

ENHANCING PRIMARY SCHOOL TEACHERS' METHODOLOGICAL PREPAREDNESS BASED ON TIMSS COMPETENCIES

Nasiba Urazbayevna Urazova

Doctoral student (PhD) at the Abdulla Avloni National Institute of Pedagogical Skills, Tashkent, Uzbekistan
urazovanasiba2@gmail.com

ABSTRACT

The article analyzes the professional preparedness level, methodological needs, and pedagogical challenges of primary school teachers in Uzbekistan regarding international assessment programs, particularly the TIMSS (Trends in International Mathematics and Science Study). The research is based on the results of surveys conducted among 4,053 respondents. According to the findings, primary school teachers face the greatest difficulties in mathematics (66.7%) and science (22.7%). Moreover, high levels of need in pedagogical technologies (44.8%), psychological knowledge (25.9%), and pedagogical techniques (23%) indicate the importance of developing competencies aligned with modern teaching requirements. The study concludes that organizing professional development courses, practical workshops, and interactive training sessions based on TIMSS competencies is a key factor in improving the quality of primary education and enhancing teachers' instructional effectiveness.

Keywords: TIMSS, international assessment program, methodological preparedness, pedagogical technologies, competency.

INTRODUCTION

Globally, effective technologies for improving primary school teachers' methodological preparedness for teaching based on the TIMSS (Trends in International Mathematics and Science Study) international assessment program are being integrated into educational practice.

Enhancing the quality of education and preparing personnel in accordance with international standards have become urgent tasks in today's globalized world. In particular, TIMSS (Trends in International Mathematics and Science Study) - an international study of trends in mathematics and science education - assesses the knowledge, understanding, and skills of 4th- and 8th-grade students in these subjects. The study is administered every four years by the International Association for the Evaluation of Educational Achievement (IEA).

In developing a pedagogical technology model for preparing primary education teachers based on the TIMSS international assessment framework, several theoretical approaches are taken into account. In particular, the system-activity approach, the competency-based approach, and learner-centered education principles serve as key methodological foundations. The system-activity approach makes it possible to view all components of the model - aims, content, methods, tools, and outcomes—as an integrated system directed toward the single goal of developing teacher professional competence in accordance with TIMSS requirements. Each element of the model is interconnected, ensuring a holistic understanding of the teacher's preparation process for participation in TIMSS.

LITERATURE REVIEW

In order to train pedagogical personnel who meet modern requirements, extensive work is being carried out to develop mechanisms for enhancing the methodological training of prospective primary school teachers based on the TIMSS international assessment program, to create multimedia electronic resources grounded in international assessment frameworks, and to improve the evaluation of educational quality [1, 5, 7].

In recent years, as a result of the reforms implemented in Uzbekistan, significant economic growth indicators have been achieved, which has further increased the demand for qualified personnel and highly skilled specialists in all sectors. [2, 3, 4]. This, in turn, requires increasing students' interest in learning and strengthening teachers' attention to comprehensive education and upbringing. In the process of improving the quality and effectiveness of education, studying advanced international practices and implementing the requirements of international standards is of great importance.

In Uzbekistan, there is an increasing need to prepare prospective primary school teachers for pedagogical practice based on international assessment programs and to enhance their didactic competencies. This includes analyzing existing challenges in the field, clarifying pedagogical and psychological requirements, developing didactic learning materials and tasks grounded in international assessment criteria, and identifying the key pedagogical factors that promote students' mathematical literacy in preparation for international studies [1, 6].

METHODOLOGY

The research methodology is based on extensive empirical data collected from 4,053 primary school teachers working in various regions of Uzbekistan. The geographical distribution of respondents significantly broadened the territorial coverage of the study. Data collected from Tashkent city (33.4%), Fergana region (34.5%), Khorezm region (16.3%), and Bukhara region (15.8%) made it possible to examine regional differences influencing teachers' methodological preparedness. Such proportional representation provides an important methodological foundation for identifying how pedagogical processes operate under different regional conditions and for evaluating mechanisms of preparing teachers for TIMSS requirements.

The educational background structure of the 3,960 teachers participating in the study is also one of the factors strengthening the reliability of the research. The majority of respondents - 76.8% - hold a bachelor's degree, which corresponds to the standard qualification requirement for primary school teachers in the country. The share of teachers with a master's degree constitutes 8.4%, indicating a shortage of educators with advanced academic training and highlighting the need for additional methodological preparation to deeply understand and implement TIMSS criteria.

The distribution of respondents according to the grade levels they teach further expands the methodological capacity of the study. According to the survey results, 26.1% of teachers teach Grade 1, 26.9% teach Grade 2, 21.7% teach Grade 3, and 25.4% teach Grade 4. This relatively balanced distribution across grade levels allows the research to capture methodological needs at all stages of primary education. The sufficient representation of Grade 4 teachers is particularly important, considering that the cognitive skills assessed by TIMSS are formed at this stage. Meanwhile, teachers working in lower grades reveal how foundational mathematical and science competencies are developed, forming the basis for student performance in TIMSS assessments.

DISCUSSION

The diversity of respondents in terms of regions, educational levels, and the grades they teach made it possible to comprehensively examine primary school teachers' professional preparedness, methodological needs, and existing challenges in relation to TIMSS requirements. Below are the results of the analysis of primary school teachers' methodological preparedness within the context of the TIMSS international assessment program (Figure 1).

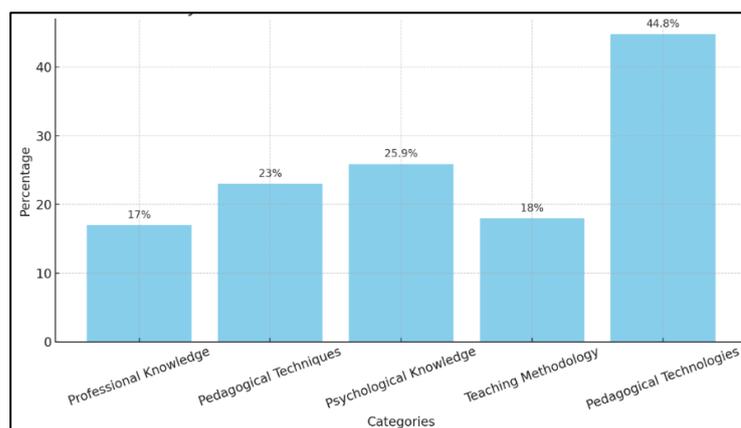


Figure 1. Analysis of the level of primary school teachers' need for pedagogical technologies in their current professional activity

As the diagram shows, the greatest need in teachers' current professional practice is related to pedagogical technologies, accounting for 44.8%. This indicates the necessity of effectively using innovative technologies, digital tools, and interactive methods in modern teaching processes. Current educational reforms require teachers to deepen their knowledge and skills specifically in this direction. The second highest needs are psychological knowledge (25.9%) and pedagogical techniques (23%). These results highlight teachers' growing need to establish effective communication with students, create a psychologically supportive and positive classroom environment, and stimulate students' intrinsic motivation.

Although teaching methodology (18%) and professional knowledge (17%) account for relatively lower percentages, these areas also represent essential components of a teacher's professional activity. These indicators suggest that teachers possess basic theoretical knowledge in these domains; however, there is a need to update and enrich this knowledge in accordance with modern requirements. The analysis shows that the demand for updating technological, psychological, and methodological knowledge is high among teachers. This situation highlights the necessity of paying particular attention to digital pedagogy, organizing interactive lessons, and implementing learner-centered instruction in the educational process.

The diagram below presents the results of the survey conducted among 4,053 respondents, asking: "In which subject do you experience difficulties while teaching based on the current textbooks you use?" (Figure 2). The analysis of the data shows that the largest group of respondents - 2,705 teachers (66.7%) - experience difficulties in teaching mathematics. This outcome reflects challenges related to the content of mathematics textbooks, teaching methodology, and students' foundational knowledge levels. Moreover, since mathematics is one of the key domains assessed in the TIMSS international study, it is logically expected that teachers encounter more difficulties in this area. Therefore, it is necessary to strengthen teachers' methodological preparedness in mathematics, enhance their skills in analyzing tasks, organize learning activities that promote students' critical thinking, and further develop their practical competencies.

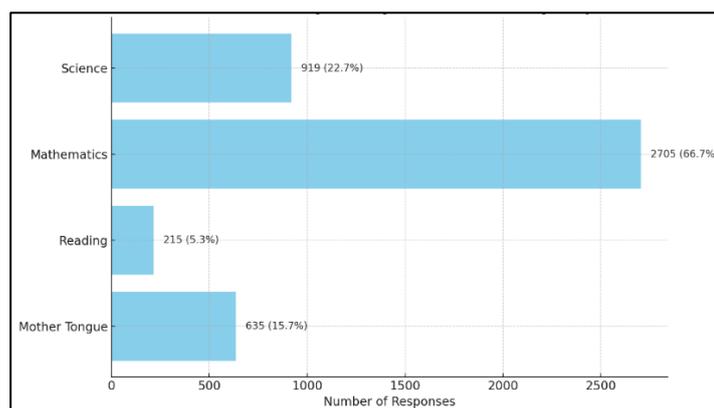


Figure 2. Analysis of the methodological challenges faced by primary school teachers during the teaching process across different subjects

In second place, 919 teachers (22.7%) reported experiencing difficulties in teaching natural sciences. This can be attributed to the integrative nature of science subjects, which require learning through experimentation and observation, thus demanding stronger practical preparation and proficiency in using technical tools. Consequently, teachers exhibit a greater need for laboratory equipment, resources, and methodological guides in this area..

A total of 635 respondents (15.7%) reported encountering difficulties in teaching the mother tongue (native language). These challenges are associated with effectively conveying grammatical concepts to students in a conscious and practical manner, developing written and oral communication skills, and applying text-based instructional strategies. The lowest rate of difficulty was observed in teaching reading, with only 215 teachers (5.3%) reporting challenges in this area. This indicates that reading textbooks and methodological guidelines are relatively effective, user-friendly, and easier for teachers to implement.

Overall, the findings indicate that strengthening teachers' methodological preparedness in mathematics and science is a pressing need. Developing students' thinking, analytical skills, and problem-solving competencies in these subjects requires a high level of professional mastery from teachers. Therefore, it is essential to enhance the methodology of teaching mathematics and science within the professional development system based on international assessment requirements (TIMSS competencies) and to organize practical training sessions on the use of innovative and interactive technologies in the teaching process.

The study also demonstrates that improving the quality of education requires teachers to master instructional methods that foster logical thinking and problem-based learning. Additionally, conducting experiments, promoting observation- and inquiry-based learning, and cultivating a culture of practical investigation in science education should be regarded as an integral part of teacher preparation.

According to the research findings, nearly two-thirds of primary school teachers (73.7%) feel the need to deepen their professional development and methodological preparedness within the framework of international assessment systems (TIMSS). This figure highlights that preparing teachers in accordance with international standards is a highly relevant issue in Uzbekistan's education system. Additionally, 17.7% of teachers consider themselves sufficiently prepared, which can be explained by their prior participation in training courses, conferences, or national assessment programs. Meanwhile, 8.7% of respondents indicated the need to update their methodological knowledge in certain areas. The results indicate that it is necessary to organize professional development courses and practical workshops for teachers based on TIMSS requirements. Moreover,

aligning the content of textbooks with the international competency framework and strengthening teachers' skills in diagnostic analysis and the development of problem-based tasks should be identified as priority directions.

During the TIMSS-related surveys conducted among 4,053 respondents, the results of the question *"How well are you informed about the TIMSS international studies?"* showed that 62.4% of participants reported having partial knowledge about TIMSS. This indicates that although many teachers possess a general understanding of the TIMSS study, they do not have comprehensive knowledge of its deeper content, assessment methodology, cognitive domains (knowing, applying, reasoning), or the structure of test items. This situation suggests that teachers are still at the introductory stage of familiarization with international assessment systems.

According to the study, 36.4% of respondents reported having complete knowledge about the TIMSS international assessments. This group mainly consists of teachers who have become familiar with the TIMSS concept, the competency-based approach, and the test structure through professional development courses or methodological seminars. These teachers have the capability to apply international assessment criteria in their teaching practice. Among the participants, 1.2% stated that they had no knowledge about TIMSS at all. Although this percentage is small, it indicates the presence of certain regional, methodological, or informational gaps within the system.

Overall, although the general level of awareness about the TIMSS international assessment program among teachers in Uzbekistan is adequate, a significant number of teachers still lack in-depth knowledge of its methodological foundations, test system, assessment criteria, and ways of integrating these elements into classroom instruction. Therefore, it is necessary to develop specialized training programs based on TIMSS competencies and to regularly conduct trainings, methodological workshops, and practical seminars for teachers. These findings once again confirm that the successful integration of international assessment programs into the national education system is directly dependent on the level of teachers' methodological preparedness.

The level of teachers' knowledge regarding the content and purpose of the TIMSS international study was assessed through a survey. According to the results of the question *"What is the purpose of TIMSS?"* conducted among 4,053 teachers, 79.8% correctly understood that TIMSS is a system designed to monitor and evaluate the quality of students' achievement in mathematics and science at the international level. This is a highly positive indicator, demonstrating that teachers have developed a sufficient understanding of the main purpose of international assessment programs, particularly TIMSS. These results also show that recent efforts in the country - such as disseminating information about international assessments and conducting seminars and professional development courses - have been effective in increasing teachers' awareness.

Meanwhile, 13.4% of respondents incorrectly interpreted TIMSS as a study aimed at assessing 4th-grade students' reading and comprehension skills. This response actually corresponds to PIRLS (Progress in International Reading Literacy Study), indicating that some teachers are unable to fully distinguish between different international assessment programs. Such a situation highlights the need to more clearly explain the fundamental methodological differences between TIMSS, PIRLS, and PISA within the system of international assessments.

Additionally, around 6.8% of participants viewed TIMSS as a program focused on the international comparative analysis of pedagogical processes conducted in various countries. This perspective is partially accurate, as TIMSS does indeed aim to compare the effectiveness of education systems internationally; however, its primary focus is specifically on measuring students' achievement in mathematics and science. Overall, although the majority of teachers correctly understand the essence

of the TIMSS program, a portion of them still confuse it with other international studies. This underscores the need to widely implement methodological seminars, practical trainings, and instructional materials that provide comprehensive and systematic information about international assessment programs.

CONCLUSIONS

In conclusion, the findings show that the majority of primary school teachers feel the need to deepen their professional and methodological preparation for international assessment systems, particularly the TIMSS program. The fact that the highest difficulties were observed in mathematics (66.7%) and science (22.7%) indicates the necessity of developing teachers' methodological approaches, analytical thinking, and competency-based teaching skills in these subject areas. Furthermore, the high levels of need related to pedagogical technologies (44.8%), psychological knowledge (25.9%), and pedagogical techniques (23%) confirm the importance of effectively using innovative approaches, digital tools, and interactive methods in modern teaching. The results demonstrate that establishing systematic professional development courses, practical workshops, and training sessions based on TIMSS competencies is one of the most effective means of improving the quality of education.

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