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Exploring the impact of a conceptual model on students' reflective skills development: a case study of Kazakhstan

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ABSTRACT

The growing interest in reflection and the development of reflective skills (RS) among future teachers is linked to a shift in Kazakhstan's educational paradigm. Reflective thinking is recognized as an effective means of analyzing everyday practice, introducing students to key aspects of their profession, and encouraging lifelong learning. However, a paradox exists in the professional training system: although students' RS are considered professionally essential, insufficient attention is given to their systematic development. This study aimed to examine the impact of a conceptual model (CM) on fostering students' RS. A quasi-experimental design was employed with 120 participants. The experimental group (EG) demonstrated significantly higher levels of RS compared to the control group (CG) ($p<0.05$). The dynamic changes in students' RS observed during the learning process indicate the strong pedagogical potential of the proposed model. The findings show that teachers perceive the use of the CM as an effective tool for enhancing students' RS. It was also found that the model increases students' interest in the learning process and contributes to the development of RS. Overall, the study supports the effectiveness of using a CM to enhance RS, thereby contributing to the professional readiness of future primary school teachers.

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1. INTRODUCTION

Approaches to educating future teachers must be rethought in light of new educational technologies that emphasize variability, subjectivity, creative individuality, a culture of pedagogical communication, and teachers' personal potential [1]. The primary goal is to develop a teacher's personality capable of self-development, which necessitates mastering not only a knowledge system, but also skills that enable self-realization and self-improvement [2]. Reflection is regarded as the most important factor in the development of high professionalism, as evidenced by the subject's ability to continuously improve personal and professional skills, as well as creative growth, using psychological mechanisms such as self-analysis and self-regulation [3], [4]. Reflective skills (RS) are the foundation for the development of reflection, as they are required for the construction of new knowledge, understanding, and new ways of acting [5]. The ability to

reflect constructively and work on problems reflexively is most effectively cultivated during the student years. Therefore, developing RS during a student's professional training is a key issue because it is one of the main outcomes of university education [6].

According to researchers, reflection is a highly personal trait [7]. Reflection allows one to connect one's consciousness, values, and opinions to those of others, a group, and society [8]. Reflection is a complex mental ability that involves constantly analyzing and evaluating every aspect of one's professional activity [9]. Consequently, graduates of pedagogical universities often find themselves inadequately prepared to cope with non-standard teaching situations and to make flexible decisions when faced with uncertain career trajectories [10]. Moreover, general education courses typically occupy the first two years of university study, which delays the development of pedagogical competence (PC) [11]. Research and practice both confirm that the issue of enhancing the PC of pre-service primary school teachers (PPSTs) remains urgent and insufficiently addressed [12]. There is still a need for more in-depth study of the aspects of professional competence developed specifically through higher education in the field of primary education. The integration of subject knowledge and practical skills continues to receive inadequate attention in the training of future teachers [13]. RS-intellectual, personal, communicative, and cooperative-can be used to manage professional activities and create conditions for self-education [14].

The structure of reflection and the dynamics of its development are of great interest, both theoretically and practically, because they allow us to gain a better understanding of the mechanisms that govern personality development. Reflective mechanisms are at the heart of a high level of self-awareness, a willingness to analyze and evaluate one's own activities, and the identification and implementation of personal development paths. A teacher's ability to engage in self-knowledge and self-analysis as a subject of pedagogical activity is dependent on their RS. As a result, developing RS should be a primary goal of a teacher's professional development, particularly during the initial stages of professional training [15]. Zamiri and Esmaeili [16] believe in using assignments that simulate professional activities, organizing group reflection on students' own teaching activities, and holding training sessions to improve social perception, interpersonal skills, and verbal communication. Akmam *et al.* [17] recommend problem-solving with conflict-based content, group discussions, organizational activity, and learning games to encourage reflection. Despite the wide scope and variety of modern research on reflection, the development of RS among students in Central Asian countries, particularly Kazakhstan, remains underexplored. The growing interest in reflection and the development of RS among future teachers is linked to recent shifts in Kazakhstan's educational paradigm. Reflective thinking is recognized as an effective method for analyzing everyday practice, introducing students to key professional competencies, and fostering lifelong learning.

However, a paradox exists in the professional training system: although RS are acknowledged as essential for teaching, insufficient attention is given to their development. The lack of research on RS development creates contradictions between the personal paradigms of teacher professional thinking, shaped in real practice, and the current teacher training model, which remains primarily focused on a subject-knowledge approach. This study focuses on the impact of the conceptual model (CM) on students' RS, with a particular emphasis on PPSTs. This study is novel in that it proposes and empirically validates a CM for the development of RS among PPSTs within the context of Kazakhstan's higher education system, a setting that has remained largely unexplored in previous research. The study also provides a structured approach to fostering RS through targeted pedagogical conditions and instructional methods.

Despite intensive developments in Kazakhstan's higher education system [18], several shortcomings remain, including limited technological support and a highly disciplinary approach to the educational process [19]–[22]. Although reflection is recognized as important, teacher training often provides insufficient opportunities for students to engage in self-knowledge and self-determination. Consequently, primary school teachers frequently encounter difficulties with reflective practice [23]–[25]. A review of educational programs revealed a lack of structured approaches to developing students' RS. These shortcomings reflect a broader contradiction between society's need for individuals capable of self-knowledge, self-development, and self-realization and the insufficient readiness of university graduates to engage in these processes. In particular, the potential for reflective training of future primary school teachers remains underrealized. Addressing these contradictions may require a reassessment of the approaches used to foster RS in PPSTs. However, Kazakhstani researchers have not examined this issue in terms of either content or teaching methods [26]–[28]. This study aims to fill this scientific knowledge gap. Specifically, it investigates the impact of the CM on fostering students' RS. The guiding research question is: how does a CM influence the development of RS among PPSTs?

The most significant issues with professional training in Kazakhstan are the limited use of reflective technologies in the educational process and a lack of diagnostic tools for assessing future teachers' reflexivity. The main difficulties are related to the fact that reflection remains a formal component of the educational process, without reaching a deep level of awareness among students. For the first time in

Kazakhstani practice, a CM for developing RS in PPSTs has been created, theoretically supported, and tested. This study is significant because it contributes to understanding how a CM develops students' RS, as well as how innovative forms and methods of teaching contribute to the development of skills for assessing and self-assessing future teachers' readiness for professional work, as well as increasing the effectiveness of the university educational process. The findings may be useful for teachers and curriculum and methodological material developers when creating strategies for developing students' RS, as well as for addressing one of the state's top priorities: ensuring a high level of professional readiness among PPSTs.

2. THEORETICAL FRAMEWORK

The concept of reflection is distinguished by its ambiguous conceptual status and position within the conceptual system [29]. This ambiguity is due to the variety of approaches to the study of reflection. Researchers believe that reflection serves as an explanatory principle for the development of self-awareness and the psyche as a whole [30]. At the same time, reflection enables individuals to self-analyze, comprehend, and rethink their social relationships with the outside world and is considered an essential component of developed intelligence [31]. External reflection is concerned with the external world, which includes actions, activities, and deeds. A higher level of external reflection helps explain why a subject behaves in a particular way [32]. Researchers emphasize the distinction between reflection and reflexivity [33]. According to Kimberley [34], reflexivity is a personality trait that characterizes reflection as a process. Reflexivity has varying degrees of expression and is defined by the self-directed nature of cognitive processes manifested through actions, deeds, and reflection [35]. This orientation can be assessed by examining the criteria for the correctness of actions and deeds, as well as indicators of cognitive ability development (intelligence) and self-assessment. Reflection and reflexivity are achieved through the development of RS [36]. RS are closely linked to thought processes (analysis and synthesis) and other cognitive processes [37]. Professional knowledge and skills, including those related to reflection, are intrinsically valuable. They become personal assets only when they are independently perceived and developed, driven by intrinsic motivation.

Korthagen's core reflection model is particularly relevant to the current study because it highlights the connection between cognitive, affective, and behavioral components-precisely the structure that underpins the proposed CM for enhancing students' RS [13], [38]. While Korthagen's core reflection model provides a general framework for integrating these dimensions of reflection, the CM proposed in this study extends and adapts this approach in several important ways. First, the model is specifically tailored to the professional training of PPSTs and to the contextual conditions of Kazakhstan's higher education system. Second, it operationalizes reflection through a structured set of RS embedded within cognitive, value-motivational, and activity-based components, rather than focusing primarily on reflection as an internal process. Finally, the proposed model emphasizes the cyclical interaction between awareness, action, and new understanding as a pedagogically guided process supported by targeted instructional conditions, which distinguishes it from more generalized reflective learning models. The structure of the model is presented in Figure 1.

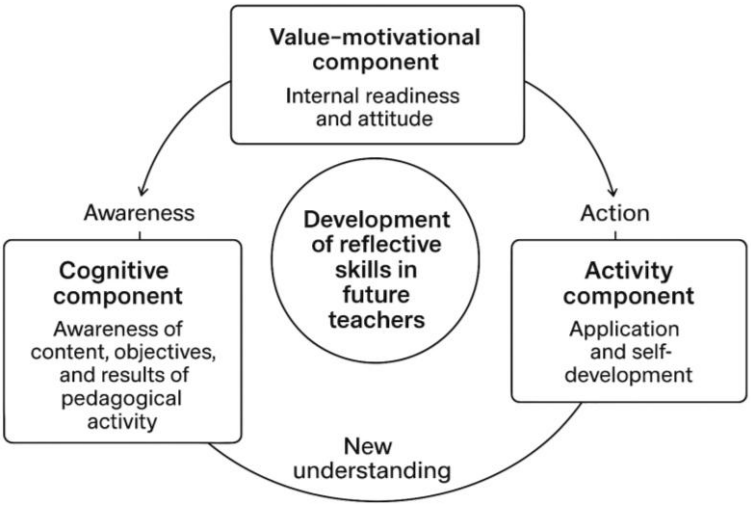

Figure 1. Structure of the CM for developing RS

The CM is based on the integration of constructivist, metacognitive, and activity-based approaches, taking into account the specific characteristics of Kazakhstan's educational system. It is structured into three interrelated components: cognitive, value-motivational, and activity-based. The cognitive component serves as the starting point of the reflective cycle, where conscious understanding of experience and the need for self-assessment emerge. It reflects students' ability to comprehend the content, goals, and outcomes of their own pedagogical activity; to identify cause-and-effect relationships between actions and their consequences; and to use reflection as a management tool by comparing actual results with predicted outcomes. The value-motivational component reveals the essence of the future teacher's developing professional orientation, expressed through intrinsic motivation and attitudes toward professional activity and self-understanding. This component connects the cognitive and activity-based levels, facilitating the transition from awareness to purposeful action. The activity-based component integrates reflection with action, contributing to the formation of professional competencies and encouraging the development of a reflective culture. This reflective cycle, in which each component performs an independent function while simultaneously reinforcing the others, fosters the long-term development of RS.

3. METHOD

3.1. Study design

The model's impact on students' RS was assessed using a quasi-experimental quantitative design with control and experimental groups (EG) [39]. The primary hypothesis is that the conceptual learning model in the EG helps increase RS compared to traditional methods in the control group (CG). The study lasted one academic semester and included three phases: diagnostic (pretest), intervention, and control (posttest).

3.2. Participants

The researchers contacted E. Buketov Karaganda National Research University in Karaganda, Kazakhstan, for permission to conduct the study. Following a positive decision by the university administration, invitation letters were sent to students who met the following inclusion criteria: i) university enrollment; ii) willingness to provide informed consent to participate in the study; and iii) voluntary participation in the survey. Groups were randomly formed from students in existing study groups. The study involved 120 third-year students enrolled in the "pedagogy and methodology of primary education" program. This stage is crucial for developing RS because students have already acquired certain competencies and skills through their coursework and teaching internships. The 120 participants were split into two groups: CG (n=60) and EG (n=60). The academic performance of students in both groups was similar. Participants' ages ranged from 17 to 20 years, with the majority (67.6%) falling within this range. The overall sample consisted of 70% women and 30% men. This reflects the actual gender distribution of Kazakhstan's pedagogical university student body. Women tend to choose teaching professions, especially primary school teaching. Participants were informed about the study's goals and objectives, as well as the fact that their participation is confidential and voluntary. Table 1 summarizes the participants' characteristics.

Table 1. Characteristics of study participants

Indicator	EG (n=60)	CG (n=60)	Total (n=120)
Gender			
Women, n	42 (70%)	42 (70%)	84 (70%)
Men, n	18 (30%)	18 (30%)	36 (30%)
Age (mean, years)	20.3	20.5	20.4
Year of study	3rd year	3rd year	3rd year
Grade point average (GPA)	3.45	3.47	3.46
Previous teaching practice experience	25 (41.7%)	27 (45%)	52 (43.3%)

3.3. Procedure

The study was conducted from 2024 to 2025. The developed model was approved by the Department of Education at Buketov Karaganda National Research University. To determine the initial level of RS, both groups were given a pretest. The EG took part in the implementation of the CM, while the CG continued training with the standard program. Following the training, a post-test was administered.

Four teachers with at least 5 years of teaching experience were chosen to implement the model. The teachers were informed that the study was not designed to evaluate their professional performance, but rather to test the model's effectiveness. They volunteered to participate in the study. The teachers signed informed consent as part of a training program that included the model's theoretical foundations, reflective learning

methods, and objective observation of student development. The two-week teacher training included a discussion of common implementation challenges, an examination of pedagogical case studies, and the creation of individual lesson plans for the EG. By the end of the training, instructional packages had been created with detailed instructions for each lesson, observation diary templates, criteria for assessing student reflection, and suggestions for conducting reflective discussions and providing feedback. The intervention consisted of weekly consultations and lesson debriefings with the researcher; control observations were conducted twice during the experimental period; intermediate results were discussed; and teaching emphases were adjusted accordingly. Observation data and teacher reports were used only in aggregate. This ensured a high level of coordination between teachers and researchers, reducing the influence of subjective factors while increasing the experiment's internal validity.

3.4. Intervention

The model was used in the core courses of the psychology and pedagogy cycle, with targeted sessions based on the "experience-comprehension-reflection-action" principle. The first stage concentrated on developing the cognitive component, as knowledge selection was intentional, taking into account its future use in educational activities. Understanding the value of reflection and its functions in professional work came from studying the recommended literature and materials presented in the lecture course. Material was chosen either through free searching or, if algorithmically guided by the instructor, by compiling a glossary on the topic and creating a conceptual map. The second stage emphasized students' ability to understand themselves, empathize with others, and accept feedback. This was accomplished through group discussions, tournaments, quizzes, educational games, and other events. The third stage emphasized developing RS in pedagogical situations. Working in micro-groups was the most efficient mode of activity at this point. The class format included interactive lectures incorporating reflective analysis, reflective seminars and group discussions, individual reflection portfolios, micro practices, and role-playing teaching scenarios. Each class ended with a brief written reflection from the students, ensuring an objective record of changes. The CG followed the traditional program, which emphasized theoretical assimilation rather than the systematic inclusion of reflective procedures. The weekly structure of the intervention is presented in Table 2.

Table 2. Weekly structure of the intervention

Week	Content focus	Forms of work
1	Introduction to pedagogical reflection; self-analysis of professional qualities	Mini-lecture, questionnaire, group discussion
2	Understanding the role of reflection in teaching and learning	Case studies (analysis of teaching situations)
3	Development of self-observation and self-assessment skills	Individual reflective tasks, observation journal
4	Developing empathy and understanding students' experiences	Role-play activities, video lesson analysis
5	Designing a personal strategy for professional self-development	Reflective seminar, mind mapping
6	Applying reflective techniques during teaching practice	Micro-teaching, peer feedback
7	Analysis of common teaching mistakes	Group discussion, pair work
8	Development of written reflection skills	Reflective essays, reflection journal
9	Reflection on personal achievements and challenges	Group supervision
10	Comparing one's own teaching stance with those of others	Pedagogical debate, self-assessment tasks
11	Integrating reflective practices into future professional activity	Project assignment
12	Final reflection and self-analysis; preparation for the post-test	Portfolio work, group discussion

3.5. Instrument

The reflective thinking questionnaire (RTQ) [40] served as the basis for data collection. Its items were translated into Kazakh and Russian through a back-translation procedure to ensure linguistic accuracy, as seen in Table 3. The relevance and clarity of the 16 statements were evaluated by subject-matter experts, after which a pilot test was conducted with a sample of 42 students. Agreement with each statement was rated on a 5-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree). The scale demonstrated good internal consistency (Cronbach's α=0.85). Data were collected in university classrooms using both paper and electronic formats, and completion took approximately 20–25 minutes. Responses were recorded anonymously using unique participant codes to match pre- and post-test results. Before completing the questionnaire, all participants were informed about the study's purpose and the voluntary nature of their participation. Research assistants were present to provide clarification if needed. The study received approval from the university's ethics committee.

3.6. Data analysis

The statistical data processing methods are shown in Table 4. The collected data were analyzed using appropriate statistical techniques to ensure the reliability and validity of the results. Descriptive and inferential statistics were applied to identify patterns, relationships, and significant differences within the dataset.

Table 3. Structure of the questionnaire

Subscale	Number of items	Description
Habitual action	4	Mechanical completion of learning tasks without analysis
Understanding	4	Meaningful comprehension of knowledge and its connection to experience
Reflection	4	Analysis of one's own actions and their outcomes
Critical reflection	4	Ability to reconsider beliefs and professional assumptions

Table 4. Data analysis methods

No.	Stage of analysis	Methods and procedures
1	Software	SPSS Statistics, version 28.0
2	Descriptive statistics	Mean values (M) and standard deviations (SD) were calculated
3	Group difference testing	Independent samples t-test; analysis of variance (ANOVA)
4	Assumption checking	Shapiro-Wilk test-to assess normality; Levene's test-to assess homogeneity of variances
5	Effect size estimation	Cohen's d was calculated to determine the magnitude of the model's effect
6	Significance level	$p<0.05$

4. RESULTS

Table 5 and Figure 2 present comparisons of reflective thinking scores before and after the intervention. A t-test for dependent samples revealed a significant increase in scores in the EG across all scales ($p<0.001$). Changes in the CG were not statistically significant ($p>0.05$).

Table 5. Mean values and standard deviations of RTQ scores (pretest and posttest)

Subscale	Group	Pre-test M (SD)	Post-test M (SD)	*t*	*p*
Habitual action	EG	3.02 (0.53)	2.60 (0.49)	5.21	0.000
	CG	3.04 (0.54)	3.00 (0.52)	0.55	0.584
Understanding	EG	3.16 (0.50)	3.88 (0.52)	7.23	0.000
	CG	3.17 (0.49)	3.20 (0.51)	0.42	0.675
Reflection	EG	3.12 (0.55)	3.92 (0.54)	8.14	0.000
	CG	3.14 (0.56)	3.19 (0.55)	0.61	0.543
Critical reflection	EG	2.90 (0.48)	3.78 (0.56)	8.47	0.000
	CG	2.93 (0.49)	2.98 (0.50)	0.68	0.499
RTO index: general	EG	3.05 (0.45)	3.65 (0.46)	9.12	0.000
	CG	3.07 (0.46)	3.10 (0.44)	0.52	0.606

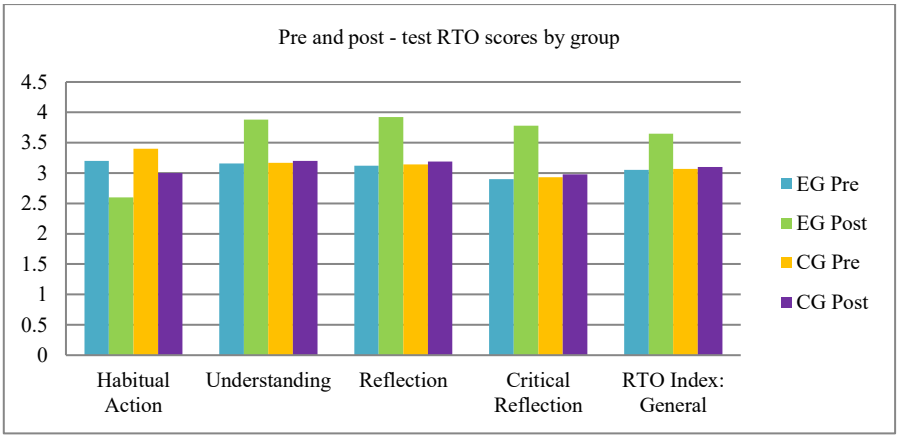

Figure 2. Pre and post-test results

Figure 2 presents the mean reflective thinking scores for the EG and CG before and after the intervention. The EG shows clear increases in all reflective thinking subscales in the post-test compared with the pre-test. The CG exhibits minimal changes across measurements, which aligns with the non-significant statistical results. To compare the differences between the EG and CG in the final (post-test) results, a t-test for independent samples was used, which was confirmed by a one-way ANOVA, as seen in Table 6. The results show significant differences between the EG and CG on all reflective thinking measures ($p<0.001$). The reflection and critical reflection scales revealed the most significant differences, indicating that students were better able to engage in deep self-analysis and rethink their professional attitudes.

Table 6. Comparison of final RTQ scores between the EG and CG (post-test)

Subscale	EG M (SD)	CG M (SD)	*t*	*p*	Cohen's d
Habitual action	2.60 (0.49)	3.00 (0.52)	-4.08	<0.001	0.75
Understanding	3.88 (0.52)	3.20 (0.51)	7.13	<0.001	1.32
Reflection	3.92 (0.54)	3.19 (0.55)	7.40	<0.001	1.36
Critical reflection	3.78 (0.56)	2.98 (0.50)	7.82	<0.001	1.51
RTO index: general	3.65 (0.46)	3.10 (0.44)	7.61	<0.001	0.98

A one-way ANOVA was used to further assess the impact of the experimental design, as in Table 7. All subscales show statistically significant differences between EG and CG ($p<0.001$). The η^2 values ranging from 0.12-0.33 indicate a significant effect of the model. The results showed that the model had a statistically significant effect on the overall level of reflective thinking, indicating that the intervention was effective.

Table 7. Results of one-way ANOVA for RTQ subscales (post-test)

Subscale	Source of variation	SS	df	MS	F	*p*	η^2
Habitual action	Between groups	4.22	1	4.22	16.65	<0.001	0.12
	Within groups	29.83	118	0.25			
	Total	34.05	119				
Understanding	Between groups	15.29	1	15.29	49.92	<0.001	0.30
	Within groups	36.14	118	0.31			
	Total	51.43	119				
Reflection	Between groups	17.25	1	17.25	52.75	<0.001	0.31
	Within groups	38.61	118	0.33			
	Total	55.86	119				
Critical reflection	Between groups	18.62	1	18.62	57.12	<0.001	0.33
	Within groups	38.45	118	0.33			
	Total	57.07	119				
RTO index: general	Between groups	12.71	1	12.71	48.32	<0.001	0.29
	Within groups	31.03	118	0.26			
	Total	43.74	119				

Note: SS=sum of squares; df=degrees of freedom; MS=mean square; F=F-value of the ANOVA test; p=significance level; η^2=eta squared, representing the effect size.

5. DISCUSSION

The findings indicate that the conceptual teaching model had a statistically significant and pedagogically relevant impact on the development of RS among PPSTs. At the start of the study, participants in a traditional academic environment exhibited a tendency toward habitual action. In the EG, the teaching model facilitated a gradual transition to reflective and critical self-assessment, leading to a decrease in the habitual action score and an increase in understanding, reflection, and critical reflection scores, as well as the overall RTQ index ($p<0.001$ for all subscales). Consequently, students' automatic behavior patterns diminished, while their awareness, analytical comprehension, and critical evaluation of personal experience increased. Participants progressed from superficial reflection to a deeper, more critical understanding of their experiences. These results align with previous research [41], [42], which emphasizes the role of targeted educational conditions in promoting self-analysis and awareness of cognitive processes.

From a theoretical perspective, these findings contribute to the understanding of reflective learning as a structured and developable competence rather than a spontaneous personal trait. The results support theoretical positions that conceptualize reflection as a dynamic interaction between cognitive awareness, value-motivational engagement, and purposeful action. By demonstrating the effectiveness of a pedagogically guided reflective cycle, this study extends existing reflection theories by emphasizing the role of instructional design in fostering higher-order RS among PPSTs.

The Cohen's d coefficient confirms the model's strong effect and significant influence on participants' ability to reflect critically, particularly in the domains of critical reflection and reflection. These findings are consistent with previous studies [43], [44], which reported significant gains in critical reflection following specially designed teacher training programs. Similarly, other studies [45], [46] observed that structured, targeted training is necessary to facilitate the transition from "descriptive" to "critical" reflection. Chen *et al.* [47] also found that RS development is closely linked to active learning and student engagement in analyzing their own actions. Significant differences between groups were observed across all subscales ($p<0.001$), with critical reflection, reflection, and understanding showing the highest η^2 values, indicating strong experimental effects on RS development. These results support Prieto *et al.* [48], who emphasized that reflection is activated during pedagogical interaction when teachers evaluate their own decisions in real time, and Brailas [49], who highlighted the importance of a systemic approach incorporating cognitive, emotional, and value components.

Importantly, the observed changes in RS can be interpreted through the structure of the proposed CM, in which cognitive, value-motivational, and activity-based components operate as an integrated system. The transition from habitual action to critical reflection reflects not only quantitative growth but also qualitative shifts in how students interpret and regulate their professional experience. This supports the assumption that RS develop most effectively when reflection is embedded within meaningful pedagogical activity rather than treated as an isolated cognitive process.

From a practical standpoint, the findings suggest that the proposed CM may be effectively integrated into teacher education programs through targeted instructional strategies, reflective assignments, and guided self-assessment practices. The model provides teacher educators with a structured framework for systematically developing RS, particularly in educational contexts where reflective practice has not traditionally been emphasized. This approach may support future teachers in developing sustained reflective habits that extend beyond initial training into professional practice. Finally, the findings confirm the applicability of Western reflective learning models in the context of Kazakhstan's primary education. The underlying mechanisms for developing RS appear universal and resilient to sociocultural differences. Even within predominantly reproductive pedagogical settings, RS can be cultivated with appropriate support.

6. CONCLUSION

The study demonstrated that the implementation of the conceptual teaching model had a significant positive impact on the development of RS among PPSTs. RS developed both indirectly, through students' theoretical and practical mastery of their profession, and directly, within the framework of a specially designed intervention. Throughout the experiment, students showed increased interest in understanding themselves as individuals and professionals, gained experience in systematic self-reflection, and demonstrated a growing orientation toward professional self-improvement. Overall, the findings confirm the hypothesis that the conceptual teaching model implemented in the EG enhances RS more effectively than traditional instructional methods used in the CG. While the study addressed its core objectives, future research may further expand these findings by exploring the potential for developing reflection among students from other academic profiles, specifying strategies for preparing future teachers to foster RS, and examining RS development within integrative and interdisciplinary approaches. In addition, future studies could complement quantitative data with qualitative analyses to provide a deeper understanding of the processes and dynamics underlying RS development. This study has several limitations that should be acknowledged. First, the use of a self-report instrument may be subject to social desirability bias and may not fully capture the complexity of students' RS. Second, the sample was drawn from a single higher education institution, which may limit the generalizability of the findings to other educational contexts. However, these limitations are common and acceptable in quasi-experimental educational research and do not diminish the validity of the observed trends and relationships.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The corresponding author may provide study data upon reasonable request.

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