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Development and validation of an interactive assessment tool for the numerical skills of learners with autism spectrum disorder

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ABSTRACT

Despite ongoing policy reforms and curriculum adaptations in inclusive education, learners with autism spectrum disorder (ASD) continue to encounter substantial barriers in accessing high-quality mathematics assessment. These challenges are largely attributed to the limited response to these persistent gaps. This study developed an Interactive Mathematics Assessment Tool (IMAT), specifically designed to support the creation and delivery of accessible, engaging, and adaptive assessment tasks for learners with ASD.

Guided by a Research and Development (R&D) design, the study involved 10 identified elementary SNED teachers, 5 expert validators, and 5 key teacher evaluators from public elementary schools in the Schools Division of Apayao. Data were gathered using both researcher-made and adapted survey instruments, structured interviews, and expert validation tools. They were analyzed through descriptive statistics, particularly mean scores, complemented by thematic analysis of qualitative responses to capture teachers' experiences and assessment practices.

Results revealed that teachers experience considerable difficulty in designing mathematics assessments across various competencies, such as Fractions, which was identified as the most challenging area due to its abstract and multi-representational demands. In response, PowerPoint-based Interactive Mathematics Assessment Tools were developed. Validation results confirmed that the assessment tool was highly valid and acceptable, indicating that its integration in classroom settings could improve engagement, autonomy, and numeracy outcomes among learners with ASD. Therefore, the materials are recommended for institutional adoption and expansion of IMAT across other functional academic areas to enhance inclusive education for learners with ASD.

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Introduction

Mathematics plays an important role in the development of problem solving skills and independence, and is useful for everyday and work life. Various barriers to learning mathematics exist for people with Autism Spectrum Disorder (ASD). People on the spectrum can vary in communication, behavior, executive function, sensory processing, and the application of learning across situations. Difference in the math performance between learners with an ASD and typically developing peers, which was strongly

predicted by verbal ability and working memory (Tonizzi & Usai, 2023). For example, difficulties with communication, executive functioning, and transfer of learning as possible reasons that learners with ASD could struggle to complete mathematical tasks (Bouck et al., 2021) .

These concerns have led to a growing need for more flexible, engaging, and developmentally appropriate assessment tools that are aligned with these children's learning styles. Similarly, it is emphasized that effective assessment tools should integrate learner-centered principles, psychometric validity, and differentiated approaches to better support diverse learners in inclusive settings (Sands, Kozleski, and French, 2021), through the implementation of DepEd Order No. 021, s. In 2020, the Department of Education has been geared towards using flexible teaching and assessment approaches to recognize the different learning needs of pupils. Teachers in SPED classrooms usually utilize modified regular assessment procedures that may not effectively cover all learning domains of children with ASD.

This study addresses this gap by developing and validating an interactive mathematics assessment tool that leverages multimedia-based learning and educational software to enhance motivation and conceptual understanding through animations, instructions, and interactive practice. Previous studies have clearly shown that digital technology supports self-learning and promotes involvement of children with ASD. Nonetheless, the majority of these studies focused more on the use of technology for instruction than for assessment.

The current study aims to develop an Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorders to assess numerical competency in inclusive, technology-enhanced ways.

Review of related literature

This chapter provides an overview of the literature and studies that formed the foundation of the study's basic concepts.

Characteristics of Autism Spectrum Disorder

These core characteristics significantly influence how learners with ASD engage with academic tasks, particularly in mathematics, where instruction and assessment often require interpreting language and symbols and engaging in abstract reasoning. Research highlights that learners with ASD frequently experience challenges in pragmatic language use, social understanding, and flexible thinking, which can directly affect their ability to comprehend traditional teacher-led instructions and assessment items (Hyman et al., 2020). In the context of an Interactive Mathematics Assessment Tool, these characteristics underscore the need for clear, structured, and visually supported assessment environments that reduce linguistic ambiguity and enhance comprehension.

Furthermore, the heterogeneity of ASD necessitates adaptable assessment designs that can accommodate varying cognitive and communication profiles within the spectrum (Lord et al., 2020).

Functional academic skills of Autism Spectrum Disorder

Functional academics refer to practical applications of basic academic domains—such as numeracy, literacy, time awareness, and money handling—that are directly linked to real-world scenarios and daily living skills (Ayres et al., 2020). Studies from 2020 to 2024 reflect a shift toward individualized, technology-supported, and evidence-based approaches. Current research emphasizes the importance of contextualized learning—embedding academic instruction in real-life tasks and routines. For learners with ASD, who may have difficulty generalizing abstract concepts across environments, functional instruction improves not only skill retention but also performance in daily living (Banda & Spooner, 2023). Furthermore, longitudinal studies are recommended to track how early mastery of functional academic domains affects post-school outcomes, including employment, community integration, and mental health (McMahon et al., 2022).

K to 12 transition curriculum for learners with disabilities

The implementation of the Enhanced Basic Education Act of 2013 (Republic Act No. 10533), commonly known as the K to 12 curriculum, represents the Philippine government's commitment to providing inclusive, equitable, and quality education for all, including learners with disabilities, such as those with Autism Spectrum Disorder (ASD). Learners with ASD, characterized by challenges in social interaction, communication, and repetitive behaviors (American Psychiatric Association, 2013), require individualized and structured support, particularly during transition phases from school to post-secondary life.

In the Philippine K to 12 contexts, the Department of Education mandates the use of an Individualized Education Program (IEP) as a framework for customizing instruction and assessment based on each learner's functional and academic profile (DepEd Order No. 72, s. 2009). For learners with ASD, this includes behavioral goals, communication strategies, and social integration plans tailored to developmental needs.

Assessment tool used to assess the numerical skills of learners with Autism Spectrum Disorder

Assessing the numerical skills of learners with Autism Spectrum Disorder (ASD) has become an increasingly important aspect of special education, particularly as educational systems push for inclusive and differentiated instruction. Numerical skills—which include counting, number recognition, basic operations, and understanding of mathematical concepts—are foundational for functional independence and academic success.

However, standardized tools often fall short in capturing the nuanced learning profiles and processing differences observed in children on the autism spectrum (Wilson et al., 2022). For example, a study by Barber et al. (2023) emphasized that learners with ASD often excel in pattern recognition and rote memory but may struggle with abstract reasoning and verbal instruction, which are frequently embedded in traditional mathematics assessments. The Autism-Specific Numeracy Assessment Framework (ASNAF) integrates numerical skills with executive functioning and social-emotional cues. It uses

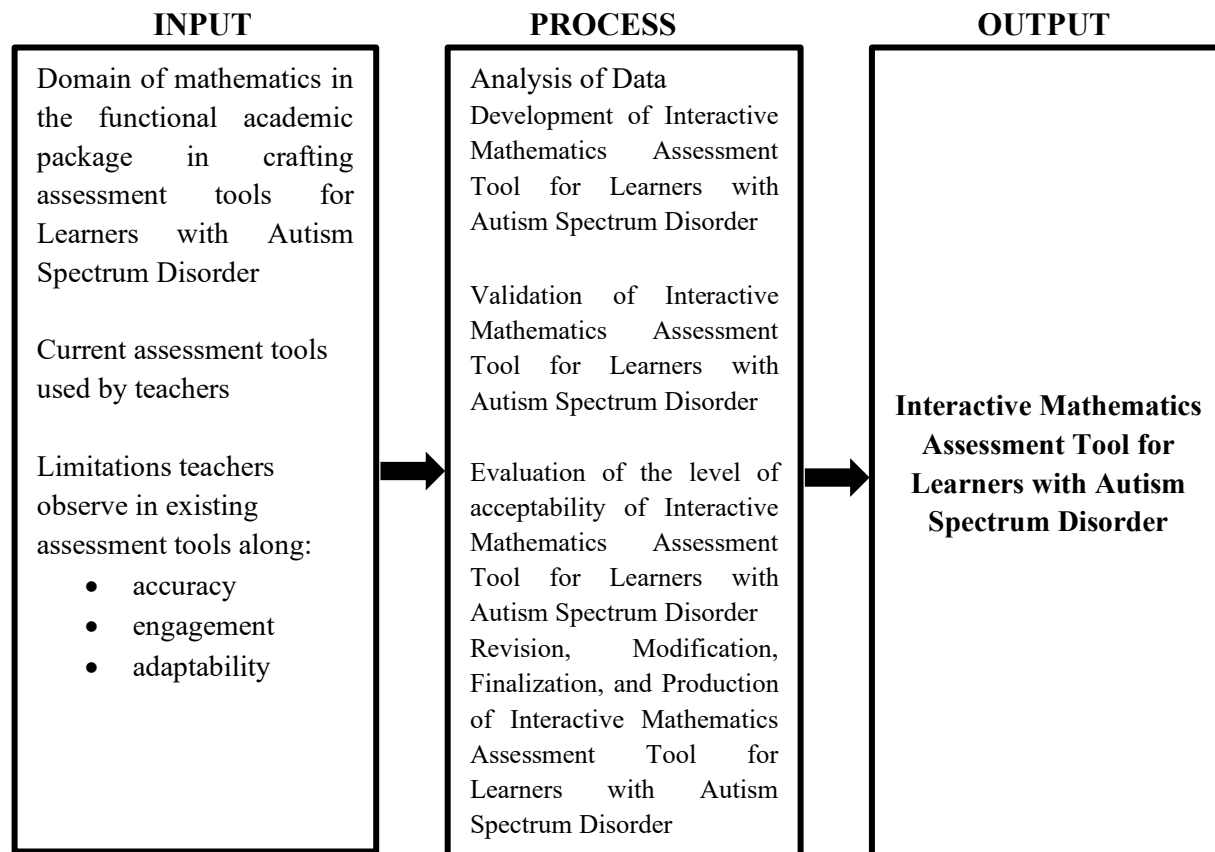
adaptive item delivery and supports multimodal expression (e.g., selecting, pointing, or arranging items), which is particularly beneficial for nonverbal or minimally verbal learners (Li & Choudhury, 2023).

Interactive mathematics assessment tool for learners with Autism Spectrum Disorder

Interactive mathematics assessment tools that utilize visual supports, gamified elements, and immediate feedback mechanisms have been shown to improve not only learners' motivation but also the reliability of assessment results (Hwang, Chien, and Chao, 2022). Recent studies underscore that traditional paper-and-pencil assessments often fail to capture the true capabilities of learners with ASD due to their sensory sensitivities, social-communication challenges, and preference for visual and interactive stimuli (Frith & Happé, 2022).

Moreover, the integration of adaptive technologies, such as machine learning algorithms, has enabled the personalization of mathematics assessments based on the learner's pace, accuracy, and engagement patterns (Liu et al., 2024). The interactive mathematics assessment tool showed that learners with ASD, when provided with digital tasks grounded in everyday scenarios such as money recognition, time-telling, and basic operations, displayed improved task persistence and reduced behavioral disruptions. The use of culturally relevant icons, localized language support, and feedback sounds tailored to Filipino learners further contributed to a more inclusive assessment experience (de Leon & Manlapig, 2023).

Conceptual framework



Source: Villanueva (2025)

The INPUT phase examines the specific domains of mathematics within the functional academic package, in which teachers face significant challenges in crafting appropriate assessment tools for learners with ASD. It also examines the assessment tools currently in use by teachers and the documented limitations they observe in existing tools across accuracy, engagement, and adaptability.

The PROCESS phase involves a comprehensive analysis of data collected during the needs assessment and preliminary investigation to develop the assessment tool. Afterward, the assessment tool undergoes content validation to evaluate its accuracy, instructional appropriateness, and technical clarity, followed by teachers' evaluation of its acceptability in terms of clarity, usefulness, language and style, presentation and layout, and suitability.

The OUTPUT phase is the production of a functional and empirically grounded Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder (ASD). It is a pedagogical innovation that bridges research, practice, and technology, with long-term implications for equitable education and inclusive assessment.

Statement of the problem

This study aimed to develop an interactive mathematics assessment tool for learners with autism spectrum disorder (ASD) to assess their numerical skills.

Specifically, it sought to answer the following questions:

1. Which domain of Mathematics in the functional academic package do teachers find difficulty in crafting assessment tools for learners with ASD?
2. What assessment tool do teachers currently use to assess the numerical skills of learners with ASD?
3. What limitations do teachers observe in existing assessment tools, along with:
 - 3.1 accuracy;
 - 3.2 engagement;
 - 3.3 adaptability?
4. What can be developed to assess the numerical skills of learners with ASD?
5. How valid is the interactive assessment tool for the numerical skills of learners with ASD?
 - 5.1 Content Quality
 - 5.2 Instructional effectiveness; and
 - 5.3 Technical quality.
6. What is the level of acceptability of the interactive mathematics assessment tool for the numerical skills of learners with autism spectrum disorder in terms of:
 - 6.1 clarity;

- 6.2 usefulness;
- 6.3 language and style;
- 6.4 presentation and layout; and
- 6.5 suitability?

Methodology

This chapter outlines the research design, data sources, population and sampling, data-gathering instrument, and data analysis, including its ethical standards.

Research design

This study adapted the Research and Development (R&D) methodology, which is well-suited to its objective of designing an Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder. The R&D process will be carried out in three sequential phases—planning, development, and validation.

Location of the study

This study was conducted in five districts within the Schools Division of Apayao—these districts: Flora, Sta. Marcela, Luna, Pudtol, and Calanasan represent a cross-section of geographically diverse, predominantly rural communities characterized by limited access to specialized educational resources.

Respondents of the study

The population of this study consisted of teachers handling learners with Autism Spectrum Disorder (ASD) who were enrolled in selected public elementary schools offering Special Needs Education (SNED) programs, 5 expert validators, and 5 key teachers who evaluated the acceptability within the Schools Division of Apayao.

Instrumentation and data collection

The study utilized three research instruments. The first was a researcher-made questionnaire designed to gather information on: (1) the assessment tools currently used by teachers to assess the numerical skills of learners with Autism Spectrum Disorder (ASD); (2) the mathematics domain of the Functional Academic Package specified in the 2020 K to 12 Transition Curriculum for Learners with Disabilities, which served as the basis for developing the assessment tool; and (3) the limitations of existing assessment tools in terms of accuracy, engagement, and adaptability.

The second instrument was a Content Validity Rating Scale adapted from the Department of Education (DepEd) Validation Tool for Non-Print Materials, which was used to evaluate the content validity of the developed instructional material.

The third instrument was the Level of Acceptability Rating Scale, adopted from Paguirigan (2023), which was administered to randomly selected teachers to determine the acceptability of the developed Interactive Mathematics Assessment Tool (IMAT).

Ethical considerations

This study strictly followed the ethical principles and considerations established by the Department of Education, and those stipulated in the Data Privacy Act of 2012 (RA 10173). Appropriate authorization from the Schools Division Superintendent was obtained before conducting any data gathering. The participants were made aware of the study's objectives, how their privacy would be protected, and their right to participate voluntarily.

Data analysis tool

This scale utilized a set of mean scores, each being associated with an equivalent descriptive description, to better capture which domain of mathematics should be crafted for an assessment tool and offer valid comments on their numerical skills as follows:

<i>Range of Means</i>	<i>Descriptive Interpretation</i>
4.51-5.00	<i>Extremely Difficult (ED)</i>
3.51-4.50	<i>Very Difficult (VD)</i>
2.51-3.50	<i>Moderately Difficult (MD)</i>
1.51-2.50	<i>Slightly Difficult (SD)</i>
1.00-1.50	<i>Not Difficult (ND)</i>

The assessment tools currently used by teachers to assess the numerical skills of learners with ASD were analyzed and interpreted using frequency count analysis. At the same time, limitations that teachers observed in existing assessment tools, along with accuracy, engagement, and adaptability, were analyzed using qualitative data by reading teacher responses multiple times, developing codes to capture key issues, organizing these codes into themes, and refining them for definition. To interpret the validity and acceptability levels, weighted mean ranges were used. The following scale and its corresponding descriptive interpretations were used to analyze the responses.

Range of Means	Descriptive Interpretation	
	Level of Validity	Level of Acceptability
4.51-5.00	Very Highly Valid (VHV)	Very Highly Acceptable (VHA)
3.51 – 4.00	Highly Valid (HV)	Highly Acceptable (HA)
2.51 – 3.50	Moderately Valid (MV)	Moderately Acceptable (MA)
1.51 – 2.50	Slightly Valid (SV)	Slightly Acceptable (SA)
1.00 – 1.50	Not Valid (NV)	Not Acceptable (NA)

Data presentation and analysis

The results were presented following the structure of the statement of the problem and were organized to provide answers to the following research questions:

Problem 1: Which domain of Mathematics in the functional academic package do teachers find it difficult to craft assessment tools for learners with ASD?

Table 2. Level of difficulty of learners with ASD in selected mathematics domains.

Domain of Mathematics	M	DI
1. Number Values	2.70	MD
2. Money Values	3.00	MD
3. Basic Operations	3.10	MD
4. Tell Time and Days/Months	3.10	MD
5. Fractions	3.90	VD
Composite Mean	3.16	MD

Source: DepEd Order No. 21, s. 2020 K to 12 transition curriculum

Legend:**Range of Means**

4.51-5.00

3.51-4.50

2.51-3.50

1.51-2.50

1.00-1.50

Descriptive Interpretation

Extremely Difficult(ED)

Very Difficult (VD)

Moderately Difficult (MD)

Slightly Difficult (SD)

Not Difficult (ND)

The data show that most domains, especially those involving number values, money values, basic operations, telling time, and days/months, fall within the *moderately difficult (MD)* range, with a composite mean of 3.16. Among the five domains, fractions obtained the highest mean score of 3.90, which falls within the very difficult (VD) range, indicating that learners encountered the greatest challenges in understanding and solving fraction-related concepts.

Problem 2: What assessment tool do teachers currently use to assess the numerical skills of learners with ASD?**Table 3. Current assessment tools used by teachers.**

Current Assessment Tools Used	The number of teachers who used the assessment tool
Paper and Pencil Test	7
Oral Questioning	9
Using Manipulatives	10
Worksheets with pictures	8
The teacher-made activity sheets	9

Source: Villanueva (2026)

The data show a distinct trend favoring greater interactivity and concreteness. Manipulatives appear to be the most common assessment instrument ($n = 10$), followed by oral questioning and teacher-made activity sheets ($n = 9$ each). On the other hand, the least favored forms of assessment instruments are worksheets with pictures ($n = 8$) and paper-and-pencil tests ($n = 7$). This trend implies that efforts have

been made to adopt more visually, tactilely, and orally directed assessment methods – characteristics that suit learners with ASD well.

Problem 3: What limitations do teachers observe in existing assessment tools, along with:

3.1 accuracy;

3.2 engagement;

3.3 adaptability?

Table 4. Organization of data based on accuracy.

Category	Significant Responses
Assessments Do Not Reflect True Student Ability	- "Test anxiety and unclear instructions affect performance." (R1) - "Assessments measure recall rather than real understanding." (R2) - "Tests have limited questions, leading to incomplete measurement." (R3&10)
Overemphasis on Memorization Rather Than Understanding	- " Tools measure recall more than understanding." (R2) - " Some tests only measure memory, not real understanding." (R6)
Mismatch Between Test Content and Students' Level or Experience	- " Questions may be too hard or too easy." (R7) - " Tests do not match real-life experiences or skills." (R8)
Lack of Inclusivity for Learners with Diverse or Special Needs	- "Assessments do not measure the abilities of learners with special needs." (R4) - " Recognizing unique needs is crucial for designing effective assessments." (R5)
Structural and Design Issues in Assessments	- " Inconsistent scoring can distort accuracy. " (R2) - " Mistakes in scoring and unclear instructions impact results. " (R9)

Source: Villanueva (2026)

These limitations manifest across several interrelated dimensions, including construct misrepresentation, cognitive misalignment, learner-level mismatch, lack of inclusivity, and structural design flaws. Collectively, these issues compromise the validity and interpretability of assessment results. Many responses emphasize that current assessment tools often fail to measure what students actually know or can do. External factors—such as test anxiety, unclear instructions, and limited items—distort accuracy. Several point out that assessments focus too much on rote memorization and too little on conceptual reasoning or application. Hence, this reveals that assessment practices are misaligned with deeper cognitive goals in mathematics, weakening the accuracy of measuring real learning.

Table 5. Organization of data along engagement.

Category	Significant Responses
Lack of Interest and Motivation	- " Assessments are neither exciting nor motivating and are often repetitive. Hence, learners lose focus and perform poorly because tasks feel mundane or routine." (R1, 2, 3, 4, and 9)
Over-Reliance on Text and Writing	- " Tests are text-heavy, involve too much writing, and lack variety." (R2, 4, and 5)
Insufficient Interactivity and Multisensory Features	- " Students disengage when assessments lack interactive or sensory-rich elements, such as a lack of interactivity, visuals, sounds, or activities." (R3, 4, and 6)
Limited Feedback and Support	-Students need more immediate reinforcement or guidance. For example, the absence of instant feedback reduces student interest. (R7)
Assessment Anxiety and Pressure	- " The emotional experience of testing also contributes to disengagement. The tests feel like pressure rather than a challenge." (R8)

Source: Villanueva (2026)

The findings indicate that existing assessment tools exhibit substantial engagement-related limitations, particularly a lack of interest and motivation, overreliance on text-based formats, insufficient interactivity and multisensory features, limited feedback and support mechanisms, and heightened assessment anxiety and pressure. Collectively, these constraints reduce learners' willingness and ability to meaningfully engage with assessment tasks, thereby compromising the validity of assessment results.

Table 6. Organization of data along adaptability.

Category	Significant Responses
Lack of Differentiation for Diverse Learning Needs	- " Assessment tools do not adjust to the varied learning styles, abilities, speeds, and needs of students." (R1, 2, 3, 4, and 9)
Inflexibility in Format and Delivery	- " Tools often lack multiple modes of engagement, such as visual, audio, or interactive options. " (R3, 4, and 6)
One-Size-Fits-All Testing	- " Most tests are the same for everyone, even when students learn differently. This uniform approach fails to account for learners who require modifications. " (R2, 4, and 5)
Difficulty of Adapting Assessments for Teachers	-The burden placed on teachers to adjust assessments, such as the difficulty of adapting tests to meet individual student needs, and teachers' lack of flexible tools that can be easily customized."(R7)

Category	Significant Responses
Mismatch Between Assessment Demands and Student Abilities	- " Students may struggle with the specific format required by the tool, such as students with special needs being unable to respond effectively, and the assessments do not adjust to different skill levels or pacing. Hence, assessment formats can become barriers rather than supports for learning measurement." (R8)

Source: Villanueva (2026)

These limitations include a lack of differentiation for diverse learning needs, one-size-fits-all testing structures, inflexibility in format and delivery, difficulty of teacher-led adaptation, and mismatches between assessment demands and student abilities. Collectively, these concerns undermine fairness, validity, and instructional responsiveness. To enhance fairness, inclusivity, and validity, assessment reform efforts must prioritize flexible design principles, differentiated pathways for demonstrating learning, and institutional support mechanisms that empower teachers to adapt tools effectively.

Problem 4: What can be developed to assess the numerical skills of learners with ASD?

Interactive Mathematics Assessment Tool for Learners with ASD

The developed interactive mathematics assessment tool targets learners with Autism Spectrum Disorder. It is aligned with the K to 12 Transition Curriculum for Learners with Disabilities and DepEd Order No. 44, s. 2021. It provides accessible, learner-friendly resources for inclusive classrooms. The IMAT was developed using Microsoft PowerPoint, a widely accessible and user-friendly platform. This choice underscores the study's commitment to practicality and scalability, particularly in resource-limited settings. PowerPoint enables structured navigation, interactive features (e.g., hyperlinks and clickable responses), and immediate feedback, all of which are essential components of effective digital learning tools for learners with ASD. Furthermore, the tool's functionality ensures its usability in geographically isolated areas, enhancing its applicability across diverse educational contexts. It comprises 6 PowerPoint presentations covering the competencies of fractions: recognize and identify $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ of a whole object, represent a whole into $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, describe a whole and a $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ of a whole, read and write fractions, compare fractions using relation symbols, and arrange fractions in increasing and decreasing order. These assessment tools are easy to access and distribute, as they can be shared via USB drives, Bluetooth, Google Drive, or QR Codes.

Problem 5: How valid is the interactive assessment tool for the numerical skills of learners with ASD?

5.1 Content Quality

5.2 Instructional effectiveness; and

5.3 Technical quality.

Table 7. Panel of experts' evaluation of the validity of the Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder, along with content quality.

Indicator	Mean	DI
1. Content is consistent with topics/skills found in the DepEd Learning Competencies for the subject and grade/year level it was intended for.	5.00	VHV
2. Concepts developed contribute to enrichment, reinforcement, or mastery of the identified learning objectives.	4.80	VHV
3. Content is accurate.	5.00	VHV
4. Content is up-to-date.	5.00	VHV
5. Content is logically developed and organized.	4.80	VHV
6. Content is free from cultural, gender, racial, or ethnic bias.	5.00	VHV
7. Content stimulates and promotes critical thinking.	4.60	VHV
8. Content is relevant to real-life situations.	4.80	VHV
9. Language (including vocabulary) is appropriate to the target user level.	4.60	VHV
10. Content promotes positive values that support formative growth.	4.20	HV
Composite Mean	4.78	VHV

Source: DepEd Validation for Non-Print Materials

The composite mean of 4.78, interpreted as Very Highly Valid (VHV), indicates that the content quality is excellent and meets very high standards of validity. This suggests that the material is highly appropriate, reliable, and effective for its intended educational purpose.

Table 8. Panel of experts' evaluation of the validity of the Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder and its instructional quality.

Indicator	Mean	DI
1. The purpose of the material is well defined.	4.40	HV
2. Material achieves its defined purpose.	4.40	HV
3. Learning objectives are clearly stated and measurable.	5.00	VHV
4. Level of difficulty is appropriate for the intended target user.	4.60	VHV
5. Graphics/colors/sounds are used for appropriate instructional reasons.	4.80	VHV
6. Material is enjoyable, stimulating, challenging, and engaging.	4.60	VHV
7. Material effectively stimulates the creativity of the target user.	4.80	VHV
8. Feedback on the target user's responses is effectively employed.	4.60	VHV
9. The target user can control the rate and sequence of presentation and review.	4.60	VHV
10. Instruction is integrated with the target user's previous experience.	4.80	VHV
Composite Mean	4.66	VHV

Source: DepEd Validation for Non-Print Materials

The findings from the panel of experts indicate strong support for the Interactive Mathematics Assessment Tool (IMAT), demonstrating that it upholds high standards of instructional design and aligns

with evidence-based practices that foster meaningful and effective learning experiences for learners with ASD. The composite mean of 4.66 for instructional quality falls within the 4.51–5.00 range, corresponding to Very Highly Valid (VHV). This indicates that the instructional component of the material is excellent and strongly meets expected standards. Overall, the instructional quality demonstrates strong pedagogical effectiveness, with nearly all aspects exceeding high validity standards.

Table 9. Panel of experts' evaluation on the validity of the Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder, along with technical quality.

Indicator	Mean	DI
1. Music and sound effects are appropriate and effective for instructional purposes.	4.60	VHV
2. Screen displays (text) are uncluttered, easy to read, and aesthetically pleasing.	4.80	VHV
3. Visual presentations (non-text) are clear and easy to interpret.	4.80	VHV
4. Visuals sustain interest and do not distract the user's attention.	4.80	VHV
5. Visuals provide an accurate representation of the concept discussed.	4.60	VHV
6. The user support materials (if any) are effective.	4.60	VHV
7. The design allows the target user to navigate freely through the material.	4.80	VHV
8. The material can easily and independently be used.	4.80	VHV
Composite Mean	4.73	VHV

Source: DepEd Validation for Non-Print Materials

The results of the expert evaluation demonstrate an exceptionally high level of validity across all technical indicators. The material's technical aspects are exceptionally well designed and effective, as evidenced by a composite mean of 4.73, which falls within the Very Highly Valid (VHV) range.

Problem 6: What is the level of acceptability of the interactive mathematics assessment tool for the numerical skills of learners with autism spectrum disorder in terms of:

- 6.1 clarity;
- 6.2 usefulness;
- 6.3 language and style;
- 6.4 presentation and layout; and
- 6.5 suitability?

Table 11. Teachers' evaluation of the acceptability of the Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder, along with its clarity.

Indicator	Mean	DI
1. The instructions provided in the interactive mathematics assessment tool are easy to understand.	5.00	VHA
2. The language used in the materials is appropriate for the learners' comprehension levels.	4.80	VHA

3. The objectives of each assessment tool are clearly stated.	5.00	VHA
4. The steps to complete each activity are straightforward and unambiguous.	4.80	VHA
5. The feedback given to learners during the activities and assessment is clear and helpful.	4.60	VHA
6. The goals of the interactive mathematics assessment tool tasks are explicitly explained.	4.80	VHA
7. The assessment tool provides clear examples to illustrate key numeracy concepts.	5.00	VHA
Composite Mean	4.86	VHA

Source: Paguirigan (2023)

The data reveal that, in terms of clarity, the material obtained a composite mean of 4.86, interpreted as *Very Highly Acceptable*. This shows that the respondents found the instructions, objectives, steps, feedback, and examples in the interactive mathematics assessment tool clear and easy to understand.

Table 12. Teachers' evaluation of the acceptability of the Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder, along with its usefulness.

Indicator	Mean	DI
1. The interactive mathematics assessment tool effectively enhances numeracy skills in learners with autism spectrum disorder.	5.00	VHA
2. The activities are relevant to the learners' daily lives and practical applications.	4.80	VHA
3. The assessment tool helps learners to understand fractions better.	4.80	VHA
4. The interactive mathematics assessment tool approach keeps learners engaged and motivated.	5.00	VHA
5. Teachers find the materials helpful as supplementary teaching tools.	4.80	VHA
6. The activities encourage problem-solving and critical thinking skills.	5.00	VHA
7. The assessment tool addresses various learning styles and needs of learners with autism spectrum disorder.	4.80	VHA
Composite Mean	4.89	VHA

Source: Paguirigan (2023)

The findings show that the evaluators gave uniformly high scores, ranging from 4.80 to 5.00, yielding an overall mean of 4.89. This is rated *Very Highly Acceptable* based on all relevant criteria. This implies that the respondents considered the material highly beneficial in improving the numeracy skills of learners with autism spectrum disorder.

Table 13. Teachers' evaluation of the acceptability of the Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder, along with its language and style.

Indicator	Mean	DI
1. The presentation is clear, observing correct grammar.	4.60	VHA

2. The language is clear and comprehensive in terms of vocabulary	4.80	VHA
3. There is sufficient familiar vocabulary to ensure learning.	5.00	VHA
4. The structure, style, and format are appropriate to the target level.	5.00	VHA
Composite Mean	4.85	VHA

Source: Paguirigan (2023)

It shows that the assessment tool obtained a composite mean of 4.85, interpreted as *Very Highly Acceptable*. This reveals that the respondents found the language, vocabulary, structure, style, and format of the material appropriate for the target learners.

Table 14. Teachers' evaluation of the level of acceptability of the Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder, along with presentation and layout.

Indicator	Mean	DI
1. The presentations used in the assessment tool are visually appealing and engaging.	4.80	VHA
2. The layout of the assessment tool is organized and easy to follow.	5.00	VHA
3. The use of color and design enhances the learning experience.	5.00	VHA
4. The visuals support the understanding of the numeracy concepts.	4.80	VHA
5. The font size and style are appropriate for learners with autism spectrum disorder.	5.00	VHA
6. The presentations accurately represent the mathematical concepts being taught.	5.00	VHA
7. The overall design of the materials facilitates easy navigation for both teachers and learners.	5.00	VHA
Composite Mean	4.94	VHA

Source: Paguirigan (2023)

In the area of presentation and layout, the material garnered the highest composite mean of 4.94, with a descriptive interpretation of *Very Highly Acceptable*. This indicates that the evaluators were particularly satisfied with the visual and organizational features of the interactive mathematics assessment tool.

Table 15. Teachers' evaluation of the acceptability and suitability of the Interactive Mathematics Assessment Tool for Learners with Autism Spectrum Disorder.

Indicator	Mean	DI
1. The interactive mathematics assessment tool is appropriate for the age and developmental level of the learners.	4.80	VHA

2. The content of the assessment tool aligns with learners' educational goals and needs.	4.80	VHA
3. The activities are adaptable to different learning styles paces and abilities.	4.60	VHA
4. The assessment tool is culturally relevant and inclusive.	4.80	VHA
5. The interactive mathematics assessment tool approach suits the learners' interests and preferences.	4.80	VHA
6. The assessment tool has been positively received by learners during classroom activities.	4.80	VHA
7. The interactive mathematics assessment tool meets the educational standards for special needs education numeracy programs.	4.80	VHA
Composite Mean	4.77	VHA

Source: Paguirigan (2023)

The evaluators' ratings yielded mean scores ranging from 4.60 to 4.80, with an overall composite mean of 4.77, indicating a descriptive rating of *Very Highly Acceptable*. The results show that the interactive mathematics assessment tool is appropriate for the age and developmental level of learners, aligned with educational goals and needs, adaptable to different learning paces and abilities, suited to learners' interests and preferences, positively received during classroom activities, and consistent with educational standards for special needs education numeracy programs.

Results and discussion

The IMAT is a curriculum-aligned assessment innovation anchored in the Functional Mathematics domain, emphasizing real-life numeracy skills such as fractions, money recognition, time, measurement, and basic operations. This alignment ensures that the tool measures competencies that are meaningful and transferable to daily living contexts, consistent with the principles of functional curriculum design highlighted in international literature (Root et al., 2017). By focusing on applied mathematics, the IMAT addresses the gap between academic instruction and the acquisition of practical skills among learners with ASD.

Teachers appear to prioritize tools that promote engagement, accommodate diverse learning profiles, and provide authentic evidence of understanding, aligning with contemporary inclusive education frameworks (Fletcher & Doabler, 2017; Rivera & Tharp, 2019). When assessments prioritize efficiency over clarity and authenticity, they risk measuring test-taking skills rather than genuine learning. This finding is consistent with research on inclusive education, which underscores the limitations of one-size-fits-all assessments and calls for flexible, accessible, and differentiated evaluation approaches (Florian & Black-Hawkins, 2019; Rose et al., 2022). Empirical evidence indicates that anxiety can impair working memory, reduce concentration, and negatively influence performance, thereby distorting assessment outcomes (Putwain et al., 2020; von der Embse et al., 2018). When assessments evoke anxiety rather than curiosity or confidence, learner engagement is significantly compromised.

Inflexibility in assessment format and delivery- the traditional assessment modalities—such as timed written examinations—offer limited opportunities for multimodal expression, performance-based demonstration, or technology-enhanced interaction. Research on assessment innovation underscores the value of flexible and multimodal formats in capturing complex competencies and accommodating diverse learner strengths (Mayer, 2020; Redecker, 2020).

A key strength of the IMAT lies in its evidence-based design process. These insights informed the selection of content, level of task difficulty, visual supports, and interaction design. Such practitioner-informed development enhances the content and ecological validity of the tool, ensuring that it reflects authentic classroom conditions and learner needs. This approach is supported by research emphasizing the importance of teacher involvement in designing instructional and assessment materials for learners with disabilities (Odom et al., 2015).

The IMAT was developed using Microsoft PowerPoint, a widely accessible and user-friendly platform. This choice underscores the study's commitment to practicality and scalability, particularly in resource-limited settings. PowerPoint enables structured navigation, interactive features (e.g., hyperlinks and clickable responses), and immediate feedback, all of which are essential components of effective digital learning tools for learners with ASD. Furthermore, the tool's functionality ensures its usability in geographically isolated areas, enhancing its applicability across diverse educational contexts. With these assessment tools in place, it is expected that learners' performance in mathematics will improve, teachers will be better supported in delivering instruction, and students with special needs will be more fully included in achieving equitable, high-quality education.

This study advances special education by demonstrating how Universal Design for Learning (UDL) and Applied Behavior Analysis (ABA) can be integrated into an interactive mathematics assessment tool that supports the functional mathematics skills of learners with Autism Spectrum Disorder (ASD). It promotes learner-centered, technology-assisted assessment through visual prompts, audio guidance, and interactive activities that can be used by both teachers in schools and parents at home, in alignment with the K to 12 Transition Curriculum. Limitations include the selection of only certain functional mathematics competencies and a reliance primarily on expert validation. Future research should conduct large-scale implementation, investigate the tool's long-term effects, and evaluate its applicability to learners with other disabilities.

Conclusion

The findings revealed varying levels of difficulty across mathematical competencies, with Fractions emerging as the most challenging area for crafting an assessment tool. The results revealed that teachers predominantly rely on traditional, teacher-directed assessment approaches, including paper-and-pencil tests, oral questioning, manipulatives, picture-based worksheets, and teacher-made activity sheets. These assessment methods remain valuable in measuring learners' academic performance; however, they may not fully address the diverse learning characteristics, engagement needs, and communication preferences commonly associated with learners with ASD. These limitations highlight a critical gap in existing assessment practices: the inability to simultaneously ensure measurement accuracy, sustained learner

engagement, and individualized adaptability. This gap provides strong justification for the development of the Interactive Mathematics Assessment Tool (IMAT), which is designed to integrate interactive, responsive, and learner-centered features to support learners with ASD better, as evidenced by the very highly valid and highly acceptable ratings from experts and key teachers, indicating that the materials may be adopted for classroom use.

The study provides validation for Hyper-Systemizing Theory, in which learners with autism spectrum disorder show heightened sensitivity to surroundings that are organized, predictable, repetitive, and structured. According to the *Multimedia Learning Theory*, students have better cognitive processing when there is a meaningful association between words, visuals, sounds, and interactivity in the learning environment. Furthermore, the *Alternative Assessment Theory* suggests that tests must measure understanding rather than mere memorization.

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