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INTEGRATED USE OF CASE STUDY METHODS AND REFLECTIVE PRACTICES IN DEVELOPING PROFESSIONAL COMPETENCIES OF FUTURE CHEMISTRY TEACHERS IN AN INCLUSIVE EDUCATION ENVIRONMENT

Abstract. The article examines the impact of the integrated use of the case method and reflective practices on the development of professional competencies of future chemistry teachers in the context of inclusive education. The theoretical section substantiates the need to develop teachers' knowledge, skills, and value orientations that enable effective teaching of diverse groups of students, and proposes an approach that combines analysis of practical cases with systematic reflection. In a pedagogical experiment, students of a teacher training university were divided into an experimental group (with the use of cases and reflective tasks) and a control group (traditional instruction). The experiment lasted one semester. By the end of the course, the experimental group showed a statistically significant improvement in indicators of readiness for inclusive teaching compared to the control group ($p < 0.001$). A thematic analysis of students' reflective journals was also conducted, revealing positive dynamics in their awareness of learners' individual needs, professional self-improvement, and confidence in working with children with special needs. In the discussion section, the results are compared with contemporary research; conclusions are drawn about the high effectiveness of the combined use of case method and reflection in preparing teachers for inclusive practice, and the limitations of the study are considered. Finally, practical recommendations for teacher education programs and directions for further research are provided.

Keywords: case method, reflective practice, inclusive education, professional competencies, chemistry teacher, pedagogical experiment.

Introduction

Inclusive education, recognized worldwide as a fundamental right of every child, aims to educate all students together, regardless of their developmental differences and educational needs. Its goal is to ensure the full participation of each student in the educational process, valuing diversity and promoting social integration. Achieving this goal largely depends on teachers' willingness to differentiate instruction and create a supportive environment for all students (Georgiadi & Papazafiri, 2025). However, research shows that many teachers lack the competencies to work in inclusive classrooms. In one study, only one in ten teachers reported a sufficient understanding of inclusive teaching methods; the majority acknowledged the need for additional training in this area. Graduates of pedagogical universities often begin working without sufficient practical experience working with children with special educational needs, which leads to difficulties and a sense of insecurity early in their careers. A lack of knowledge and skills in inclusive pedagogy negatively impacts teachers' attitudes toward inclusion and the quality of education for children with special educational needs. Thus, a pressing issue is the search for effective means of developing the professional competencies of future teachers to work in inclusive education.

Modern approaches to teacher training emphasize the need to shift from predominantly theoretical teaching to active methods that develop teachers' practical skills and reflective thinking (Georgiadi & Papazafiri, 2025). In particular, the case method, a teaching technique based on the analysis and discussion of realistic situations from practice, has attracted attention. The case method originally originated in legal and business education, but in recent decades it has also become widespread in teacher training. Immersing future teachers in scenarios that simulate complex teaching situations allows them to "revive" theoretical knowledge and connect it with real-world classroom practice. Research shows that case-based learning increases student engagement and participation, develops analytical and decision-making skills, and fosters empathy and tolerance (Georgiadi & Papazafiri, 2025). Sharing and analyzing stories from practice helps develop a deeper understanding of student diversity and how to work with them in future teachers, which is

especially important in an inclusive classroom. For example, in a study, web-based case studies were used to teach 40 future teachers the principles of adapting lessons for children with special needs and demonstrated effectiveness in developing inclusive skills. Another study found that the use of case studies significantly enhanced students' reflective thinking regarding pedagogical problems, although it did not fundamentally change their initial views (Hoffer, 2020). This confirms the potential of case studies as a tool for stimulating critical reflection on their own teaching experiences.

Along with the case study method, reflection is recognized as a key component of teacher professional development. The concept of "reflective practice" involves the meaningful analysis of one's own experience with the goal of learning lessons for the future. According to the definition, reflective practice is a set of mental and emotional actions in which a specialist examines their experience to arrive at new understandings (Deniz & İlik, 2021). John Dewey noted that reflection begins with a state of doubt or difficulty and culminates in the discovery of a conclusion or solution, thereby extracting meaning from each experience for future action (Saloviita, 2020). In the context of teacher training, reflection is considered an essential component of professional learning. As researchers note, reflective practices are incorporated into all teacher education programs, following the cyclical process of "action - analysis - new knowledge - improved practice." Common forms include reflective journals, portfolios, group discussions of experiences, and others all of which help future teachers develop the habit of self-observation and continuous self-improvement (Larios & Zetlin, 2023). Reflection plays a particularly important role in inclusion settings: teachers, faced with the diverse needs of their students, must be able to critically evaluate the effectiveness of their methods and, if necessary, promptly adjust them. The review emphasizes that the reflective practice of special educators is directly linked to the successful inclusion of children with special educational needs in the general classroom (Sancar et al., 2021). Reflection allows teachers to understand what happened in the lesson and why, and, based on this experience, develop more effective teaching strategies that take into account the interests and abilities of all students.

Both the case study method and reflective practices have proven effective tools for teacher training. Moreover, the idea of their integrated application is gaining increasing support in both theory and practice (Byrd & Alexander, 2020). Analyzing pedagogical situations through case studies provides material for reflection, while reflection deepens the assimilation of this material, transforming the experience into a foundation for professional growth. It can be assumed that the combination of the case study method with targeted reflection creates a synergistic effect: future teachers not only learn about the principles of inclusive education but also experience typical situations, reflect on their experiences, and thereby develop sustainable competencies (Kelly & Barrio, 2021). This approach is consistent with modern models of inclusive teacher training, which emphasize the development of both knowledge and skills (cognitive and practical components) and values and motivation a mindset toward inclusion, empathy, and confidence (affective component). In a number of studies, such holistic preparation is described using the "Heart-Head-Hands" metaphor, implying the unity of a teacher's beliefs, knowledge, and skills for successful inclusive practice.

The aim of the study was to experimentally test the effectiveness of the integrated use of case studies and reflective practices in developing the professional competencies of future chemistry teachers for work in an inclusive education environment. The hypothesis was that integrating case studies and reflection into the educational process of future teachers would lead to a more significant increase in their readiness for inclusive education (compared to traditional training methods). To test this hypothesis, a pedagogical experiment was planned with chemistry students, comparing their competency indicators before and after training, as well as a qualitative analysis of the students' reflective materials reflecting the dynamics of their professional consciousness.

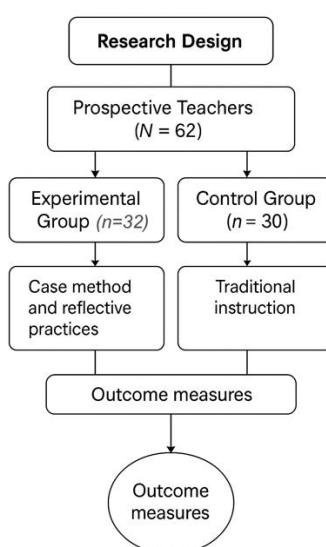
Methods and Organization of the Study

A pedagogical experimental study was conducted using a control group vs. experimental group design, with pre- and post-test measurements. The independent variable was the use of specialized teaching methods: the experimental group integrated the case study method and reflective practices, while the control group followed a traditional curriculum without an emphasis on these methods. The dependent variables indicators of the development of professional competencies for working in an inclusive environment were measured before and after the experiment (at the beginning of the semester) and after its completion (at the

end of the semester) in both groups. In addition, qualitative data (reflective diaries) were collected from the experimental group to allow for an in-depth analysis of changes in their perceptions of inclusive education.

Sixty-two fourth-year students majoring in Chemistry (Chemical Education) at a pedagogical university participated in the study. All participants had previously completed basic courses in chemistry pedagogy and teaching methods. They had not completed a separate systematic course on inclusive education before the experiment. Students were randomly assigned to two groups: experimental (N = 32) and control (N = 30). The groups were comparable in terms of age and gender and academic composition: average age was ~21 years; the proportion of girls was 68% (experimental) and 70% (control); the average grade point average at the beginning of the experiment was ~3.7 (on a five-point scale) in both groups. Participation in the experiment was voluntary, and all students gave informed consent for the processing of the obtained data in aggregate form (Figure 1).

Figure 1.
Research Design Flowchart



The experimental training program lasted one semester (15 weeks) and was implemented within the framework of the academic discipline "Chemistry Teaching Methods in an Inclusive Classroom," specially developed for the study. In the experimental group, training in this discipline included: (1) regular use of the case method: students weekly analyzed cases (descriptions of situations) from the practice of teaching chemistry related to inclusive education (e.g., conducting a chemistry experiment with a student with a hearing impairment; group work including a student with an autism spectrum disorder; differentiated explanation of a new topic taking into account the different levels of preparation of students, etc.). Cases were prepared by the teacher based on real cases and included supporting materials: student characteristics, lesson fragments, student performance. Case discussions took place in small groups of students, followed by a general discussion in class. (2) Systematic reflective practices: Students kept individual reflective diaries after each lesson and case discussion, recording their conclusions, questions, emotions, and plans for applying what they had learned in practice. In addition, reflective sessions were held in small groups every two weeks: students shared experiences and diary entries with each other, discussing what they had learned about teaching in an inclusive environment and how this changed their approach. The teacher (researcher) facilitated these discussions, asking guiding questions and encouraging in-depth analysis. Otherwise, the curriculum followed the standard: students studied the principles of inclusive education, didactic strategies for a diverse class, adapting teaching materials and assessment tools, working in teams with tutors and psychologists, etc. – but all topics were illustrated with cases and accompanied by reflective reflection. In the control group, the same course was taught using the traditional method: lectures and seminars, without a specific emphasis on case studies and reflection. Students in the control group received the same amount of theoretical information on inclusive education (definitions, principles, methods) and completed practical assignments (developing lesson fragments, tests, etc.), but did not analyze case studies or keep mandatory

reflective journals. Thus, the main difference between the groups was the teaching method.

A comprehensive approach was used to quantitatively assess the development of competencies. An integrated criterion, "readiness for inclusive education," was developed, including three components: (a) Knowledge - assessed using a specially designed 30-question test on key aspects of inclusive pedagogy (knowledge of the legislative framework, differentiation methods, the main categories of special educational needs and ways to support students, etc.); (b) Skills - assessed based on the results of completing a practical assignment: developing a chemistry lesson on a given topic for a class with two students with disabilities (hearing and cognitive impairments). The lessons were assessed by two independent experts using a developed scale (criteria: adaptation of learning objectives, variability of methods, consideration of special needs, methods of student interaction, differentiated assessment, etc.). The average score of the experts was converted into a percentage. (c) Attitudes – measured using the ATI (Attitudes Toward Inclusion) questionnaire in an adapted version containing 20 statements assessed on a Likert scale (1–5). The questionnaire revealed the degree of agreement with positive and negative statements about inclusion (e.g., "Education in a regular classroom is beneficial for children with special needs," "The presence of a student with a disability in the classroom reduces the academic performance of the rest," etc.). For each component (knowledge, skills, attitudes), the percentage of the maximum possible was calculated. Then, the integral indicator of competence was calculated as the average value of the three components (in %). This summary score, reflecting the student's overall readiness for inclusive education, was used for statistical comparison of the groups. The measurement was conducted twice – before the start of the course (pretest) and after its completion (posttest). The reliability of the instruments used was pre-checked: the cognitive test had a Cronbach's α coefficient of 0.82; The agreement between expert assessments of lessons is the agreement coefficient of ~ 0.75 ; the attitudes questionnaire is $\alpha = 0.88$.

To test the hypotheses about the differences, the parametric Student's t-test was used. Since the sample size was relatively small, the conditions for applying the t-test were preliminarily checked: the distributions of pre- and post-test scores in the groups were close to normal (Shapiro-Wilk criterion $p > 0.1$), the variances were comparable (Levene's criterion $p > 0.05$). Paired t-tests for dependent samples (to assess the significance of changes within each group before and after training) and independent t-tests (to compare the experimental and control groups with each other at the end of training) were performed. The significance level was set at $p < 0.05$. To estimate the effect size, Cohen's d coefficient was calculated. Regarding the qualitative data, thematic analysis was conducted manually using MS Excel tables; the reliability of the resulting thematic categories was ensured by coding agreement between two researchers (the agreement coefficient was ~ 0.8 at the coding stage). Students' quotes in the text are provided anonymously (the student's reference number is indicated).

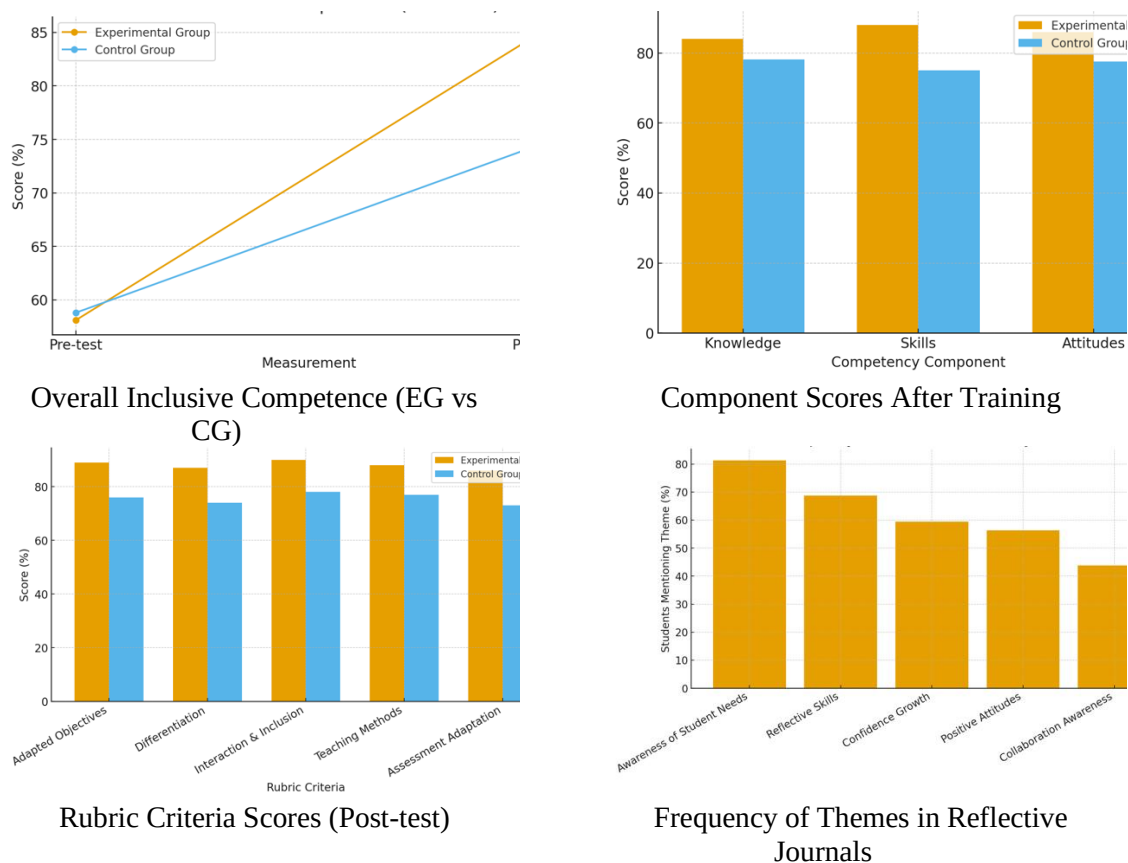
Research Results and Discussion

At the pre-test stage, no significant differences were found between the experimental and control groups in the integrated indicator of readiness for inclusive education ($M = 58.1\%$ and $M = 58.8\%$, respectively; $t(60) = -0.28$; $p = 0.78$). This indicates that the participants had comparable levels of competence prior to the experiment. In both groups, the average pre-test score indicated a moderately low level of student readiness for inclusive education ($\sim 59\%$ of the maximum): many students lacked knowledge of terminology and methods (the procedure for developing an individualized curriculum was particularly poorly understood – less than 40% of correct answers), and the attitudes questionnaire showed some uncertainty (for example, about 30% of students agreed with the statement "in a regular class, it is impossible to pay sufficient attention to children with special needs"). Thus, the starting conditions of the groups can be considered equal and characterize the typical level of preparation of graduates, which has significant potential for development. Following the implementation of the experimental program (posttest), a statistically significant increase in the average competence score was observed in both groups (Fig. 2). In the control group, the increase was approximately 15.8 percentage points (from 58.8% to 74.6%; paired t-test: $t(29) = -7.75$; $p = 1.5 \times 10^{-8}$), indicating a positive impact of even traditional training on expanding knowledge and partially correcting attitudes. However, in the experimental group, the increase was significantly higher – approximately 27 percentage points (from 58.1% to 85.1%; $t(31) = -12.25$; $p = 5.5 \times 10^{-13}$). The final average competence score in the experimental group reached 85%, which corresponds

to a high level of readiness for inclusive activities (close to professional): students demonstrated a deep understanding of the principles of inclusion, the ability to develop detailed, adapted lesson plans, and expressed a predominantly positive attitude and self-confidence.

Figure 2

Dynamics of the integral indicator of readiness for inclusive education (as a percentage of the maximum) among students in the experimental and control groups (before and after training).



The difference between the experimental and control groups at the end of the training was statistically significant. The average post-test score in the experimental group (85.1%) exceeded that of the control group (74.6%) by approximately 10.5 points; an independent t-test showed: $t(60) = 4.94$; $p = 6.9 \times 10^{-6}$. The effect size (Cohen's d) for this difference was approximately 1.3, corresponding to a large effect. In other words, the experimental teaching method demonstrated a significant advantage in developing the competencies of future teachers for working in inclusive education.

A more detailed analysis of the competency components revealed that the greatest differences between the groups by the end of the experiment were observed in the "skills" and "attitudes" components. For example, in the experimental group, the average score for the practical assignment (lesson development) was 88%, while in the control group it was 75%. Experts noted that in the experimental group's work, students proposed a wider range of adaptations and differentiated techniques and demonstrated a creative approach to inclusiveness (for example, they proposed group experiments with assigning roles accessible to students with disabilities, using multisensory demonstrations, etc.). In the control group, many of the works were more general in nature and erred on the formal side (some students limited themselves to the instruction "I will pay more attention to a weak student" without providing specifics). In the attitudes component (ATI questionnaire), the experimental group achieved an average of 86% positive responses, while the control group achieved approximately 78%. The difference in confidence was particularly striking: 90% of students in the experimental group agreed with the statement "I will be able to effectively teach a class if it includes children with special needs" in the posttest, while in the control group the figure was 63%. This fact demonstrates that the combined use of case studies and reflection not only equips future teachers with

knowledge but also strengthens their self-confidence and alleviates unnecessary fears about inclusion (Machost & Stains, 2023).

Overall, the statistical results confirm the main hypothesis: the integration of case studies and reflective practices into teacher training significantly increases the effectiveness of developing inclusive competencies compared to traditional teaching (lecture and seminar model). Next, we will examine the qualitative changes that occurred in students in the experimental group based on an analysis of their reflective diaries.

An analysis of the reflective entries of students in the experimental group revealed three key themes reflecting the development of their professional thinking and attitudes during their participation in the experiment. These themes can be roughly summarized as: (1) Awareness of students' individual needs; (2) Development of reflective skills; (3) Increased confidence and readiness for inclusive education. Figure 2 presents a summary of each topic, with examples of typical student utterances and the proportion of students whose entries contained the relevant ideas.

Understanding the Individual Needs of Students. Nearly all students (~80%) noted in their diaries that working with case studies helped them gain a deeper understanding of the uniqueness of each student and the importance of an individualized approach. While at the beginning of the course, many discussed students with special educational needs in rather general terms (e.g., "we need to pay more attention to weaker students"), by the end, they had a clear understanding of the specific needs and how to address them. Students wrote that, while analyzing the cases, they "felt like looking at the lesson through the eyes of different students." One student noted, "Now I see that two students with the same diagnosis may require completely different support" (Student E5). They realized that an inclusive approach is not a set of universal solutions, but constant attention to the unique characteristics of each child. For example, one student described, "After the case about the blind student, I wondered, how does he even experience a chemistry experiment? I hadn't even imagined before that boiling could be heard and warmth felt instead of seen." Such reflections demonstrate the development of empathy and the ability to put themselves in the student's shoes (Kaya & Öz, 2021). Students began to use the word "individualization" more frequently in their notes and to provide specific ideas (detailed differentiation of tasks, the use of different perception channels as visual, audio, kinesthetic; flexible group assignments, etc.). This qualitative shift in thinking, from a general understanding of inclusion to specific methodological solutions is directly related to the experience of case analysis and subsequent reflection.

Table 1 presents the summarized results of the thematic analysis of reflective journals, illustrating the above themes.

Table 1

Identified themes in the reflective statements of students in the experimental group (N = 32) based on the results of the pedagogical experiment

Theme	Description (content of the theme)	Example of a student statement	Percentage of students who mentioned the theme
Awareness of students' individual needs	Recognition of learner diversity, understanding the necessity to differentiate instruction and adapt methods for different abilities and needs.	"Each student is unique in their own way, and I need to adjust my teaching methods to their needs."	80%
Development of reflective skills	Ability to critically analyze one's teaching experience: identifying successful and problematic aspects of lessons, understanding causes and consequences of one's actions, and planning improvements.	"By analyzing my lessons, I learned to look at them from the outside and find what can be improved."	70%
Growth of confidence and readiness for inclusive teaching	Increased confidence in one's abilities as a teacher; positive attitude toward inclusive education and belief in the ability to implement it in practice.	"Solving practical cases and discussing them with classmates helped me feel more confident as a future teacher."	60%

The qualitative data obtained are consistent with the results of the quantitative analysis. Students in the experimental group demonstrated not only an increase in formal knowledge/skill indicators but also personal

and professional growth, reflected in changes in their attitudes and level of awareness. It can be concluded that the combination of case studies and reflection enabled the development of deeper competencies, addressing the value-motivational component (Meadows et al., 2020). Future teachers began to perceive inclusive education not as an external requirement, but as a natural part of their profession, requiring creativity and dedication. Many experienced "insight" for the first time – the understanding that the success of inclusion depends largely on their own actions and attitudes.

Thus, the qualitative analysis confirmed the hypothesis regarding the benefits of an integrated approach: it not only imparts knowledge but also transforms students' professional consciousness. Below, we discuss the significance of these results and relate them to the findings of other studies. The results of the experiment convincingly demonstrate the effectiveness of the integrated use of the case study method and reflective practices in developing inclusive competencies in future chemistry teachers. The experimental group, trained using this approach, demonstrated a significantly higher increase in readiness for inclusive education (on average +27 percentage points) than the control group in traditional instruction (+16 percentage points). A statistically significant advantage for the experimental group ($p < 0.001$, $d \approx 1.3$) was evident across all key competency components knowledge of methods, practical skills, and positive attitudes toward inclusion. These quantitative data are also reflected in the qualitative changes recorded in the students' reflective materials: the experiment participants demonstrated a deeper understanding of individual student needs, developed critical thinking regarding their own teaching practices, and increased confidence in their ability to work in an inclusive classroom.

These results are consistent with the findings of several previous studies in related fields. First, our experiment confirmed the significant benefits of case studies for teacher training. As Meadows et al. (2020) noted, case studies don't always immediately change students' attitudes, but they certainly enhance their reflective thinking. We observed a similar phenomenon: although students in the control group also learned about inclusion, students in the experimental group learned to ask "what if..." and "why..." questions through case studies, their understanding became more critical and analytical. Furthermore, our participants reported the "perspective transfer" effect noted in the literature: the case study allowed them to see the lesson through the eyes of a student with special needs, which increased empathy and a willingness to adapt instruction to different abilities. This supports Hoffer's (2020) observation that storytelling and case discussions "expand the conversation" and provide the opportunity to "see the world from different perspectives," opening the minds of future teachers to the values of inclusion. Our students noted that after the case studies, they had a clearer understanding of the challenges children with disabilities face in chemistry lessons and actively sought ways to make the subject more accessible. This is an important step in what the literature describes as the transition from the theoretical acceptance of inclusion to the practical skills for its implementation (Baxter et al., 2021).

Reflective practices played an equally significant role. They acted as a learning "accelerator," transforming case study work from a one-time activity into an ongoing process of professional self-analysis. As Kelly & Barrio (2021) note, reflection is a cyclical process of understanding experience, leading to continuous improvement in practice. In our experiment, through journaling and reflective sessions, students underwent several such cycles of self-analysis over the course of the semester. They effectively learned to learn from their own experiences, a meta-skill that is extremely valuable for teachers, whose profession requires continuous development. Interestingly, by the end of the experiment, many participants reflected not only after an activity (lesson or case) but also during discussions or assignments, adjusting their approaches on the fly. This is reminiscent of the concept of "reflection-in-action" (Szocik et al., 2021), whereby a professional is able to analyze and modify their actions directly in the process. The development of this rudimentary skill in students is evidence of the effectiveness of our approach, as it is typically acquired by experienced teachers.

The combined use of case studies and reflection also led to important changes in attitudes and motivation. Future teachers' attitudes toward inclusive education became more positive, and fears and resistance subsided, consistent with the results of international studies. For example, Sancar et al. (2021) demonstrated that specially designed inclusion courses can reduce students' anxiety and increase their self-efficacy regarding inclusive practice. In our experiment, a similar course enriched with active methods had an even more pronounced effect: many students not only felt confident but also expressed a personal

commitment to the idea of inclusion, a desire to apply their acquired knowledge in practice, and a desire to share it with colleagues. This aspect is extremely important, as the success of implementing inclusive education largely depends on the teacher's attitude, their willingness to embrace the ideology of "education for all". According to the "heart-set" concept changing a teacher's beliefs and values is the foundation for developing all other competencies. Our data show that integrating case studies and reflection can tap into this deep-seated component: through experiencing situations and self-discovery, students rethink their views on teaching and internalize inclusive values.

Conclusion

The study found that the integrated use of case studies and reflective practices is an effective approach to developing the professional competencies of future chemistry teachers for work in inclusive education settings. Students who studied using this approach demonstrated a significant increase in their readiness for inclusive learning compared to their traditionally educated peers, both in terms of mastering specific skills for differentiating and adapting instruction, and in developing a positive attitude and confidence in their ability to successfully work with a diverse student body. This finding is consistent with trends in modern pedagogical science, which emphasize the importance of active, experience-based methods in teacher training (case-based learning, experiential learning, and reflective practice). Our contribution is to empirically demonstrate the synergistic effect of combining these methods when applied to preparing teachers for inclusion.

The theoretical significance of this study lies in its enrichment of the model for developing inclusive teacher competencies. It has been shown that effective preparation must take into account a trinity: immersion in a practical context (the case as a model classroom), the development of a reflective culture (the ability to learn from experience), and the assimilation of inclusive values. The findings confirm and concretize the concepts of "reflective practitioner" and "heart-head-hands" as applied to a narrow field chemistry education in an inclusive classroom demonstrating that even in subject-specific conditions, general pedagogical principles remain valid.

Conflict of Interest Statement

The authors declare no potential conflicts of interests regarding the research, authorship, or publication of this article.

Author Contributions

Akbope Balgabaykyzy Tulegenova, Perizat Adilbekovna Abdurazova, and Kulyash Zaurbekovna Kerimbaeva contributed equally to this work. All authors contributed to the conceptualization, methodology, investigation, data analysis, interpretation of the findings, manuscript writing, review, and editing. All authors have read and approved the final version of the manuscript.

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