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Assessment of Students' Functional Mathematical Literacy in a Distance Learning Format

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Abstract: This paper explores how students' functional mathematical literacy can be effectively assessed in remote learning environments. The emphasis is placed on meaningful assessment strategies that incorporate authentic problem-solving tasks, the integration of digital technologies, and formative approaches that support ongoing learning. Drawing on a range of international studies published between 2019 and 2024, the paper provides practical recommendations for adapting assessment models to digital formats. Particular attention is given to the challenges of technological accessibility and student motivation. The findings suggest that a deliberate combination of real-life tasks,

interactive platforms, and student reflection yields more comprehensive and equitable assessment outcomes in virtual mathematics instruction.

Keywords: functional mathematical literacy, digital assessment, remote education, math instruction, equity, student engagement, formative strategies.

Introduction

The global transition to online learning during the COVID-19 pandemic brought about substantial and lasting changes in educational practices across all levels of schooling. Beyond the shift in instructional delivery, the disruption exposed long-standing challenges related to educational equity, access, and assessment. One of the most pressing issues that emerged was the difficulty of evaluating students' real-world mathematical competencies in remote contexts, particularly those competencies that go beyond procedural knowledge.

Functional mathematical literacy, defined as the ability to interpret, analyze, and apply mathematical knowledge to solve problems in everyday life, represents a crucial component of 21st-century skills (OECD, 2021). It reflects a student's ability not only to perform accurate calculations but also to reason logically, communicate mathematically, and transfer conceptual understanding to unfamiliar situations. In traditional classroom settings, these skills are commonly assessed through complex tasks, collaborative discussions, or performance-based activities. However, distance learning environments often lack the infrastructure and pedagogical flexibility required to support such methods.

Standardized tests and conventional mathematics assignments, which already have limitations in capturing deeper levels of understanding, have proven even less effective in remote settings. The absence of in-person interaction, reduced opportunities for teacher-student feedback, digital fatigue, and unequal access to technological resources further complicate the evaluation process. Additionally, variations in students' digital competence and learning autonomy have introduced new inequities in demonstrating functional mathematical literacy online.

This paper examines both theoretical and empirical perspectives on the assessment of functional mathematical literacy in remote and hybrid learning environments. It seeks to identify the core characteristics of effective assessment tools adapted for distance learning, review best practices from international contexts, and critically evaluate current limitations. In doing so, the study contributes to the ongoing discourse on how educational systems can refine evaluation strategies to foster deeper mathematical understanding and promote equity in digital learning contexts.

Research results

Functional mathematical literacy refers to the ability to interpret numerical data, apply mathematical reasoning in various real-life contexts, and communicate findings effectively. These skills are essential not only for academic achievement but also for making informed decisions in everyday situations (OECD, 2021). Remote instruction complicates the assessment process. Students may experience unequal access to reliable internet, appropriate learning devices, or quiet study environments (UNESCO, 2022). Simultaneously, teachers lose access to nonverbal cues and the ability to monitor students in real time. These limitations raise concerns about academic integrity, fairness, and the

overall effectiveness of feedback. Recent research has demonstrated that platforms such as GeoGebra and Desmos can enhance assessment by enabling students to explore and visualize mathematical concepts dynamically. These tools support interactive problem-solving and provide immediate feedback, which assists both learners and educators in tracking progress (Clark-Wilson et al., 2021). They can also be tailored to accommodate varying skill levels and learning speeds.

Encouraging students to reflect on their own thought processes serves as a powerful assessment strategy. Activities such as self-assessments, guided reflection prompts, and digital learning journals help improve students' metacognitive abilities and foster a stronger sense of ownership over their learning (Lee and Choi, 2022). For instance, after completing a task, students might describe the strategy they used or evaluate their level of confidence in the solution.

One of the most critical considerations in online assessment is ensuring equity. Not all students have equal access to technology or adult support at home. According to research by UNICEF (2022), these disparities can significantly distort learning outcomes. Educators can address this issue by providing alternative printable tasks, offering flexible deadlines, and incorporating hybrid options. Effective teacher communication and family engagement also contribute to supporting learners who may face challenges in digital learning environments. Findings from a systematic review indicate that formative assessment has a positive impact on the development of both cognitive and non-cognitive skills, particularly among middle school students. The effect was found to be more substantial in cases involving long-term interventions (lasting more than three months) and when individualized feedback was given to students with low initial performance levels (Zulliger et al., 2025). Computer-based adaptive assessments, specifically A-VLAT and A-CALVI, developed to measure visualization literacy in tasks involving peripheral data, demonstrated high reliability (intraclass correlation coefficient = 0.98) and validity (correlation coefficient = 0.81). These results confirm the effectiveness of adaptive formats in online assessment contexts (Cui et al., 2023).

In her study, Seitbekova (2024) emphasizes the methodological foundations of assessing functional mathematical literacy. She highlights the importance of combining theoretical instruction with practice-oriented tasks, which serves as the basis for designing tests aimed at developing key competencies.

Kobernyk (2025) analyzes the impact of interactive approaches, progress journals, and digital tools such as GeoGebra and Desmos on the motivation of future teachers. The study reveals that the use of these technologies increases the average test score by 23 percent and fosters the development of students' autonomy and reflective skills. Shestakova et al. (2024) examined integrative methods for developing assessment literacy among mathematics teachers. The findings indicate that only comprehensive training, which includes a semester-long course on criterion-based assessment along with practical components, significantly enhances future educators' readiness to assess student knowledge objectively and effectively in authentic educational settings. Overall, current international research confirms the urgent need to reconceptualize the assessment process. It should evolve from a simple mechanism for measuring knowledge into a flexible, personalized, and context-sensitive tool capable of capturing each student's actual learning potential (Zulliger et al., 2025; Seitbekova, 2024; Kobernyk, 2025). This transformation entails not only technological improvements but also

conceptual shifts in educational strategies, with an emphasis on cultivating critical thinking, reflection, and independence among both learners and educators.

Assessment Strategies in Practice

1. Real-Life Problem Tasks

Incorporating authentic, real-world scenarios into mathematics tasks can deepen student understanding and engagement. Examples include:

- Creating a weekly budget with specific financial constraints.
- Interpreting health statistics from actual reports.
- Simulating everyday shopping situations with discounts and taxes.

These tasks go beyond rote memorization by requiring students to analyze data, make estimates, and justify their reasoning (Stillman et al., 2020).

2. Interactive Digital Platforms

Technological tools enhance assessment through features such as:

- Manipulatives and modeling, where students adjust variables or visualize graphs.
- Immediate feedback, as online quizzes adapt to student responses and highlight errors.
- Analytical dashboards, which allow teachers to track how students interact with content.

Such platforms support both formative and summative assessment in dynamic ways.

3. Student-Centered Reflection

When students reflect on their understanding and identify areas of difficulty, learning becomes more meaningful. Effective techniques include:

- Maintaining daily or weekly learning logs.
- Using rating scales to assess confidence.
- Writing explanations of problem-solving strategies.

Reflection fosters autonomy, which is essential for success in self-directed learning environments.

4. Inclusive Assessment Design

To ensure meaningful participation for all learners, educators should:

- Provide assessments in multiple formats (online and offline).
- Allow flexible deadlines and timeframes.
- Regularly check in with students regarding technical and emotional challenges.

Implementing a learner-centered approach helps address achievement disparities and supports student motivation.

Conclusion

In an era when remote learning may continue or resurface, educators require reliable, equitable, and meaningful methods to assess functional mathematical literacy. This demands a shift from static evaluations toward more dynamic, student-centered approaches. The deliberate integration of real-world tasks, digital tools, and formative assessment strategies can enhance our ability to understand and support students' mathematical learning. To genuinely promote mathematical literacy, assessments must capture the complexity of real-life problem-solving while accounting for the varied digital access and learning contexts students experience.

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