

Improving the Methodological Preparation of Primary School Teachers Based on International Assessment Standards (Timss)

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Abstract: This article analyzes the methodological foundations and practical results of developing the methodological preparation of primary school teachers based on the requirements of the TIMSS international assessment program. Within the scope of the research, a diagnostic analysis was conducted involving primary school teachers to study their methodological needs and perceptions of international assessment systems across different regions. The study develops cognitive, activity-based, technological, and reflective criteria, along with their corresponding indicators, for evaluating methodological readiness. The effectiveness of a methodological system based on "Adaptive-Scaffolding" technology, as well as PBL (Problem-Based Learning) and STEAM approaches, was statistically analyzed during the experimental- work phase. The research results confirmed that the proposed methodological recommendations significantly enhance teachers' professional competence, particularly their ability to independently design TIMSS-style tasks.

Keywords: TIMSS, primary education, methodological preparation, competence, cognitive criterion, digital technologies, experimental- work.

Introduction: In the modern education system, international assessment programs, particularly TIMSS (Trends in International Mathematics and Science Study), serve as crucial criteria for determining and comparing the quality of primary education. The TIMSS international assessment program evaluates the knowledge and skills of 4th and 8th-grade students in mathematics and science [6, 10]. Teachers' methodological preparation in alignment with the requirements of this program is a key factor that determines not only the effectiveness of the educational process but also the country's standing in international rankings. From this perspective, developing the methodological competence of primary education teachers remains one of the most pressing issues in contemporary pedagogy.

The TIMSS international assessment program enables the identification of strengths and weaknesses within the national education system by assessing the knowledge, skills, and reasoning competencies of 4th-

grade students in mathematics and science. TIMSS studies do not merely compare student achievement levels; they also perform a complex analysis of factors such as educational content, teaching processes, school resources, and teacher potential. The TIMSS 2023 results [12] indicate that primary school students in the Uzbekistan education system recorded lower results compared to international average indicators.

Data regarding the level of teachers' profound mastery of the TIMSS program requirements are reflected in monitoring studies conducted by the National Center for International Research on Education Quality Assessment. According to the results of a study conducted in 2021, only 35% of general secondary school teachers in our republic are fully proficient in the primary requirements and assessment criteria of the TIMSS program; 45% are familiar only with basic concepts, while the remaining 20% lack sufficient information about this program [4, 5].

The effectiveness of the support system for the

professional development of primary education teachers serves as a crucial factor in assessing the current state. Analytical reports by the OECD on Uzbekistan's education policy and assessment systems emphasize the necessity of improving mechanisms for motivating and supporting the methodological preparation of teachers [8, 9].

Furthermore, the availability of scientific and methodological literature aimed at enhancing teachers' knowledge of international assessment program requirements is a significant factor in evaluating the effectiveness of the educational process. Despite a number of manuals prepared by authors such as A.A. Ismoilov [5], M.T. Ergasheva [2, 3], Sh.A. Abdullayeva [1], and others being important methodological resources, the distribution of these materials to schools and the level of their systematic utilization in practice have not been sufficiently ensured.

According to the analysis of international report results, the performance of 4th-grade students is as follows: students from Uzbekistan participating in the study scored 412 points in science literacy, ranking 54th among 58 participating countries. In mathematics literacy, they ranked 50th among 58 countries with a score of 443 points. In Uzbekistan, 4th-grade girls (446 points) achieved better results in mathematics than boys (440 points), and a similar disparity was observed in science (girls: 414 points, boys: 409 points) [11].

These challenges are particularly evident in identifying the cognitive complexity levels of tasks and adapting them to students' age-related characteristics. Specifically, more than 60% of the teachers involved in the study faced difficulties in evaluating tasks with high cognitive demand [7].

METHODOLOGY

One of the critical stages of this research involves the practical testing of the developed methodological technologies, determining their effectiveness, and reaching scientifically grounded conclusions. Therefore, within the framework of the study, experimental-testing activities aimed at developing the methodological preparation of primary education teachers based on the requirements of the TIMSS international assessment program were organized. The following objectives were established for conducting the research:

- Forming experimental and control groups;
- Determining the initial level of methodological preparation;
- Implementing methodological trainings based on the developed methodological support within the experimental group;
- Re-evaluating the level of methodological preparation upon the completion of experimental-testing activities;
- Performing mathematical-statistical analysis of the obtained results and evaluating their effectiveness.

The experimental-testing activities were carried out in three stages: ascertaining (diagnostic), formative, and control (final) stages. During the ascertaining stage, the existing level of methodological preparation among primary education teachers was determined. To substantiate the relevance of the research topic, surveys were conducted among 4,053 primary education teachers across four regions: Tashkent city, Khorezm region, Fergana region, and Bukhara region.

DISCUSSION

Data regarding the participants' professional regions indicated that the largest shares belong to Tashkent city (33.4%) and Bukhara region (34.5%). Furthermore, 16.3% of the teachers participated from the Khorezm region, and 15.8% from the Fergana region. These results demonstrate a high level of interest in international assessment programs among education system employees in the Tashkent and Bukhara regions.

It was observed that teachers in these regions actively employ innovative pedagogical technologies and possess experience in integrating TIMSS competencies into the educational process. Conversely, the relatively lower participation rates in the Fergana and Khorezm regions highlight the necessity of further strengthening preparatory activities for international assessment systems, enhancing teacher qualifications, and activating the operations of methodological centers in these areas. Overall, the regional analysis results show that the level of teacher preparation and the state of developing TIMSS-related competencies vary significantly across different regions.

The survey results regarding the comprehension of the TIMSS program content served to determine the teachers' level of knowledge in this area. Specifically,

83.3% of the participating primary education teachers provided correct answers, noting that the TIMSS program evaluates the knowledge levels of 4th-grade students in mathematics and science, compares educational quality, and helps identify disparities within national education systems. This result indicates that the majority of teachers accurately understand the goals and essence of the international assessment program, suggesting that the scientific-methodological content of TIMSS is becoming integrated into their professional awareness.

However, 9.1% of the teachers associated the TIMSS program with reading comprehension, interpretation, and making independent life decisions, which is an approach primarily characteristic of the PISA program. Another 7.6% of respondents linked TIMSS with mathematical, scientific, computer, and financial literacy. This situation reveals certain methodological confusion regarding the distinction between the objectives and indicators of various international assessment programs.

When summarizing the results, although a large proportion of primary education teachers correctly understand the essence of the TIMSS program, it is evident that some face difficulties in distinguishing between the goals and directions of different assessment systems. This underscores the necessity for a systematic methodological approach to developing teachers' international assessment competencies. Such findings highlight the need to introduce specialized modules in teacher training and professional development programs aimed at analyzing the specifics of international assessment systems-such as TIMSS, PIRLS, and PISA and identifying their mutual differences and commonalities.

The survey results indicate that the level of methodological preparation regarding international assessment programs is steadily increasing within the Uzbekistan education system. Teachers recognize the core concept of the TIMSS program as a tool that enables the international comparison of student knowledge in mathematics and science. However, there is a clear need among some educators to further deepen their knowledge of international assessment systems and integrate them into practical teaching activities. These findings underscore the necessity of strengthening the scientific foundations for preparing

teachers in accordance with international criteria by sharing regional experiences, organizing methodological seminars, and applying TIMSS competencies within the educational process.

As a continuation of the research, primary education teachers were asked: "In your opinion, what should be the primary focus when preparing students for the TIMSS international assessment program?" This inquiry aimed to identify their views on priority areas within the TIMSS framework, demonstrating the interrelationship between methodological preparation, the organization of the educational process, and the level of awareness regarding international assessment. According to the survey results, 80% of respondents believed that focus should primarily be directed toward developing technologies for the methodological preparation of primary education teachers. This figure clearly confirms that methodological preparation is the most pressing issue among educators. In their view, the key to success in the TIMSS program lies in deepening the teacher's methodological competence and organizing the lesson process through scientifically grounded technologies. This result demonstrates an understanding among teachers that teacher readiness-rather than just student preparation-is the decisive factor in international assessment systems.

Additionally, 14.3% of the teachers participating in the study expressed the need for organizing seminars and training sessions to provide information about international assessment programs. This suggests that there is a lack of sufficient practical and theoretical understanding of programs such as TIMSS, PIRLS, and PISA within pedagogical communities, and many teachers are not practically familiar with the objectives and assessment criteria of these programs. Consequently, this result justifies the necessity of expanding the system of training seminars for disseminating methodological information, sharing experiences, and developing practical skills regarding international assessment systems. Furthermore, 5.7% of the respondents emphasized that focus should be placed on preparatory work for TIMSS tests with specifically selected students. This indicates that a segment of teachers believes the international assessment process should be implemented through an individual approach. However, this approach is methodologically limited and does not fully align with

the original purpose of international assessment programs, which is to evaluate the overall quality of the education system. Therefore, these responses suggest that among some teachers, TIMSS is being interpreted as a selective approach (working only with certain students) rather than a systemic one.

The Pedagogical Proficiency Centers in these regions—specifically the Uzbekistan National University of Pedagogy named after Nizami, the Khorezm Region Pedagogical Center, the Fergana Region Pedagogical Center, and the Bukhara Region Pedagogical Proficiency Center—were selected for the experimental-testing activities. During the experiment, the methodological preparation of primary education teachers in science and mathematics was observed based on the TIMSS

international assessment program. Subsequently, survey results were analyzed by region, and 480 teachers were selected for the experimental-testing phase. At this stage, methods such as questionnaires and surveys, testing, interviews, observation, and analysis of practical assignments were utilized.

The assessment focused on the methodological proficiency of primary school teachers, specifically their ability to comprehend and apply TIMSS tasks, design lessons using modern technologies, and exercise evaluation and reflection skills. The evaluation of methodological readiness was conducted based on four primary criteria: cognitive, operational, technological, and reflective (Table 1).

Table 1

Criteria and Indicators for Assessing the Methodological Readiness of Primary School Teachers Based on TIMSS Standards.

№	Criteria	Indicators
1.	Cognitive	1. Knowledge of methodological concepts 2. Understanding the TIMSS assessment system 3. Comprehensive mastery of subject content 4. Knowledge of instructional methods
2.	Operational	1. Ability to design lessons 2. Developing TIMSS-style assessment tasks 3. Application of interactive methods 4. Creating problem-based learning scenarios
3.	Technological	1. Utilization of digital platforms 2. Creation of electronic educational resources 3. Application of Artificial Intelligence (AI) tools 4. Use of multimedia resources
4.	Reflective	1. Self-analysis of professional activity 2. Identification and correction of errors 3. Evaluation of student performance results 4. Commitment to continuous self-development

Based on these criteria and indicators, the assessment levels were established. Furthermore, during this stage, the curriculum for a short-term training course titled "Developing the Methodological Readiness of Primary School Teachers Based on the Requirements of the

TIMSS International Assessment Program" was developed and officially approved.

The analysis of the results from the diagnostic stage, along with interviews conducted with primary school teachers, revealed a lack of sufficient understanding

regarding TIMSS standards. Key challenges identified included difficulties in designing tasks oriented toward high-level thinking and the infrequent use of interactive

and digital methods during lessons (Table 2). These findings further confirmed the urgent necessity of enhancing the methodological readiness of teachers.

Table 2

Based on these findings, teachers were categorized into

Proficiency Levels	Classification / Description	Percentage (%)
Elementary	Indicators are not demonstrated at all.	0-59%
Basic	Indicators are weak or minimally demonstrated.	60%-79%
Intermediate	Indicators are partially demonstrated, with some existing deficiencies.	80%-89%
Advanced	All indicators are fully and consistently demonstrated; works independently and creatively.	90%-100%

The formative stage constitutes the core of the experimental research, during which the proposed methodology is implemented. This phase focused on the following key areas:

1. Short-term professional development course titled "Developing the Methodological Readiness of Primary School Teachers Based on the Requirements of the TIMSS International Assessment Program." This program aims to enhance the methodological proficiency of primary school teachers through a modern competency-based approach. It focuses on the practical application of instructional technologies designed to foster students' cognitive competencies—specifically knowing, applying, and particularly reasoning—as required by the TIMSS international assessment framework. The development of this program was strictly guided by the following regulatory frameworks of the Republic of Uzbekistan: Decree of the President No. UP-5712 (April 29, 2019) "On Approval of the Concept for Developing the Public Education System of the Republic of Uzbekistan until 2030"; Resolution of the Cabinet of Ministers No. 997 (December 8, 2018) "On Measures to Organize International Research in the Field of Education Quality Assessment within the Public Education System"; Decree of the President No. UP-79 (May 26, 2023) "On Measures for the Effective Organization of the Ministry of Preschool and School Education and Its Subsidiary Organizations"; Resolution of the President No. PP-231

(June 21, 2024) "On Additional Measures to Improve the Continuous Professional Development System for Employees of Preschool and School Education Organizations"; Resolution of the Cabinet of Ministers No. 867 (December 20, 2024) "On Improving the System of Continuous Professional Development for Preschool and School Education Personnel"; Order of the Minister of Preschool and School Education No. 246 (August 7, 2024) "On the Gradual Implementation of 'Professional Development Day' and 'Professional Development Hour' Activities for General Secondary Education Teachers."

2. TIMSS-Based Methodological Training. Specialized seminar-trainings were organized for teachers, focusing on the classification of TIMSS assessment tasks (knowing, applying, and reasoning) and pedagogical strategies designed to foster higher-order thinking skills.

3. Lesson Redesign. Instructional materials and lesson plans were developed in alignment with TIMSS requirements. These included competency-based lessons and problem-solving sessions, where teachers were trained to design assessment tasks based on real-world scenarios.

4. Development of Innovative Pedagogical Technologies. The following methodologies were implemented in practice: Problem-Based Learning (PBL), Case Studies, the STEAM approach, as well as

interactive games and simulations.

5. This observed growth reflects the preliminary outcomes of the methodological intervention, indicating that teachers have begun to internalize new pedagogical methods and approaches. However, the growth rate during this stage remained relatively modest, underscoring the necessity of more time and a systemic approach for the comprehensive mastery of these methodological technologies. In the final

summative stage, the results of the formative phase were synthesized, and the overall effectiveness of the methodological technologies was evaluated. This process involved post-diagnostic assessments, systematic observation of teachers' methodological activities, and the analysis of open lessons and practical sessions. Finally, the data were statistically processed and compared to determine significant progress (Table 3).

Table 3

Dynamic indicators of methodological readiness levels among primary school teachers within the framework of experimental research.

Pedagogical Centers	Groups	Grade 2	Grade 3	Grade 4	Grade 5
National G. Nizami University of Pedagogy	Pre-test (n=60)	15	31	10	4
	Post-test (n=60)	0	2	37	21
Khorezm Region Center for Pedagogical Excellence	Pre-test (n=58)	15	18	21	4
	Post-test (n=58)	0	3	30	25
Fergana Region Center for Pedagogical Excellence	Pre-test (n=61)	17	27	14	3
	Post-test (n=61)	0	5	32	24
Bukhara Region Center for Pedagogical Excellence	Pre-test (n=61)	14	28	15	4
	Post-test (n=61)	0	4	34	23
Total	Pre-test (n=240)	61	104	60	15
	Post-test (n=240)	0	14	133	93

According to the results of the final stage, the developed methodological technologies effectively contributed to the professional competency development of the teachers. Notably, significant positive shifts were recorded in their skills regarding the design of TIMSS tasks, the promotion of critical thinking, and the effective utilization of digital technologies.

CONCLUSION

The results obtained at the conclusion of the experimental research demonstrate that the methodology aimed at developing the methodological

readiness of primary school teachers, in accordance with the TIMSS international assessment program requirements, is highly effective. Specifically, by the end of the experiment, teachers' methodological proficiency across the cognitive and technological criteria was substantially optimized: low-level indicators were replaced by stable performance at intermediate and high levels (80-100%). These findings scientifically validate that the proposed "Adaptive-Scaffolding" technology, alongside Problem-Based Learning (PBL) and STEAM approaches, enabled teachers not only to

deepen their theoretical knowledge but also to develop independent skills for designing high-level thinking tasks aligned with TIMSS standards.

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