SDU
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An Inclusive Analysis of Mathematics Achievement and Attitudes in Diverse Educational Environments

Zoya Yuzeyeva

A thesis submitted to the Faculty of Education and Humanities
in partial fulfillment of the requirements for the degree of

MASTER OF PEDAGOGICAL SCIENCES

in Mathematics

«SDU University»
Department of Pedagogy of Natural Sciences

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Kaskelen, 2025

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List of Abbreviations

SEN-Special Educational Needs
LSEN-Learners with Special Educational Needs
PMPC-Psychological-Medical-Pedagogical Commission
FSES-Federal State Educational Standards
AEP-Adapted Basic Educational Program
SIDP-Special Individual Development Program
UC-Universal Competencies
PC-Professional Competencies
SC-Specialized Competencies
CC-Communicative Competencies
SES HE 3++ -State Educational Standards of Higher Education (version 3++)
OECD-Organization for Economic Co-operation and Development
ICT-Information and Communication Technologies
ULAs-Universal Learning Actions
UNESCO-United Nations Educational, Scientific and Cultural Organization
UN-United Nations
UNICEF-United Nations Children's Fund
CAPS-Curriculum and Assessment Policy Statement (referenced in comparative contexts)

ABSTRACT

This dissertation presents an inclusive analysis of mathematics education by examining the development of inclusive competence in future mathematics teachers within diverse educational environments in the Republic of Kazakhstan. Rooted in national and international frameworks on inclusive education, the research explores how cultural, linguistic, psychological, and regional factors affect teacher preparedness and attitudes toward working with learners with special educational needs (SEN).

The study focuses on Almaty and rural areas as case settings, analyzing how educational equity and inclusivity are addressed in mathematics classrooms. A structural-logical model was developed to support the formation of inclusive competence through a task-based, personalized, and culturally responsive methodology. The model integrates motivational, cognitive, practical, and reflective components, preparing future teachers to adapt mathematics instruction for learners with a wide range of abilities and backgrounds.

A three-stage pedagogical experiment involving 180 pre-service mathematics teachers and 28 in-service educators were conducted. Quantitative and qualitative data were collected to assess initial readiness, track development of inclusive attitudes, and evaluate the effectiveness of proposed instructional strategies. Results revealed significant improvements in teachers' motivation, adaptability, and use of inclusive methods following implementation of the model.

The findings highlight the importance of localized, inclusive teacher education that reflects Kazakhstan's evolving educational landscape. This work contributes to the broader discourse on equitable mathematics education and supports ongoing efforts to create accessible and high-quality learning environments for all learners.

Keywords: inclusive education, mathematics achievement, teacher attitudes, diverse educational environments, inclusive competence, Kazakhstan, special educational needs (SEN)

АҢДАТПА

Бұл диссертация Қазақстан Республикасындағы әртүрлі білім беру ортасында болашақ математика мұғалімдерінің инклюзивті құзыреттілігін дамыту үрдісін зерттеу арқылы математикалық білім берудің инклюзивті талдауын ұсынады. Инклюзивті білім беруге қатысты ұлттық және халықаралық тұжырымдамаларға сүйене отырып, зерттеу мәдени, лингвистикалық, психологиялық және аймақтық факторлардың мұғалімдердің дайындық деңгейіне және ерекше білім беру қажеттіліктері (ББҚ) бар оқушылармен жұмыс істеуге деген көзқарасына қалай әсер ететінін қарастырады.

Зерттеу математика сабақтарында білім берудегі теңдік пен инклюзивтіліктің қалай жүзеге асырылатынын талдай отырып, Алматы мен ауылдық жерлерге жағдайлық зерттеу ретінде қарастырады. Тапсырмаға негізделген, дербестендірілген және мәдениетке бейімделген әдіснама арқылы инклюзивті құзыреттілікті қалыптастыруды қолдау мақсатында құрылымдық-логикалық модель әзірленді. Бұл модель мотивациялық, когнитивтік, практикалық және рефлексиялық компоненттерді біріктіре отырып, болашақ мұғалімдерді түрлі қабілеттері мен дайындық деңгейі бар оқушыларға математикалық оқытуды бейімдеуге дайындайды.

Математика пәні бойынша 180 болашақ мұғалімі мен 28 тәжірибелі педагогтың қатысуымен үш кезеңнен тұратын педагогикалық эксперимент жүргізілді. Бастапқы дайындық деңгейін бағалау, инклюзивті көзқарастардың қалыптасуын қадағалау және ұсынылған оқыту стратегияларының тиімділігін сараптау мақсатында сандық және сапалық деректер жиналды. Эксперимент нәтижелері үлгіні енгізгеннен кейін мұғалімдердің мотивациясын, бейімделу қабілеті және инклюзивті әдістерді қолдану деңгейі айтарлықтай артқанын көрсетті.

Қорытындылар Қазақстанның дамып келе жатқан білім беру кеңестігін ескере отырып, жергілікті жағдайға бейімделген және инклюзивті мұғалімдерді даярлаудың маңыздылығын көрсетеді. Бұл зерттеу математиканы тең негізде оқытуға қатысты ғылыми пікірталасқа өз үлесін қосып, барлық оқушылар үшін қолжетімді және сапалы білім беру ортасын қалыптастыруға бағытталған үздіксіз күш-жігерді қолдайды.

Кілт сөздер: инклюзивті білім, математиканың жетістігі, мұғалімнің қарым-қатынасы, әртүрлі білім беру ортасы, инклюзивті құзіреттілік, арнайы білім беру қажеттіліктері

АННОТАЦИЯ

В данной диссертации представлен инклюзивный анализ математического образования путем изучения развития инклюзивной компетентности у будущих учителей математики в различных образовательных средах Республики Казахстан. Опираясь на национальные и международные рамки инклюзивного образования, исследование изучает, как культурные, языковые, психологические и региональные факторы влияют на готовность и отношение учителей к работе с учащимися с особыми образовательными потребностями (ООП).

Исследование фокусируется на примере Алматы и сельской местности, анализируя, как вопросы образовательного равенства и инклюзивности решаются в математических классах. Была разработана структурно-логическая модель для поддержки формирования инклюзивной компетентности с помощью методики, основанной на задании, персонализированной и учитывающей культурные особенности. Модель объединяет мотивационный, когнитивный, практический и рефлексивный компоненты, подготавливая будущих учителей к адаптации обучения математике для учащихся с широким диапазоном способностей и происхождения.

Был проведен трехэтапный педагогический эксперимент с участием 180 будущих учителей математики и 28 преподавателей без отрыва от работы. Были собраны количественные и качественные данные для оценки начальной готовности, отслеживания развития инклюзивного отношения и оценки эффективности предложенных учебных стратегий. Результаты показали значительное улучшение мотивации, адаптивности и использования инклюзивных методов учителями после внедрения модели. Полученные результаты подчеркивают важность локализованного инклюзивного педагогического образования, которое отражает развивающийся образовательный ландшафт Казахстана. Данная работа вносит вклад в более широкую дискуссию о справедливом математическом образовании и поддерживает усилия по созданию доступной и высококачественной среды обучения для всех учащихся.

Ключевые слова: инклюзивное образование, успеваемость по математике, отношение учителей, разнообразные образовательные среды, инклюзивная компетентность, Казахстан, особые образовательные потребности (ООП)

INTRODUCTION

The Republic of Kazakhstan's educational system is dynamically changing in order to promote a society that is more inclusive, egalitarian, and learner-centered. The idea that every learner has the right to receive high-quality instruction in mainstream settings, irrespective of their unique characteristics, developmental needs, or special educational needs, is fundamental to this change (Ismailova, 2019). Kazakhstan's laws ensure that all students, including those with special educational needs (SEN), have access to inclusive education in their communities, in accordance with national and international human rights frameworks.

Children and adolescents with physical, sensory, intellectual, or developmental disabilities are included in the category of learners with special educational needs in Kazakhstan. These students need inclusive settings that support fair learning outcomes in addition to modified teaching strategies and supportive services. The number of students with special educational needs in general education schools is continuously rising, according to national statistics and UNICEF data (UNICEF, 2013). This is putting an increasing amount of strain on educational institutions, teacher preparation programs, and school-level inclusion strategies.

The sociocultural framework of L.S. Vygotsky (1996), which highlights the significance of social integration, compensatory techniques, and adaptive pedagogies, is the foundation of Kazakhstan's inclusive education reforms. According to national policy, inclusive education is a strategy that addresses the whole range of learner diversity while guaranteeing equal learning opportunities.

Despite these developments, the successful application of inclusive education is hampered by a number of systemic issues. These include low public awareness, underdeveloped methodologies, insufficient teacher preparation, and a lack of human and material resources. Even though inclusive competence is now required by national professional standards for all educators, not just special education specialists, many pre-service teachers express that they are not prepared to handle the intricate demands of inclusive classrooms.

These difficulties are particularly apparent in the teaching of mathematics. High-stakes tests and strict curricula are common in math classes, which further hinders students who need individualized instruction. Therefore, it is both a pedagogical and a policy imperative that aspiring math teachers develop inclusive competence.

Motivational, cognitive, practical, and reflective aspects are all integrated into the complex concept of inclusive competence. It requires not only in-depth subject-matter expertise but also the pedagogical adaptability to modify lessons, differentiate resources, and foster inclusive learning environments. There is still a lack of math teachers who are prepared to address these changing demands in an urban area with as much cultural and linguistic diversity as Almaty, where inclusive initiatives are rapidly growing. Digital tools and personalized learning strategies can improve access and engagement for students with special educational needs, according to an increasing body of empirical research. These resources can improve reflective teaching methods,

increase motivation, and promote inclusive attitudes when incorporated into teacher preparation programs. Math teachers' capacity to function in inclusive settings can be greatly enhanced by a customized preparation program that takes into account each student's interests, professional aspirations, and personal strengths.

While inclusive education has been the focus of numerous global and national studies, relatively few investigations have addressed the formation of inclusive competence in specific subject areas such as mathematics. Even fewer have explored these questions within localized educational environments in Kazakhstan. Regional literature reveals a significant gap in understanding how future mathematics teachers in Almaty develop the competencies, attitudes, and strategies needed to support diverse learners. Addressing this gap defines the scientific novelty and practical relevance of this research.

Although inclusive education is increasingly taken into account in teacher training - such as the inclusion of a “inclusive education” course in the second year of the curriculum of math faculties - this course often provides only an overview. The subject-specific application of the topic in the math classroom is not comprehensively addressed. Therefore, this thesis is still of great importance as it provides a specialized mathematics-focused approach that supports the practical development of holistic competencies in future teachers.

The Republic of Kazakhstan has made great strides in creating inclusive education policies, but there are still obstacles in putting these policies into practice, especially when it comes to teaching mathematics. Teacher training programs frequently lack cohesive frameworks for developing inclusive competence in subject-specific contexts, despite national standards requiring all educators to be prepared for inclusive teaching.

In inclusive classrooms, mathematics poses special difficulties. For students with a range of skill levels, rigid curriculum structures, abstract material, and standardized tests can be barriers. When it comes to modifying their teaching to accommodate students with special educational needs, many pre-service and experienced math teachers lament inadequate training, methodological ambiguity, and a lack of experience. These challenges are especially acute in diverse educational environments such as Almaty and rural regions, where linguistic, cultural, and infrastructural differences influence teaching and learning processes.

An inclusive approach to mathematics education demands more than general awareness of inclusive values. It calls for a thorough comprehension of the cognitive and emotional needs of students, knowledge of differentiated teaching methods, and the ability to design inclusive, equitable, and culturally sensitive learning environments. However, these are areas where current teacher education curricula frequently fall short.

- Several unresolved contradictions are highlighted by a review of regional and national research:

- At the socio-pedagogical level: Although there is a growing commitment to inclusive education, there is a dearth of math teachers with the necessary training to put inclusive practices into practice.
- At the theoretical level: Although the value of inclusive mathematics education is well acknowledged, conceptual frameworks tailored to Kazakhstan's multilingual and multicultural environments are still lacking.
- At the methodological level: Although inclusive competence is a necessary part of teacher preparation, there aren't many organized, task-based approaches or online resources that help math teachers develop this competency.

These contradictions form the basis of the central research problem:

How can future mathematics teachers be effectively prepared to work in inclusive classrooms, and how can their inclusive competence be developed and evaluated in diverse educational environments such as those found in Almaty and other regions of Kazakhstan?

The purpose of this study is to develop and empirically validate a localized methodology for forming inclusive competence in future mathematics teachers, with a particular focus on diverse educational environments in the Republic of Kazakhstan. This includes analyzing teacher attitudes, instructional preparedness, and the use of personalized and technology-supported strategies to improve mathematics achievement and engagement among all learners, including those with special educational needs (SEN).

1. The study tackles the following particular goals in order to fulfill this purpose:
to examine the theoretical, policy, and historical underpinnings of inclusive education at the national, international, and regional levels, with a focus on how they apply to Kazakhstani math instruction;
2. To look into the sociocultural, pedagogical, and psychological traits of students with special education needs and how they relate to inclusive math education;
3. To outline the framework and essential elements of inclusive competence for aspiring math teachers, such as reflective, practical, cognitive, and motivational components;
4. To create a system of practice-oriented tasks and a structural-logical model for enhancing inclusive competence in mathematics teacher education;
5. To put the suggested model into practice in a phased educational trial and evaluate how well it enhances teacher attitudes, preparedness, and teaching methods;
6. To assess the degree to which the inclusive, individualized approach enhances the learning environment for mathematics in various educational contexts, especially in Almaty and similar regional contexts. He extent to which the personalized, inclusive approach contributes to improving mathematics learning conditions in diverse educational settings, particularly in Almaty and comparable regional contexts.

The process of preparing aspiring math teachers for successful employment in inclusive educational settings is the focus of the study.

The research's focus is on personalized, task-based, and culturally sensitive approaches that are tailored to Kazakhstan's varied educational environments in order to foster inclusive competence in aspiring math teachers.

Research Hypothesis: A tailored, task-based approach that incorporates inclusive pedagogy, subject knowledge, and digital tools—adapted to Kazakhstan's varied educational contexts—can successfully foster inclusive competence in aspiring math teachers.

In accordance with the purpose and objectives of the study, a three-stage pedagogical experiment was conducted to develop and evaluate a methodology for forming inclusive competence in future mathematics teachers. The research was carried out over several academic years and implemented within a defined experimental framework, ensuring methodological consistency and empirical rigor.

The experimental base consisted of two key educational settings:

- 180 pre-service mathematics teachers participated as part of their professional training;
- Dostyk School network in Almaty, where 28 in-service mathematics teachers took part in the applied phase of the study.

In order to develop the motivational, cognitive, practical, and reflective aspects of inclusive competence, a customized, task-based methodology was introduced and tested during the experimental work. The assignments were modified to fit the actual circumstances of Kazakhstan's various educational environments and incorporated into professional development activities, teaching practicums, and academic coursework.

- The following methodological guidelines were followed in order to guarantee the validity and dependability of the study findings:
- Internationally acknowledged theoretical and methodological underpinnings in the field of inclusive education served as the basis for the study;
- The growth of inclusive competence was tracked using a systematic system of diagnostic, formative, and summative evaluations;
- A wide range of empirical techniques were used, such as case analysis, reflective journals, diagnostic testing, surveys, and classroom practice observation.

Seminars, colloquia, and faculty meetings within SDU University's Faculty of Education and Humanities were among the academic forums where the research findings were presented and discussed. These platforms made it easier to validate the research process and provide helpful criticism.

Additionally, the study's theoretical and applied findings were published in peer-reviewed scholarly journals, conference proceedings, and educational forums, demonstrating the study's wider scholarly and practical significance for teacher preparation in Kazakhstan.

1. LITERATURE REVIEW

1.1 Evolution of Inclusive Education: International, National, and Local Perspectives

The 21st century is not only an era of new digital and information technologies, economic progress, and demographic growth – It is also a time of educational innovation, social transformation, and ethical development (Capurro R. , 2000). The realization that the primary goal of all forms of development is personal self-realization is coming to define this era more and more. A new paradigm for education has emerged as a result of these changes in public perception, one that is based on ideas and methods influenced by modern practice. One of the central elements of this paradigm is the concept of inclusive education (Omwami, 2020). In 1994, UNESCO hosted the World Conference on Special Needs Education in Salamanca, Spain. It was here that the term *"inclusion"* was formally introduced into international discourse, and the vision of inclusive education was officially proclaimed. Since then, there hasn't been a single, widely recognized definition of inclusive education. However, the definition of inclusive education in the context of high-quality education is perhaps best reflected in the interpretation given in UNESCO's own report.

The improvement of students' involvement in the educational process, cultural life, and society at large is how UNESCO defines inclusive education as a response to the various needs of all students. Additionally, it entails initiatives to lessen educational exclusion and stop discrimination in classroom settings (Asian, 2014).

As S.V. Alekhina (2013) states, "Inclusive education is not merely about the active participation of learners with special educational needs in the life of a mainstream school. More importantly, it is a complete transformation of the educational system itself, aimed at meeting the learning needs of all learners."

According to research by (Blecker, 2010) , inclusive education is defined as a specific form of interaction between teachers, learners without special needs, and learners with special educational needs within a general education setting. This interaction is based on both organizational factors—such as legal frameworks, comprehensive diagnostics, and the phased integration of learners with special educational needs into mainstream schools – and pedagogical factors, which include the creation of an adaptive educational environment, psychological-medical-pedagogical support throughout the learning process, and the development of an inclusive culture among learners, educators, and families.

Some scholars argue that the terms *inclusive education* and *integrated education* may be considered conceptually close (MISCALENCU, 2023). For instance, Professor Peter Mittler (1995) describes inclusive education as "…a step toward the ultimate goal of building an inclusive society—one that allows all children and adults, regardless of gender, age, ethnicity, ability, developmental conditions, or health status (including HIV), to participate in and contribute to community life. In such a society,

differences are respected and valued, and discrimination and prejudice are actively challenged in policy, everyday life, and institutional practice".

Inclusive education, therefore, requires an educational environment that not only accommodates learners with special educational needs but is also intentionally designed to support their full participation and learning success.

Based on these definitions, the term "learners with special educational needs" (hereafter referred to as LWD) may be more precisely defined as:

Individuals with special educational needs who have documented physical and/or psychological developmental impairments, confirmed by a psychological-medical-pedagogical commission, which hinder their ability to fully access the general curriculum without the use of specialized teaching methods and supports (Spooner, 2006).

In many countries, including Kazakhstan, the term "special educational needs" (SEN) has become an integral part of both educational policy and academic research. This term's broad usage reflects a global shift toward inclusive values and learner-centered education, despite variations in its classification and scope across national systems (Passeka, 2024).

For example, students with special educational needs are typically referred to as SEN in the United States, Germany, Greece, Hungary, Iceland, the Netherlands, and Spain. Czechia, Estonia, Finland, Latvia, Norway, Portugal, and the United Kingdom, on the other hand, take a more inclusive view that encompasses students from underprivileged backgrounds, members of ethnic minorities, and even gifted students. Sweden, Australia, and New Zealand, on the other hand, do not use strict classifications. The phrase is used in Australia and New Zealand to refer to any student who needs extra help, regardless of their diagnosis or classification. However, in Sweden, a student may still be placed in a specialized setting after being identified as having special educational needs (Schwab, 2020).

This range of interpretations demonstrates that inclusive education is a dynamic framework that adapts to local pedagogical, cultural, and legal contexts rather than being a set model. Across these systems, however, a shared understanding is emerging inclusive education is a collaborative educational process, where learners with and without learners with special educational needs engage together in academic instruction, extracurricular activities, and various forms of supplementary learning (Lindsay, 2003).

In Kazakhstan, as in many countries, the number of learners identified as having special educational needs has steadily increased in recent years. This growing diversity among learners has placed the issue of inclusion—particularly in mathematics classrooms—at the center of educational reform efforts. Following international commitments such as the UN Convention on the Rights of Persons with learners with special educational needs, Kazakhstan has actively participated in theoretical and practical research aimed at improving inclusive practice.

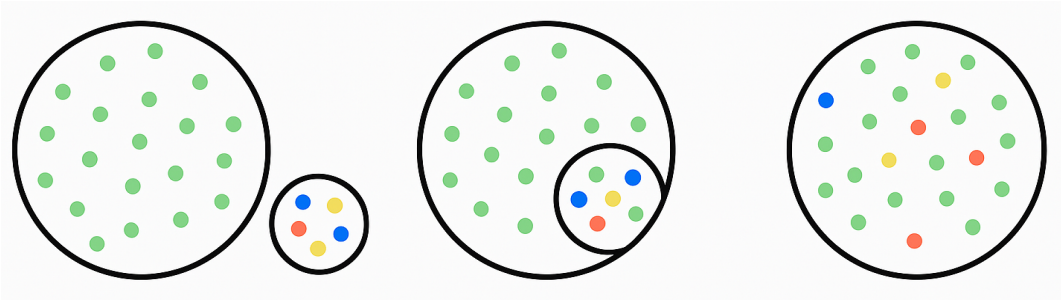
It is crucial to comprehend the conceptual and historical development of inclusive education before looking at the present obstacles and opportunities for creating inclusive mathematics education (Oad, 2023).

The historical development of inclusive education, which has been studied by numerous scholars, is another crucial aspect to comprehend. Although any periodization is necessarily imprecise, we utilize the classification put forth by N.S. Groznaya (2006) to delineate the three primary phases in the evolution of inclusive education:

- The establishment of residential institutions and specialized schools, where students with special educational needs were taught apart from their peers, was known as Stage I—Segregation. With little to no interaction with the general education system, this model placed a strong emphasis on segregation and a medical approach to students with special education needs.
- Stage II: Integration: In mainstream schools, special education needs students are placed in separate classrooms. This limited full participation by keeping learners educationally and structurally apart, even though it permitted some social interaction with peers who were typically developing.
- Stage III: Inclusion: All students, regardless of ability, actively participate in a common learning environment. This stage places a strong emphasis on the importance of diversity and the necessity of educating all students together while utilizing flexible teaching methods to accommodate a variety of needs.

Figure 1.1 depicts these phases, emphasizing the transition from exclusion to inclusion as well as the associated structural and philosophical adjustments in education.

Figure 1.1 Developmental Stages of Inclusive Education



Growing awareness that students with developmental or sensory differences can learn led to the first historical phase of inclusion. As a result, their right to an education was recognized by law, and distinct special education systems were created. This era began in Western nations in the late 18th and early 19th centuries, when early laws started to encourage the establishment of specialized institutions (Winzer, 1993).

Similar developments started in the former Soviet Union in the 1920s, driven by the groundbreaking work of L.S. Vygotsky, whose theories established the foundation for the current inclusive and special education system (Daniels, H., & Lunt,

I. , 1993). Beginning in 1954, the Tuva Autonomous Soviet Socialist Republic established specialized educational institutions for students with special needs. The pedagogical and structural conditions required to support students with developmental challenges were supplied by these institutions (Anderson, B. A., Silver, B. D., & Velkoff, V. A. , 1987).

This historical summary offers crucial background information for comprehending the evolution of the concept of inclusion, from isolation and exclusion to shared learning and equitable participation. In modern educational systems, including those in Kazakhstan, these historical foundations guide ongoing reforms to build inclusive practices, particularly in areas like mathematics education, where learners with diverse needs must be actively supported to succeed.

During the Soviet era, learners with special educational needs received their education in segregated institutions, where they also assimilated Soviet ideology and were taught to believe in the principle of equality for all citizens in the USSR (Galmarini-Kabala, 2019). However, many students with special educational needs realized the difficulties they faced in society at large after they grew up and left boarding schools. Even though overt segregation was gradually abandoned in the educational system, the exclusion and separation model persisted until the middle of the 1960s.

The United Nations' adoption of the "Declaration on the Rights of Mentally Retarded Persons" in 1971 marked a significant turning point. This was the start of the normalization model, which persisted until the middle of the 1980s. In contrast to institutionalization, the normalization principle placed an emphasis on integrating students with special educational needs into regular social interactions. This change signified significant advancements in public perceptions of students with special education needs (Nirje, 1969).

After World War II ended, special education entered its second phase of development. It was distinguished by the introduction of numerous specialized instructional models, the development of new kinds of special schools, and structural advancements in special education systems. Movements for the rights of students with special educational needs gained traction throughout North America and Europe. Widespread demonstrations against the segregation and discrimination ingrained in education and society at large were frequently led by advocacy organizations, parents of children with developmental delays, and students with special educational needs.

This mounting pressure led to the closure of psychiatric hospitals and large residential institutions for people with developmental needs in Sweden and other highly developed countries (Lemay, 2009). Public Law 94-142 (1975), a historic law that guaranteed students with special educational needs the right to an education in inclusive settings, was adopted in the United States as a result of this momentum. Other nations subsequently implemented comparable legislative changes, further solidifying the integration tenets.

Between 1950 and 1960, the Soviet Union also introduced major reforms in its special education system. This period saw the classification of special schools into

eight distinct types, later expanded to fifteen specialized school models. The planning and organization of education for learners with special educational needs became more systematic. By the late 1970s and early 1980s, special classes were introduced into general education schools for learners with mental health challenges, and experimental classrooms were opened for children with intellectual needs (Anderson, B. A., Silver, B. D., & Velkoff, V. A. , 1987).

Current inclusive education initiatives are based on these historical developments, especially in subjects like mathematics where students with special educational needs still encounter obstacles to full participation and success. Designing educational systems that support equity and academic achievement in diverse classrooms requires an understanding of this evolution.

The process of integrating students with special educational needs into general education classrooms started to take shape in the mid-1990s after the Republic of Kazakhstan's Law on Education was adopted (Allan, J., & Omarova, T. , 2022). Implementing constitutional rights for students with special educational needs, including those who are officially identified as having needs, was one of the state's social priorities.

A network of special (correctional) educational institutions was created to help achieve this goal by giving students with special educational needs access to education. According to Path (2014), these initiatives set the stage for more extensive inclusive practices in the country's educational system.

- However, a number of enduring issues emerged when integration-focused educational reforms were implemented in Kazakhstan's mainstream schools:
- the requirement for a lucid and well-organized legal framework to promote inclusive education;
- inadequate funding for general education schools;
- a lack of organizational support and methodological direction at the school level;
- a lack of qualified educators with the know-how to help students with social, cognitive, or developmental challenges and to help integrated learning models reach their full potential (Rollan, K., & Somerton, M., 2021).

Because of these restrictions, special education students were frequently included in general education classes in a formal rather than practical way. Despite being physically present in the classroom, students frequently lacked the individualized attention and instructional support needed for both personal growth and meaningful learning. Studies indicate that in approximately half of such cases, learners were unable to achieve their full potential, which could otherwise have been realized through specialized support programs and adapted educational strategies (Walsh, 2018).

These challenges highlight the need to move beyond physical integration and focus on developing the inclusive competence of teachers – particularly in mathematics education, where academic success depends on a teacher’s ability to address diverse learning needs, personalize instruction, and create supportive learning environments for all.

The gradual and uneven application of legal and policy frameworks worldwide is reflected in the third stage of inclusive education development. Examining the dates on which important laws, proclamations, and resolutions were published reveals that inclusive education was implemented gradually rather than all at once.

Documents published in 1993 and 1994 signaled a turning point in the global recognition of universal access to education as a fundamental right in the 20th century. In response to the global call for "Education for All," there was a growing need to draft new legislation that would guarantee equal access to education for learners with special educational needs, aligning national practices with those in Europe and the United States.

One such milestone document – devoted entirely to inclusive education – was endorsed by 92 countries and 25 international organizations. Its main objective was to promote an educational model grounded in openness and accessibility for all citizens (Ainscow, M., Slee, R., & Best, M. , 2019). The following priorities for inclusive systems were listed in the document:

- ensuring that children from underprivileged backgrounds, members of linguistic, ethnic, and cultural minorities, gifted students, students with special educational needs, and those residing in remote areas have access to education;
- offering students with health issues medical, socio-pedagogical, and psychological support within the general education system, including through the use of support staff and tutors;
- creating medical and support facilities close to educational institutions to offer students from different groups immediate, specialized help (Danylenko, 2020).

These commitments were further reinforced by the adoption of the United Nations Convention on the Rights of learners with special educational needs, signed on December 13, 2006. Article 24 of the Convention formally recognizes the right of learners with special educational needs to education. It obligates member states to:

"Ensure an inclusive education system at all levels and lifelong learning, without discrimination and on the basis of equal opportunity" (Ololube, N. P., & Agbor, C. N. , 2016).

This global legal framework continues to shape educational policy and reform efforts around the world, including in the Republic of Kazakhstan, where inclusive education is increasingly recognized as a pathway toward equitable learning outcomes and full societal participation.

Although inclusive education began to emerge globally in the late 20th century, the Republic of Kazakhstan began actively implementing inclusive education reforms in the early 2000s, following the ratification of international agreements such as the UN Convention on the Rights of learners with special educational needs. Amendments to the national Law on Education were introduced in the years that followed – especially from 2012 onward – Incorporating inclusive components that enabled the expansion of inclusive practices in general education settings (Makoelle, Schools' transition toward inclusive education in post-Soviet countries: Selected cases in Kazakhstan. , 2020).

According to these reforms, inclusive education in Kazakhstan is available to all learners, regardless of age, health status, or developmental characteristics. Inclusive principles are implemented through additional support programs offered within mainstream schools (Rollan, K., & Somerton, M., 2021). The national goals of inclusive education include:

- Supporting the maximum development of learners' intellectual and physical abilities;
- Enabling all individuals to participate meaningfully in the life of society;
- Ensuring access to education within the learner's place of residence;
- Improving educational outcomes for learners with special educational needs and individual health needs through personalized support;
- Creating inclusive learning environments that strengthen social interaction and communication skills;
- Providing training and ongoing professional development for teachers and educational specialists in inclusive pedagogy (Brennan, A., King, F., & Travers, J., 2021). Kazakhstan has adopted strategic frameworks to facilitate its recent shift from integration to full inclusion. The creation of a national concept paper on the "Development of Inclusive Education in the Republic of Kazakhstan," which aims to provide high-quality instruction for students with special educational needs, was one of the major turning points (Allan, J., & Omarova, T. , 2022). Governmental and legislative initiatives have reinforced this endeavor even more. Government resolutions, such as those pertaining to federal subsidies and the creation of inclusive school networks, supported the development of infrastructure and capacity-building within mainstream schools to better serve students with special educational needs (Ebersold, S., Óskarsdóttir, E., & Watkins, A., 2020). For instance, the Law of the Republic of Kazakhstan "On Education," as amended in the 2010s, established the legal basis for inclusive education throughout the nation (Turlubekova, M. B., & Bugubayeva, R. O. , 2021).

When taken as a whole, these policies show Kazakhstan's growing dedication to creating an inclusive, accessible, and learner-responsive educational system, especially in subjects like mathematics where students frequently need modified methods to guarantee equal participation and success.

- The Republic of Kazakhstan's foundation for inclusive education has been further reinforced by additional legislative and policy initiatives. Among these are the Psychological-Medical-Pedagogical Commission Regulation, which establishes the protocols for determining and assisting students with special educational needs (Kravchenko, O., Chupina, K., Koliada, N. S., & Bondarenko, H. , 2021).
- Government programs like the "Accessible Environment" program are designed to improve the lives of students with special education needs by guaranteeing that they have access to high-quality instruction, facilities, and support services (Vakorina, L. Y., Prikhodko, O. G., & Yugova, O. V., 2019).

Three main strategies for teaching students with special educational needs in Kazakhstan can be distinguished from an examination of contemporary educational practices (Autayeva, A. N., Satova, A. K., Butabayeva, L. A., & Kulesza, E. M., 2019):

1. Special education students study with their peers in general education classrooms in integrated classrooms. These classes usually have no more than three of these students, encouraging their active engagement in both the social and academic facets of education.
2. More individualized instruction is given in special (correctional) classrooms, which have little contact with the regular school system. Although it limits full inclusion, this model provides targeted support.
3. Classrooms that are inclusive include both students with and without special needs. These classrooms use individualized support and adaptive teaching strategies to foster accessibility, equality, and teamwork.

In conclusion, Kazakhstan's efforts to implement inclusive education are still developing. In contrast to international benchmarks, where higher standards are backed by more extensive systems and consistent policy commitment, the rate of development is still uneven.

As a long-term strategic priority, inclusive education necessitates perseverance, tolerance, consistency, and an all-encompassing approach. These attributes are crucial for creating inclusive learning environments that support positive attitudes and academic success, especially in math classes where individual differences can have a big impact on learning outcomes.

1.2 Psychophysiological and Cognitive Characteristics of Learners with Special Educational Needs

An examination of learners' psychophysiological traits and developmental features is provided in this section. For the educational process to be effectively organized, these qualities must be taken into account. The type and nature of the impairment is the most important factor influencing each learner with special needs' educational profile.

According to the classification proposed by Lapshin and Puzanov, learners with special educational needs are grouped into the following developmental categories:

- learners with hearing impairments,
- learners with visual impairments,
- those with speech and language disorders,
- learners with chronic somatic conditions,
- delayed psychological development,
- autism spectrum disorders, and others (Sigafoos, 2000). At all educational levels (preschool, primary, basic, and secondary), students without developmental disabilities usually follow the mainstream general education curriculum. However, it is advised that a learner with special educational needs receive a program that is specifically adapted to their unique strengths, limitations, and developmental needs (Pillay, J., & Di Terlizzi, M. , 2009). The educational

institution's Psychological-Medical-Pedagogical Commission (PMPC) is responsible for creating and implementing Adapted Basic Educational Programs (AEPs). These programs are tailored to each diagnostic category's unique needs and are created in compliance with the Federal State Educational Standards (FSES) for students with special educational needs (Table 1.2.1) (Vakorina, L. Y., Prikhodko, O. G., & Yugova, O. V., 2019).

The first variant of adapted education allows the learner to participate in the general curriculum, while receiving additional individualized support outside the regular classroom. The content, format, and support mechanisms for such instruction are regulated by the Federal State Educational Standard for Primary General Education, specifically for learners with visual and auditory sensory impairments.

These categories and support systems aid in making sure that inclusive teaching methods are sensitive to the various and actual needs of students. Understanding psychophysiological traits enables teachers to create genuinely accessible and successful instruction for mathematics education, where symbolic understanding and abstract reasoning are essential (see Table 1.2.1).

Table 1.2.1 Diagnostic Categories and Program Codes Recommended by the Psychological-Medical-Pedagogical Commission

№	Category of learners with learners with special educational needs	Fses program variants (primary education)
1	Deaf	1.1, 1.2, 1.3, 1.4
2	Hard of hearing	2.1, 2.2, 2.3
3	Blind	3.1, 3.2, 3.3, 3.4
4	Low vision	4.1, 4.2, 4.3
5	Severe speech and language impairments	5.1, 5.2
6	Musculoskeletal system disorders	6.1, 6.2, 6.3, 6.4
7	Delayed psychological development	7.1, 7.2
8	Autism spectrum disorders	8.1, 8.2, 8.3, 8.4
9	Intellectual needs (mental retardation)	FSES Order No. 1599, Variant 1

The second variant of adapted education is designed for learners who require a lower-level academic curriculum, which places greater emphasis on corrective and developmental instruction. This program complies with the requirements of the Federal State Educational Standards (FSES) and the corresponding Adapted Basic Educational Programs (AEPs). In addition to academic progress, special attention is given to the development of life skills. A working group within the educational institution,

following local regulations, is responsible for making necessary adjustments to the achievement assessment framework for both life skills and corrective work.

The third variant of education applies to learners with a primary developmental disorder accompanied by a mild intellectual need. In this case, academic achievement is not the primary focus. Instead, the main goal is the development of functional life skills, communication abilities, and basic social behaviors that support the learner's ability to live as independently as possible.

The fourth variant is intended for learners whose primary developmental condition is combined with moderate to severe intellectual needs. For these learners, education is implemented through a Special Individual Development Program (SIDP), which is customized based on the learner's current abilities and developmental potential (Rens, J., & Louw, H., 2021).

These program variations demonstrate the adaptability and customization that inclusive education entails. Regardless of whether the focus is academic, functional, or both, they guarantee that every learner receives the proper support. To encourage access, engagement, and the development of skills pertinent to each learner's cognitive and developmental profile, differentiation of this kind is crucial in mathematics education.

In the context of this research, we consider the psychophysiological characteristics of learners with hearing impairments as one of the key diagnostic categories in inclusive education. According to the World Health Organization, 7% of the population suffers from hearing impairment. This group includes deaf learners, hard-of-hearing learners, and those who have lost hearing later in life (post-lingually deaf) (Schley, S., & Stinson, M. A. , 2016).

Hearing loss significantly impacts a child's development by depriving them of a primary channel of information—auditory perception. This restriction impacts cognitive functions such as memory, abstract thought, and conceptual understanding in addition to speech development (Lieu, 2020). In the study of mathematics, where reasoning, symbolic comprehension, and verbal instruction are essential, these elements are crucial.

Kinesthetic, tactile, and visual modalities are frequently used to help students with hearing impairments understand the world. Speech acquisition issues are frequently noted, with a preference for visual-spatial thinking over verbal-logical reasoning. The development of language-based thinking may be delayed by insufficient auditory input, which can impact learners' capacity to verbally communicate, generalize ideas, and control their own learning.

Because of this, many students with profound hearing loss develop more slowly than their peers, especially in subjects that depend on verbal instruction and symbolic abstraction (Levrez, 2012). These students gain from interactive hands-on activities, written explanations, visual aids, and sign language interpretation in inclusive classrooms. These resources complement their learning styles and help them succeed in math and other subjects.

According to statistical data, students who have hearing impairments also face a variety of related developmental difficulties. Up to 80% of cases show delayed motor development, and 62% show disharmonious psychological development. Furthermore, 43.6% of these learners have disorders of the musculoskeletal system, and more than 70% have comorbid medical conditions (Kalivoda, K. S., Higbee, J. L., & Brenner, D. C. , 1997).

Importantly, the personality traits and behavioral patterns of learners with partial or complete hearing loss are not biologically predetermined. When appropriate support systems are in place, these characteristics can be effectively shaped and improved. Personal development in learners with hearing impairments is often influenced by slowed information processing and communication barriers with peers. Relationship difficulties can result in aggressive behavior or social disengagement. However, these tendencies can be addressed and healthy personality development can be restored with prompt and focused corrective interventions (Gomos, Y. D., & Adebisi, R. O. , 2020).

When compared to their hearing, children with partial or total hearing loss frequently exhibit developmental delays that can last for several years. Overcoming these barriers requires comprehensive, socially oriented educational support, which focuses not only on academic content but also on emotional and psychological development. It is essential to create learning environments that help mitigate the effects of hearing loss by strengthening communication skills and fostering the development of core cognitive and emotional capacities (Harris, 2015).

In the pedagogical process, special attention should be given to closing gaps in speech development and expanding the learner's access to varied communication strategies. For learners with hearing impairments, educational methods that emphasize visual and experiential learning are particularly effective. By constructing representations and concepts at the concrete level, strategies like pantomime, dramatization, and role-playing help students progressively advance toward more abstract levels of reasoning. Therefore, when designing inclusive instruction, it is important to take into account the distinct cognitive and personality profiles that children with hearing impairments frequently develop (Polvanov, 2023).

Students with visual impairments are included in the second category taken into consideration in this study. A recent cross-sectional study in Almaty, Kazakhstan, found that 28.3% of school-aged children (6–16 years old) had myopia, and the prevalence of refractive errors was 31.6% (Mukazhanova, 2022). The distribution of myopia severity included 79.2% with mild, 16.4% with moderate and 4.5% with high myopia. In addition, 3.4% of children were diagnosed with hypermetropia and 2.8% with astigmatism. The prevalence of myopia has a clear age trend: from 17.6% in grade 1 to 40.5% in grade 9. Strabismus, myopia, hyperopia, and astigmatism are the most prevalent visual disorders in school-age children (Gull, A., & Raza, A. , 2014). Depending on where they originate, these impairments can be categorized as acquired, congenital, or hereditary. Children with visual impairments are typically classified as either completely blind or having low vision (residual vision), depending on how

severe their condition is. A learner's ability to access environmental information is greatly impacted by vision loss, which causes them to rely more on touch and hearing. Children who are visually impaired consequently acquire distinct sensory representations of the world, which impact their perception and comprehension of their environment (Laplane, A. L., & Batista, C. G. , 2008).

Children with visual impairments may face difficulties like decreased work capacity, increased fatigue, and slower information processing, according to research. Individual psychological characteristics, such as emotional sensitivity, irritability, conflict-prone behavior, tension, and a limited capacity to interpret the emotional states of others, can also contribute to these challenges in addition to the visual impairment itself (McKay, C., & McCubbin, I. , 2024).

These students may be less adaptable and spontaneous in their behavior, and they may also lack confidence in their choices. According to Legge and Chung (2016), learners with low vision frequently ask adults for feedback on their performance and assurance.

Using tactile, auditory, and adaptive visual teaching methods is crucial in inclusive math classrooms where visual-spatial reasoning frequently plays a major role. Students with visual impairments can greatly benefit from structured materials, verbal instructions that are easy to understand, tactile diagrams, large-print resources, and technological aids like magnifiers or screen readers.

Children with speech and language impairments make up the third group of learners this study focuses on. These learners typically have preserved hearing and no primary intellectual needs, yet they experience significant language-related difficulties that affect their overall psychological development. Although the manifestations of speech disorders can vary, they consistently influence cognitive activity, emotional regulation, and interpersonal interaction (Fujiki, 2004).

Many of these learners demonstrate perceptual difficulties, which depend on the dominant sensory modality – either visual or auditory. Their phonetic system of language is often underdeveloped, and they struggle with reading and writing skills. For this reason, targeted development of visual perception is crucial, as it is typically delayed and marked by specific functional characteristics (Johnston, 1990).

A common co-occurring feature of severe speech disorders is memory impairment when compared to typically developing children. These learners show reduced capacity across all types of memory, along with distinct attention-related difficulties, such as low concentration, poor attentional switching, and limited voluntary attention span (Kavanaugh, 2016).

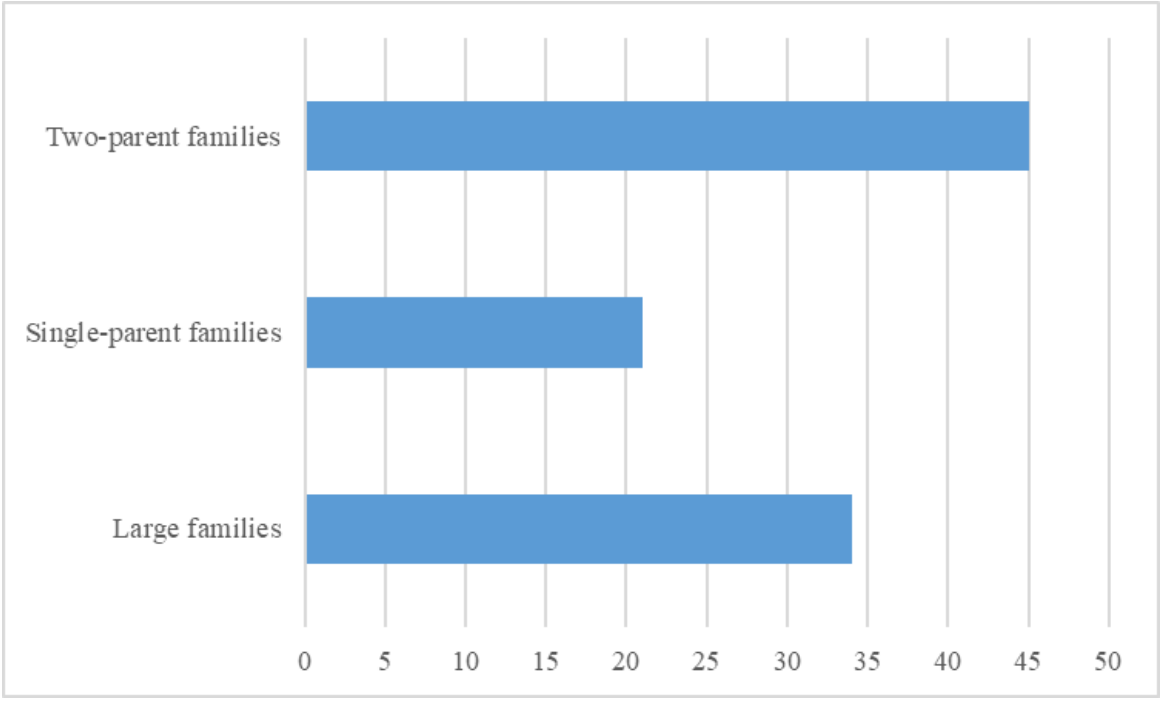
In addition to exhibiting character traits like protest behavior, avoidance, low self-esteem, and oversensitivity, many students with severe speech disorders also show low initiative and a limited capacity to maintain social boundaries (Feigin, J., & Meisgeier, C. , 1987). These characteristics often lead to difficulties in peer communication and a tendency toward social withdrawal. As a result, the development of social-role behavior becomes a key aspect of successful personal adaptation in inclusive environments (Lyons, J. C., & Weiss, J. , 2011).

Furthermore, emotional and personality-related challenges in these learners negatively affect their work capacity and academic performance. Nonetheless, speech correction therapies have demonstrated efficacy in progressively enhancing communication abilities, resulting in enhanced autonomy, linguistic diversity, and more assured engagement in daily tasks (Keshavarzi, A., & Amiri, H. , 2016).

A child's view of the importance of education, the cultural background of their family, and the kind of school they attend are all directly correlated, according to research conducted by psychologists from Kazakhstan and Russia. Children from families with more cultural diversity are more likely to be curious, motivated to learn, and to frequent gyms and lyceums. On the other hand, general education schools tend to have students from families with less social and cultural resources. These settings might not have access to cultural institutions (theaters, museums, galleries), books, or computers, which are essential for fostering a child's development.

Several significant trends emerged from an anonymous survey given to parents and students with special education needs (see Figure 1.2.1 and Figure 1.2.2).

Figure 1.2.1 Results of the survey among parents of learners with special educational needs (SEN)



According to the data, two-parent households account for the majority of respondents (45%), followed by large families (34%) and single-parent households (21%). According to these results, a significant percentage of students with special education needs come from homes that might experience more difficulties, even though many of them reside in more stable family settings. Due to a lack of resources and parental attention, children from large families and single-parent households may receive less individualized academic support. Lower self-esteem and the emergence of

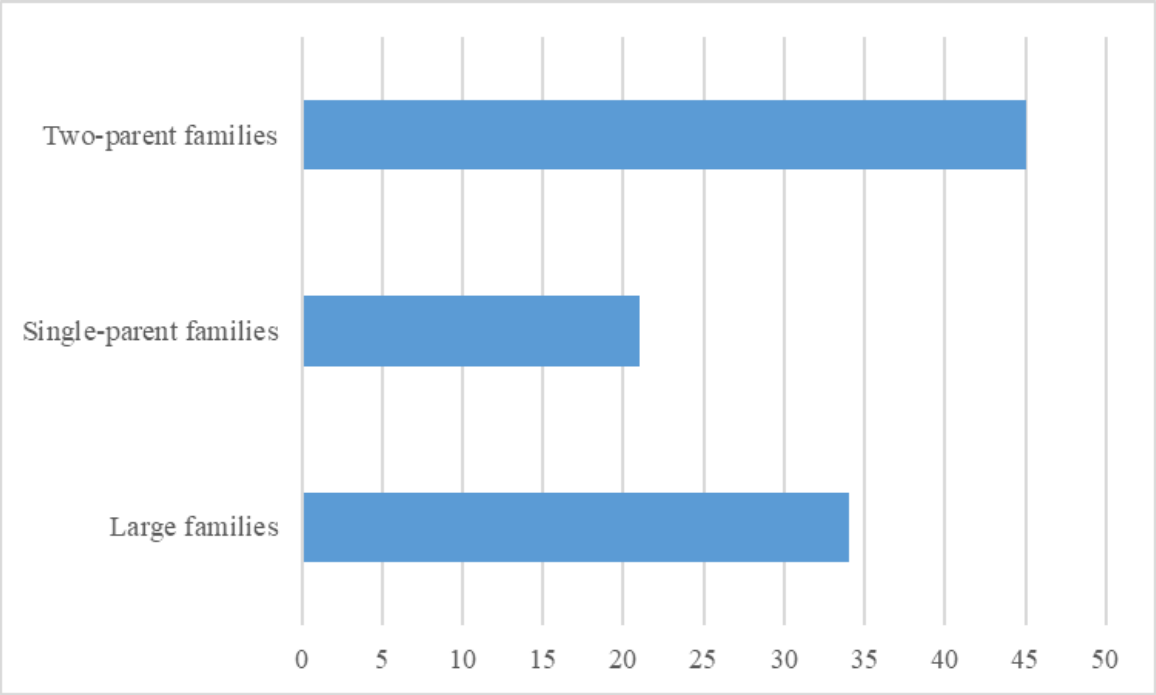
negative emotional experiences linked to academic difficulties are frequently caused by these conditions.

Many students with special educational needs do not view mathematics as a core subject and are not aware of its relevance for future career opportunities, according to the results of a learner-centered survey. Lack of proficiency in Russian and English was also noted as a significant obstacle, which hinders comprehension of specialized terminology and leads to poor performance in STEM-related subjects like mathematics and informatics (Alharbi, L. J., & Maroof, N. , 2020).

The following crucial traits were found in students with special educational needs using a combination of questionnaires and testing tools:

1. varying degrees of prior mathematical knowledge;
2. low cultural capital in the context of the family;
3. low self-esteem in relation to one's intellectual prowess; unfavorable emotional connections to the process of learning;
4. low self-motivation and decreased participation in educational activities; strong emotional reliance on adults, peers, or particular groups.

Figure 1.2.2 Results of the survey among parents of learners with special educational needs (SEN)



These findings highlight the urgent need for careful selection and justification of didactic approaches that will allow for the effective instruction of learners with special educational needs. In inclusive classrooms, particularly in mathematics and informatics education, teaching strategies must address not only academic gaps but also emotional and motivational barriers to learning.

Based on the reviewed diagnostic categories, it can be concluded that, regardless of the specific nature of learners with special educational needs, certain shared characteristics significantly influence their learning experience.

First of all, students with special education needs frequently have underdeveloped perceptual skills, which slows down information processing and results in an incomplete awareness of the world around them.

Second, these students typically struggle with spatial perception, which makes it difficult for them to comprehend relationships between elements, analyze shapes, recognize symmetry, and build or integrate visual-spatial models—all of which are critical mathematical abilities. Their attention is frequently dispersed, and task-switching can be difficult due to reduced intellectual activation. Many struggles with self-regulation, responsibility, and intrinsic interest in learning.

Memory functions are often limited to short-term recall, and mechanical thinking typically dominates over logical reasoning. These learners rely heavily on visual cues, rather than verbal explanations, which may reduce motivation in language-dominant instruction. As a result, they process information more slowly during cognitive tasks and tend to rely more on concrete visual thinking than on figurative or verbal-logical reasoning.

There are also notable differences in social development. Students with special education needs frequently interact with peers and adults less socially. Their scenarios are frequently repetitive, their play behavior is limited, and their social roles and communication styles are constrained. Delays in speech and language, or the total lack of these abilities, are also frequently noted.

Moreover, these learners may experience low work stamina, mental fatigue, psychomotor agitation, and instability in behavior. Their psychological characteristics may not always support the development of effective learning habits, making it more difficult to plan, achieve goals, and stay in rhythm with classroom activities.

These developmental challenges result in common learning difficulties across all needs categories, including:

- Low cognitive engagement and intellectual stamina
- Speech and language delays
- Poor attention and memory control
- Insufficient social development

As a result, many learners with special educational needs enter school with underdeveloped psychological readiness for academic learning, which complicates the mastery of learning skills, lowers self-confidence, and increases feelings of insecurity.

It's also critical to acknowledge that students from culturally specific areas, like rural or ethnically diverse communities, frequently experience worsening developmental outcomes. For example, cultural attitudes, family structures, and limited access to enrichment resources can provide additional challenges for certain Kazakhstani learners, especially those from traditionally underrepresented or rural groups. These factors can impact both academic performance and personal growth.

1.3 Organizational and Sociocultural Conditions for Inclusion in Kazakhstan's Ethnolinguistic and Regional Contexts

In the Republic of Kazakhstan, as in many modern educational systems, the legal framework for inclusive education is formally defined through national legislation. According to the Law on Education, the state guarantees the creation of conditions for the implementation of inclusive education regardless of learners' financial status, social background, ethnic origin, language, religion, gender, or individual abilities (Shalbayeva, 2021).

A number of normative documents, including rules set by the Ministry of Education and Science, support Kazakhstan's inclusive education policy. For example, the 2015-approved regulation "On the Psychological-Medical-Pedagogical Commission (PMPC)" describes how to evaluate and place students with special education needs in suitable learning environments. According to this regulation, the admission of children with special educational needs (SEN) into general education institutions must follow a comprehensive evaluation process conducted by a multidisciplinary team – Including psychologists, medical professionals, and educators—who recommend suitable forms of instruction based on individual needs (Makoelle, Inclusive Education in Kazakhstan: Achievements and Challenges. , 2022).

Families can choose from three organizational models for the education of students with special educational needs under the most recent national guidelines:

1. In inclusive classrooms, students with special needs work side by side with their peers to fully engage in the general education process. No more than three students with special educational needs are usually included in each inclusive class, guaranteeing sufficient support and attention.
2. Students with special educational needs can receive targeted support while participating in the larger educational system through specialized (correctional) classes, which provide a partially integrated environment.
3. Students with special educational needs learn alongside their peers who are typically developing in mixed-inclusion settings, but they also receive extra support services that are customized to meet their needs (Hove, N., & Phasha, N. T., 2024).

Based on the PMPC's recommendations and the child's functional, emotional, and cognitive profile, these options enable parents or legal guardians to select the best educational path for their child.

These inclusive models also need to take into consideration linguistic, cultural, and social elements that influence the accessibility and relevance of instruction as well as develop learner identity in Kazakhstan's ethnoculturally diverse regions, especially in multilingual communities. Because of this, inclusive pedagogy is not only required by law but also prioritized in Kazakhstani education as a culturally sensitive approach.

A network of Psychological-Medical-Pedagogical Commissions (PMPCs) in the Republic of Kazakhstan coordinates the identification and assistance of students with special educational needs. These multidisciplinary commissions are responsible

for evaluating the developmental, behavioral, and learning characteristics of children under the age of 18. Based on diagnostic results, the commissions issue individualized recommendations regarding the appropriate educational setting and learning support needed for each learner, considering their psychophysical development.

To guarantee that inclusive educational services are in line with each learner's developmental profile, PMPCs also offer consultative support to families and children with special educational needs (SEN) as well as methodological assistance to educators (Keller-Schneider, 2020).

According to the latest statistics, Kazakhstan has advanced inclusive education significantly. For instance, more public schools are being outfitted to provide inclusive learning environments in places like Almaty. These include compensatory and adaptive education programs for students with intellectual needs, hearing impairments, musculoskeletal disorders, and speech or language difficulties, as well as mainstream schools with inclusive classrooms.

To illustrate, a selection of kindergartens and primary schools in Almaty now offer:

- Inclusive classrooms for joint learning between learners with and without special needs;
- Compensatory classes for children with somatic weaknesses or delayed psychological development;
- Specialized preschool groups for children with intellectual needs, hearing impairments, speech disorders, and musculoskeletal challenges.

Even though there has been progress, learners from rural or remote areas still have limited equitable access because the majority of inclusive infrastructure and services are still concentrated in larger urban centers like Almaty and Astana.

Kazakhstan maintains a network of specialized institutions offering adapted educational programs in addition to inclusive programs in general schools. These include:

- Schools for children with intellectual needs;
- Boarding schools for learners with hearing impairments;
- Institutions for children with musculoskeletal disorders.

In total, hundreds of children with SEN – many of whom are officially registered as learners with special educational needs – are currently enrolled in such programs. According to Kazakhstan's educational development strategies and international standards, the country's objective is still to gradually integrate students into inclusive mainstream settings whenever feasible, even though these schools offer focused developmental and therapeutic support (Allan, J., & Omarova, T. , 2022).

The Republic of Kazakhstan has made great progress in recent years in promoting remote learning for kids with special education needs (SEN). Students with special educational needs can now access remote learning opportunities through four regional support centers. About 13.65 million tenge have been set aside to create barrier-free infrastructure in educational institutions as part of Kazakhstan's national initiative "Accessible Environment" (2021–2025). Improved classrooms for

psychologists, speech therapists, and sensory support, as well as wider doorways and ramps, have all been made possible by this funding in 43 general education organizations. To increase visibility and awareness, schools have also implemented information corners for students with special education needs (Allan, J., & Omarova, T. , 2022). The preschool education system in Kazakhstan provides a variety of approaches to working with students who have special needs. Preschool settings currently consist of 41 health-focused groups, 1 combined group, and 69 compensatory-oriented groups, per the automated information system for early childhood institutions (Ewa, K., & Laura, B. , 2016).

These changes show how far Kazakhstan has come in establishing conducive conditions for inclusive education. But there are still significant obstacles to overcome, especially in rural, sparsely populated areas where there may not be enough specialized schools or inclusive classes. In these situations, parents frequently place their students with special education needs in regular classrooms with their classmates who are developing normally (Allan, J., & Omarova, T. , 2022). Teachers are under more pressure as a result of this integration, and they must be ready to modify their methods and content to accommodate a range of student needs (Modupe, 2010).

The ability to accommodate learners' ethnocultural and ethnopsychological characteristics, as well as societal values, are critical to the success of inclusive education. In rural and culturally distinct communities, such as ethnic Kazakh or Kazakh-Turkic groups, local values shape how inclusion is perceived and practiced. Geographic, climatic, and social conditions contribute to the formation of key cultural traits such as patience, self-restraint, modesty, and emotional composure. These groups frequently place a high importance on humility, collectivism, and public opinion awareness.

There is little nonverbal communication, and expressive or complicated language is frequently avoided. These standards affect how students interact in the classroom and need to be taken into account in inclusive education. Another significant factor is language barriers, especially in rural areas. In some regions, Kazakh or other local languages dominate daily communication, and learners often begin school with limited exposure to the official language of instruction (Kazakh or Russian), which creates additional difficulties in mastering abstract academic content—especially in subjects like mathematics and informatics (Kuzhabekova, 2019).

These elements emphasize how crucial culturally sensitive methods of inclusive education are. Teachers need to be prepared to identify and deal with linguistic, cultural, and regional diversity in the classroom. These interrelated factors may pose additional cognitive, emotional, and social development challenges for students with special educational needs.

Consequently, the role of the teacher in an inclusive classroom is not only to facilitate learning but also to design an instructional process that is culturally responsive and addresses the specific educational needs of learners with special educational needs. This task requires balancing professional teaching responsibilities with a deep understanding of learners' ethnocultural backgrounds and inclusive

practices (Vavrus, 2008). This further underscores the relevance and necessity of present research.

Statistical analysis results indicate a consistent rise in the number of learners requiring inclusive education, which highlights the urgent need for teacher preparation in this area. Interestingly, the number of students enrolled in specialized correctional classes has decreased over the last five years, indicating a move toward more inclusive educational models.

Further investigation, however, indicates that the true number of students in the Republic of Kazakhstan who require inclusive education probably surpasses official figures. This observation is supported by recent national exam data, socioeconomic difficulties in specific areas, and our firsthand knowledge from working in colleges and schools.

Thus, it can be said that the adoption of inclusive education is still a very important and urgent problem. Expanding inclusive infrastructure, improving teacher competencies, and attending to the cultural, linguistic, and developmental needs of all students are all essential components of a methodical approach to addressing this challenge (Van Mieghem, 2020).

A survey of parents and students with special educational needs was carried out in order to gain a better understanding of the current status of inclusive education in the Republic of Kazakhstan. According to the results, 73% of parents reported being aware of the possibility for their children to study in inclusive classrooms. Of these, 45% expressed a desire for their children to be placed in general education classrooms, while another 45% favored adapted educational programs tailored to their learner's individual needs. Just 9% of parents said they preferred special (correctional) schools.

55% of parents selected full-time education when asked about their preferred learning model, whereas 45% preferred a blended (part-time) model. Remarkably, 91% of respondents think that the current system for educating and informing families about opportunities for students with special education needs is inadequate.

The responses' analysis showed a significant relationship between learners' developmental outcomes and the educational attainment of their parents. Higher educated parents are more likely to pay attention to their children's intellectual growth from a young age, which improves their readiness for inclusive education. In contrast, learners whose parents have lower educational status often face greater challenges in speech and psychological development, which may hinder their ability to succeed in the general curriculum.

A study aimed at assessing the level of inclusive competence among practicing mathematics teachers was conducted with the participation of 53 educators. Participants' average teaching experience was eight years, with a range of one to fifteen years. According to the findings, 76% of those surveyed are currently employed in inclusive educational settings. But according to a thorough analysis, almost 99 percent of teachers find it difficult to plan the learning process in these kinds of environments.

The majority of participants (83.5%) acknowledged that they themselves feel inadequately prepared to work effectively with students who require additional support

and voiced concerns about their schools' lack of readiness for inclusive education. Merely 62% of respondents said they were familiar with inclusive classroom methodologies and instructional strategies, as well as the legal and regulatory framework for inclusive education. Furthermore, 58% of teachers stated they apply individualized approaches when interacting with learners with special educational needs, while just 26.5% associated this practice specifically with distance learning environments (Forlin, C., & Chambers, D. , 2011).

Most mathematics teachers working in inclusive settings pursue professional development through local schools for the Development of Education and Professional Advancement. Participants did note, however, that these programs frequently fail to address the methodological and practical issues they face in actual classroom settings.

These results underline once more how important it is to improve the methodological and practical preparation of aspiring subject teachers, especially in fields like mathematics and informatics, so they are prepared to function well in inclusive classrooms.

In summary, it can be concluded that while inclusive education and its implementation are clearly stated in official plans, reports, and policy documents in the Republic, the practical realities reveal numerous challenges that must be addressed directly by teachers within their specific educational institutions. The establishment of an accessible environment, the purchase of classroom technology, the availability of methodological resources, and the creation of varied individualized learning programs for students with different kinds of needs are all hampered by a lack of funding and inadequate support.

These limitations pose serious challenges for educators who want to successfully implement inclusive education as well as for students. Because inclusion adds more work and complexity without matching institutional or financial support, some educators may become resistant to it. For inclusive practices to be long-lasting and advantageous for all parties involved in the educational process, systemic solutions are required, such as improved training, resource allocation, and support systems.

1.4 Competence Requirements and Attitudinal Readiness of Future Mathematics Teachers for Inclusive Instruction

Most experts, both in Kazakhstan and internationally, agree that the successful implementation of inclusive education depends on a wide range of pedagogical and psychological resources, with particular emphasis on the professional competence of teachers (Kozlova, M., & Ryabichenko, T. , 2024). International experience demonstrates that inclusive education places higher demands on teachers, requiring them to broaden their roles and adopt more complex teaching responsibilities. In this context, both the professional and personal qualities of the teacher evolve, as traditional knowledge about general education standards, curricula, and methods is no longer sufficient. The expansion of inclusive practices calls for the development of new didactic models and the transformation of teacher education programs (Kudarinova, 2023).

One of the teachers' key responsibilities is to identify the individual learning potential of learners with special educational needs and to design instructional processes that meet those needs—while still maintaining high academic expectations for all learners.

We contend that a key element of aspiring teachers' training should be the development of inclusive competence. In order to give aspiring educators real-world experiences that mirror the realities of diverse classrooms, these competencies ought to be fostered in inclusive educational settings.

In Kazakhstani and post-Soviet pedagogy, the term "competence" is used to describe a high level of qualification and professional preparedness. Comparing various interpretations, the concept of "competence" can be understood as an integrated set of personality traits, including knowledge, skills, and methods of activity required for effective performance in a specific professional context.

The term "competency", in turn, refers not only to the possession of relevant knowledge and skills but also to the personal engagement and emotional relationship a teacher has with their professional activity (Gulevska, V., & Atanasoska, T. , 2015).

Various scholars interpret the concept of teacher professional competence differently. This diversity in understanding was confirmed through an analysis of relevant definitions. According to the Pedagogical Dictionary, professional competence is defined as:

"A teacher's mastery of the necessary body of knowledge, skills, and abilities that determine the development of their pedagogical activity, communication, and personal identity as a bearer of certain values, ideals, and pedagogical consciousness" (Omarov, 2016).

Key, core (basic), and specialized competencies are the three categories of professional competence, according to M.P. Lapchik (2021), an academician with the Russian Academy of Education.

- Professionals in every field need to possess key competencies. These pertain to a person's capacity to thrive in a world that is changing quickly and are demonstrated by their ability to use information to solve professional problems and interact with others in a social and legal context.
- Core (basic) competencies are professional-specific and serve as the foundation of a specialist's professional competence. In education, basic pedagogical competencies are shared by all teachers, regardless of subject area.
- Specialized competencies represent the practical realization of both key and core competencies within a specific professional domain – in this case, mathematics education in inclusive settings.

Professional competence, which V.S. Bezrukov views as the foundation of professional effectiveness, is the capacity to use one's intellectual, psychological, and physical abilities to apply knowledge and skills in practice. He broadens this idea to encompass both social and specialized competencies, such as the ability to work with colleagues while accepting responsibility for one's actions, the readiness for autonomous decision-making, and the capacity for professional development and self-

evaluation. According to this perspective, professional competence is a personal attribute that fosters ongoing self-improvement and, crucially, the awareness of one's shortcomings and potential growth areas (Demkina, 2019).

This interpretation is extremely pertinent to the current study because it supports the notion that reflective practice, adaptive teaching techniques, and cooperative problem-solving in a variety of learning contexts are necessary for future math teachers to be inclusively competent.

N.K. Sergeev's contribution is equally important; he contends that professional competence involves not only the application of preexisting knowledge but also the development, modification, and innovation of novel concepts and methods. He highlights that being competent entails having the initiative to establish one's own goals, accepting goals and professional standards consciously, and being able to function well under both self-formulated and externally recognized principles. Moreover, Sergeev underscores the importance of critical thinking, innovation, and forecasting the outcomes of one's actions and relationships, which are especially important in inclusive educational settings (Ketrish, 2016).

Researchers offer a comprehensive structure of specialist competence that aligns closely with the objectives of this research. They outline the following five components:

- Motivational component: the willingness and internal drive to demonstrate competence, viewed as the expression of a teacher's personal resources;
- Cognitive component: the knowledge content related to the specific competence;
- Behavioral component: experience in applying competence across various standard and non-standard professional contexts;
- Value-semantic component: the teacher’s personal attitude toward the content and application of the competence, which is closely tied to their motivation;
- Emotional-volitional component: the emotional and self-regulatory processes involved in performing and sustaining competent actions (Gutsu, 2016).

They also draw attention to the intimate conceptual link between readiness and competence, which is especially crucial for future math teachers' development of inclusive competence. According to this link, being ready for inclusive teaching involves not just having the necessary knowledge and abilities but also having a strong sense of personal involvement and ethical obligation in the inclusive educational process.

In some cases, perspective aligns with the view that competence is inseparable from the concept of readiness, which she defines as:

“...an integral quality of the individual, characterizing their preparedness to address challenges encountered in both professional and everyday life” (Popov, 2016).

Similarly, A.M. Aronov contends that a specialist's readiness to perform a specific task should be interpreted as competence (Demkina, 2019). According to this dynamic interpretation, competence is defined as the capacity and willingness to act in a professional setting rather than just as knowledge.

In further extend this line of reasoning, emphasizing that:

“The nature of competence is such that, although it results from learning, it does not follow directly from it. Rather, it is the consequence of a person’s self-development, rooted not merely in psychological maturity but in personal growth, self-organization, and the synthesis of both practical and personal experience” (Romanovtseva, 2016).

These theoretical stances support the idea that knowledge transmission alone cannot foster inclusive competence in aspiring math teachers. Rather, it must manifest via self-directed professional development, active participation, and reflective practice.

Teachers in inclusive education need to have a thorough understanding of students with special educational needs and be ready to use a variety of pedagogical techniques. This includes offering emotional safety and inclusion in addition to academic support. Additionally, strong interpersonal skills are necessary for effective inclusive teaching because they allow for meaningful collaboration with students, families, and other educators in a variety of roles within the educational setting (Zagona, 2017).

The need for targeted professional preparation in inclusive education is consistently emphasized in both Kazakhstani and international research. Scholars emphasize that inclusive competence must be considered a key component of teacher preparation.

L.V. Goryunova defines inclusive teacher preparation as:

“A process of transformation in a teacher’s professional and personal sphere, shaped by external and internal factors that may influence their readiness—either positively or negatively—to work in inclusive settings” (Makoelle, T. M., & Burmistrova, V. , 2021).

Therefore, it is essential to examine the distinction between inclusive competence and inclusive readiness, and to analyze the key factors that contribute to a teacher’s preparedness for inclusive education. According to Shumilovskaya (2011), Cherkasova (2012), Khafizullina (2008), and Khitryuk (2008), these factors include:

- Motivation to work inclusively;
- Cognitive understanding of learners and inclusive practices;
- Creative capacity and innovation in the classroom;
- Engagement and initiative in educational activities.

Despite variations in how inclusive readiness is structured across the literature, the following three components are consistently emphasized:

1. Motivational aspects that drive personal and professional commitment;
2. Knowledge of the educational subject and learner needs;
3. Reflective practice, allowing teachers to analyze and improve their pedagogical approaches (Santos, 2016).

Yu.V. Shumilovskaya defines readiness for inclusive teaching as: “a combination of knowledge, skills, and personal qualities that foster motivation for working in inclusive education. It includes motivational, cognitive, creative, and practical components, equipping teachers to focus on each individual learner, generate new values, and develop professional competencies” (Adams, 2023).

S.A. Cherkasov similarly emphasizes that: “students’ readiness for inclusive teaching includes motivation, personal characteristics, emotional-volitional mindset, and cognitive abilities. It is important to understand the interrelationship among these components and how they influence readiness. Indicators include tolerance, social awareness, empathy, and social intelligence. Readiness for inclusive education is a set of personal traits, motivations, and cognitive resources needed to support learners with special educational needs. Key areas include learner adaptation, cooperation with parents, and collaboration with the classroom teacher” (Martynchuk, 2021).

In recent years, there has been a growing consensus that a teacher’s readiness is closely tied to their ability to solve professional challenges effectively, which is the essence of competence (Keller-Schneider, 2020).

Several researchers have highlighted that professional competence in teaching is closely connected to a teacher’s active engagement and deep personal interest in their work. According to this body of research, a modern teacher must be able to:

- Recognize and respond to the needs of each learner within the educational process;
- Create an educational environment that supports achievement of defined learning goals;
- Build and sustain productive relationships with all participants in the educational process, including school partners;
- Utilize the learning environment effectively to meet pedagogical objectives;
- Engage in ongoing professional development and self-directed learning (Henderson, L., & Jarvis, J. , 2016).

I.N. Khafizullina offers a more specific definition of inclusive competence in future teachers, viewing it not as a simple sum of educational elements, but as:

“the ability to carry out professional tasks within inclusive education. It requires understanding learners’ diverse educational needs and creating conditions for the inclusion and development of learners with special educational needs. Inclusive competence consists of motivational, cognitive, operational, and reflective components. Its assessment is based on four criteria: motivation, knowledge, practical experience, and capacity for reflection. There are four identified levels of inclusive competence development: zero, low, moderate, and high” (Linker, G. R., & Yusupova, Y. M. , 2019).

In diverse and multilingual educational contexts like those in Kazakhstan, this integrated framework offers a strong theoretical basis for evaluating and fostering the inclusive competence of aspiring math teachers.

According to I.A. Turchenko, inclusive competence is "a process of acquiring and developing values, motivations, knowledge, skills, and experience that enable a teacher to be prepared and motivated to carry out effective pedagogical activity in inclusive settings" (Ketrish, 2016).

We investigate the content and structure of inclusive competence among aspiring math teachers in the framework of our study. This analysis is based on our

own research on preparing future math teachers for inclusive education, as well as findings from Kazakhstani and international scholars.

In light of this research, we define future math teachers' inclusive competence as an integrative quality necessary for carrying out their professional duties in inclusive learning environments. The need to address a variety of learner needs while promoting the inclusion of students with special educational needs in regular classrooms is reflected in this competency, which includes motivational, cognitive, practical (behavioral), and reflective dimensions.

The process of developing inclusive competence in mathematics teacher education can be divided into two interrelated stages:

1. General professional preparation, which includes foundational teacher training with a strong emphasis on psychological and pedagogical subjects;
2. Methodological preparation, which focuses on subject-specific pedagogy tailored to the unique characteristics of learners with special educational needs (SEN), including various diagnostic categories. University-level subject-methodologists are largely in charge of carrying out this training phase (Deniz, S., & İlik, Ş. , 2021).
3. The development of inclusive competence in Kazakhstan's educational system must take into account both the unique qualities of students and the regional cultural and linguistic diversity, especially in diverse urban centers like Almaty.
4. The synthesis of motivational, cognitive, operational (practical), and reflective elements—all of which necessitate the application of specialized teaching methodologies—is how we define the inclusive competence of aspiring math teachers in this dissertation. We have developed a set of indicators for evaluating inclusive competence in mathematics teacher education based on this understanding (see Table 1.3.1) (Durdukoca, 2021).

For use in your master's thesis on the inclusive competency of aspiring math teachers in Kazakhstan, this is the translated and modified version of your table. While maintaining the original structure and intent, the language has been improved for clarity and academic tone:

The key competencies and professional abilities required for successful instruction in inclusive environments can be identified thanks to this analysis (Indenbaum, 2020).

The analysis indicates that the competencies outlined in the SES HE 3++ standard are insufficient to fully address the current demands placed on teachers working in inclusive education settings. It is therefore recommended that universities introduce additional requirements for knowledge, skills, and abilities when developing their educational programs. Depending on the focus of the program, each higher education institution develops its own list of specialized competencies, which is not included in the SES HE 3++.

The development of these specialized competencies in the context of training future math teachers needs to be closely related to the idea of inclusive competence. To ensure relevance and applicability, it is necessary to explicitly specify the tools,

methods, and technologies used when working with learners who require inclusive educational support.

Table 1.3.1 Structure of Inclusive Competence Formation for Future Mathematics Teachers

Component	Indicators
Motivational	- Willingness to carry out professional duties, including the application of inclusive teaching methods; - Commitment to continuous self-development in the field of inclusive education; - Understanding of key concepts and principles of inclusive education.
Cognitive	- Knowledge of how learners with diverse needs perceive and process educational information, including the specific characteristics of learners in Kazakhstan; - Familiarity with a variety of teaching methods and instructional strategies used in inclusive classrooms; - Understanding of lesson planning that supports collaborative learning for learners at different developmental levels; - Knowledge of subject-specific adaptations required in inclusive mathematics education.
Practical (Behavioral)	- Ability to assess the universal learning actions (ULAs) of learners with special educational needs (SEN); - Application of modern teaching methods and technologies for inclusive instruction, particularly in linguistically and culturally diverse settings; - Development of instructional materials, including digital resources, tailored to the specific needs of learners with special educational needs; - Adaptation of curriculum and learning materials to support effective instruction for learners with SEN; - Evaluation of academic progress and learning outcomes for learners with special educational needs; - Design and piloting of inclusive teaching strategies for mathematics instruction.
Reflective	- Ability to reflect critically on one's professional practice in inclusive settings; - Commitment to high standards and goal-oriented teaching outcomes.

Thus, based on the analysis of theoretical perspectives, the results of our research, and national educational standards, it becomes evident that inclusive competence is essential for future mathematics teachers. This competence represents an integrated system comprising four interrelated components: motivational, cognitive, practical, and reflective. The development of inclusive competence occurs through the integration of general professional, universal, and specialized skills, enabling future teachers to effectively support diverse learners in inclusive educational environments.

The review of national and international research, along with philosophical, psychological-pedagogical, and methodological perspectives related to inclusive education, leads to the following conclusions:

- In the Republic of Kazakhstan, including the city of Almaty, there are three primary models of organizing education for learners with special educational needs (SEN):
    - Integrated classrooms, where learners with SEN participate in general education classes with supplementary support services;
    - Adapted learning environments, which follow individualized educational plans tailored to the learner's specific developmental needs;
    - Inclusive classrooms, where learners with special educational needs study alongside their peers in a unified classroom setting, with appropriate accommodations and inclusive teaching strategies.
- The concept of inclusive education has been clarified, and both general and specific characteristics of learners with special educational needs have been identified. These characteristics must be addressed when developing instructional strategies and teaching mathematics in inclusive classrooms. General traits include limited cognitive engagement, attention and memory challenges, and reduced social development. Specific traits vary by the learner's particular diagnosis or condition.
- Educational policy documents in Kazakhstan—such as the State Compulsory Standard for Higher Education, the Professional Standard for Teachers, and statistical data from Almaty schools—highlight the urgent need to prepare future mathematics teachers to work effectively in inclusive settings and respond to the diverse needs of all learners.
- The definition of inclusive competence for future mathematics teachers has been refined. It is understood as an integrated construction that enables teachers to carry out their professional duties effectively in inclusive classrooms. This competence consists of motivational, cognitive, practical, and reflective components, each of which plays a crucial role in supporting diverse learners and ensuring the successful inclusion of those with special educational needs into general education environments.
- On the example of Almaty city we can trace the positive dynamics of inclusive education implementation, which is confirmed by the following statistical data (see Table 1.3.2)

Table 1.3.2 Statistics on Inclusive Education in Almaty (2023). Source: compiled by the author on the basis of open data of the Ministry of Education of the RK, as well as publications inform.kz (2023) and vecher.kz (2023)

№	Indicator	Value / Number	Year
1	Number of schools with special education	198 schools (92% of the total number)	2023
2	Number of students with special educational needs (SEN)	4,632 children (960 more than in 2020)	2023
3	Support offices for special education	96 schools have equipped Inclusive Support Rooms (ISRs)	2023
4	Number of special education specialists in schools	1105 specialists (psychologists, speech therapists, assistants)	2023
5	Special classes for children with Developmental Delay (DD)	66 classes in 14 schools, covering 355 children	2023

2. METHODOLOGY

2.1 Development of a Practical Handbook for Inclusive Competence Formation in Future Mathematics Teachers

Based on an analysis of regulatory documents, scientific-pedagogical literature, and research findings, including the results of our own empirical study – we developed a practical handbook for forming inclusive competence in future mathematics teachers.

The proposed teacher training handbook is multi-level and consists of three interconnected and interdependent components: the goal-setting block, the content-technological block, and the assessment block. Table 2.1.1 presents this model for the context of the educational system in the Republic of Kazakhstan.

These legal and policy documents, along with the public demand for inclusivity in education, form the foundation for the development of a practical handbook aimed at fostering the inclusive competence of future mathematics teachers to meet the educational needs of diverse learners in Kazakhstan.

The content-technological block is structured into two developmental stages:

1. First Stage – Formation of General Pedagogical Competence:
    a. Competencies: UC (Universal Competencies)-3, UC-5, PC (Professional Competencies)-3, PC-6, PC-7, PC-8.
    b. Courses: Developmental Psychology, Inclusive Education, Sociology, Social Psychology, Information Technologies in Education.
2. Second Stage – Development of Subject-Specific Methodological Skills:
    a. Competencies: UC-3, UC-5, PC-3, PC-6, PC-7, PC-8, SC (subject competencies)-1, SC-2.
    b. Courses: Methods of Teaching Mathematics, ICT in Inclusive Education, Digital Educational Resources for SEN learners.

Instructional Methods: problem-based learning, case studies, project work, collaborative and individual tasks, interactive teaching methods.

Forms of Instruction: lectures, seminars, practical classes, consultations, independent study (individual and group).

Teaching Tools: electronic methodology-oriented courses, adapted educational tasks, digital learning materials.

The assessment block includes criteria and methods for evaluating inclusive competence across four domains: motivational; cognitive; practical; reflective

Assessment Methods: testing, interviews, self-assessment, observation, reporting.

Levels of Readiness: high, sufficient, low.

The expected outcome of implementing this handbook is to support the formation of fully developed inclusive competence in future mathematics teachers, enabling them to work effectively in diverse educational settings across the Republic of Kazakhstan.

Table 2.1.1 Structural and Content of the Handbook for Developing Inclusive Competence in Future Mathematics Teachers for the Educational System

<table>
<tr><td>Motivational Component</td><td colspan="2">Rationale – social demand, regulatory documents, and requirements of the Standard of Higher Education (FSES HE 3++)
Goal – to form the inclusive competence of the future mathematics teacher within the educational system</td></tr>
<tr><td></td><td colspan="2">Content-Technological Block</td></tr>
<tr><td rowspan="4">Cognitive-Activity Component</td><td>Approaches:
Competency-based approach
Personalized approach</td><td>Principles:
principle of inclusivity
principle of motivational engagement
principle of content relevance
principle of active use of digital technologies in education
principle of considering national and regional specificities</td></tr>
<tr><td colspan="2">Stages of Forming Inclusive Competence in Future Mathematics Teachers</td></tr>
<tr><td>Level One.
Formation of general professional competencies of future mathematics teachers for working with children with special educational needs (SEN) in an inclusive education environment.</td><td>Level Two.
Formation and development of methodological skills and abilities that characterize the development of specific competencies necessary for future mathematics teachers to work with children with SEN.</td></tr>
<tr><td>Teaching Methods:
project-based method
case-study method</td><td>Forms of Instruction:
lectures
seminars</td></tr>
</table>

	individual and team-based work interactive teaching methods problem-based learning, etc.	practical sessions consultations independent work (individual and group-based)
	Teaching Tools: electronic method-oriented courses educational-methodological tasks (situational, project-based, case-based) adapted learning materials for children with special educational needs (SEN)	

Reflexive Component	Readiness Criteria: Motivational cognitive activity reflexive	Diagnostic Methods: tests, questionnaires interviews self-monitoring observation reports	Readiness Levels: High Sufficient low
	Result: The inclusive competence of the future mathematics teacher has been formed for the educational system.		

The content-technological block integrates both the substantive and technological components of the handbook and characterizes the organization of inclusive competence formation for future mathematics teachers.

Based on the proposed methodology, analysis of scientific literature in the field of inclusion, and the results of the diagnostic phase of our research, the use of a personalized approach is emphasized as the most effective method for developing inclusive competence in future mathematics teachers within the educational system of the Republic of Kazakhstan.

Currently, personalization is interpreted differently across various scientific fields. In sociology, for example, it refers to a process by which social connections take on a personal character. In the educational context, personalization is seen as a process

in which the learner develops qualities and skills that allow them to fulfill social roles, engage meaningfully with others, and influence collective perceptions and self-evaluation, while fostering academic integrity and avoiding plagiarism (Johnston, 1990).

Although personalization is often mentioned alongside individualization, the two are not synonymous (Durdukoca, 2021). Personalization focuses on the learner as a personality embedded within society, whereas individualization highlights the learner's unique personal trait – such as physical, mental, age-related, or temperamental characteristics. An individual cannot fully become a personality without socialization, even if they possess exceptional abilities, unless these abilities are developed through interaction within a social environment (Harris, 2015).

Personalized education enables the construction of a learning process tailored to the individual characteristics of each learner, considering both their personal growth and their interaction with the broader social environment in educational and professional contexts.

According to researchers personalized education (or a personalized approach) refers to any pedagogical actions that consider the individual and personal needs of learners. They emphasize that within teacher education systems, the personalized approach is oriented toward creating conditions that match the students' level of preparation; while also considering their interests and the personal meaning they assign to pedagogical activity (Forlin, C., & Chambers, D. , 2011). In several instructional models, personalization is also linked with the use of digital technologies, which enables its application in broader educational practice (Henderson, L., & Jarvis, J. , 2016).

(Gull, A., & Raza, A. , 2014) note that a personalized approach to education may be an effective solution to challenges associated with changes in the socio-cultural environment. It not only helps meet the demands of the modern labor market but also allows learners to develop and implement their own learning pathways in the future.

Analyzing scholarly articles and dissertation research and drawing on the work of V.G. Onushkin and O.V. Popova, we adopt the following working definition in our study: a personalized approach refers to any pedagogical action in which the learner takes an active role in selecting an educational pathway, one that is oriented toward their future professional activity in inclusive educational settings.

As an extension of individualized learning, the personalized approach recognizes the teacher as a key figure in designing each learner's educational trajectory. It treats each learner as a unique individual, attending to their specific needs and capabilities. In accordance with this interpretation, a comparative analysis of individualization vs. personalization in education is presented in Table 2.1.2, based on the model developed by the "Center for Blended Learning."

Table 2.1.2 Comparative Analysis of Individualization and Personalization in Education

Individualization	Personalization
Common goals for all learners	Individualized goals for each learner
Use of various teaching methods to help learners achieve core skills	Application of diverse pedagogical approaches to develop learners' individual abilities
The teacher designs the learning program	The learner is actively involved in designing the learning program
Emphasis is placed on the psychological dimension of the learner's personality	Attention is paid to all dimensions of the learner's personality, including emotional, social, and life-related aspects, not just cognitive
The teacher plays the key role	The mentor plays the key role

Thus, individualization in education refers to a teaching and learning process structured around the unique characteristics of learners and aimed at creating optimal conditions for their academic growth and personal development (Kalivoda, K. S., Higbee, J. L., & Brenner, D. C. , 1997).

An essential and effective tool for supporting personalized learning is student activity. We argue that helping pre-service teachers understand and embrace their future professional roles is most effectively achieved through a personalized approach. During the learning process, students develop the professional and methodological competencies necessary for teaching in inclusive classrooms (Ivleva, 2023).

The learning tasks used in our handbook – such as contextual tasks, project-based assignments, and adapted exercises – are directly aligned with the real-world responsibilities of teachers working in inclusive educational settings. Without engaging in these tasks, future teachers cannot fully master the knowledge or develop the methodological skills required to work with learners with special educational needs (SEN) (Shnarbekova, 2018).

The implementation of this approach was realized through digital learning platforms, where students completed individualized project tasks and solved methodological problems selected according to their educational needs. This was reinforced during their teaching practicum, which included direct work with students with SEN.

Numerous studies have shown that teachers working in inclusive education often encounter challenges due to a lack of teaching and methodological materials. In practice, they are frequently required to independently develop or adapt assignments

for learners with special educational needs (SEN), taking into account their academic levels, types of impairments, and other individual characteristics. Therefore, it becomes essential to equip pre-service teachers with the skills and competencies necessary to effectively use, adapt, and create instructional materials, including digital resources and online tools, specifically tailored for students with SEN.

In this study, the learning tasks aim to provide students with new strategies and generalized methods of pedagogical action, closely aligned with the professional responsibilities of in-service inclusive education teachers of mathematics.

The formation of inclusive competence in future mathematics teachers is based on the following core educational principles: inclusiveness, relevance (modeling of professional activity), active use of digital technologies in teaching, consideration of national and regional specificities, and motivational engagement. Below is a detailed analysis of these principles in the context of developing inclusive competence among future mathematics teachers (Polvanov, 2023).

- The Principle of Inclusiveness calls for eliminating all forms of discrimination against learners and ensuring equal treatment for all. It also includes the creation of appropriate conditions for those whose learning needs require individualized support.
- The Principle of Relevance (Modeling of Professional Activity) ensures that the content of teacher education reflects the realities of future professional practice. For future mathematics teachers working in inclusive classrooms, this principle guides the development of essential inclusive competencies and subject-specific as well as personal qualities through authentic, practice-oriented learning experiences. Relevance also promotes the use of case studies, situational tasks, and adapted assignments aligned with the specific needs of students with SEN.
- The Principle of Active Use of Digital Technologies in Learning encourages the meaningful integration of digital tools and platforms to improve instructional effectiveness. The creation of personalized e-learning environments enhances the quality and flexibility of education, allowing for the development of tailored content that considers the diverse needs of learners with SEN. Furthermore, digital technologies foster interactivity, collaboration, individualization, and the implementation of peer/self-assessment tools within inclusive settings.
- The Principle of Motivational Engagement is particularly critical given the relatively low level of motivation among students to work with learners with SEN. Challenges arise from both the complexities of real-life inclusive teaching and the difficulties of managing student engagement in digital environments. According to survey data, the majority of pre-service teachers demonstrate either low (39.6%) or only moderate (50.9%) interest in teaching students with SEN. Therefore, it is imperative to design educational experiences that foster intrinsic motivation and deeper involvement in inclusive pedagogical practice.

The motivational orientations of future teachers encompass not only an understanding of how to teach learners with special educational needs (SEN) and function in inclusive classroom settings but also involve a critical self-assessment of their own professional capabilities. These include the ability to perform essential duties

in inclusive educational institutions and recognizing the pedagogical role in such environments as both a professional and personal value.

An essential part of this motivation is the teacher's awareness of their thematic and methodological readiness to apply learned knowledge in practice. One promising instructional method for enhancing the motivation of pre-service teachers of mathematics and informatics is the case-study method. This pedagogical technology is based on the use of concrete instructional scenarios, which encourage students to identify problems and generate solutions, followed by in-class discussions and critical analysis.

In the context of forming inclusive competence, particular attention is given to national and regional characteristics. The development of a mathematics teacher prepared to work in inclusive classrooms must consider the specificities of the educational landscape of Kazakhstan, including ethnocultural, linguistic, psychological, and socio-economic conditions that vary across regions.

In contemporary literature, the term "national and regional" is linked to several aspects such as:

- cultural identity,
- language and communication patterns,
- psychology and mentality of the local population,
- lifestyle traditions, and
- economic conditions of the region (Ismailova, 2019).

In the context of Kazakhstan's educational system, including rural and remote areas, the following challenges are often encountered:

- insufficient teacher training in working with students with SEN;
- low effectiveness of integration processes, particularly in multi-grade or rural schools;
- inadequate adaptation of teaching methods to reflect regional and cultural traits of learners in inclusive classrooms;
- lack of accessible educational environments for SEN students.

To address these challenges, the handbook incorporates project-based and scenario-driven tasks tailored to the local realities and interests of the region – specifically those of Kazakhstan and its rural educational institutions.

The theoretical foundation of the content-technological block in our model is grounded in the integration and sequencing of academic disciplines and professional practice for students specializing in the degree programs with a focus on education. This structure supports the development of core competencies required to teach in inclusive settings.

The academic curriculum is organized into two stages:

1. General professional preparation, which addresses key requirements for teacher training and emphasizes the development of tolerant attitudes toward learners with SEN. This phase includes designing appropriate educational strategies and frameworks.

2. Methodological training, which prepares future teachers for the specific needs of various SEN categories. The role of university methodologists is vital in the implementation of this stage, as they guide the development of practical teaching skills aligned with inclusive practices.

Within this structure, methodological preparation also includes general pedagogical competencies.

In the initial stage of teacher education, it is crucial to establish a foundational knowledge base for working with SEN learners. Emphasis should be placed on adapting key subjects, such as “Information Technologies in Education”, which includes 72 academic hours comprising lectures, laboratory sessions, and independent study.

As part of this course, students explore the use of Internet-based educational tools for teaching learners with SEN and study the organization of distance learning for these students, which is particularly relevant in remote or rural regions of Kazakhstan (Kuzhabekova, 2019).

Another essential course recommended for future teachers of mathematics is "Age-related Anatomy and Physiology", which comprises 72 hours. The primary goal of this course is to provide an understanding of the physical development of learners with health-related deviations. It is advised that students study the causes and contributing factors to such developmental differences and become familiar with methods of working with children experiencing a range of health conditions (Kavanaugh, 2016).

In the "Developmental Psychology" course (72 hours), students examine the psychological development of individuals, focusing on the psychogenesis of personality and the behavioral characteristics of learners with special educational needs (SEN) in inclusive environments. The course also prepares students to support the formation of general cultural competencies, socialization, and professional identity in learners with special educational needs within inclusive education. Additionally, students develop competencies in collaborative work with other professionals to form a unified correctional and pedagogical environment that facilitates both learning and social integration for learners with developmental challenges. They also learn strategies for maintaining systematic communication with parents, engaging them in the joint educational and developmental goals of children with SEN (Zagona, 2017).

The "General Pedagogy" course (72 hours), introduces the specifics of education, development, and social integration of children with special needs. Students are acquainted with various teaching strategies, methods, and tools designed to provide comprehensive support for these learners (Pillay, J., & Di Terlizzi, M. , 2009). As part of the "Sociology" course, students explore the role of society in the lives of learners with special educational needs. The course includes content on the social rehabilitation of children and adolescents with developmental differences, aiming to help these learners change their self-perception and worldview. This process supports them in understanding their equal rights and opportunities in comparison to their peers.

Furthermore, the course is designed to cultivate personality traits in learners with SEN that will support them in pursuing and achieving their life goals (Romanovtseva, 2016).

The curriculum includes a dedicated course on "Inclusive Education", comprising 72 hours. This course plays a central role in forming inclusive competencies among pre-service mathematics teachers by focusing on theoretical and practical foundations of inclusion, legislative frameworks, categories of SEN, and strategies for inclusive practice in Kazakhstan's general education system.

The presented curriculum model outlines a two-stage framework for the formation of inclusive competence in future mathematics teachers within the educational context of the Republic of Kazakhstan. The model reflects the integration of general professional and methodological training, aligned with the demands of inclusive education and current national educational standards.

General Professional Training: This foundational stage aims to develop essential pedagogical and psychological knowledge, introduce the principles of inclusive education, and acquaint future mathematics teachers with the sociocultural and developmental characteristics of diverse learners, including those with special educational needs (SEN).

Methodological Training**.** This stage emphasizes the practical application of inclusive teaching strategies through the design of lesson plans and digital resources for learners with special educational needs (SEN), mastery of differentiated instruction, and the use of adaptive assessment tools. Students develop case-based reasoning and inclusive problem-solving skills. Key courses—such as Methods of Teaching Mathematics, mathematics in Inclusive Education, and Digital Educational Resources for Learners with SEN—equip future teachers with the pedagogical, technical, and reflective skills necessary to meet diverse learner needs. Practicum experiences, including placements in rural and underserved schools in Kazakhstan, serve as capstone opportunities to demonstrate inclusive teaching competence.

Each course is mapped to a structured competency framework that includes:

- Universal Competencies (UC) – e.g., critical thinking, communication, teamwork;
- General Professional Competencies (GPC) – e.g., understanding learner development, inclusive planning, interprofessional collaboration;
- Special Professional Competencies (SPC) – focused on adaptive teaching, digital content creation for SEN, and curriculum differentiation;
- Communicative Competencies (CC) – crucial for working with diverse learners, families, and support teams.

This stage is localized to the context of Kazakhstan's education system, reflecting national inclusive education policy, multilingual and multicultural diversity (especially in Almaty and rural areas), and the demand for digitally skilled, inclusion-ready educators.

The sequencing of courses ensures that theoretical foundations are laid early, followed by increasing levels of pedagogical complexity and field engagement,

ultimately culminating in practice-oriented training that simulates real-world inclusive teaching environments.

As part of this course, students enrolled in pedagogical universities across Kazakhstan, including those based in Almaty, are introduced to the fundamentals of inclusive education. They examine the key characteristics and challenges associated with implementing inclusive education in the context of Kazakhstan's national education policy. Special attention is given to the psychological and developmental traits of learners with special educational needs (SEN) in Kazakhstani schools. Additionally, students explore a variety of psycho-pedagogical strategies and technologies used in inclusive educational settings throughout the country (Ainscow, M., Slee, R., & Best, M. , 2019).

In accordance with the State Compulsory Educational Standard for Higher Education of the Republic of Kazakhstan (SCES RK), a core discipline in developing competencies for future mathematics teachers is "Methods of Teaching Mathematics." It is advised that this field incorporate a specific module on teaching math to students with special education needs.

Higher education institutions in Kazakhstan have the academic freedom to create institutional academic programs that incorporate current educational priorities into their curricula.

In line with Kazakhstan's shift to digital education, these courses are best taught in a blended learning environment that combines in-person instruction with online learning platforms like Moodle, Google Classroom, and BilimLand.

The goal of these courses is to improve aspiring educators' methodological preparedness for teaching in inclusive classrooms. They demonstrate Kazakhstan's strategic dedication to inclusive education, which includes putting the country's Concept for Inclusive Education Development into practice until 2030.

In addition to meeting legal and policy requirements, incorporating inclusive content into teacher preparation programs fosters the growth of professionally qualified, compassionate, and flexible educators who can create engaging learning environments for all students.

Section 1: A Useful Guide for Up-and-Coming Teachers on Teaching Inclusive Mathematics

Pre-service teachers specializing in mathematics in pedagogical education programs are the target audience for this section of the handbook. It is intended to offer useful tools and inclusive teaching strategies that can be applied in actual classroom environments, building upon fundamental knowledge in pedagogy, psychology, and mathematics teaching techniques.

To equip aspiring math teachers with the skills they need to teach in inclusive, diverse classrooms that represent the Republic of Kazakhstan's educational priorities, including those that apply to both urban and rural schools.

1. With a focus on Kazakhstan's national policies and cultural-educational diversity, this section assists you in exploring the concepts and models of inclusive education.

2. to comprehend how the educational and psychological requirements of students with special educational needs (SEN) affect their ability to learn mathematics.
3. to gain proficiency in creating differentiated math lessons while incorporating inclusive and culturally sensitive teaching methods.

After Working Through This Section, you will be able to:

- important pedagogical and legal underpinnings for Kazakhstan's inclusive and equitable mathematics education;
- traits of SEN students' cognitive development and how they impact their ability to think mathematically;
- the significance of language context and ethnocultural sensitivity in math instruction in diverse classrooms.
- Possess the ability to modify lesson plans and evaluation techniques to suit a variety of student needs and skill levels;
- To increase students' interest in mathematics, use inclusive teaching strategies like interactive technology, visual aids, and manipulatives;
- work together with families and experts (such as school psychologists and special education teachers) to support each student's mathematical development.

Module 1: Inclusive Educational Environment. This module introduces the foundational principles of inclusive education, tracing its development within Kazakhstan’s educational system. It explores national policies and legal frameworks, including the Law on Education of the Republic of Kazakhstan and the State Program “Accessible Kazakhstan”. Students examine institutional strategies for creating inclusive environments in mainstream schools, with a particular focus on regional disparities. Case studies from Almaty and southern provinces illustrate how resource availability, local culture, and community practices influence the implementation of inclusive education.

Module 2: Learners' Pedagogical and Psychological Features in Inclusive Education. The developmental, cognitive, and emotional traits of students with special educational needs (SEN) are examined in this module, with a focus on ethnopedagogical aspects pertinent to Kazakhstan's multicultural society. Children from multilingual and Kazakh-speaking rural backgrounds are the focus. In order to promote learning and identity, students investigate culturally sensitive pedagogical interaction strategies, parent communication, and differentiation techniques.

Module 3: Creating an Inclusive Math Teaching Process. This topic gives aspiring math teachers the tools they need to create inclusive math lessons that are in line with the State Compulsory Standards of Education (OáHO). It addresses curriculum changes, culturally sensitive teaching methods, and the development of customized learning plans. In general education classrooms throughout Kazakhstan, special consideration is given to the instructional design for students with a variety of developmental disorders (such as intellectual, auditory, visual, and motor impairments).

Module 4: Mathematics Extracurricular Activities in Inclusive Environments

This module focuses on how extracurricular activities help students with special education needs learn mathematics. Future educators will acquire the skills necessary to create remedial workshops, enrichment programs, and inclusive clubs that balance subject mastery with the needs of each individual student. The focus is on using inclusive teaching methods and national-cultural components that represent Kazakhstan's linguistic and ethnic diversity.

Section 2: Online Learning Materials for Students with Special Education Requirements

Concerning this section: This section offers helpful advice on creating, modifying, and implementing accessible digital learning resources for children with special educational needs (SEN) as part of Kazakhstan's "Digital Kazakhstan" strategy. For teachers in underprivileged and rural locations, where distance learning and digital technology may be the main teaching methods, this part is extremely important.

in line with Kazakhstan's national aims for accessible education and technology advancement, to assist aspiring math teachers in successfully using digital and distance learning tools into inclusive learning environments.

1. Gain an understanding of the pedagogical, psychological, and legal facets of digital inclusion for students with cognitive, sensory, or physical disabilities by reading this section.
2. Examine and implement accessibility guidelines for digital information, paying particular attention to students who speak Kazakh and those who have visual or hearing problems.
3. Develop the skills to create, adapt, and evaluate inclusive digital educational resources for mathematics instruction.

Competency Development Framework.

This section contributes to the systematic formation of inclusive digital teaching competence by building four interrelated domains of professional readiness. First, it fosters regulatory competence by ensuring that future teachers understand the legal and policy context surrounding inclusive education in Kazakhstan. By assisting students in identifying and meeting the unique needs of students with sensory impairments, it also fosters psychological insight. Third, by using and modifying digital tools made accessible, it cultivates useful technical skills. Lastly, by promoting the incorporation of language, identity, and cultural context into inclusive digital content, it highlights cultural responsiveness.

Assessment Framework for Inclusive Competence. Assessment of students' development in inclusive competence is guided by the updated State Educational Standards of Higher Education (SES HE 3++) in Kazakhstan. At the low level, students demonstrate only a minimal understanding of inclusive principles, limited professional and emotional readiness to work with learners with special educational needs (SEN), and little flexibility or initiative in adapting teaching practices. At the high level, students exhibit a thorough understanding of inclusive education strategies, confidently address the individual needs of learners, and apply a variety of inclusive and digital

teaching methods. They are proactive, creative, and able to participate in collaborative professional discussions. At the satisfactory level, students demonstrate interest in inclusive education and have a basic understanding of how to teach learners with SEN. Despite the fact that they may not have a full set of strategies or psychological preparedness, they express a willingness to apply innovative methods and further develop their skills.

Curriculum Integration with Inclusive Education. This section is closely integrated with other foundational subjects that collectively support the formation of inclusive teaching competence. These include Information Technologies in Education, Developmental Psychology, Inclusive Education, Methods of Teaching Mathematics, and Digital Educational Resources for Learners with SEN. By combining these fields, future educators are better equipped to work in inclusive, multilingual, and rural classrooms, advancing Kazakhstan's national commitment to educational innovation, equity, and access.

2.2 Development and Implementation of Inclusive, Practice-Oriented Tasks to Support Mathematics Achievement in Diverse Classrooms

The handbook included a structured set of tasks that, when completed in order, helped future math teachers develop inclusive competence. With the integration of students with special educational needs (SEN) becoming an increasingly important priority in Kazakhstan's national education system, this set of tasks is intended to meet the methodological and practical requirements of teacher preparation programs.

Numerous studies confirm that teachers working in inclusive settings often face a shortage of adequate instructional and methodological resources. In practice, teachers are frequently required to independently design or adapt learning tasks for learners with special educational needs, taking into account their functional diagnosis (nosology), individual learning levels, and specific cognitive or emotional characteristics.

This emphasizes how critical it is to give teacher candidates the professional skills and abilities needed to:

- Make effective use of the banks of mathematics assignments that are currently available that are specifically designed for students with special education needs;
- carefully modify teaching resources to meet the needs of a range of learners;
- When necessary, produce fresh, inclusive materials, such as those created with digital tools and Internet-based platforms.

The tasks included in this section are classified by two major stages of professional teacher development:

1. General pedagogical preparation (focus on inclusive values, psychological and pedagogical foundations),
2. Methodological preparation (focus on planning and delivering mathematics lessons in inclusive classrooms).

This classification allows teacher training institutions in Kazakhstan to integrate inclusive education more systematically into both theory and practice across

the bachelor's curriculum in Pedagogical Education (Informatics and Mathematics profile), while considering the linguistic, cultural, and infrastructural specifics of the Republic of Kazakhstan.

Assignment Types and Samples for Fostering Inclusive Competence

A range of focused learning activities are incorporated into the handbook to aid in the thorough development of inclusive competence in aspiring math and informatics teachers. The four main facets of inclusive competence—motivational, activity-based, cognitive, and reflective—are all represented in these tasks.

Students may be exposed to compelling success stories of people with special educational needs (SEN) from Central Asia, especially Kazakhstan, in order to strengthen the motivational element. Students could investigate the life of a visually impaired graduate who taught mathematics in a rural school in Kazakhstan, for instance.

Students solve real-life situational problems that are frequently encountered in inclusive classrooms in order to reinforce the activity-based component. For example, in a rural school in Turkestan or East Kazakhstan, where resources are scarce and linguistic backgrounds are varied, they might be asked to create a seating arrangement and adaptive strategies for a mixed-ability math class. By simulating classroom situations, these assignments help students get ready to make decisions in inclusive settings.

Students develop subject-specific psychological-pedagogical diagnostic tools for the cognitive component. For instance, a math student may use simplified language and visual aids to create a diagnostic worksheet or an adaptive problem-solving exam for students with intellectual disabilities.

Lastly, this handbook encourages students to keep a reflective journal during their practicum in order to foster the reflective component. Working with SEN students in inclusive settings, especially in multilingual and rural schools in areas like Almaty Oblast or Kyzylorda, has led them to document their emotional reactions, ethical concerns, successes, and challenges in this journal. Self-awareness, professional development, and a greater comprehension of inclusive teaching practices are all facilitated by these reflections.

Types of Tasks and Assignment Examples in the Field of Methodological Training:

A variety of practice-oriented exercises are offered in this section of the handbook to aid in the creation of inclusive teaching methods in the teaching of computer science and mathematics. By emphasizing teamwork, customization, digital adaptation, and the use of e-learning tools, these assignments aim to equip aspiring educators for the challenges that will arise in Kazakhstani schools, both urban and rural.

Students are required to suggest themes and strategies for project-based learning activities that involve students with special educational needs (SEN) and their classmates who are typically developing cooperating to achieve a common objective in order to promote collaborative skills. For instance, students might plan a group coding project in which students with and without special education needs work

together to produce an instructive animation. They also examine actual case studies from Kazakh schools, like inclusive classrooms in Shymkent or Semey, where cooperation is essential for both social and academic inclusion. These exercises improve awareness of inclusion and team-based problem-solving.

Students use Kazakhstan's national curriculum and Ministry of Education guidelines to create adaptive instructional programs that support individualized approaches in computer science education. For instance, they might design differentiated math lesson plans for students with intellectual disabilities or autism spectrum disorder. In order to guarantee that children with different SEN receive appropriate and equitable support, students also practice creating customized learning pathways that take into account each learner's pace, needs, and strengths.

Future educators must develop accessible learning resources in Kazakh and Russian for students with sensory impairments in order to develop their ability to modify instructional materials using digital tools. For example, a math lesson could be redesigned with large-font text and simplified graphics for students with visual impairments, or it could include sign-language videos for students with hearing impairments. To encourage participation in inclusive digital environments, students also create interactive activities on websites like Kundelik.kz, Bilimland.kz, Moodle, UStudy, and Online Mektep, or utilize Google Classroom, Kahoot, and Quizlet.

Students create accessible digital experiences for students with visual impairments using Braille displays, tactile interfaces, or auditory feedback to support the development and use of e-learning and distance education technologies. Building a prototype of a game-based learning tool that uses sound cues to reinforce logical reasoning abilities could be one task. Students are also asked to create core modules for the course "Digital Educational Resources for Learners with Special Educational Needs," which are specifically adapted to the digital infrastructure and school realities of Kazakhstan, including multilingual requirements and rural connectivity problems.

Four different assignment types—motivational, cognitive, activity-based, and reflective—are part of the task set linked to the general professional stage of teacher preparation. These assignments are meant to help develop the component structure of inclusive competence.

The general requirements for teacher education serve as the foundation for assignments at the first level, or general professional training. The following phases are recognized in the process of training aspiring math teachers to work with students who have special educational needs (SEN):

1. Stage of Motivational Component Formation. At this point, students learn the fundamentals of inclusive education, the variety of learners in society, and the traits of students with special education needs, such as their care, learning, and development requirements. The framework of the current support system for children with special education needs in Kazakhstan and around the world is presented to the students.The methods used include:
    a. Visual methods: watching and analyzing motivational videos that demonstrate how inclusivity transforms the lives of learners with special

educational needs; organizing meetings with successful professionals who have special educational needs; and engaging in role-playing and dramatized games.

b. Verbal methods: discussions, interviews, and storytelling sessions that highlight inclusive values.

2. Cognitive and Activity-Based Component Formation Stage. At this stage, learning activities are organized to simulate the real work of teachers in inclusive classrooms. Students solve situational and case-based tasks designed to strengthen their knowledge and hands-on experience related to inclusive education. Through these activities, they improve their perception, processing, and application of educational knowledge to address theoretical and practical issues related to working with students who have special education needs.
3. Stage of Reflective Component Formation. Students are urged to hone their ability to evaluate themselves and their peers during this phase. Reflective thinking is fostered by these exercises. Students develop a greater understanding of their teaching methods, ethical issues, and responsiveness to various learner needs by analyzing their own choices as well as those of their peers.

This strategy is especially pertinent in Kazakhstan, where inclusive education policies are being actively implemented in both urban and rural schools, including those in areas with a high proportion of students from ethnically diverse backgrounds and multilingual students.

The second-level assignments are designed to support the formation, development, and mastery of methodological and instructional skills required of future computer science teachers working in inclusive educational environments. Based on our research, we have identified a set of task types which, when implemented systematically within the relevant academic courses, will contribute to the development of inclusive competence.

Task Type 1: Supporting Socialization and Peer Collaboration.

These tasks target one of the most pressing challenges in educating learners with special educational needs (SEN)—their social integration. According to L.S. Vygotsky, the lack of preparedness among learners with SEN for successful social adaptation is not rooted solely in their physical limitations but is more deeply connected to social barriers that disrupt their interaction with society and cultural norms—key sources of development.

To address this, it is critical that learners with SEN develop awareness and mastery of social roles and learn how to apply them in real-world settings. One of the most important factors contributing to the successful socialization of such learners is their interaction and cooperation with neurotypical peers.

As noted by (Modupe, 2010), learners with special educational needs often face challenges in connecting with the surrounding world due to limited mobility, restricted communication, and reduced access to cultural and educational resources. Therefore, the primary goal of their education should be socialization.

Socialization enables individuals to become full participants in society by acquiring the knowledge, skills, and behaviors required for communal life. The major obstacles faced by learners with SEN in this context include emotional instability, poor social interaction, and a lack of confidence. They might lack the life skills required for independent living, as well as the ability to make decisions and act appropriately in social situations.

In order to overcome these obstacles, it is crucial to give these students the capacity to organize and pursue their own learning objectives as well as to acquire critical abilities like social values, communication, behavior norms, and attitudes that are in line with mainstream society.

Participating inclusively in cooperative learning activities with peers is one of the best strategies to support the socialization of students with special education needs. In this sense, techniques like project-based learning, teamwork, and extracurricular involvement are effective instruments. The goal of this task category is to help future teachers develop the ability to design and facilitate such activities within the framework of teaching computer science.

These skills build upon the inclusive competencies acquired during the first (general professional) phase of training and involve the assessment of learners' individual traits and academic abilities. Planning the circumstances and chances for integrating students with special education needs into extracurricular and curricular group activities is also necessary.

Such assignments are essential for preparing future teachers to meet the demands of diverse classrooms in the real world, guarantee equitable participation, and promote inclusive learning cultures that reflect regional cultural values and national priorities in the context of the Republic of Kazakhstan, especially in rural and multilingual school environments.

Task Type 2: Developing Personalized Learning Plans and Adaptive Teaching.

This second category of assignments supports future teachers in effectively organizing corrective and developmental instruction in inclusive classrooms. Every subject teacher working in an inclusive setting must plan their teaching thoroughly, taking into account the psychological and cognitive characteristics of learners with special educational needs (SEN), their individual learning profiles, developmental dynamics, and readiness to acquire new knowledge, along with the specific nature of their special educational needs.

Adapting instruction for students with special education needs (SEN) requires taking into account both their intellectual and physical development. Even though some students may follow the same curriculum as their peers, they still need specialized support, especially when it comes to the way the curriculum is presented, depending on the particular diagnosis (e.g., hearing impairments, visual impairments, motor disabilities, or difficulties with emotional and volitional regulation). This covers differences in task structures, deadlines, level of difficulty of the material, and evaluation methods.

Every condition has its own set of difficulties, which frequently lead to diminished capacities for information perception, processing, storage, and application. As a result, students with SEN may struggle greatly in the areas of communication, skill acquisition, academic success, and the development of more general life competencies.

To prepare future teachers for implementing a personalized approach, training must focus on developing the skills needed to:

- Design individualized educational trajectories (IETs) for learners with SEN;
- Develop adapted general education curricula for the subject *mathematics* that accommodate students' specific needs;
- Modify learning activities and assessments in accordance with various disability categories (e.g., hearing loss, ASD, dyslexia, etc.).

In the context of the Republic of Kazakhstan, where schools serve students with diverse linguistic, social, and developmental backgrounds, this personalized instructional planning is critical. These tasks enable student teachers to tailor their pedagogy to the individualized pace and format suitable for every learner and foster their academic and social inclusion in real classroom settings.

Task Type 3: Integrating Digital Technologies into Inclusive Education.

The ability to complete third- and fourth-type tasks reflects the level of mastery that future teachers have in using modern digital technologies and inclusive pedagogical methods to implement effective and accessible teaching in diverse learning environments.

The advantages of integrating digital technologies into education are clear from their capacity to promote interaction and communication between all parties involved in the learning process. These technologies facilitate individualized learning experiences and give students, including those with special educational needs (SEN), access to instructional content in convenient formats.

During their teacher training, students were introduced to various tools for developing inclusive assignments, such as mind maps, interactive timelines, and visual planning apps. They studied several digital and distance education methodologies, including blended and hybrid learning, the organization of webinars and virtual classrooms, and applied them through custom-designed electronic courses such as:

- Teaching mathematics in Inclusive Education, and
- Digital Educational Resources for Children with Special Educational Needs.

By engaging in tasks built around these resources, future mathematics and informatics teachers developed structured approaches to working with learners with SEN. They acquired essential professional skills and practical experience required for inclusive instruction.

Table 2.2.1 Special Educational Challenges of Students with Hearing Impairments

Identified Challenges	Instructional Strategies and Methods	Examples of Adapted Assignments	Tasks Adapted to Learners' Individual Characteristics	Targeted Educational Competencies (ULAs)
-Underdeveloped speech (limited vocabulary, impaired grammar); Slow work pace due to challenges with auditory attention and memory; - Low levels of autonomy and responsibility; passivity; lack of initiative; - Reduced attention span and focus.	-Visual aids focused on the visual channel; - Speech development strategies (expanding vocabulary, building grammar, dialogic/monologic speaking, listening skills); - Development of accurate, full, detailed perceptions of the world, applied in various activities.	- Screencasts with subtitles.	- Screencasts that use locally relevant content and cultural references, with subtitles in either Kazakh or Tuvan.	-Cognitive Skills: - Taking in and using new information; utilizing object analysis to draw conclusions. -Self-control: adhering to the instructor's plan;

The goal is to increase students' understanding of the difficulties faced by students with special education needs, cultivate empathy and curiosity about these students' educational requirements, and encourage positive attitudes and self-motivation. By relating the course material to the experiences of real-life individuals that the students know or can identify with, the assignment aims to increase student engagement (Table 2.2.1).

Sample Activity:

- Watch and discuss a documentary about a local success story involving learners with special educational needs (e.g., a Kazakhstani student or entrepreneur with visual or hearing impairment).
- Ask a guest speaker with special education needs who has succeeded in their career or social life to address the class.

- Students should be asked to consider how inclusive education might have contributed to these tales and what difference they could make as future educators.

The proposed task supports the development of student teachers' skills in creating instructional materials for specific subject areas—such as mathematics or informatics—while considering the nature of learners with special educational needs, their personal characteristics, and their individual learning needs.

In this way, solving educational and methodological tasks contributes to the development of additional, specialized competencies among future teachers. These abilities will allow them to: autonomously create unique educational materials for students with various medical conditions and developmental stages; evaluate these materials' efficacy through real-world use; and incorporate them in a meaningful way into the inclusive learning process.

Such assignments are essential for training educators who can teach with competence and confidence in inclusive classrooms throughout the Republic of Kazakhstan, including multilingual and rural areas where cultural sensitivity and differentiated instruction are particularly crucial.

2.3 Design and Results of a Pedagogical Experiment: Measuring Competence and Attitude Change in Pre-Service and In-Service Mathematics Teachers

Testing the research hypothesis and assessing the usefulness of the suggested structural-logical model for fostering inclusive competence in aspiring math teachers were the objectives of the experimental work. In order to promote inclusive teaching practices in mathematics education, the model was put into practice using a set of pedagogical tasks that included reflective, practical, cognitive, and motivational elements.

As part of the in-field validation component, pre-service and in-service math teachers in Kazakhstan took part in the experiment. To measure baseline preparedness, track the growth of inclusive attitudes, and gauge the usefulness of the suggested teaching techniques, a three-phase pedagogical approach was used, combining quantitative and qualitative techniques.

The methodology and results were examined with reference to both urban schools in Almaty and rural educational institutions, where inclusive practices are being actively implemented, in order to guarantee contextual relevance and applicability to the Republic of Kazakhstan's educational landscape. The results support the development of locally based and culturally sensitive teacher education models that are in line with Kazakhstan's national inclusive education agenda.

The three phases of the experimental study were exploratory, final (summative), and diagnostic (baseline). Through focused pedagogical interventions, each stage was created to evaluate, implement, and assess the growth of inclusive competence in aspiring math teachers.

The following research tasks were developed in order to fulfill the stated research objective:

1. To determine future math teachers' starting level of inclusive-related competencies, with an emphasis on their preparedness to instruct students with special educational needs (SEN) in inclusive classroom environments;
2. To determine the degree of inclusive competence among both pre-service and in-service mathematics teachers using structured surveys and diagnostic tools;
3. To assess the development of key components of inclusive competence—motivational, cognitive, activity-based, and reflective—through the structured implementation of subject-specific and pedagogical content.

Diagnostic Stage of the Pedagogical Experiment:

During the diagnostic stage of the pedagogical experiment, the level of readiness among both in-service teachers and graduating students enrolled in the education program. The purpose of this stage was to evaluate their preparedness to work in inclusive educational settings. Data on their inclusive education-related knowledge, attitudes, and practices were gathered using a combination of testing and questionnaire-based techniques.

A structured survey was given to 28 active math teachers with an average of 7.8 years of professional experience in order to assess the current status of inclusive teaching practices among in-service teachers. The survey was divided into two sections. The first asked about respondents' demographics and professional backgrounds, and the second asked about their experiences with inclusive education, including the tactics and strategies they employed to put it into practice.

According to the survey's findings, 67% of math teachers who took part were already active in inclusive classrooms. Nonetheless, a startling 92% of them stated that they had significant difficulties in their teaching. Additionally, 75.5% of respondents said that their own professional training was inadequate to meet the needs of students with special educational needs (SEN) and that their schools were not adequately prepared for inclusive education. Just 42% of teachers said they used individualized approaches in their classrooms to support SEN students, despite 58% of them being aware of the legal and regulatory framework for inclusive education and related pedagogical strategies.

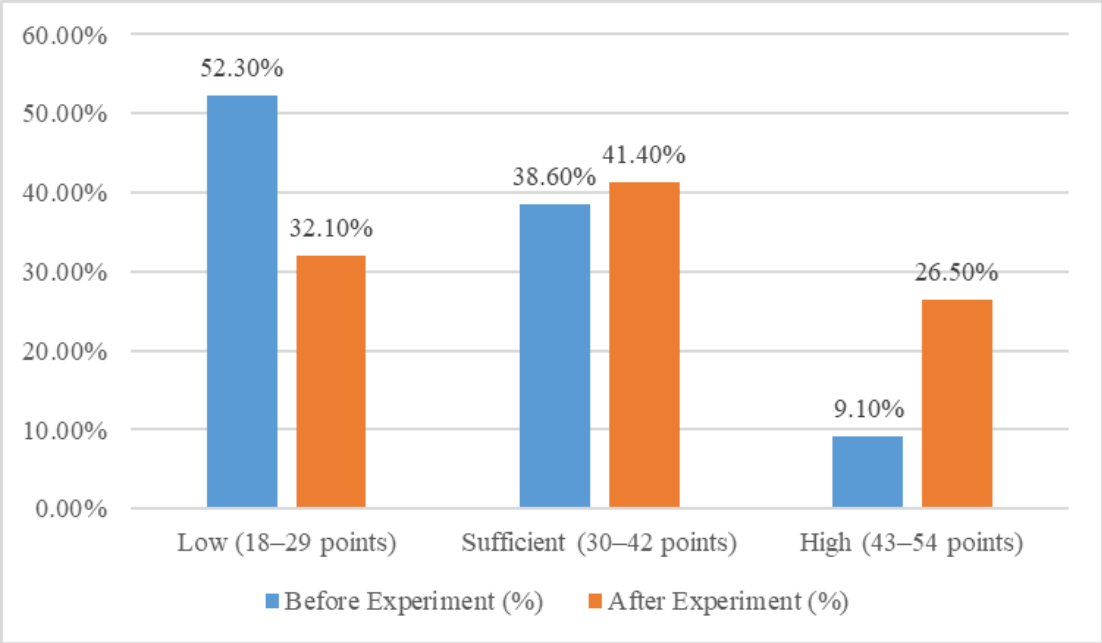
For future math teachers in particular, these findings highlight the urgent need to update and improve teacher education programs so that graduates are prepared to function well in inclusive classrooms.

A diagnostic test was given to pre-service teachers to gauge their level of readiness. Ten multiple-choice questions and three situational tasks made up the assessment, which was graded on a 10-point scale. Students were divided into three groups based on their overall scores: low level (less than six points), sufficient level (6–8 points), and high level (9–10 points). The findings of this diagnostic test provided guidance for the subsequent experimental phases and identified particular areas that required focused instructional intervention (refer to Table 2.3.1 and Figure 2.3.1).

Table 2.3.1 Baseline Diagnostic Results of Students

Readiness Level	Before Experiment (%)	After Experiment (%)
Low (18–29 points)	57.6%	38.1%
Sufficient (30–42 points)	42.4%	38.1%
High (43–54 points)	0.0%	23.8%

Figure 2.3.1 Results of Initial Diagnostic Assessment of Student Readiness



The data presented in Table 2.3.1 and Figure 2.3.1 indicate that most students initially demonstrated a low level of readiness to work in inclusive environments. These results validate the initial assumptions of the study regarding the need to develop inclusive competence within the training of future mathematics teachers.

The exploratory stage concentrated on developing and theoretically substantiating a structural-logical model intended to foster inclusive competence among aspiring math teachers, building on the empirical data collected during the diagnostic stage. During this stage, a thorough training methodology was created that was especially adapted to the inclusive education setting within Kazakhstan's national educational framework.

The effectiveness of inclusive competence formation was pursued through the integration of inclusive elements into core academic disciplines and teaching practicum experiences, which form part of the general pedagogical training. In addition, new subjects and practical activities were introduced, each developed around tasks with a focus on inclusive educational scenarios. The purpose of these curriculum

improvements was to guarantee consistency between theoretical learning and practical application in a variety of classroom environments.

A thorough defense of the chosen teaching methods, instructional designs, and instructional resources was also part of this phase. Special attention was paid to modifying the model to take into account the realities of local school environments and coordinating the learning process with the goals of Kazakhstan's inclusive education policy.

A set of standards and performance metrics was developed in order to methodically assess the development of inclusive competence. Four main components were used to organize these indicators:

The learner's values, professional interests, and readiness to work with students who have special educational needs (SEN) are reflected in the motivational component;

Comprising theoretical knowledge and comprehension of inclusive education principles, the cognitive component

Activity-Based (Operational) Component: Shows the capacity to create, organize, and carry out inclusive teaching methods in real-world settings;

The reflective component measures the teacher's capacity to evaluate, consider, and enhance their own professional endeavors pertaining to inclusive education.

A three-tiered model of inclusive competence development was built using these elements as a basis:

Low Level: characterized by a lack of motivation, a lack of familiarity with inclusive educational practices, and limited or superficial competence;

Sufficient Level: Shows a foundational level of readiness for working in inclusive environments, with sufficient proficiency and room for growth;

High Level: Demonstrates a responsible, proactive approach to inclusive education, characterized by preparedness for leadership in inclusive educational settings and strong methodological, psychological, and reflective abilities.

We used a modified version of the "Teacher's Inclination Toward Working with Learners with Special Educational Needs (SEN)" diagnostic test (see Appendix 1) to investigate the motivational aspect of inclusive competence. Additionally, we applied an adapted version of N.G. Luskanova's "School Motivation and Academic Activity" questionnaire, designed specifically for learners with SEN. This helped collect general data on learner satisfaction with the quality of inclusive educational services in schools across the Republic of Kazakhstan (see Appendix 2).

To evaluate teachers' self-perceived readiness to work in an inclusive environment, we administered a teacher self-assessment questionnaire (Appendix 3). We also surveyed parents of learners with SEN to assess their level of satisfaction with educational services provided to their children.

Table 2.3.2 Criteria and Indicators for Evaluating the Formation of Inclusive Competence of Future Mathematics Teachers

Readiness Criterion	Indicators	Methods and Tools for Diagnostics
Motivational	- Willingness to perform professional duties, including the use of inclusive teaching methods; - Willingness for self-development in the field of inclusive education; - Mastery of key inclusive education concepts.	1. Inclination test for working with learners with SEN (special educational needs); 2. Teacher self-assessment survey on inclusive readiness.
Cognitive	- Knowledge of how learners with various needs perceive mathematical content (with attention to cultural specifics, such as Kazakh, Tuvan, and multilingual classrooms); - Familiarity with diverse teaching methods for inclusive classrooms; - Understanding how to plan lessons for mixed-ability groups; - Deep subject-specific understanding for inclusive delivery.	Practice-based and diagnostic testing; Content-specific reflection tasks.
Activity-based	- Ability to assess learners' educational needs, including with SEN; - Use of contemporary digital tools (e.g., BilimLand, Moodle, Kundelik.kz) in inclusive math settings; - Development of customized lesson plans and adapted materials; - Evaluation of learner progress; - Trial and refinement of adapted teaching approaches.	A set of subject-methodology tasks focused on real-life inclusive math teaching scenarios.
Reflective	- Reflection on personal teaching experiences in inclusive settings; - Maintenance of high standards in goal achievement.	Reflective diary entries; Modified A.V. Karpov's reflexivity test (Kazakh and Russian versions).

We used a wide range of tests to evaluate the cognitive aspect of inclusive competence. These made it possible for us to compile comprehensive information on math teachers' pedagogical readiness for inclusive education.

Self-assessment techniques and performance task analysis with inclusive components were used to evaluate the activity-based component of inclusive competence. Specifically, this involved the completion of practical tasks and control exercises that simulate teaching mathematics to learners with diverse needs.

To determine the level of development of the reflective component, we analyzed student teachers' reports from teaching internships and used modified versions of reflection assessment questionnaires developed by A.V. Karpov and O.V. Kalashnikov.

To evaluate the level of formation of each component of inclusive competence among future mathematics teachers, assessment criteria were developed and applied across all surveys, tests, and performance tasks. These criteria are presented in Table 2.3.3.

The presented criteria and indicators—both quantitative and qualitative—enable an objective assessment of the level of development of inclusive teaching skills among future mathematics teachers working with learners with special educational needs (SEN) in classrooms where inclusive education is implemented within the context of the Republic of Kazakhstan.

Table 2.3.3 Assessment Criteria for the Formation of Inclusive Competence in Future Mathematics Teachers

Assessment Criteria of Inclusive Competence	**Levels of Inclusive Competence (Scores)**
	Low
Motivational Component	18–30
Cognitive Component	0–10
Activity-Based Component	0–30
Reflective Component (average score)	31–51
Total Score	49–119
Average Value	16.3–39.7

The final stage of the pedagogical experiment was dedicated to conducting a comprehensive evaluation of the effectiveness of the developed structural-logical model for forming inclusive competence in future mathematics teachers. Based on the assessment outcomes, targeted adjustments were made to the content and structure of

the educational modules, with particular attention to the course “Methods of Teaching Mathematics.”

In adapting this experience to the educational system of the Republic of Kazakhstan, particularly within the Almaty region, the experimental model was localized and structured into the following implementation stages:

Stage 1: In the early stages of training, students studied psychological and pedagogical disciplines as well as the course “Information Technologies in Education”, aligned with Kazakhstan’s national educational standards. Students learned about online learning environments like Moodle, Kundelik.kz, and Bilimland.kz during this time. This phase's main goal was to lay the groundwork for a fundamental understanding of inclusive education and the technology tools that support it.

Stage 2: Students in the course "Teaching Mathematics in Inclusive Educational Settings" completed a number of focused assignments that matched the four elements of inclusive competence: reflective, cognitive, motivational, and operational (activity-based). These assignments included solving real-world situational problems, conducting structured interviews, and analyzing case studies of successful students with special educational needs (SEN). As part of the seventh semester's "Methods of Teaching Mathematics" course, students created lesson plans and curricula while considering the regional and cultural diversity of Kazakhstan's educational system. Students completed inclusive educational projects as part of their practicum.

Stage 3: Students evaluated the appropriateness of a range of digital tools and resources as part of the course "Digital Educational Resources for Learners with Special Educational Needs." Their assignment was to modify the content of mathematics.

To measure the development of the motivational component of inclusive competence, a localized and adapted version of A.I. Darovsky’s “Teacher’s Inclination Toward Working with SEN Learners” test was employed, along with an adapted version of N.G. Luskanova’s “School Motivation and Academic Activity” questionnaire. In order to gauge participants' perceived preparedness and confidence in providing inclusive instruction, a teacher self-assessment survey was also conducted. Table 2.3.4 and Figure 2.3.2 present the findings of this thorough evaluation.

Before and after each stage of the pedagogical experiment, the table shows the development of future math teachers' motivational readiness across three levels (Low, Sufficient, and High). Since the data pertain to the cohort 2025, a phase-by-phase comparison can be made to evaluate how well the intervention changed motivational attitudes toward inclusive education.

McNemar's test was used to assess the statistical significance of variations in motivational levels between Before and After each phase. This non-parametric test determines whether the distribution of categorical responses (such as "Low" to "Sufficient/High") across paired observations differs significantly. This approach offers a strong framework for testing the null hypothesis that the intervention had no

impact on motivational shifts because participants were assessed at various points in time.

Table 2.3.4 Dynamics of the Motivational Component Levels Across the Stages of the Pedagogical Experiment (2025)

Levels of the Motivational Component	Stages of the Experiment					
	Phase I		Phase II		Phase III	
	Before	After	Before	After	Before	After
2025 year						
Low	63	45	52	50	35	5
Sufficient	26	34	31	24	43	44
High	11	21	17	26	22	51

Phase-by-Phase Findings (2025 cohort)

- In Phase I, $\chi^2 = 6.25$, $p = 0.012$, supporting a meaningful initial shift in motivational orientation.
- Phase II produced a moderate result ($\chi^2 = 4.97$, $p = 0.026$). showing the continuity of improvement.
- Phase III yielded a highly significant outcome ($\chi^2 = 14.58$, $p < 0.001$), demonstrating deep motivational transformation.

Conclusion and Implications for Education

The null hypothesis is strongly rejected by the results of McNemar's tests in every phase, suggesting that the observed increases in motivational levels were not the result of random chance. The transformative impact of the structural-logical model and its phased instructional implementation is confirmed by these statistically significant shifts.

The shift from primarily low to primarily sufficient and high motivational levels points to a deeper sense of professional responsibility toward students with special educational needs (SEN), a successful internalization of inclusive values, and an increase in pedagogical confidence. These results offer empirical evidence in favor of incorporating such structured interventions into teacher preparation programs in Kazakhstan and comparable settings.

The development of future math teachers' motivational component levels (Low, Sufficient, and High) as measured before and after each of the three stages of the pedagogical experiment is shown in detail in Figure 2.3.2. The trajectory of change within the 2025 cohort is clearly depicted in the figure. The frequency distribution of motivational readiness at various stages of the educational experiment is represented by each bar.

There is a consistent pattern that shows a significant rise in students who are highly motivated, particularly by the end of Phase III, and a steady decrease in the number of students who are not. This change in focus implies that the content and teaching methods used at every phase of the experiment make a significant contribution to the growth of inclusive motivational competence.

Statistical Analysis by Phase

Cochran's Q test was used to determine whether the observed variations in motivational level distributions across phases were statistically significant in order to support these visual trends. Analysis was done using binary transformations (e.g., Low vs. Not Low, High vs. Not High).

Phase I (2025 cohort)

High motivation: $Q(1) = 6.25$, $p = 0.012$

Low motivation: $Q(1) = 7.03$, $p = 0.008$. Reflects stronger early-stage gains in the second cohort, likely due to improved facilitation based on prior-year feedback.

Phase II (2025 cohort)

High motivation: $Q(1) = 4.97$, $p = 0.026$

Low motivation: $Q(1) = 5.41$, $p = 0.020$. Continued improvement, with statistically significant shifts confirming the sustainability of Phase I effects.

Phase III (2025 cohort)

High motivation: $Q(1) = 21.13$, $p < 0.001$

Low motivation: $Q(1) = 22.87$, $p < 0.001$. The strongest effect observed, with over half of participants reaching high motivation and near elimination of the low category.

An overview of the pedagogical and statistical insights

The results of Cochran's Q tests for every phase and cohort verify that the changes shown in Figure 2.3.2 are statistically significant shifts in motivational orientation rather than random ones. These results support the efficacy of the three-stage structural-logical model, which used field-based practice, situational reflection, and scaffolded theory to gradually develop inclusive motivation.

Foundational content and national digital platforms (such as Bilimland.kz and Kundelik.kz) were used to start the motivational changes in Phase I, and problem-solving and reflective inquiry were used to further these changes in Phase II. The most significant change was brought about by Phase III, which focused on inclusive curriculum development and microteaching experiences.

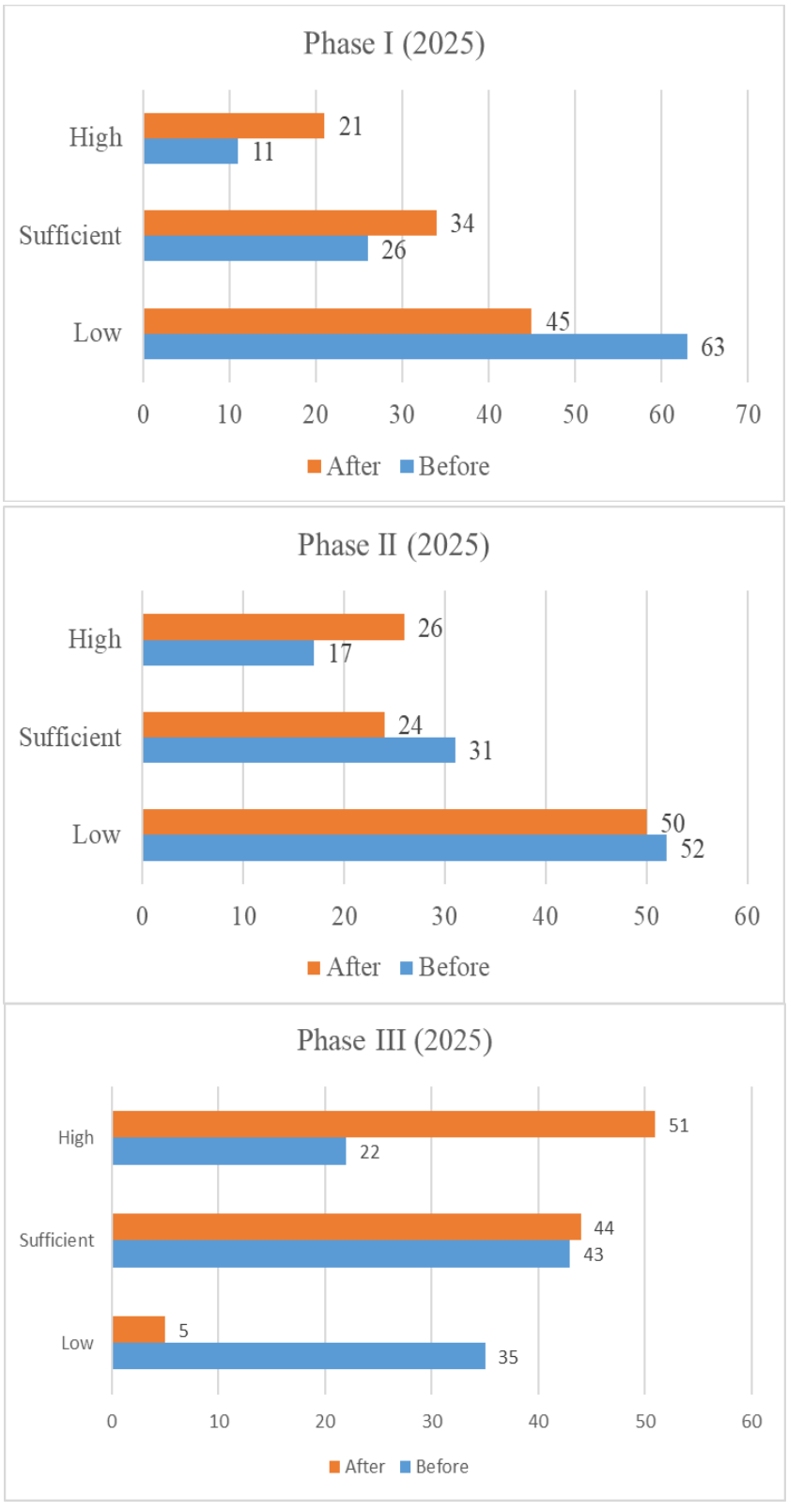
By the end of the experiment, cohort demonstrated:

- A sharp reduction in low-level motivation (from 63 to 5),
- A significant increase in high-level motivation (from 8 to 11 to 51),
- And the statistical confirmation ($p < 0.001$) of these trends in every final-phase comparison.

These findings support the model's scalability within teacher preparation programs throughout the Republic of Kazakhstan in addition to confirming its internal coherence and empirical strength. The consistent results between the two cohorts

demonstrate the model's dependability and imply its applicability to curriculum design, policy, and inclusive pedagogical reform.

Figure 2.3.2 Comparative Dynamics of Motivational Component Levels Before and After Each Phase of the Pedagogical Experiment (2025)



3. RESULTS

Taking into consideration the unique features of Kazakhstan's educational system, such as its ethnocultural diversity and inclusive policy priorities, this dissertation chapter provided the methodological underpinnings for the development of inclusive competence in aspiring math teachers. This chapter was crucial in converting theoretical frameworks into pedagogically useful tactics that would give teachers the information, abilities, and mindset they need to promote inclusive math instruction in actual classroom environments.

The chapter started by defining inclusive competence as a multifaceted concept made up of four interconnected parts: reflective, cognitive, operational (activity-based), and motivational. These elements were tailored to Kazakhstan's national professional standards and educational policy objectives in addition to being in line with global best practices in teacher education. The model enabled more accurate pedagogical content design and more focused evaluation of future teachers' development during the intervention by decomposing inclusive competence into these domains.

The creation of a structural-logical model for developing inclusive competence in aspiring math teachers is one of the chapter's main contributions. This model integrates component-specific instructional strategies with progressive training stages, acting as both a theoretical framework and a practical roadmap. In order to move beyond declarative knowledge of inclusive education and toward the development of long-lasting pedagogical habits rooted in practice and reflection, the model highlights the interaction between theoretical preparation and practical application.

A structured handbook for pre-service math teachers was created to support the implementation of this model by compiling a number of inclusive, practice-focused tasks. This guide provides flexible, context-appropriate strategies for inclusive teaching as an applied supplement to teacher education programs, particularly in environments where formal coursework may be scarce or nonexistent. The activities included creating digital educational resources, inclusive project-based assignments, and inclusive lesson plans and curriculum units. Future educators were able to experience inclusion as both a theoretical concept and a lived practice thanks to this range of pedagogical tasks, which also guaranteed the personalization of their learning experiences.

Particular attention was given to the integration of digital technologies, including national platforms such as Bilimland.kz, Moodle, and Kundelik.kz. These platforms served as a means of delivering inclusive content and modifying educational materials for students with special educational needs (SEN), in addition to being used as teaching tools. Future educators gained transferable skills in educational technology from the model's digital component, which is crucial for inclusive pedagogy in the digital era.

180 pre-service math teachers and 28 in-service math teachers from the Dostyk school network participated in a three-phase pedagogical experiment to evaluate the

efficacy of the model and related instructional techniques. Both quantitative and qualitative techniques, such as surveys, performance-based tasks, diagnostic tests, and reflective self-evaluations, were used in this experimental design. The experiment's diagnostic, formative, and summative phases were designed to assess one or more aspects of inclusive competence.

The experiment's findings showed that participants' inclusive competence increased statistically significantly at every stage, especially in the operational and motivational aspects. Notably, by Phase III, there were significantly more students in the high motivation category and significantly fewer in the low category. Statistical analyses, such as Cochran's Q test, which validated the significance of observed changes across all experimental phases, supported these findings. A consistent shift toward more inclusive attitudes and self-efficacy beliefs among aspiring teachers was also demonstrated by the visual data shown in Figure 2.3.2.

Crucially, the study emphasized how inclusive competence development is a phased and cumulative process. Phase III, which included inclusive project work, assistive technology use, and real-world teaching practicums, showed the biggest improvements. This emphasizes how important it is to incorporate inclusive practices into fieldwork and coursework.

By providing a contextualized model that connects inclusive education theory, mathematics pedagogy, and digital innovation, this chapter theoretically advances the growing conversation on subject-specific inclusive pedagogy. This study advances the field by establishing inclusive competence within the particular practices and difficulties of mathematics instruction, despite the fact that inclusive education is frequently discussed in broad terms.

Practically speaking, teacher education institutions in Kazakhstan and other post-Soviet educational systems that want to match their training with inclusive values can use the model and methodology described in this chapter as a guide. It gives pre-service teachers the skills they need to identify, accommodate, and meet the needs of diverse students, improving not only educational access but also the caliber and fairness of math instruction.

In conclusion, this chapter demonstrates how an organized, practice-rich, and reflective pedagogical approach can successfully and methodically develop inclusive competence in aspiring math teachers. This study offers a scalable and sustainable way to change mathematics education in inclusive ways by integrating inclusive strategies into teacher preparation at several levels: content, method, assessment, and technology. The results of this chapter provide specific solutions for improving inclusive, high-quality teacher education in Kazakhstan's multicultural educational environment and directly inform the dissertation's final conclusions.

CONCLUSION

The development, application, and empirical assessment of a systematic approach to developing inclusive competence in aspiring math teachers have been studied in this dissertation, with an emphasis on the varied educational settings of the Republic of Kazakhstan. The study fills a critical gap in Kazakhstan's teacher education system by preparing teachers to guarantee all students, including those with special educational needs (SEN), fair access and meaningful engagement in mathematics learning.

Several significant results were attained in accordance with the objectives and research questions of the study:

At the national and international levels, a thorough examination of the theoretical, legal, and policy underpinnings of inclusive education was conducted. In order to place inclusive mathematics education within Kazakhstan's developing educational reform agenda, this served as the conceptual and normative foundation.

The study discussed the implications for inclusive mathematics instruction of the psychological, pedagogical, and sociocultural traits of students with SEN. These results reaffirmed the need for learner-responsive, differentiated teaching strategies that support equitable learning opportunities and take into account a range of cognitive profiles.

In line with international inclusive education frameworks and national professional standards, a four-component model of inclusive competence was developed. This model consists of motivational, cognitive, activity-based (operational), and reflective components. The development of teaching methods and evaluation instruments was based on this model.

Building upon this framework, a practical handbook for aspiring math teachers was created in order to develop and implement a structural-logical model. With a focus on situational problem-solving, digital resource integration, and personalization as key mechanisms for competence development, the model integrated a series of scaffolded tasks, instructional strategies, and reflective tools.

The model's efficacy was shown in a three-phase pedagogical experiment with 180 pre-service math teachers and 28 in-service teachers from Almaty's Dostyk school network. Both quantitative and qualitative techniques, such as reflective self-assessment and diagnostic testing, were used to confirm statistically significant gains in teacher motivation, preparedness, and capacity to use inclusive teaching methods.

The research hypothesis is supported both theoretically and partially empirically by the findings, which show that inclusive competence can be developed successfully through a structured, individualized methodology that incorporates digital learning resources, inclusive instructional strategies, and subject-specific pedagogy—all of which are sensitive to Kazakhstan's educational and sociocultural contexts.

Interestingly, even though the study didn't measure learner academic outcomes directly, the gains in teacher competence and attitudes that were seen strongly imply

that classroom practices that improve access, engagement, and instructional relevance have a positive impact on math achievement among students with SEN.

Both the theoretical and practical domains benefit from this research. By providing a strong conceptualization of inclusive competence within discipline-specific teacher education, it theoretically advances the field. Practically speaking, it offers a verified teaching methodology and implementation path that can be embraced by universities and professional development facilities looking to train math teachers for inclusive practice.

To sum up, this study backs Kazakhstan's overarching educational goal of creating an inclusive, just, and superior educational system. The suggested methodology acts as a strategic contribution to national reforms by giving aspiring math teachers the abilities, information, and mindset needed to support all students, regardless of background or ability. It advances the objective of guaranteeing that every student, in every classroom, has access to a meaningful, high-quality mathematics education and encourages the development of inclusive teacher identities.

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APPENDIX

Appendix 1. "Determining a Teacher's Inclination to Work with Children with Special Educational Needs (SEN)"

(adapted from A.I. Dorovsky's test [54])
To determine the motivational component level in the formation of inclusive competence in future mathematics teachers

Dear Student!

We kindly ask you to assist in this research to help identify teachers' inclination to work with children with special educational needs (SEN).

1. Can existing methods of teaching mathematics to children with special educational needs be improved?
   A) Possibly
   B) No, they are effective enough
   C) In certain cases
2. Are you ready to make changes in your approach when working with students with special educational needs?
   A) Usually yes
   B) No
   C) Yes, in certain situations
3. Do you have specific ideas that could significantly improve interaction with children with special educational needs?
   A) Yes
   B) No
   C) Partially
4. Do you believe that you will play an important role in the future in changing the education and upbringing of students with special educational needs?
   A) Yes, definitely
   B) It is unlikely
   C) Possibly
5. Do you plan to implement your intentions to improve the current situation?
   A) Yes
   B) I often doubt my capabilities
   C) Sometimes
6. Are you interested in studying the characteristics of children with special educational needs?
   A) Yes, I am interested
   B) No, I am not attracted to it
   C) It depends on public demand
7. Would you like to engage in developing new teaching and development methods for students with special educational needs?

A) Yes
B) No, due to the lack of an incentive system
C) I don't know

8. Do you look for theoretical material when a problem remains unresolved?
   A) Yes
   B) No
   C) Depends on the situation
9. How do you react to failure?
   A) Persist and keep going
   B) Abandon your efforts
   C) Stay calm and continue working
10. How do you respond to criticism?
   A) I take it easily and without offense
   B) I take it hard but try not to be offended
   C) It depends on the source of the criticism
11. How do you criticize others?
   A) I try to encourage them during criticism
   B) I do so only when in a good mood
   C) I don't always use encouraging words
12. Can you easily recall a conversation with an interesting person in detail?
   A) Yes, without any problem
   B) I remember only what was most interesting to me
   C) It's hard to remember all the details
13. How do you react to unfamiliar terms in a familiar context?
   A) I easily repeat them in another situation
   B) I cannot repeat them
   C) I can repeat if the term is simple
14. What do you do when asked a difficult question on a "sensitive" topic?
   A) I try to answer
   B) I avoid answering
   C) I tactfully postpone the answer
15. How do you feel about your professional beliefs?
   A) I am willing to change them if given convincing arguments
   B) I stubbornly defend my point of view
   C) I may change my mind under pressure
16. What type of student answer in mathematics classes satisfies you the most?
   A) Original
   B) Balanced
   C) Sufficient
17. What do you prefer to do during your free time?
   A) Solve work-related issues
   B) Read interesting books
   C) Immerse yourself in your hobbies

18. When do you stop doing creative work?
    A) When I believe the task is done perfectly
    B) When the result satisfies me
    C) When there are other unfinished tasks

Scoring Key:

For each answer:

- "A" = 3 points
- "B" = 1 point
- "C" = 2 points

Results:

- **54–43 points** – You are genuinely interested in working with children with special educational needs in the field of information technology and have the potential for this work.
- **42–30 points** – You have some inclination to work with children with SEN, but further development requires additional effort, resources, and active self-development.
- **29–18 points** – You currently lack sufficient interest in working with children with special educational needs.

Appendix 2. Questionnaire for Teachers

On the Inclusive Educational Environment

Section 1. General Information about the Teacher

1. Please provide some information about yourself:

Your gender: _____

Your age: _____

Position: _____

Education: _____

Educational institution: _____

What is your current teaching specialization? _____

Total teaching experience (please check the appropriate box):

Experience (years)	Less than 3	3-8	9-13	14-18	More than18
General teaching					

Section 2. Identifying Motivation and Personal Characteristics Affecting Readiness to Foster an Inclusive Educational Environment

Dear colleagues, please objectively assess your readiness to create inclusive conditions in schools based on the following criteria:

Motivational and Personal Component of Readiness

№	Statement	Answers		
		Always	Sometimes	Never
1	Do you understand the importance of working with children with special educational needs (SEN)?			
2	Are you personally ready to contribute to improving work with students with SEN?			
3	Do you feel the need for professional development?			
4	Do you recognize the insufficiency of current results and strive to improve them?			
5	Are you interested in new forms and			

	methods of teaching mathematics to children with SEN?			
6	Do you have ideas for improving work with children with SEN?			
7	Are you ready to take an important role in transforming the education and upbringing of children with SEN?			
8	Do you practice self-control and self-regulation?			
9	Do you exhibit pedagogical optimism?			
10	What is your opinion on the possibility of improving current methods and approaches in teaching mathematics to children with SEN?			
11	Can you offer any ideas for significantly improving the work process with such children?			
12	Do you believe that you will play an important role in the future in changing how children with SEN are educated?			
13	When making decisions, are you confident in your ability to implement them to improve the situation?			
14	Do you wish to study the characteristics of children with SEN?			
15	Would you like to search for new methods of teaching and developing students with SEN?			
16	If a problem remains unresolved, do you try to find theoretical support to address it?			

Appendix 3. Test

Test – Version 1

Assessment of Pre-Service Mathematics Teachers' Readiness for Inclusive Education in Kazakhstan

Question 1. According to B.B. Aysmontas, what type of support for children with SEN contributes to motivation for achievement?

1. Pedagogical support
2. Methodological support
3. Psychological-pedagogical support
4. Social support

Question 2. What determines the structure of individual lessons aimed at developing auditory perception?

1. The objectives
2. The child's age
3. The topic
4. The stages of auditory image formation
5. The stage of pronunciation skills development

Question 3. According to the principles of the national concept of integrated education, inclusive education is most suitable for:

1. Children with SEN who started receiving corrective pedagogical help early
2. Children with musculoskeletal disorders
3. Children with intellectual disabilities
4. Children with hearing impairments
5. Integration through mandatory corrective support for each integrated child
6. Integration through early intervention

Question 4. What is stated in Article 26 of the Universal Declaration of Human Rights?

1. Parents have a prior right to choose the kind of education for their children
2. Education should aim at the full development of the human personality
3. Education should focus only on intellectual development
4. Everyone has the right to education
5. Schools have the right to prioritize the type of education for students

Question 5. Psychological and pedagogical support is a continuous and systematic process. What elements are included at all its stages?

1. Psychoprevention and correction
2. Psychological training sessions
3. Psychoprevention and correction
4. Psychodiagnostics
5. Psychological education

Question 6. What key principles of organizing the educational process for persons with disabilities and SEN are implemented in vocational education using e-learning and distance learning technologies?

1. Principle of mobility in learning

2. Principle of no required initial educational level
3. Principle of non-interference in learning
4. Principle of adaptability and accessibility
5. Principle of democratization of learning
6. Principle of interactivity

Question 7. What advantages do distance learning technologies provide when teaching children with disabilities and SEN?

1. Constant online and/or offline communication between all participants of the educational process
2. Use of special technical training tools that deliver educational content in a form suitable for the student's specific limitations
3. Application of special teaching methods involving customized material organization based on individual needs
4. Students cannot vary the duration or timing of their lessons

Question 8. Which of the listed characteristics describe deafness?

1. Hearing impairment that prevents speech perception without special training
2. Hearing loss from 82 to 85 dB, with perception range from 125 to 8000 Hz
3. Hearing loss degree up to 85 dB

Question 9. For children with hearing impairments, what should be used in e-courses to reduce:

1. Volume
2. Information
3. Schemes
4. Cognitive load
5. Eye strain
6. Video information
7. Audio tracks

Question 10. What accessible version of e-courses is needed for children with low vision who require enhanced illustrations?

1. Video recordings
2. Text-based
3. Multimedia content
4. High-contrast outlines
5. Graphical
6. High-brightness contours

Question 11. Which hardware is used for distance learning of students with visual impairments?

1. Microscope
2. Non-visual access software
3. Screen magnifier
4. Tactile keyboard
5. Braille display

Question 12. What software converts text into speech?

1. Screencast
2. Sound synthesizer
3. Voice engine
4. Speech

Question 13. How should textual information be adapted for children with low vision?

1. Use sans-serif fonts
2. Use scanned PDF documents
3. Avoid tables and columns
4. Include audio and video clips

Question 14. In what situations do deaf individuals who can speak resort to fingerspelling when speaking with hearing people?

1. When stating proper names or scientific terms
2. When the listener fails to understand a spoken word
3. In all cases—it is always appropriate

Question 15. What is the translation of the word *dactilos*?

1. Letter
2. Finger
3. Hand

Question 16. What is the name of the system used in Russia for educating deaf children?

1. Sign language-based
2. Developmental
3. Communicative

Question 17. Who determines the status of a child with SEN?

1. Psychological-Medical-Pedagogical Commission
2. Federal Bureau of Medical and Social Expertise
3. Psychological-Medical-Pedagogical Council of the educational institution

Question 18. According to Federal Law No. 273-FZ "On Education in the Russian Federation" dated December 29, 2012, students with SEN are:

1. Children with significant activity limitations due to disease or injury causing social maladaptation and impaired self-care, mobility, orientation, behavior control, learning, communication
2. Individuals with physical and/or psychological impairments that prevent education without special conditions
3. Individuals with physical and/or psychological impairments confirmed by a psychological-medical-pedagogical commission, hindering education without special conditions
4. Individuals requiring special educational conditions for mastering an educational program

Question 19. In which article of the Federal Law "On Education in the Russian Federation" is the education of students with SEN discussed?

1. Article 83
2. Article 79
3. Article 34
4. Article 44

Question 20. When working with deaf children, what methods should the teacher use?

1. Explain assignments in more detail
2. Present most assignments in written form
3. Focus on logical thinking
4. Conduct more frontal (whole-class) work

Question 21. Which of the following are digital audio devices?

1. Voice recorder
2. Media player
3. Braille display
4. Reading machines

Question 22. Indicate the writing tools for children with visual impairments:

1. Braille writing tools and styluses
2. Special notebooks and notepads made from Braille paper
3. Media players for listening to "talking books" on flash drives or CDs
4. Embossed drawing and drafting tools
5. Tactile geometry instruments (rulers, set squares, protractors, compasses)

Question 23. Which software receives a speech signal from a user and converts it into text?

1. Screen magnification software
2. Software for reading printed texts
3. Software for creating DAISY-format books
4. Speech recognition software

Question 24. What is needed to create embossed graphic images?

1. Braille display
2. Speech synthesizer
3. Electronic magnifier
4. Braille printer

Question 25. Which computer program is needed to correct various aspects of spoken and written language in children with speech and hearing disorders?

1. Speech therapy trainer
2. Voice trainer
3. Electronic trainer
4. Acoustic trainer