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AN EMPIRICAL ANALYSIS OF PRE-SERVICE TEACHERS' PROFESSIONAL PERCEPTIONS OF TIMSS AND PIRLS STUDIES

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Abstract. This article explores the empirical dimensions of pre-service primary school teachers' professional perceptions regarding the international comparative assessments known as TIMSS (Trends in International Mathematics and Science Study) and PIRLS (Progress in International Reading Literacy Study). The research was conducted at Korkyt Ata Kyzylorda University and involved a sample of 60 undergraduate students enrolled in the "Pedagogy and Methodology of Primary Education" program in their third and fourth years of study. A structured survey instrument consisting of 25 items was developed to assess respondents' understanding, attitudes, and expectations related to these global assessments. Each statement was rated on a five-point Likert scale, allowing for nuanced analysis of the degree of agreement or disagreement.

The collected data were analyzed using exploratory factor analysis (EFA) in the JASP statistical package. The results revealed a five-factor structure aligning with the theoretical framework: (1) general understanding of TIMSS and PIRLS, (2) perceived impact on professional competence, (3) influence on teaching practices, (4) interest and perceived necessity, and (5) individual attitudes. The structural validity of the model was confirmed using chi-square testing and parallel analysis methods.

The findings offer substantial insight into how international assessment frameworks can inform and enrich teacher preparation processes. This research underscores the importance of integrating TIMSS and PIRLS-related content into pedagogical curricula to better prepare future educators for participation in global educational dialogues. The study contributes to ongoing debates on evidence-based educational reform and emphasizes the role of international benchmarking in shaping reflective and competent teaching professionals.

Keywords: TIMSS, PIRLS, pre-service primary school teachers, professional perception, factor analysis, international assessments, pedagogical competence, empirical analysis

Introduction

In the global educational landscape, the evaluation of educational quality and its international comparability has become one of the key directions in

education policy and research. Among the most prominent tools in this domain are the TIMSS (Trends in International Mathematics and Science Study) and PIRLS (Progress in International Reading Literacy Study) assessments—large-scale international monitoring studies that provide comparative evaluations of students' achievements in mathematics, science, and reading literacy across various countries [1]. These studies not only assess learning outcomes but also serve as a reliable empirical foundation for developing informed decisions aimed at improving education policy and instructional processes [2]. The significance of TIMSS and PIRLS lies in their ability to identify strengths and weaknesses within education systems, reveal the links between early literacy and mathematics achievement, and explore gender disparities in learning outcomes [3]. Such data exert a comprehensive impact on educational policy and practice, guiding national education systems toward alignment with global standards [4]. Accordingly, the results of TIMSS and PIRLS play a pivotal role in shaping current educational reforms.

The Republic of Kazakhstan has been undertaking fundamental reforms to align its educational system with international standards. A key priority of these reforms is the enhancement of students' functional literacy, as well as the improvement of education quality through comparative analysis facilitated by participation in reputable international assessment programs such as PISA, TIMSS, and PIRLS. According to the results of PIRLS and PISA, the reading and writing skills of Kazakhstani students are significantly lower than those of their international peers [5]. These findings highlight the urgent need to strengthen the methodological training of primary school teachers in developing students' text comprehension and literacy skills. Given that the PIRLS program specifically targets the assessment of primary school learners, adapting to its requirements is directly linked to the professional competence of teachers at this level. Moreover, current educational strategies emphasize the importance of updating teacher preparation systems in accordance with international assessment frameworks to ensure effective student participation in TIMSS and PIRLS [6].

Table 1. Assessment Domains of TIMSS and PIRLS Studies

	Assessment Name	Target Group	Assessment Domain	Instruments Used
1	TIMSS	4th-grade students	Mathematics and Science	Test items; student, teacher, and school questionnaires
2	PIRLS	4th-grade students	Reading Literacy	Reading texts and test items; student, teacher, and parent surveys

Currently, Kazakhstan is undertaking systematic efforts to internationalize its education system and to ensure the global recognition of its educational quality.

Participation in international large-scale assessments such as TIMSS and PIRLS serves not only as a tool for comparing students' academic performance, but also as a strategic approach to enhancing the professional competencies of teachers.

From this perspective, examining the knowledge and professional attitudes of prospective primary school teachers toward TIMSS and PIRLS is a critical indicator of the quality of their teacher preparation. Familiarity with these international studies and the ability to integrate their principles into the educational process demand not only subject-matter expertise, but also pedagogical thinking and practices aligned with international educational standards.

In this research article, we analyze the professional attitudes of future primary school teachers studying at Korkyt Ata Kyzylorda University toward TIMSS and PIRLS through empirical methods, thereby assessing their preparedness to implement educational reforms.

The international assessment programs TIMSS and PIRLS are recognized as universal research tools that allow for cross-country comparisons of educational achievement. These studies not only evaluate students' performance in mathematics, science, and reading literacy, but also influence the formulation of policies and practices aimed at improving education systems.

Within the framework of TIMSS and PIRLS, considerable attention is given to various influencing factors, including the role of teachers, characteristics of the educational environment, and the social and psychological contexts of schoolchildren. These components are essential for understanding disparities in learning outcomes and for identifying the pedagogical and systemic changes necessary to enhance educational quality globally.

The methodological approaches employed in these studies rely on complex analytical frameworks. For example, the analysis of TIMSS and PIRLS databases requires the application of techniques such as the Jackknife replication method and the use of sampling weights [7]. These procedures are critical in ensuring the reliability and accuracy of the obtained results.

Additionally, Haberman et al. emphasize the specific features of teacher-focused survey questions, paying particular attention to methods for characterizing the teacher population and calculating response probabilities [8]. Meanwhile, Cordero et al. argue that these data can be effectively utilized to assess the causal impacts of education policy interventions [2].

Beyond evaluating students' academic achievements, TIMSS and PIRLS also examine the social, emotional, and institutional factors influencing these outcomes. For example, in their meta-analysis, Ozyildirim and Karadağ demonstrate that peer bullying has a direct negative effect on students' academic performance [9]. Similarly, Oberleiter et al. investigate the influence of gender differences on educational achievement using TIMSS and PIRLS data. They report that girls tend to outperform boys in reading literacy, while performance

in mathematics and science varies across countries depending on their economic development [3]. Using multilevel modeling techniques, Grilli et al. identify how contextual factors significantly impact students' educational outcomes [10].

One of the key issues related to international assessments is the professional competence of teachers and their professional attitudes toward such evaluations. Professional competence encompasses not only pedagogical skills but also essential attributes such as adaptability, innovative thinking, professional reflection, and metacognitive awareness [11]. In their respective studies, Azhygulova and Kalmyrzayeva [12], as well as Asanalieva and Nasipova, view professional competence as a combination of theoretical and practical preparedness with personal qualities. From this perspective, attitudes and professional values play a crucial role in shaping a teacher's overall competence [13].

Systemic and structural factors that influence teachers' professional development should also not be overlooked. Kunter et al. [14] explore the effects of teacher knowledge, experience, and the learning environment within the framework of professional competence. They emphasize the importance of openness to change and the need for continuous professional development as key conditions for working in an innovative educational setting. In this regard, professional competence is not only a matter of individual development but is also closely linked to the opportunities provided by the broader educational system.

The process of internationalizing higher education also significantly influences the professional preparation of future teachers. International studies provide opportunities to explore differences in the educational experiences of domestic and foreign students, their attitudes toward academic achievement, and the development of competencies necessary for adapting to the global labor market. For example, the PISA-2012 study found that the performance of Kazakhstani students was lower than the average for OECD countries, which sparked heated debate in society and led to criticism that the domestic education system did not meet international standards [15].

Assessment systems have a direct impact on the professional training of future primary school teachers, their pedagogical competence, and their ability to adapt to international standards. However, empirical data on future teachers' professional perspectives, their understanding, and perception of these international assessments remain scarce. This gap highlights the urgent need for further scientific inquiry in this area. An empirical analysis of future primary teachers' professional attitudes toward the TIMSS and PIRLS studies serves as a crucial step in assessing their readiness for participation in international evaluation processes, identifying the development of their professional consciousness, and contributing to the qualitative improvement of the national education system.

Materials and methods

This study aimed to empirically analyze the professional perceptions of future primary school teachers regarding the international large-scale assessments TIMSS and PIRLS. The research employed a specially designed questionnaire to collect student opinions, and the resulting data were analyzed using factor analysis techniques. As shown in Table 2, the questionnaire consisted of 25 statements grouped into five thematic blocks: (1) General Understanding, (2) Impact on Professional Competence, (3) Influence on Teaching Practice, (4) Interest and Need, and (5) Personal Attitude. Each item was rated using a five-point Likert scale (1 – Strongly Disagree, 5 – Strongly Agree), allowing the measurement of participants' levels of agreement.

The survey was administered among 3rd- and 4th-year students enrolled in the "Primary Education Pedagogy and Methods" program at Korkyt Ata Kyzylorda University. A total of 60 student responses were collected and entered into a database for comprehensive statistical processing. The collected data were analyzed using the JASP statistical software. To ensure the validity of the instrument, Exploratory Factor Analysis (EFA) was employed. This method enabled the identification of latent content factors within the questionnaire structure, the internal consistency of the scales, and the strength of the associations between individual items and the derived factors.

During the data processing stage, the number of factors was determined using Parallel Analysis and the Scree Plot method. As a result, a five-factor structure was found to be statistically optimal. The identified model also fully aligned with the theoretical framework of the questionnaire. The interpretation of the extracted factors was conducted using the Promax rotation method. The goodness-of-fit of the factor model was tested through the Chi-squared Test.

Overall, the methodology applied in this study provided a scientifically grounded analysis of future primary school teachers' attitudes toward international assessments. It enabled a systematic evaluation of their professional orientation, interest levels, and skeptical perspectives related to global comparative studies.

Table 2. Structure of the Student Survey and Factor Classification

I	General Understanding
Q1	I am aware of the objectives and content of the TIMSS assessments.
Q2	I believe PIRLS plays a significant role in assessing reading literacy.
Q3	TIMSS and PIRLS are unique tools that help improve the quality of education.
Q4	These studies provide important professional orientation for future teachers.
Q5	TIMSS and PIRLS have a direct impact on educational reforms.
II	Impact on Professional Competence
Q6	TIMSS assessments contribute to the professional development of teachers.
Q7	PIRLS tasks and criteria can be integrated into teaching methodologies.
Q8	TIMSS and PIRLS help enhance teachers' analytical thinking.

Q9	These studies deepen the subject knowledge of future primary school teachers.
Q10	I support educational programs developed based on TIMSS and PIRLS frameworks.
III	Impact on Teaching Practice
Q11	TIMSS data enables assessment of students' performance in mathematics and science.
Q12	PIRLS helps in choosing effective strategies for teaching reading.
Q13	TIMSS and PIRLS methodologies make lessons more engaging.
Q14	I would apply TIMSS or PIRLS tasks during the teaching process.
Q15	These studies are important for improving students' functional literacy.
IY	Interest and Perceived Need
Q16	I would like to learn more about TIMSS and PIRLS.
Q17	A specific university course on these studies should be introduced.
Q18	As a future teacher, I am interested in participating in TIMSS and PIRLS.
Q19	Preparing for these assessments should be part of the teacher training curriculum.
Q20	TIMSS and PIRLS results can be used to improve the quality of education.
Y	Personal Perspective
Q21	The results obtained from these studies are fair and reliable.
Q22	TIMSS and PIRLS are useful for international comparisons.
Q23	These studies should be linked to teacher certification and evaluation.
Q24	TIMSS and PIRLS influence the strategic direction of educational development.
Q25	These assessments will play an important role in my future professional path.

Results and discussion

To evaluate the structural validity of the questionnaire designed to assess the professional perspectives of future primary school teachers toward the international TIMSS and PIRLS studies, an Exploratory Factor Analysis (EFA) was conducted. According to the results, as presented in Table 3, the Chi-square test indicated a high level of model fit to the data ($\chi^2(185) = 153.855$, $p = 0.954$), suggesting that the model is statistically valid.

The results of the parallel analysis confirmed that the five-factor structure was statistically sound. The rotated factor solution accounted for 27.8% of the total variance, demonstrating the multidimensional and coherent structure of the questionnaire items. Additionally, factor loadings greater than 0.4 indicated reliable data and supported the structural integrity of the proposed model.

Table 3. Evaluation Results of the Factor Model's Validity (Chi-square Test)

Chi-squared Test			
	Value	df	p
Model	153.855	185	0.954

The indicators presented in the table confirm that the structure of the questionnaire is statistically reliable and valid. Therefore, the results of the study were further utilized for factor interpretation and the description of the structure of professional competence.

Table 4 – Factor Loadings Based on the Structure of the Obtained Responses (Promax Rotation Method)

Factor Loadings						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Uniqueness
Q7	0.627					0.576
Q18	0.485					0.613
Q13	-0.458				-0.409	0.608
Q6	-0.434					0.816
Q2	0.401					0.783
Q17		0.648				0.566
Q3		-0.529				0.614
Q20			-0.869			0.285
Q25			0.517			0.684
Q23				0.503		0.740
Q9				0.415		0.822
Q16					0.662	0.506
Q12					0.559	0.525
Q1						0.813
Q4						0.740
Q5						0.962
Q8						0.888
Q10						0.796
Q11						0.848
Q14						0.614
Q15						0.953
Q19						0.663
Q21						0.867
Q22						0.849
Q24						0.931
Note. Applied rotation method is promax.						

As shown in Table 4, the results of the factor analysis indicate that 11 out of 25 questionnaire items were grouped into five factors with loadings above 0.4. These factors align with the theoretical framework of the study and allow for meaningful content-based categorization. Loadings above 0.4 indicate internal consistency within the factors, while high uniqueness values for some items suggest the potential presence of unique, standalone components. The factor structure presented in the table confirms the multidimensionality of the indicators related to professional competence and perceptions under investigation.

Table 5 – Factor Characteristics: Eigenvalues, Variance Explained, and Loadings (Based on Rotated and Unrotated Solutions)

Factor Characteristics							
		Unrotated solution			Rotated solution		
	Eigenvalues	SumSq. Loadings	Proportion var.	Cumulative	SumSq. Loadings	Proportion var.	Cumulative
Factor 1	2.628	1.966	0.079	0.079	1.666	0.067	0.067
Factor 2	2.058	1.392	0.056	0.134	1.355	0.054	0.121
Factor 3	1.926	1.263	0.051	0.185	1.325	0.053	0.174
Factor 4	1.873	1.241	0.050	0.234	1.314	0.053	0.226
Factor 5	1.673	1.078	0.043	0.278	1.280	0.051	0.278

Based on the results of the conducted factor analysis, a five-factor structure was identified. The eigenvalues of the extracted variables exceeded 1, thereby providing strong empirical support for retaining the factors. In the unrotated solution, the highest eigenvalue was recorded for Factor 1 (2.628), while the lowest was for Factor 5 (1.673).

In the rotated solution, all five factors together accounted for 27.8% of the total variance, which is considered an acceptable level for studies in the social and educational sciences. The variance explained by each factor was distributed as follows: Factor 1 – 6.7%, Factor 2 – 5.4%, Factor 3 – 5.3%, Factor 4 – 5.3%, and Factor 5 – 5.1%.

These results confirm that the factor structure underlying the professional perceptions of prospective primary school teachers toward the TIMSS and PIRLS studies is statistically robust and aligns well with the theoretical model of the survey.

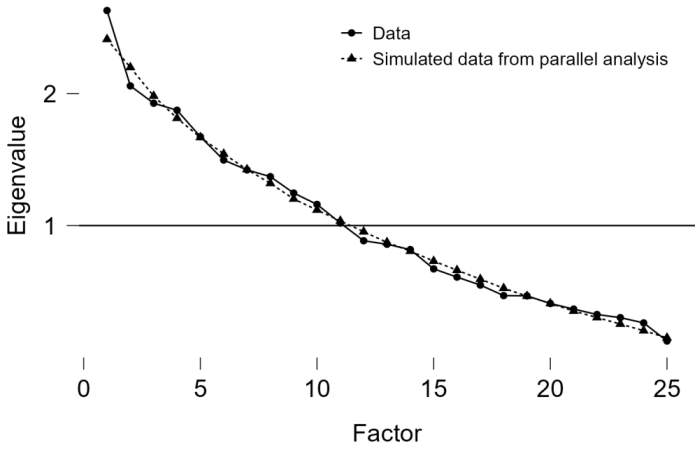

Figure 1 – Determining the Number of Factors Based on Parallel Analysis (Scree Plot)

To accurately determine the number of factors, the parallel analysis method was conducted. As illustrated in Figure 1, an intersection between the line representing the actual data (Data) and the line representing the simulated random data (Simulated data) occurs at the fifth factor. This indicates the final significant factor, as the eigenvalues for the first five factors are above 1.0, while the remaining factors fall below this threshold. Thus, retaining a five-factor model is a statistically justified decision. This outcome aligns with the theoretical framework of the study and confirms the factorial validity of the survey data.

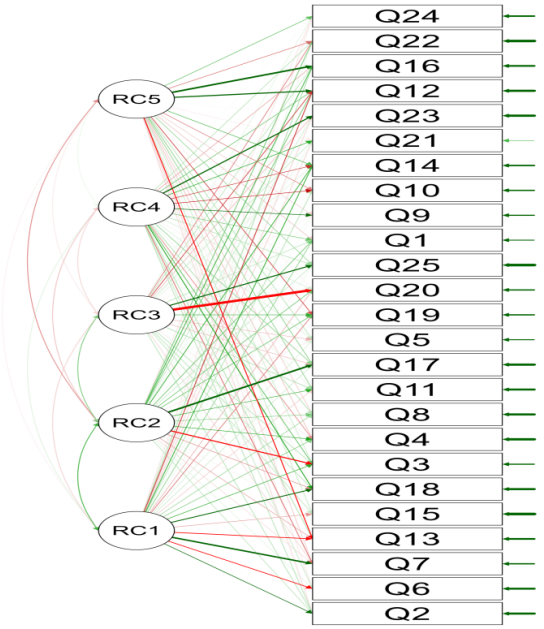

Figure 2 – Visualization of the Factor Structure
(Based on 5 Components Using Promax Rotation)

The factor structure diagram presented in Figure 2 illustrates how the 25 observed indicators are distributed across five core components (RC1–RC5). Thick green lines represent high loading values, while red and thinner lines indicate weaker directional connections. The components RC1–RC5 correspond to key thematic areas within the questionnaire framework, such as professional perception, interest, and skepticism. Items such as Q25, Q23, Q17, and Q12 demonstrate clear loadings on specific factors, highlighting their internal consistency.

The results of the factor analysis reveal that prospective primary school teachers' attitudes toward the TIMSS and PIRLS studies are divided into five dimensional structures. These include: belief in professional development, orientation toward research experience, individual professional perspective, interest in international studies, and a skeptical view of such assessments.

The findings reinforce the structural integrity of the research instrument and validate its effectiveness in identifying future educators' readiness within the context of international assessment frameworks. Furthermore, the study affirms the relevance of developing teacher education programs grounded in empirical insight and aligned with global standards in educational evaluation.

The results of the conducted factor and correlation analyses indicate a high level of interest among prospective primary school teachers regarding the TIMSS and PIRLS studies. Furthermore, the findings suggest that these future educators possess a solid understanding of the significance of international assessment systems in education.

A considerable number of student respondents expressed support for the inclusion of TIMSS and PIRLS topics as dedicated subjects within university curricula, and also advocated for aligning these studies with teacher certification processes. Such responses reflect an increasing demand for the integration of global assessment tools within the national education framework.

Overall, the outcomes of this research confirm that future teachers demonstrate a strong capacity for adapting to international evaluation systems. Moreover, the TIMSS and PIRLS assessments are perceived as having a tangible impact on their professional preparedness. These insights emphasize the need for systematically incorporating such international assessment mechanisms into the training processes of prospective primary school educators.

Conclusion

This study aimed to empirically examine the professional perceptions of prospective primary school teachers toward the international TIMSS and PIRLS assessments. The findings demonstrate that these assessment systems are not merely tools for evaluating students' academic performance in a comparative context, but also serve as valuable pedagogical resources in the development of future teachers' professional competencies.

The majority of participants expressed interest in the content and objectives of the TIMSS and PIRLS frameworks and supported the integration of these assessments into educational curricula and teacher preparation programs. These insights underscore the importance of incorporating international large-scale assessments into the teacher training process as part of broader efforts to align national education systems with global quality standards.

The results of the conducted survey and factor analysis revealed that the TIMSS and PIRLS studies are perceived through four key dimensions: general understanding, impact on professional competence, influence on teaching practice, and individual interest and perceived necessity. These factors indicate that prospective primary school teachers do not view these assessments merely as evaluation tools, but rather as methodological instruments that can be integrated into modern educational practices. Furthermore, the participants expressed confidence in the potential of TIMSS and PIRLS as effective mechanisms for conducting international comparative analyses, informing pedagogical decision-making, and fostering the development of students' functional literacy.

In the context of Kazakhstan's integration into the global educational landscape, the issues of preparing for and participating in international assessments such as TIMSS and PIRLS are becoming increasingly relevant. Therefore, the professional preparation of future primary school teachers for these assessments is a crucial pathway to improving educational quality, understanding the causes and consequences of academic achievement, and ensuring the effectiveness of educational policy. Institutions that train teachers must systematically incorporate both the theoretical foundations and practical methodologies of TIMSS and PIRLS into their curricula. Doing so will enhance students' pedagogical thinking and foster their professional self-development.

In conclusion, the findings of this study demonstrate that shaping prospective primary teachers' professional attitudes toward international educational assessment systems contributes to their ability to make data-driven decisions in the learning process. A deeper scientific understanding of the TIMSS and PIRLS international assessments represents a significant step toward developing high-quality and innovative pedagogical approaches.

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БОЛАШАҚ МҰҒАЛІМДЕРДІҢ TIMSS ЖӘНЕ PIRLS ЗЕРТТЕУЛЕРІНЕ КӘСІБИ КӨЗҚАРАСТАРЫН ЭМПИРИЯЛЫҚ ТАЛДАУ

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Аңдатпа. Бұл мақалада болашақ бастауыш сынып мұғалімдерінің TIMSS және PIRLS халықаралық салыстырмалы зерттеулеріне деген кәсіби көзқарасын эмпириялық тұрғыда талдау көзделді. Зерттеу барысында Қорқыт ата атындағы Қызылорда университетінің «Бастауыш оқыту педагогикасы мен әдістемесі» мамандығының 3–4 курс студенттері арасынан 60 білім алушы таңдалып, құрылымдалған сауалнама әдісімен деректер жиналды. Сауалнама 25 тұжырымнан құрастырылып, бес ұпайлы Ликерт шкаласы негізінде бағаланды. Алынған деректер JASP математикалық-статистикалық бағдарламасының көмегімен факторлық талдау арқылы өңделді. Жүргізілген зерттеу нәтижесінде сауалнама көрсеткіштері бес негізгі мазмұндық факторға бөлінді: жалпы түсінік, кәсіби құзыреттілікке әсері, оқыту тәжірибесіне ықпалы, қызығушылық және қажеттілік, жеке

көзқарас. Анықталған факторлық модельдің жарамдылығы Chi-square және параллельді талдау нәтижелерімен дәлелденді. Бұл зерттеу халықаралық бағалау зерттеулерінің болашақ бастауыш сынып мұғалімдерінің кәсіби құзыреттілігін қалыптастырудағы рөлін теориялық әрі эмпириялық тұрғыда негіздеуге үлес қосады. Сондай-ақ мұғалім даярлау жүйесіне TIMSS және PIRLS зерттеулерінің мазмұнын кіріктірудің өзектілігін көрсетеді. Зерттеу нәтижелері білім беру реформаларына академиялық-тәжірибелік негіз ұсына отырып, болашақ бастауыш сынып мұғалімдерінің халықаралық зерттеулерге қатысу ынтасын арттырудың әлеуетін айқындайды. болашақ бастауыш сынып мұғалімдері

Тірек сөздер: TIMSS, PIRLS, болашақ бастауыш сынып мұғалімдері, кәсіби көзқарас, факторлық талдау, халықаралық зерттеулер, педагогикалық құзыреттілік, эмпирикалық талдау

ЭМПИРИЧЕСКИЙ АНАЛИЗ ПРОФЕССИОНАЛЬНЫХ ВЗГЛЯДОВ БУДУЩИХ УЧИТЕЛЕЙ НА ИССЛЕДОВАНИЯ TIMSS И PIRLS

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Аннотация: В данной статье рассматривается эмпирический анализ профессиональных взглядов будущих учителей начальных классов на международные сравнительные исследования TIMSS и PIRLS. В исследовании приняли участие 60 студентов 3–4 курсов образовательной программы «Педагогика и методика начального обучения» Кызылординского университета имени Коркыт Ата. Сбор данных осуществлялся с помощью структурированного анкетирования. Анкета состояла из 25 утверждений и оценивалась по пятибалльной шкале Лайкерта. Полученные данные были обработаны с использованием математико-статистической программы JASP методом факторного анализа. В результате исследования были выделены пять основных содержательных факторов: общее понимание, влияние на профессиональную компетентность, воздействие на педагогический опыт, интерес и потребность, а также личное отношение. Валидность полученной факторной модели была подтверждена с помощью критерия хи-квадрат и параллельного анализа. Данное исследование вносит вклад в теоретическое и эмпирическое обоснование роли международных оценочных исследований в формировании профессиональной компетентности будущих учителей начальных классов. Также подчеркивается актуальность интеграции содержания TIMSS и PIRLS в систему подготовки педагогических кадров. Результаты исследования предоставляют академико-практическое основание для реформирования образования и выявляют потенциал повышения мотивации будущих учителей к участию в международных исследованиях.

Ключевые слова: TIMSS, PIRLS, будущие учителя начальных классов, профессиональное мнение, факторный анализ, международные исследования, педагогическая компетентность, эмпиричекий анализ

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