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SHALABAYEVA LAURA[1], UMIRBEKOVA AKERKE[2], SOVETKANOVA DAMIRA[2]*

[1]International University of Tourism and Hospitality (Turkistan, Kazakhstan)
[2]Abai Kazakh National Pedagogical University (Almaty, Kazakhstan)

*Address of correspondence: Akerke Umirbekova, Postdoctoral Researcher, Abai Kazakh National Pedagogical University, Muratbayev Str., 14, Almaty, 050014, Republic of Kazakhstan, https://orcid.org/0000-0001-7964-7322, E-mail address: umirbekova.akerke@list.ru

Development of an Inclusive Education Ecosystem Based on the Adapted Future Classroom Lab Model

Abstract

Introduction: The article discusses the problem of forming an effective inclusive education ecosystem in the system of training future teachers. The study aims to scientifically substantiate the potential to develop future teachers' inclusive competencies by adapting the Future Classroom Lab (FCL) model to the conditions of higher pedagogical education. *Methodology and Methods.* The study's methodological framework draws on mixed-methods research design, providing a broad and nuanced understanding of the inclusive education ecosystem. *Results.* The study found that implementing the FCL model enables inclusive education to be organized not as a set of individual methods, but as a holistic ecosystem whose pedagogical, spatial, and technological components are interconnected. Future teachers have systematically developed their skills in diagnostic and evaluative, didactic adaptation, and inclusive assessment. TEIP results in quantitative indicators increased significantly: confidence in inclusive education rose from 2.8 to 3.9, task adaptation from 2.6 to 3.8, and behavior management from 2.7 to 3.7. Class indicators also improved (emotional support, process organization, and cognitive stimulation). According to SACERS, the overall average assessment of the learning environment was high, ensuring the availability and safety of premises, flexibility of zones, and inclusive adaptation. *Scientific novelty.* The study's scientific novelty lies in adapting the Future Classroom Lab model to the context of higher pedagogical education and justifying inclusive training at the university-future-teacher level using an ecosystem approach - *practical significance.* The results provide a clear methodological basis for training future teachers in universities to work in an inclusive environment based on experience. The FCL ecosystem allows for the reorganization of the learning space, the development of adapted educational materials, the creation of a safe psychosocial environment, and the implementation of inclusive approaches to assessment.

Keywords: inclusive education, future classroom lab, inclusive ecosystem, pedagogical competence, blended methodology, learning environment, inclusive competence.

Introduction. Today, the global educational landscape is changing rapidly. Accelerating social processes, technological advancements, and economic transformations have placed new demands on the education system. In the ever-changing, uncertain, complex, and ambiguous VUCA world, education must no longer be limited to the transmission of knowledge and skills. Instead, it must evolve as a flexible, open, and sustainable ecosystem that empowers individuals to reach their full potential. As part of these changes, it is especially important to consider the interests of students with special educational needs. Ensuring their equal access to quality education has become one of the main strategic priorities in education.

The development of inclusive education in the Republic of Kazakhstan has been identified as one of the most important areas of state policy. This position is directly linked to the country's long-term development goals. In his Address "Economic Guidelines for a Just Kazakhstan" (2023), President Kassym-Jomart Tokayev emphasized that inclusivity and justice are the foundation for sustainable social development. (Tokayev, 2023).

This approach aims to ensure that every child, including those with special educational needs, has the right to receive a safe, accessible, and high-quality education. From this perspective, implementing the national project "Comfortable School" (2022) (Government of the Republic of Kazakhstan, 2022), developing a digital educational environment, and improving the professional quality of teaching staff are closely interconnected and complementary tasks. However, the difficulties in implementing inclusive education are not limited to a lack of material and technical resources. In fact, the main challenge is that future teachers are not adequately prepared to work in an inclusive environment. In today's universities, the teacher training process remains insufficient, focusing on experience-based education that often prioritizes theory and lacks specific inclusive conditions.

As a result, young professionals face serious difficulties working with students with different educational levels and psychophysiological characteristics when they enter school. Today's teacher is not only a specialist who is well-versed in their subject matter. They must also be a professional who can identify each student's individual needs in the classroom, adapt learning tasks accordingly, use flexible assessment approaches, and make effective use of digital technologies. These requirements call for a new approach to training future teachers. Therefore, introducing modern approaches and practice-oriented, innovative models in teacher training has become urgent. In this regard, the adaptive implementation of the Future Classroom Lab (FCL) model in higher education is particularly important as an effective way to create an inclusive education ecosystem. Developed by the European Schoolnet initiative, this model offers a fresh perspective on the educational landscape. (European Schoolnet, 2012). The FCL concept views the classroom not just as a technology-equipped room, but as a flexible, multifunctional environment with interconnected areas for research, creation, presenting ideas, building relationships, sharing experiences, and reflection. This educational space provides a real opportunity for the comprehensive development of professional, social, and digital competencies for future teachers.

This research is relevant to the need to implement innovative best practices in education, as outlined in the Law of the Republic of Kazakhstan on Education (Law of the Republic of Kazakhstan, 2007). In particular, Article 43-1 of the law clearly states the importance of modern approaches aimed at modernizing the education system. At the same time, this issue relates to the task of creating a digital pedagogical environment, as outlined in the Concept for the Development of Higher Education and Science in the Republic of Kazakhstan for 2023–2029 (Government of the Republic of Kazakhstan, 2023).

The article explores the importance of Future Classroom Lab zones in developing soft skills for future teachers. It also analyzes the application of the SACERS and CLASS scales for assessing the quality of the educational environment, as well as the methodological aspects of using digital technologies in inclusive education. The research results will serve as a basis for developing a modern model of training inclusive teachers. They will make a real contribution to the modernization of the higher education system for teachers.

The Future Classroom Lab (FCL) concept, developed by the European Schoolnet in 2012, has become one of the most influential models for transforming educational environments in response to the demands of 21st-century learning. The model emphasizes flexible learning spaces, digital technologies, active pedagogies, and student-centered instruction. According to a systematic review by Pablo Dúo-Terrón (2024), research on FCL demonstrates its positive impact on learner engagement, collaboration, digital competence development, and innovative teaching practices. The author highlights that the FCL framework promotes reorganizing educational spaces into interconnected learning zones that support creativity, inquiry, interaction, and the presentation of knowledge. Related research on innovative learning environments also highlights the effects of classroom design on learning (Barrett et al., 2015), differences

between traditional and innovative environments (Byers et al., 2018a, 2018b), transition strategies (French et al., 2020), the design of a Future Classroom Laboratory (Colton et al., 2020), and the use of FCL-based active and gamified learning (Montero-Izquierdo et al., 2024). Studies of 21st-century classrooms further emphasize changes in learning and teaching practices (Göçen et al., 2022).

A growing body of research suggests that contemporary educational institutions should be viewed as learning ecosystems Yang, C., Wang, T., & Xiu, Q., 2025) rather than isolated classrooms. Learning ecosystems integrate pedagogical, technological, social, and organizational components into a unified educational environment. Recent studies emphasize that effective educational ecosystems facilitate personalized learning, collaboration among stakeholders, and equitable access to educational resources. Such ecosystems are particularly important in the context of inclusion because they enable the participation of diverse learners with different educational needs. Research on inclusive innovative learning environments further emphasizes inclusive practice and belonging for students with disabilities (Page et al., 2021a, 2021b, 2023, 2024), psychological safety in innovative spaces (Charteris et al., 2024), and the challenges of creating inclusive learning environments in higher education (Korthals Altes et al., 2024). Evidence from Scotland also demonstrates the importance of space in supporting pupils with additional support needs (Clemson & Coyle, 2025).

The development of an inclusive educational ecosystem requires not only technological innovation but also collaborative relationships among teachers, students, parents, and community organizations. Research by Khairul Anam and colleagues (2022) demonstrates that inclusive collaboration serves as a key mechanism for creating a supportive school environment where all participants contribute to educational success. Their findings indicate that sustainable educational ecosystems emerge when schools build partnerships that extend beyond the classroom and involve multiple stakeholders in decision-making.

Recent research by Shalabayeva et al. (2025) further emphasizes the Future Classroom Lab concept's potential to prepare future teachers to work in inclusive educational environments. The authors highlight the importance of combining flexible learning spaces, innovative pedagogical approaches, and practical teacher preparation within the Future Classroom framework. In their research, Kazakhstani scientists A. D. Zhumageldieva and G. A. Abayeva emphasize the need to implement inclusive education through systemic models. They highlight barriers that arise when integrating children with special educational needs into the general education environment and point to a lack of teacher readiness as a major challenge. They argue that inclusive education should be complemented by models that address teachers' specific professional needs, rather than relying solely on legislative changes. The authors also note that a lack of understanding of the theoretical foundations of inclusion, limited knowledge of the psychological characteristics of children with special needs, and difficulty choosing effective methods and technologies reduce teachers' confidence in inclusive education. This situation creates instability in teachers' professional activities and affects the quality of the inclusive environment (Zhumageldieva & Abayeva, 2024).

Continuing this line of reasoning, Kudarinova A. S. and Autayeva A. N. specifically analyze the professional and personal readiness of future teachers to implement inclusive education (Kudarinova & Autayeva, 2022). The authors describe inclusive education as a phenomenon that involves providing high-quality, accessible education for everyone, based on UNESCO principles, and emphasize that the main foundation is each student's perception based on their individual characteristics.

The problem of readiness in inclusive education is not only voiced at the general level, but also deepened in the context of working with special categories. A striking example is the work with students with autism spectrum disorders. Authors Sardarova Zh. I. and Sarsenbay U., one of the researchers who specifically raised the relevance in this area, note that the organization

of education for students with autism spectrum disorders in modern conditions of inclusive education requires a special approach (Sardarova & Sarsenbay, 2025). According to them, since this category of children often faces serious difficulties in learning, adaptation, and social interaction, their integration into the general education environment does not occur "spontaneously." Instead, it requires proper harmonization of special education forms, flexible implementation, and support tailored to individual needs.

Sardarova Zh. I., Kismetova G. N., and Kadyrgalieva S. I. show that the psychological readiness of future teachers for professional activity in an inclusive environment is of particular importance. The authors consider psychological training as "complex synthetic knowledge" and divide its structure into two main groups: motivational-emotional and cognitive components (Sardarova et al., 2024). In other words, readiness for inclusion is not measured by a single "intention": on the one hand, the emotional response, fear, or perception of the teacher; and on the other hand, the level of actual knowledge and understanding go hand in hand.

An important aspect of this study is the relationship between psychological training and emotional intelligence. The authors believe that a teacher with high emotional intelligence can create a psychologically supportive environment in an inclusive setting, ensuring both their own safety and their students' safety. Conversely, an emotionally unstable adult's reaction can undermine children's self-confidence, increase anxiety, and turn negative experiences into a constant role model. Therefore, developing emotional intelligence to adapt to an inclusive environment is not only a personal development issue but also a professional necessity.

One study that explains the formation of a teacher's readiness through real opportunities at the university level is the work of G. K. Shugaeva and N. Shmankyzy (Shugaeva & Shmankyzy, 2020). The authors consider how universities can prepare future specialists for an inclusive school education system and associate the essence of inclusive education not only with the child's resources, but primarily with the resources of the surrounding educational environment.

Gavrilova E. A. proposes the hypothesis that including a special author's discipline in the curriculum can effectively prepare future teachers for work in an inclusive educational environment (Gavrilova, 2022). According to E. A. Gavrilova, the frequent lack of preparation of school teachers for working with "special" children is largely due to psychological barriers, a lack of psychological and pedagogical knowledge, and methodological approaches. Therefore, training should be carried out purposefully during professional training, i.e., at the university stage. An important study that complements this logic at the "system model" level is authored by I. A. Akhmetshina and A. A. Loseva. The authors note that as inclusive education develops, social demand and educational standards require teacher training to be organized at a new level (Akhmetshina et al., 2019).

Gorbunova N.V. shows that the tasks of a specialist working in an inclusive environment include several areas: organizational, educational, and research activities, as well as psychological support, medical rehabilitation, and information and consulting services (Gorbunova, 2017). From the author's perspective, the goal of inclusive education goes beyond academic outcomes and includes creating a unified environment, socialization, psychological and pedagogical support, individualized educational trajectories, systematic work with parents, and fostering positive attitudes among all participants.

These ideas naturally align with the concepts of "system model" and "practice-oriented training" discussed above: inclusive competence is viewed as comprehensive training shaped by an organized environment and coordinated teamwork, rather than as an individual skill. Another important area of research is developing the project competencies future teachers need for an inclusive environment. This problem can be addressed using the project-competence approach proposed by Ketrish et al. (2016). The authors note that, in the context of

inclusive education, teacher readiness requires changes to the professional training process that go beyond individualized approaches and general pedagogical education. Smantser and Ignatovitch (2015) similarly emphasize the need to prepare future teachers through experience for work in inclusive educational environments.

The literature review suggests that preparing future teachers for inclusive educational environments should be based on systemic, multi-level, and practice-oriented models. However, the analyzed works often focus on the inclusive environment at the school level or on individual subjects and training components, and do not sufficiently address the need to provide future teachers with a comprehensive, "live" model of working in an inclusive environment at the university. This highlights the need for innovative educational models that develop future teachers' professional, psychological, and project-related competencies in a single environment.

Materials and Methods. The study employed a mixed-methods quasi-experimental research design to examine the effectiveness of an adapted Future Classroom Lab (FCL) model in developing an inclusive education ecosystem within a university-based teacher education context. The mixed-methods approach was selected because developing an inclusive educational environment involves both measurable changes in students' professional competencies and qualitative characteristics of the learning environment, including accessibility, flexibility, interaction, collaboration, and pedagogical support.

The quantitative component assessed changes in future teachers' self-efficacy for inclusive practices and evaluated the quality and inclusiveness of the learning environment before and after the intervention. Systematic observations of instructional interactions and expert assessment of the educational environment supported the qualitative component.

The research was organized into four interconnected stages. The first stage was theoretical and conceptual. At this stage, scientific literature and international practices concerning inclusive education, innovative learning environments, and the Future Classroom Lab model were analyzed. The analysis focused on principles of accessibility, flexibility, learner-centered education, collaboration, personalization, digital technology integration, and adapting learning environments to diverse educational needs. The theoretical analysis identified key characteristics to incorporate into an adapted FCL environment for inclusive teacher education.

The second stage was design and adaptation. The principles of the Future Classroom Lab model were adapted to the context of university-based teacher education and inclusive education. The adapted learning environment emphasized flexible organization of learning spaces, accessibility, movable furniture, collaborative and individual learning zones, digital resources, opportunities for differentiated learning activities, and interaction among students and instructors. The university educational space was therefore conceptualized not simply as a physical classroom but as an integrated ecosystem combining spatial, technological, pedagogical, and psychosocial components.

The third stage was implementation and observation. During this stage, students in the experimental group participated in learning activities organized within the adapted FCL environment. The Classroom Assessment Scoring System (CLASS) was used to assess the quality of instructional interactions. The environmental characteristics of the university learning space were assessed using an adapted version of the school-Age Care Environment Rating Scale (SACERS).

The fourth stage was the evaluation stage. At this stage, the Teacher Efficacy for Inclusive Practices (TEIP) questionnaire assessed future teachers' self-efficacy in inclusive educational practices. The study also conducted environmental and instructional assessments and compared pre-test and post-test results to determine changes after implementing the adapted FCL model.

Participants. The study involved 78 undergraduate students enrolled in teacher education programs at a pedagogical university in Kazakhstan. Participants were randomly

assigned to an experimental group (n = 39) and a control group (n = 39).

The experimental group participated in learning activities organized within an adapted Future Classroom Lab environment based on the principles of inclusive education. The control group continued their studies in traditional classroom settings during the same period.

The intervention lasted 12 weeks (one academic semester). Data were collected at two measurement points: before implementing the adapted FCL model (pre-test) and after completing the intervention (post-test). The pre-test provided baseline measurements, while the post-test assessed changes in participants' inclusive competencies and perceptions following the intervention.

Random assignment of participants to experimental and control groups reduced potential selection bias and increased group comparability. Both groups followed the same general teacher education curriculum, but the learning environment and activities differed in their organization.

Research Instruments. Three complementary instruments were employed to assess different components of the inclusive education ecosystem: the Teacher Efficacy for Inclusive Practices (TEIP) questionnaire, an adapted School-Age Care Environment Rating Scale (SACERS), and the Classroom Assessment Scoring System (CLASS).

Teacher Efficacy for Inclusive Practices (TEIP)

The Teacher Efficacy for Inclusive Practices (TEIP) scale assessed future teachers' perceived self-efficacy in implementing inclusive educational practices. The instrument consists of 18 items organized into three dimensions: efficacy in inclusive instruction, efficacy in collaboration, and efficacy in managing student behavior. (Sharma et al., 2012).

Participants responded to each item using a 6-point Likert scale, ranging from 1 ("strongly disagree") to 6 ("strongly agree"). Higher scores indicated greater perceived self-efficacy for working in inclusive educational settings.

The TEIP was administered at both measurement points, before and after the 12-week intervention. Changes in TEIP scores were used to determine whether participation in the adapted FCL environment was associated with increased future teachers' confidence in applying inclusive practices.

Classroom Assessment Scoring System (CLASS). The Classroom Assessment Scoring System (CLASS) was used to evaluate the quality of instructional interactions within the learning environment. The instrument assessed three broad domains: Emotional Support, Classroom Organization, and Instructional Support. (Pianta et al., 2008).

The Emotional Support domain examined the quality of interpersonal relationships, responsiveness, and the emotional climate of the learning environment. Classroom Organization focused on the organization and management of learning activities, student engagement, and effective use of learning time. Instructional Support addressed pedagogical practices supporting students' cognitive engagement, learning processes, and higher-order thinking.

CLASS observations were conducted at both pre-test and post-test stages. Two trained external experts conducted the observations independently. The observers were not involved in the teaching process and therefore did not participate in implementing the adapted FCL intervention.

Inter-rater agreement between the two observers exceeded 0.85, indicating satisfactory agreement and supporting the reliability of the observational assessment.

Data Collection Procedure. Data collection was conducted during a 12-week academic semester and included pre-intervention and post-intervention measurements. At the pre-test stage, both the experimental and control groups completed the TEIP questionnaire. At the same stage, the adapted SACERS instrument assessed the educational environment, and CLASS observations established baseline characteristics of instructional interactions (Harms et al., 1996). Following the baseline assessment, the experimental group participated in learning activities within the adapted FCL environment for 12 weeks. The environment was organized around flexibility, accessibility, collaboration,

personalization, digital technology integration, and learner-centered education.

Ethical Considerations. The study followed ethical principles applicable to educational research. Participation was voluntary, and all participants provided informed consent before data collection. Participants were informed about the study's purpose, the procedures involved, the voluntary nature of participation, and their right to withdraw without academic or other negative consequences. The researchers-maintained confidentiality and anonymity throughout the research process. Participants were identified by code rather than name, and individual identifying information was not included in the analytical database or published results. The collected data were used exclusively for scientific purposes. The researchers also adhered to academic integrity principles throughout all stages of the study. The research data were not intentionally falsified or manipulated, and the sources used to develop the theoretical and methodological framework were appropriately acknowledged. Copyright and intellectual property requirements were respected.

Data Analysis. Quantitative data were analyzed using IBM SPSS Statistics 29.0. We calculated descriptive statistics, including means and standard deviations, for the main study variables. We assessed the internal consistency of multi-item scales using Cronbach's alpha. The distribution of quantitative variables was examined before inferential analysis to determine the appropriateness of parametric statistical procedures.

Results. As a result of the first theoretical and conceptual stage, foreign scientific works and international experience in applying the Future Classroom Lab model in inclusive education were comprehensively analyzed and systematized. The analysis revealed that in the organization of inclusive education in European countries and the United States, the structure of the educational space, pedagogical interaction, and the assessment system are not considered separately. Instead, these components are designed as a unified system focused on individual student needs.

Practical work in the Future Classroom Lab (FCL) environment has led to significant changes in future teachers' professional development. In particular, three main universal inclusive skills have been systematically developed in their professional image. These skills were identified through qualitative observations conducted during the study, an analysis of students' practical assignment progress, and the results of the TEIP survey. The data showed that future teachers became more confident working in an inclusive environment and developed a more conscious and purposeful approach to their professional activity.

Table 1
Universal inclusive skills of the future teacher

Universal skill	Content description	Formation mechanism in the FCL environment
Diagnostic and evaluation	Identification of cognitive, emotional and behavioral characteristics of the student	Control cards, case analysis, digital monitoring
Didactic adaptation	Adaptation of the same reading content to different levels of perception	Multimodal content, level tasks
Inclusive assessment	Taking into account the dynamics of individual student progress	Formative and criterion-based assessment

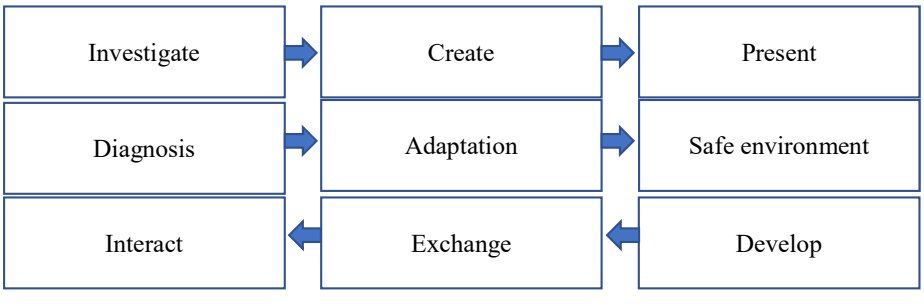
Developing diagnostic and evaluative skills changed the future teacher's attitude toward the student. Students began to see the student not as an abstract individual who meets the "average standard," but as an individual with a unique learning pace and capabilities. This skill becomes an essential foundation for teachers to make independent, informed decisions in an inclusive classroom. The results showed that future teachers prioritized functional pedagogical assessment over defectological diagnostics, aligning with current inclusive

education requirements. The development of didactic adaptation skills clearly demonstrated the growth of students' ability to flexibly reframe the learning content. Through experimentation, they realized that the same learning material could be presented at multiple levels, and they gradually moved away from the "one program, one approach" principle. This shows that future educators are willing to consciously choose learning strategies that meet students' diverse needs in an inclusive environment.

The development of inclusive assessment skills revealed a significant shift in the pedagogical approach to assessment. Assessment was no longer seen as a tool for control or selection, but rather as a mechanism that supports student development and reflects their progress. This change means that the professional culture of future teachers has reached a new quality level. The results showed that the regional structure of the Future Classroom Lab environment supports the comprehensive development of the future teacher's inclusive competence. These areas are organized as an interconnected, complementary, and holistic system, rather than as elements that operate independently. This interaction creates conditions for viewing the learning process as a cycle aimed at continuous professional development (Figure 1).

Figure 1

Cyclical model of an inclusive ecosystem based on FCL



This cycle clearly demonstrates the logic of future teachers' actions in an inclusive environment. First, teachers identify students' learning characteristics and psychosocial needs and conduct initial diagnostics. Based on this data, the learning content and tasks are adapted to different abilities. Next, students have the opportunity to present their work in a safe, supportive environment. The Future Classroom Lab environment consists of six interconnected areas. Each region focuses on developing specific skills and competencies future teachers need to work in an inclusive environment. These areas function not individually, but as a unified system, providing comprehensive professional development for teachers (Table 2).

Table 2

FCL areas and emerging inclusive competencies

FCL Zone	Main action	Formed competence
Investigate	Analysis of the student's educational and individual needs	Analytical thinking
Create	Development of adapted educational materials	Didactic flexibility
Present	Presentation of results in a safe environment	Psychosocial support
Interact	Organization of classroom interaction	Inclusive management
Exchange	Group and collaborative work	Social integration
Develop	Reflection and self-development	Emotional stability

The Investigate area teaches the future teacher to understand the student first. At this stage, students analyze the student's learning pace, interests, emotional state, and areas that

need support. As a result, the future teacher in an inclusive environment becomes accustomed to teaching based on real data rather than random decisions. The learning content is recompiled based on the data obtained in the Create area. The future teacher will learn to present the same topic at different levels and in different formats. This stage builds didactic flexibility and helps the future teacher move away from a "one-size-fits-all" approach.

The Present Zone emphasizes safety and support in an inclusive environment. Here, students can freely present their work without fear of criticism. For future educators, this area serves as an important learning platform for giving feedback while maintaining students' self-esteem. The Interact Zone focuses on developing classroom management and collaboration skills. Students learn effective leadership techniques based on cooperation and understanding rather than strict discipline control when working with students with diverse abilities. This is considered a crucial aspect of inclusive management.

The Exchange area is focused on collaboration and sharing experiences. Here, students recognize the importance of teamwork and operate in an environment that values each individual's contributions. As a result, social awareness is enhanced, and an inclusive culture is fostered. The Developer area focuses on reflection and professional self-development. Future educators review their actions, analyze their achievements, and address their challenges. This phase enhances emotional resilience and promotes tolerance for professional stress.

The FCL areas develop future teachers' inclusive competence not only at the knowledge level but also at the cognitive, social, and emotional levels. This approach allows for the development of inclusive education as a holistic professional culture rather than a collection of individual methods. The study's quantitative results demonstrate the effectiveness of the Future Classroom Lab ecosystem through accurate data. The findings show a significant increase in future teachers' confidence in working in an inclusive environment.

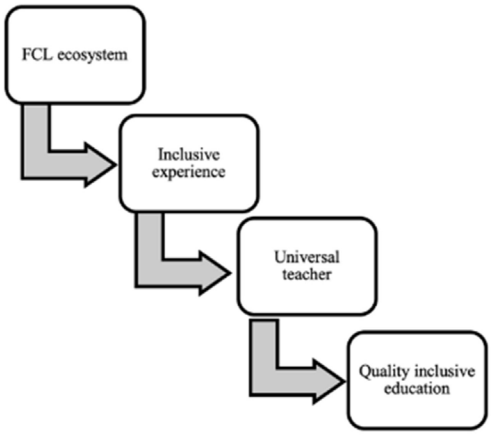
Table 3

Changes in TEIP scores

Indicator	Initial	Final	Changes
Confidence in inclusive education	2,8	3,9	+40%
Adaptation of tasks	2,6	3,8	+46%
Behavior management	2,7	3,7	+37%

The increase in all TEIP scores indicates that future teachers have increased their internal trust in working in an inclusive environment. In particular, the increased ability to adapt learning tasks indicates that students are ready to be flexible and aware in an inclusive classroom. Additionally, improved behavior management scores indicate that future teachers have reduced their fear of challenging teaching situations. These changes are directly related to the FCL's practice-oriented, error-tolerant, and supportive environment. In such an environment, students have the opportunity to try their hand at something, analyze their mistakes, and become more confident in their professional abilities. The results obtained using the SACERS scale showed that the Future Classroom Lab environment fully meets inclusive requirements not only at the formal level, but also in terms of content and organization. The impact of the FCL ecosystem can be seen in the following logical chain (Figure 2).

Figure 2
Logical sequence of FCL ecosystem effects



The results of the study show that the Future Classroom Lab model can create a full-fledged, sustainable, and effective inclusive education ecosystem in the process of training future teachers. This model allows for the development of inclusivity not as a collection of individual methods, but as an integral part of a teacher's professional culture. Results for the criterion of organizing the educational process revealed the lesson structure. They showed increased use of educational instruction; future teachers have begun to plan educational activities more consistently.

The increase in cognitive development stimulation indicators suggests that students are using more tasks that encourage them to think, analyze, and justify their opinions. This demonstrates future teachers' readiness to engage in active, meaningful learning in an inclusive environment. The quantitative data from the CLASS methodology show that the Future Classroom Lab ecosystem systematically enhances the culture of pedagogical communication, emotional sensitivity, and the quality of professional interaction among future teachers.

Discussion. The results showed that the adaptive model of the Future Classroom Lab (FCL) can serve as a basis for building an inclusive education ecosystem. In this section, the obtained data are discussed in the context of the original research questions and assumptions, and their theoretical and practical significance is revealed.

The study analyzed the current state of the inclusive educational environment in Kazakhstan against SACERS international standards. The results showed that the main limitation in ensuring inclusivity is not the material and technical base, but the lack of effective pedagogical approaches. In other words, the availability of space and modern equipment is not enough to create a self-sustaining inclusive ecosystem.

The analysis contributes to the harmonious interconnection of pedagogy, technology, and space as the main condition for the effective development of an inclusive environment. The main advantage of the Future Classroom Lab model is that it can combine these three components into a single system. This approach aligns with the ecosystem approach widely used in international practice and supports the comprehensive development of inclusive education.

During the study, attitudes changed significantly. Inclusion is now perceived not only as the "responsibility of a specialized professional, such as a speech therapist", but also as part of the professional responsibility of any educator. This change shows that inclusion has become a common, universal value in future teachers' professional self-awareness. Additionally, this result proves that the integrated learning model is effective and plays an important role in preparing educators to work in an inclusive environment.

One of the study's main assumptions was that the Future Classroom Lab environment could serve as a safe, experimental platform for future educators to combine theory and practice. The results of the study showed that this assumption was fully confirmed. While traditional university learning environments often focused on theoretical knowledge, the FCL laboratory allowed students to engage in professional activities earlier by simulating specific inclusive situations.

In the study, students participated in solving virtual and physical cases that focused on working with children with special educational needs before they even started school. This format of work transformed the theoretical understanding of "I know" into a reflective competence that can critically approach the specific action of "I can" and my work. Based on the data obtained, it was found that graduates who have completed the FCL model have a school adaptation period that is approximately half as long as that of those who have completed traditional training. This result directly contributes to reducing the professional stress that arises from working in an inclusive environment and to the stability of teaching staff.

The results of the study have shown that the impact of the Future Classroom Lab model is not limited to the educational process. The social and economic consequences of this model are also evident and systemic. From a social perspective, increasing the number of teachers who are able to provide an inclusive environment reduces the isolation of children with special educational needs from society. Children who are educated in such an environment are exposed to social interaction at an early age and begin to feel like full members of society. In the long term, this process helps to reduce social inequality. From an economic perspective, providing teachers with the necessary skills to create an inclusive environment can help reduce the cost of retraining staff. In addition, the active participation of individuals with inclusive education in the future labor market will bring additional human capital to the country's economy. In this sense, the Future Classroom Lab model can be considered as a long-term investment with high social significance.

Conclusion. The research conducted has shown that the implementation of the adapted Future Classroom Lab (FCL) model in the training of future teachers provides a real opportunity to create an effective, sustainable, and systemic ecosystem of inclusive education. The results of the study clearly demonstrate the importance of considering inclusive education not as a collection of individual methods and techniques, but as a holistic system that integrates pedagogical approaches, space, and technologies. The research objectives and tasks were fully achieved. The study, based on a mixed methodology, allowed for a comprehensive analysis of the level of development of inclusive competencies among future teachers and provided a scientific basis for the effective implementation of the Future Classroom Lab model in higher education institutions. The combined use of qualitative and quantitative data ensured the reliability and validity of the results obtained.

The results showed that there were clear qualitative changes in the professional image of future teachers. In particular, students who participated in the Future Classroom Lab ecosystem consistently developed diagnostic and evaluative skills, content adaptation skills, and the ability to perform inclusive criterion-based assessments. These skills were identified as the universal professional foundation necessary for successful work in an inclusive classroom. The 40% increase in self-confidence on the TEIP scale provides strong evidence of the psychological readiness of future teachers to work in an inclusive environment.

The results of the study showed that the regional structure of the FCL model is crucial for the training of future teachers. The functioning of the Investigate, Create, Present, Interact, Exchange, and Develop zones as an interconnected system allows for the equal development of the cognitive, social, and emotional competencies of future teachers. The learning environment was rated as "very good" on the SACERS scale. The analysis clearly demonstrated that the Future Classroom Lab

model is an effective tool that combines theory and practice. Modeling an inclusive classroom in a university setting allows for a shorter period of professional adaptation for future teachers, avoiding professional stress and creating ready, reliable personnel for school practice. In this sense, the FCL laboratory serves as a safe and practical professional testing ground for future teachers.

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Information about authors:

Shalabayeva Laura, PhD, Associate Professor, International University of Tourism and Hospitality. ORCID https://orcid.org/0000-0003-2231-7888, email: lolabany84@mail.ru

Umirbekova Akerke, PhD, associate professor, Postdoctoral researcher, Abai Kazakh National Pedagogical University. ORCID https://orcid.org/0000-0001-7964-7322, email: umirbekova.akerke@list.ru

Sovetkanova Damira, PhD, Postdoctoral researcher, Abai Kazakh National Pedagogical University. ORCID https://orcid.org/ 0000-0003-2737-4021, email: Dami_88@list.ru