characteristics ($M = 23.5 \pm 1.9$ years) studying under the traditional model. No statistically significant differences were found between the groups in demographic indicators ($p > 0.10$).

The Stackable Degree program included 60 ECTS of formal courses and a catalog of micro-credentials (1–5 ECTS) available both within the university environment and on external platforms such as Coursera, edX, and OpenEdu.

Institutional mechanisms ensured automatic recognition and conversion of micro-credits into academic credits through a Hyperledger Fabric 2.4 blockchain registry and a "entry/exit point" system, which allowed the recognition of up to 20 external ECTS upon admission and the awarding of a Graduate Certificate upon completion of 40 ECTS.

The learning progress monitoring system was implemented as a digital competency wallet (React/NodeJS, PostgreSQL), integrated with Moodle LMS via LTI. It tracked academic performance, accumulated micro-credentials, mobility data, and credit recognition records.

Evaluation Indicators

To assess the effectiveness of the model, the following indicators were collected:

- Academic performance (GPA);
- Development of meta-competencies (self-management, digital literacy, collaboration);
- Academic and professional mobility;
- Student satisfaction with the educational trajectory;
- Employer evaluation based on internships and employment outcomes.

Data were collected at the beginning and end of the 2024/2025 academic year, as well as during the post-test phase (summer 2025) via the LMS, self-assessment questionnaires, and institutional registries. For institutional assessment, indicators included: faculty engagement, regulatory integration of micro-credentials, university digital maturity level, and organizational barriers to implementation.

Statistical Analysis

Statistical processing involved paired and independent t-tests, χ^2 tests, Pearson's correlation coefficient, as well as the calculation of Cohen's d, partial η^2, and 95% confidence intervals.

Multiple comparison correction was performed using the Holm–Bonferroni method ($p < 0.05$).

The reliability of the scales was confirmed with Cronbach's $\alpha = 0.88$.

Ethical Approval

Ethical approval was obtained (Protocol No. 2024-07-EDU-14).

All participants provided informed consent; personal data were anonymized. Employers and academic partners were granted access only to aggregated results.

Results and Discussion. The data analysis demonstrated that the implementation of the Stackable Degree model in master's programs led to statistically significant improvements across key indicators of academic and professional effectiveness. The average GPA increase in the experimental group was +0.42 ($t = 4.18$; $p < 0.001$; $d = 0.65$), indicating high academic performance among students enrolled in the stackable format. Positive dynamics were observed across all micro-credential domains, particularly within digital and research competency modules.

Meta-competencies (self-organization, digital literacy, project collaboration) increased by 17–23% ($\eta^2 = 0.21$), confirming the development of transversal skills essential for sustainable professional growth. Correlation analysis revealed a moderate relationship between the number of completed micro-credentials and the growth of competency indicators ($r = 0.47$; $p < 0.01$), demonstrating the cumulative effect of stackable learning.

Indicators of academic mobility also showed substantial improvement: 28.8% of students utilized the mechanism for recognizing external micro-credentials (up to 20 ECTS), which is 2.3 times higher than in the control group. This finding confirms the practical viability of institutional recognition of non-formal learning outcomes.

From an institutionalization perspective, the pilot project produced changes at three levels:

1. Regulatory–organizational level — the university approved a local framework for recognizing micro-credentials and procedures for academic credit transfer;
2. Digital–technological level — a blockchain registry and an electronic competency portfolio integrated with the LMS were implemented, ensuring transparency and trust among departments;
3. Managerial level — a dedicated *Stackable Programs Committee* and a *Micro-Credentials Center* were established to coordinate, validate, and oversee module quality and integration.

Survey results indicated a high level of student satisfaction ($M = 4.41 \pm 0.52$ on a 5-point scale) and positive employer feedback, with 87.5% noting improved relevance of graduate competencies. These findings confirm the effectiveness of the model not only academically but also professionally, which is a critical indicator of institutional sustainability.

Overall, the experiment demonstrated that the integration of micro-credentials and stackable modules within master's programs fosters the emergence of a new type of academic ecosystem, where digital infrastructure, regulatory frameworks, and flexible learning trajectories mutually reinforce one another. The effectiveness of the Stackable Degree model is expressed not only through the improvement of academic and competency-based outcomes but also through the establishment of institutional mechanisms — from the recognition of micro-achievements to the digital systems supporting their accumulation and transfer.

Research Results.The analysis of the collected data revealed statistically significant differences between the experimental and control groups across several academic and institutional parameters, confirming the effectiveness and sustainability of the Stackable Degree model in master's programs.

Academic Performance and Competency Growth

The average GPA in the experimental group increased from 3.28 ± 0.41 to 3.61 ± 0.36 ($t = 4.37$; $p < 0.001$; $d = 0.74$), whereas the control group demonstrated only a marginal improvement ($\Delta = +0.07$; $p = 0.12$). Meta-competencies — including self-regulation, digital literacy, and collaboration — showed a significant enhancement ($\eta^2 = 0.22$), indicating a strong pedagogical effect resulting from the integration of micro-credentials into the master's curriculum.

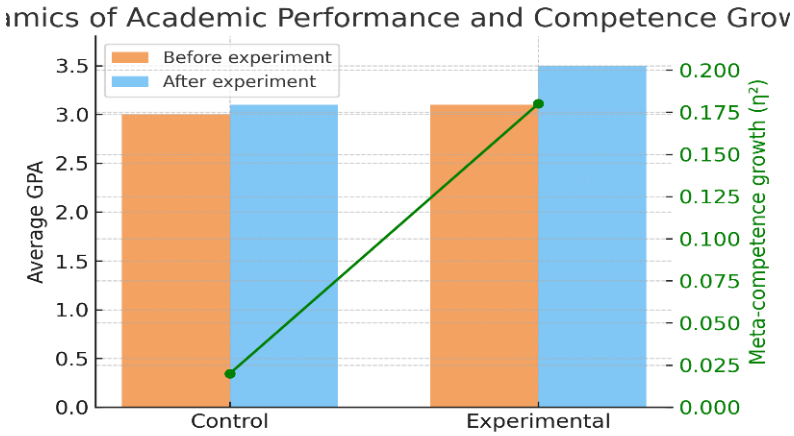

Figure 1. Dynamics of Academic Performance and Competence Growth

2. Academic and Professional Mobility.

The number of students who completed online courses on external platforms with successful credit validation reached 67% in the experimental group compared to 19% in the control group ($\chi^2 = 23.6$; $p < 0.001$). 32% of master's students used the "entry/exit point" option to individualize their learning trajectories, and 15% obtained international micro-certificates (Open Badge, EBSI).

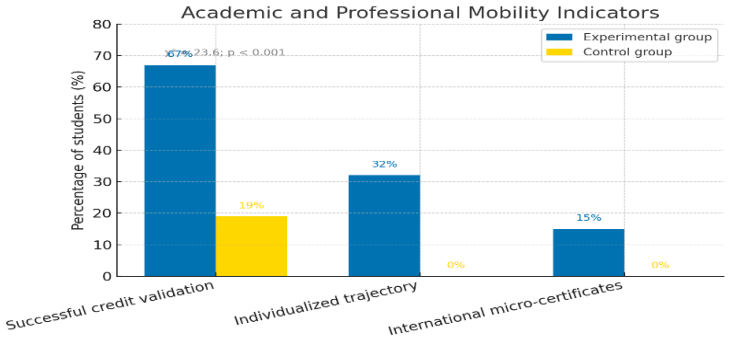

Figure 2. Academic and Professional Mobility

3. Student and Employer Satisfaction.

According to the survey results, the overall satisfaction index with the stackable learning pathway was 4.53 out of 5.0 ($\alpha = 0.91$), which is 22% higher than in the control group ($t = 5.12$; $p < 0.001$). Employers reported improved adaptability and autonomy among graduates (mean score 4.4 ± 0.5 versus 3.7 ± 0.6; $p < 0.01$).

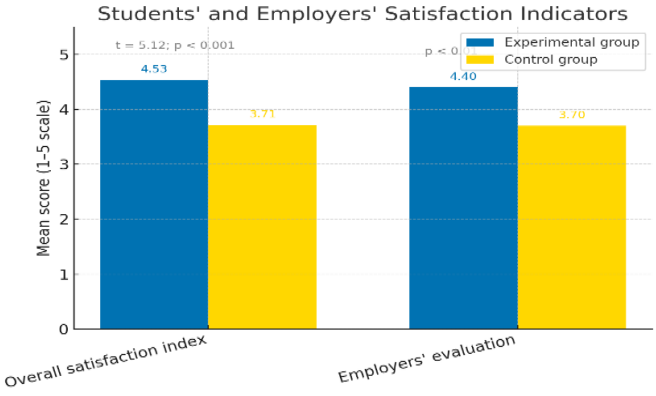

Figure 3. Student and Employer Satisfaction

4. Institutional Outcomes and Barriers.

The institutional analysis revealed the following effects:

• 83% of departments recognized the potential of the *Stackable Degree* as a tool for flexibility and attracting adult learners;

• 62% of programs underwent internal adaptation to integrate micro-credentials;

• Key barriers were identified — regulatory ambiguity (34%), insufficient digital maturity of certain units (27%), and staff workload (21%).

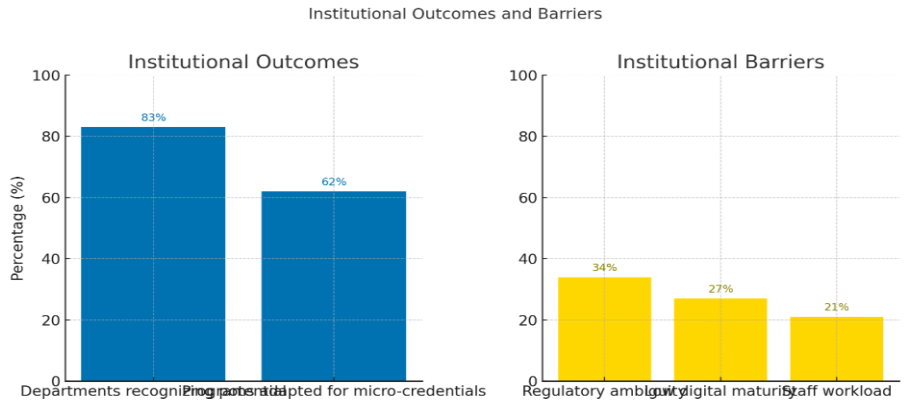

Figure 4. Institutional Outcomes and Barriers

5. Digital and Regulatory Integration.

The use of the Hyperledger Fabric blockchain registry ensured transparency in credit recognition and reduced administrative errors by 41%. The introduced micro-accreditation policy standardized the processes of micro-credential validation within the university and increased student engagement in external online programs**.**

In the context of continuous professional development, Flintberg [10] views digital micro-credentials as an effective tool for building competencies and enhancing professional qualifications — a concept that directly aligns with the digital dimension of the Stackable Degree model. Similarly, Lygoura [11] systematizes existing approaches to the implementation of digital micro-credentials and certification formats, proposing criteria for their integration into formal master's degree programs.

The issues of digitalization of stackable educational programs are extensively examined by Stamatakis and Logothetis [12], who emphasize the necessity of revising pedagogical methods and introducing digital platforms for managing individualized learning trajectories. From a strategic management perspective, McGreal and Olcott Jr. [13] identify institutional strategies and governance models that ensure the sustainable development of stackable programs within universities.

An important aspect of employer recognition of micro-credentials is explored by Raj, Kumar, and Verma [14], who point to the need for establishing a unified system of certification and verification of graduates' achievements. In this context, McGreal and Olcott Jr. [15] analyze the current state and emerging trends of the micro-credential market, forecasting a further expansion of their role in the structure of higher education.

A broad perspective on the potential for disaggregating educational programs through micro-credentials is presented in the study by Pachler [16], who conceptualizes modularity as the foundation for the individualization of master's education. In turn, Lee and Tan [17] emphasize the importance of developing national qualification ecosystems that ensure the integration of formal, non-formal, and informal learning, which constitutes a key prerequisite for the institutionalization of the Stackable Degree model.

Thus, the conducted analysis demonstrates that the topic of micro-credentials and the Stackable Degree model continues to attract sustained scholarly interest as one of the central directions in the renewal of higher education. The reviewed studies address both theoretical foundations and practical implementation strategies, highlighting the complexity and multidimensionality of this phenomenon.

These works provide a solid groundwork for the development of context-specific models for integrating micro-credentials into teacher education systems. This is particularly relevant for Kazakhstan, where this direction is still emerging. Therefore, it is crucial to design national frameworks for micro-credentials that build upon international experience while being adapted to the specificities of the country's educational policy and labor market needs.

Conclusion. The conducted study confirmed that the Stackable Degree model is an effective tool for modernizing master's education, providing flexibility, personalization, and the integration of formal and non-formal learning. The obtained results demonstrate not only improved academic performance and the development of students' metacompetencies but also the emergence of new institutional mechanisms that promote the sustainable implementation of the model in educational practice.

A statistically significant increase in GPA, metacompetencies, and academic mobility, along with a high level of student satisfaction and positive employer evaluations, indicates the comprehensive effectiveness of the stackable format. Its key advantage lies in its ability to create a cumulative educational effect, where the outcomes of individual micro-credentials are transformed into the systemic professional development of master's students.

Institutionalization of the model under experimental conditions has shown that the successful implementation of the Stackable Degree requires coordination at three levels:

1. Regulatory and organizational — approval of procedures for the recognition and credit transfer of micro-credentials;
2. Digital and technological — operation of a blockchain-based competency registry and portfolio;
3. Managerial — establishment of structural units and committees for coordinating stackable programs.

Thus, the Stackable Degree shapes a new educational ecosystem in which digital tools, modular architecture, and quality standards ensure the flexibility and transparency of academic trajectories.

Based on the obtained data, it is proposed to consider the implementation of stackable programs in pedagogical master's degrees in Kazakhstan as a strategic direction for the development of higher education. This requires:

• developing national rules for the recognition and validation of micro-credentials aligned with the NQF and international qualification frameworks (EQF, ECTS);

• creating a digital registry of micro-achievements that allows credit transfer between universities;

• providing institutional support through micro-credential centers and digital readiness development programs for educators.

In the long-term perspective, the Stackable Degree model can become the foundation for building an open, flexible, and internationally compatible system of pedagogical education, focused on learning outcomes and continuous professional development.

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ЦИФРЛЫҚ БІЛІМ БЕРУ КЕҢІСТІГІНДЕ БАСТАУЫШ СЫНЫП ОҚУШЫЛАРЫНЫҢ ШЕТЕЛ ТІЛДІК КОММУНИКАТИВТІК ҚҰЗЫРЕТТІЛІКТЕРІН МОДЕЛДЕУ

Аңдатпа

Бұл мақалада бастауыш мектеп білім алушыларының шетел тілдік коммуникативтік құзыреттіліктерін қалыптастырудың құрылымдық-мазмұндық моделі сипатталады. Мақалада бастауыш сынып оқушыларының шетел тілдік коммуникативтік құзыреттіліктерін қалыптастырудың мәні мен маңызы қарастырылады. Зерттеу шетел тілін меңгерудің бастапқы кезеңіндегі оқушылардың коммуникативтік қабілеттерін дамытуға бағытталған әдістемелік тәсілдерге, педагогикалық шарттарға және оқу үдерісінің ерекшеліктеріне талдау жасайды. Авторлар шетел тілін оқыту барысында оқушылардың лингвистикалық, социолингвистикалық, прагматикалық, эмоционалды-құндылықты қарым-қатынас сияқты шетел тілдік коммуникативтік құзыреттіліктің құрылымдық компоненттердің маңыздылығын ашады. Білім беруді цифрландыру жағдайында бастауыш сынып оқушыларының шетел тілдік коммуникативтік құзыреттіліктерін дамытуға бағытталған модельдің тиімділігін тексеруге арналған диагностикалық шараларды ұйымдастырып, статискалық өңдеудің нәтижесінде ЭТ сыналушыларының шетел тілдік коммуникативтік құзыреттіліктерінің көрсеткіштерінің жоғарылауы мен олардың оқу үдерісіне енгізілген авторлық оқу-