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DEVELOPING PROSPECTIVE TEACHERS' ASSESSMENT LITERACY BASED ON THE REQUIREMENTS OF THE INTERNATIONAL PISA AND TIMSS STUDIES

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Abstract: The quality of contemporary education depends not only on teachers' subject knowledge and instructional competence but also on their ability to design, administer, interpret, and use assessment effectively. This article examines the methodological foundations of developing prospective teachers' assessment literacy in accordance with the principles reflected in the international PISA and TIMSS assessment frameworks. Assessment literacy is interpreted as an integrated professional competence that includes knowledge of assessment purposes, alignment of learning outcomes and assessment tasks, development of valid test items, use of formative and summative assessment, interpretation of quantitative and qualitative evidence, provision of feedback, and observance of ethical and fairness principles. The article compares the competence-oriented and real-life problem-solving approach of PISA with the curriculum-related content and cognitive domains of TIMSS. Based on this comparison, a model for developing prospective teachers' assessment literacy is proposed.

Keywords: assessment literacy, prospective teachers, teacher education, educational assessment, PISA, TIMSS, formative assessment, assessment competence, test item design, mathematical literacy, scientific literacy, data interpretation.

Assessment is an integral component of the educational process. It provides evidence about learners' knowledge, skills, competencies, misconceptions, progress, and readiness for further learning. Assessment results also enable teachers to evaluate the effectiveness of instructional methods, identify learning difficulties, provide feedback, differentiate educational activities, and make decisions about future teaching.

However, assessment cannot fulfil these functions when it is understood only as assigning marks or administering tests at the end of a topic. Contemporary assessment requires teachers to define the purpose of assessment, formulate measurable learning outcomes, select appropriate methods, develop valid tasks, establish transparent criteria, interpret evidence, provide constructive feedback, and use the results to improve instruction.

These abilities are commonly associated with the concept of **assessment literacy**. Teacher assessment literacy is generally understood as the knowledge, skills, professional dispositions, and contextual understanding required to conduct assessment effectively and use its results to support learning. Contemporary research also emphasises that assessment literacy is not merely a technical checklist. It is a dynamic professional competence shaped by teachers' beliefs, identities, classroom contexts, institutional expectations, ethical responsibilities, and relationships with learners.

The development of assessment literacy is especially important during initial teacher education. Prospective teachers may have theoretical knowledge about testing and evaluation but experience difficulty in translating this knowledge into classroom practice. They may construct questions that assess only memorisation, use unclear scoring criteria, confuse formative and summative purposes, or interpret scores without considering validity and fairness.

A systematic review of initial teacher education found that teacher candidates develop assessment-for-learning competence most effectively through a combination of explicit instruction, modelling, repeated opportunities to apply assessment practices, professional feedback, and subsequent revision of teaching and assessment decisions. This finding indicates that assessment literacy should not be taught only through lectures. It should be developed through practice-based activities in which prospective teachers design, administer, analyse, and improve real assessment tasks.

International large-scale assessment programmes provide important methodological resources for this purpose. The Programme for International Student Assessment, or PISA, evaluates how 15-year-old students can apply their knowledge and skills in reading, mathematics, and science to real-life challenges. TIMSS, the Trends in International Mathematics and Science Study, assesses mathematics and science achievement among fourth- and eighth-grade students and places greater emphasis on the relationship between assessment and the school curriculum.

PISA and TIMSS do not directly prescribe professional standards for teacher education. Nevertheless, their frameworks provide internationally recognised models for defining assessment constructs, balancing content and cognitive processes, designing tasks, using authentic contexts, interpreting evidence, and ensuring technical quality. Therefore, their principles can be transformed into learning outcomes for the development of prospective teachers' assessment literacy.

The purpose of this article is to develop a methodological model for improving prospective teachers' assessment literacy on the basis of the PISA and TIMSS international assessment frameworks.

The study addresses the following objectives:

1. to explain the professional meaning and structure of assessment literacy;
2. to compare the methodological characteristics of PISA and TIMSS;
3. to identify assessment competencies that prospective teachers should develop;
4. to propose a staged methodology for PISA- and TIMSS-oriented teacher preparation;
5. to determine criteria and indicators for evaluating prospective teachers' assessment literacy;
6. to formulate recommendations for integrating international assessment principles into teacher education programmes.

Assessment literacy initially referred mainly to teachers' knowledge of measurement principles, test development, scoring, validity, and reliability. The concept has since expanded to include formative assessment, feedback, learner involvement, fairness, professional judgement, data interpretation, and the sociocultural context of assessment.

An assessment-literate teacher should be able to answer several fundamental questions:

- Why is the assessment being conducted?
- What knowledge, skill, or competence should be measured?
- Which assessment method is appropriate for the intended learning outcome?
- What evidence will demonstrate that the learner has achieved the outcome?
- How should the evidence be scored and interpreted?
- How can assessment results be used to improve teaching and learning?
- Is the assessment fair, accessible, valid, and ethically appropriate?

Assessment literacy therefore includes both theoretical knowledge and practical performance. A teacher may know the definition of validity but still design an invalid assessment. Similarly, a teacher may understand formative assessment theoretically but fail to use evidence to adjust instruction.

In this article, prospective teachers' assessment literacy is defined as an integrated professional competence that enables them to plan assessment, develop tasks, collect and interpret evidence of learning, provide feedback, make pedagogical decisions, and maintain validity, reliability, fairness, transparency, and ethical responsibility.

This competence includes seven interconnected components.

This component includes knowledge of assessment purposes, principles, types, functions, validity, reliability, objectivity, fairness, and alignment. Prospective teachers should distinguish diagnostic, formative, summative, criterion-referenced, norm-referenced, classroom-based, and large-scale assessment.

Prospective teachers should be able to connect curriculum requirements, learning outcomes, teaching activities, assessment tasks, scoring criteria, and feedback. An assessment should measure the competence stated in the learning outcome rather than a related but unintended ability.

This component includes the ability to develop multiple-choice questions, constructed-response tasks, performance activities, projects, practical assignments, contextual problems, and analytical questions. Teachers should be able to control the cognitive level, difficulty, clarity, and fairness of tasks.

Assessment-literate teachers should analyse scores, response patterns, errors, written explanations, observations, and performance evidence. They should be able to identify misconceptions and determine the instructional implications of assessment results.

This component includes clarifying learning intentions, sharing success criteria, eliciting evidence during instruction, providing feedback, and involving learners in self-assessment and peer assessment.

Prospective teachers should understand the opportunities and limitations of computer-based testing, interactive tasks, automated scoring, digital platforms, response data, and artificial intelligence-supported assessment.

Teachers should protect confidentiality, avoid bias, provide reasonable access, explain assessment criteria, use results responsibly, and reflect critically on their own decisions as assessors.

The most recent official PISA assessment framework available at the time of writing is the PISA 2025 Assessment and Analytical Framework, published by the OECD on 29 May 2026. PISA 2025 covered reading, mathematics, and science, with science as the major domain. It also included Learning in the Digital World as an innovative assessment domain and an optional foreign-language assessment.

The central methodological feature of PISA is its focus on learners' ability to use knowledge and skills in meaningful situations. PISA items are generally not limited to reproducing textbook information. They present personal, occupational, societal, scientific, environmental, or technological situations in which learners must interpret information, select relevant evidence, reason, solve problems, and justify decisions.

This orientation has several implications for prospective teachers' assessment literacy. First, teachers should learn to assess not only what students remember but also what they can do with what they know. Second, assessment tasks should include unfamiliar or partially unfamiliar contexts. Third, learners should be required to integrate content knowledge with reasoning and interpretation.

The PISA mathematics framework emphasises mathematical reasoning and problem solving across different content areas and contexts. Tasks are designed to assess how learners formulate situations mathematically, apply mathematical concepts and procedures, and interpret results in relation to the original context.

A PISA-oriented mathematics teacher should therefore be able to transform a formal mathematical topic into a context-based problem. For example, instead of asking students merely to calculate a percentage, the teacher may present information about prices, population change, energy consumption, or statistical data and ask students to determine which calculation is appropriate and explain the result.

The PISA science framework requires students to apply content, procedural, and epistemic knowledge. The PISA 2025 framework identifies competencies related to explaining phenomena scientifically, constructing and evaluating scientific enquiry, interpreting data and evidence critically, and researching and evaluating scientific information for decision-making and action. It also gives increased attention to environmental issues, science identity, agency, and the critical evaluation of information.

This approach requires future science teachers to design tasks that go beyond factual recall. Learners should interpret graphs, compare explanations, evaluate an experimental design, identify evidence supporting a claim, distinguish reliable and unreliable information, or propose a scientifically justified solution.

PISA also provides a valuable model for reading assessment. Reading literacy involves understanding, using, evaluating, reflecting on, and engaging with texts. In contemporary information environments, this requires learners to work with different sources, identify the author's purpose, evaluate credibility, compare claims, and integrate information.

The PISA 2025 Learning in the Digital World assessment adds another significant dimension. It focuses on students' capacity to engage in iterative knowledge construction and problem solving through computational tools. It uses both response and process information to examine how students approach digital problems.

For prospective teachers, this means that digital assessment literacy should include more than transferring paper-based questions onto a computer. Teachers should understand interactive tasks, multiple representations, process data, digital navigation, scaffolding, and the ways in which technology changes the nature of evidence collected from learners.

TIMSS provides another important framework for developing prospective teachers' assessment competence. Whereas PISA is age-based and emphasises the application of competencies to real-life situations, TIMSS is grade-based and more directly related to the mathematics and science curricula taught in schools.

The latest framework available at the time of writing is the TIMSS 2027 Assessment Framework, published in 2025. TIMSS 2027 is the second fully digital cycle and maintains continuity for measuring trends while incorporating updated global priorities.

The TIMSS frameworks organise assessment through two major dimensions: **content domains** and **cognitive domains**. The content domains specify what mathematical or scientific knowledge is assessed. The cognitive domains describe the kinds of thinking students are expected to demonstrate.

For both mathematics and science, the cognitive domains are:

- **Knowing**;
- **Applying**;
- **Reasoning**.

Knowing includes recalling facts, recognising concepts, describing relationships, and carrying out familiar procedures. Applying requires learners to select and use knowledge in a particular situation, represent information, implement procedures, and solve routine or moderately unfamiliar

problems. Reasoning includes analysing, integrating, generalising, justifying, evaluating, and solving more complex problems.

The cognitive-domain structure offers a practical tool for prospective teachers. It enables them to analyse whether a test is dominated by memory-based questions or provides a balanced representation of knowledge, application, and reasoning.

For example, a teacher may prepare ten science questions and initially assume that the test measures different skills. After classifying the questions according to TIMSS cognitive domains, the teacher may discover that eight items assess only knowing. This analysis can lead to revision and the inclusion of tasks involving data interpretation, scientific explanation, comparison, and justification.

The TIMSS mathematics framework includes content related to number, measurement and geometry, and data, with age-appropriate differences between the fourth and eighth grades. The updated framework also highlights computational thinking and real-world applications. The science framework covers life science or biology, physical science, chemistry, and Earth science, with increased attention to environmental knowledge and scientific practices.

TIMSS also collects contextual information about students' homes, schools, classrooms, teachers, and learning conditions. This aspect helps prospective teachers understand that achievement results should not be interpreted in isolation. Learner performance may be associated with instructional opportunities, resources, attitudes, school climate, attendance, language, and family circumstances.

Therefore, TIMSS-oriented assessment literacy includes both task-design competence and contextual data interpretation.

The integration of these approaches can produce a more comprehensive model of teacher assessment literacy. PISA contributes competence orientation, authenticity, information evaluation, and real-life problem solving. TIMSS contributes systematic curriculum coverage, cognitive-domain balance, and structured content specifications.

This article is based on a theoretical and methodological research design. Official OECD PISA and IEA TIMSS frameworks were comparatively analysed. Scientific studies concerning teacher assessment literacy and the preparation of prospective teachers for assessment were also examined.

The comparative analysis focused on the following dimensions:

- assessment purpose;
- target population;
- construct definition;
- content domains;
- cognitive processes;
- task context;
- digital assessment;
- interpretation of results;
- implications for teacher education.

Based on this analysis, the competencies required of prospective teachers were identified and organised into a developmental model.

The proposed model does not attempt to reproduce PISA and TIMSS tests directly in everyday classrooms. Instead, it adapts their methodological principles to classroom assessment and initial teacher education.

The proposed model includes four interrelated blocks:

1. **target block**;

2. **content block**;
3. **process block**;
4. **evaluation and results block**.

The target block defines the main objective as developing prospective teachers who can design and use valid, fair, cognitively balanced, and instructionally useful assessments.

The content block includes assessment theory, PISA and TIMSS frameworks, task-design principles, cognitive domains, formative assessment, data analysis, digital tools, feedback, fairness, and ethics.

The process block includes lectures, workshops, case analysis, modelling, task transformation, collaborative item development, microteaching, pilot administration, psychometric analysis, and reflective activities.

The evaluation block includes diagnostic tests, observation, task-quality rubrics, portfolios, practical examinations, self-assessment, peer assessment, and expert evaluation.

At the beginning of the course, prospective teachers' initial assessment literacy should be diagnosed. The diagnostic process may include a knowledge test, analysis of sample questions, a task-design activity, and a questionnaire concerning beliefs about assessment.

The diagnostic stage should determine whether students can distinguish assessment purposes, identify weak items, classify cognitive demand, formulate criteria, and interpret basic performance data.

Particular attention should be paid to assessment beliefs. Some prospective teachers may view assessment mainly as control, punishment, or the calculation of final grades. Such beliefs can limit their acceptance of formative and learner-centred approaches.

Prospective teachers should study the fundamental concepts of educational assessment. These include validity, reliability, fairness, alignment, diagnostic assessment, formative assessment, summative assessment, criterion-referenced interpretation, feedback, scoring, moderation, and ethical use of results.

Theoretical content should be connected with practical examples. For instance, validity should not be taught only as a definition. Students should compare two tasks and determine which one better represents the intended competence.

At this stage, prospective teachers study the purposes, domains, constructs, and task structures of PISA and TIMSS. They analyse publicly released tasks and identify:

- the assessed knowledge;
- the required cognitive process;
- the context;
- the response format;
- the expected evidence;
- possible learner difficulties;
- the scoring approach.

They should also compare a conventional textbook question with a PISA- or TIMSS-type task. Such comparison demonstrates how context, cognitive demand, data representation, and reasoning requirements change the nature of assessment.

Prospective teachers select traditional questions and transform them into competence-oriented tasks.

For example, a recall-based mathematics question may be transformed into a problem involving transport, budgeting, construction, climate data, or household energy use. A factual

science question may be transformed into an activity requiring learners to interpret an experiment, compare explanations, or evaluate evidence.

The transformation should preserve curriculum relevance while increasing cognitive demand and authenticity.

Prospective teachers learn to prepare a test specification or blueprint. The blueprint connects content domains, learning outcomes, cognitive processes, item formats, number of tasks, score weight, and expected difficulty.

A blueprint based on TIMSS principles may distribute tasks across knowing, applying, and reasoning. PISA principles may be used to ensure the inclusion of meaningful contexts, interpretation, argumentation, and problem solving.

The blueprint prevents the assessment from being dominated by easily written factual questions.

Prospective teachers develop selected-response and constructed-response tasks. Each task should include:

- a clear construct;
- a measurable learning outcome;
- appropriate context;
- unambiguous instructions;
- necessary data or stimulus material;
- scoring criteria;
- expected answer;
- cognitive classification;
- justification of validity.

Tasks are reviewed by peers and teacher educators. The review should identify unclear language, irrelevant difficulty, implausible distractors, multiple possible answers, cultural bias, and inconsistency with learning outcomes.

Prospective teachers administer their assessment tasks during microteaching or school practicum. They observe how learners interpret the questions, what difficulties arise, and whether the allocated time is appropriate.

A task that appears clear to its author may be misunderstood by learners. Pilot administration therefore helps prospective teachers understand that task quality cannot be determined solely through personal judgement.

Prospective teachers should learn to analyse simple assessment data. This includes calculating percentages, examining response distributions, identifying common errors, comparing groups, and evaluating whether distractors function effectively.

More advanced students may calculate item difficulty, discrimination, internal consistency, or use spreadsheets and statistical software.

The aim is not to turn every teacher into a professional psychometrician. The purpose is to develop sufficient data literacy for responsible classroom decisions.

Assessment results should be used to support learning. Prospective teachers analyse learner responses and prepare feedback that explains:

- what was done successfully;
- what needs improvement;
- why the error occurred;
- what the learner should do next.

They also modify lesson plans according to assessment evidence. If many learners fail to interpret a graph, for example, the teacher should not merely record low marks. The teacher should identify the source of difficulty and plan additional instruction.

Each prospective teacher develops an assessment portfolio containing:

- an initial diagnostic task;
- a test blueprint;
- PISA- and TIMSS-oriented items;
- scoring rubrics;
- peer-review comments;
- revised tasks;
- pilot results;
- data analysis;
- feedback examples;
- reflective reports.

The portfolio demonstrates the development of assessment competence over time and provides more authentic evidence than a single theoretical examination.

Prospective teachers' assessment literacy may be evaluated according to motivational, cognitive, practical, analytical, and reflective criteria.

This criterion reflects the teacher candidate's understanding of assessment as a means of supporting learning rather than merely controlling students. Indicators include professional responsibility, openness to evidence, respect for fairness, and willingness to revise assessment decisions.

Indicators include knowledge of assessment concepts, PISA and TIMSS frameworks, cognitive domains, validity, reliability, scoring, feedback, and ethical principles.

This criterion assesses the ability to formulate learning outcomes, develop a blueprint, construct valid tasks, control cognitive demand, prepare rubrics, and ensure clarity.

Indicators include the ability to interpret results, identify misconceptions, analyse item performance, compare evidence, and make justified pedagogical decisions.

This criterion evaluates how effectively the prospective teacher uses questions, observation, feedback, self-assessment, and peer assessment to improve learning.

Indicators include appropriate selection of digital tools, design of interactive tasks, interpretation of digital response data, and protection of learner information.

This criterion includes self-evaluation, revision of weak tasks, response to peer feedback, and evidence-based improvement of assessment practice.

Assessment literacy levels may be classified as low, developing, competent, and advanced.

At the low level, the prospective teacher mainly reproduces theoretical definitions and designs recall-based questions. At the developing level, the teacher can design different task formats but may have difficulty with validity, criteria, or data interpretation. At the competent level, the teacher aligns outcomes, tasks, scoring, and feedback and balances cognitive domains. At the advanced level, the teacher critically evaluates assessment quality, uses data to improve instruction, ensures fairness, and designs innovative contextual and digital tasks.

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