

Needs Analysis for Developing an Adaptive Interactive E-Module to Strengthen Junior High School Students' Numeracy Skills for the Mathematics Test of Academic Competence

Soraya Djamilah¹, Istiqamah², Noor Leha³, Muhammad Setiawan⁴

^{1,4}Mathematics Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Banjarmasin, Indonesia

^{2,3}Indonesian Language Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Banjarmasin, Indonesia

*Corresponding author: sorayadjamilah@umbjm.ac.id

Proceedings of the Kalijaga International Conference on Education 2026

Abstract. Numeracy is an essential competency that needs to be strengthened to support junior high school students' readiness for the Mathematics Test of Academic Competence (TKA). This study aimed to analyze teachers' and students' needs as a basis for developing an adaptive interactive e-module to strengthen junior high school students' numeracy skills for the Mathematics TKA. A descriptive quantitative approach was employed, involving five mathematics teachers and 28 junior high school students in South Kalimantan, Indonesia. Data were collected using needs analysis questionnaires and analyzed descriptively using frequencies and percentages. The results showed that all teachers indicated that students' numeracy skills still needed improvement, while 96.4% of students reported needing more numeracy practice. All teachers agreed that digital media could increase student engagement and expressed a need for an interactive e-module supported by multimedia components, while 92.9% of students needed attractive and user-friendly digital numeracy learning materials. The need for adaptive characteristics was also evident, as all teachers and students indicated a need for opportunities to revisit learning materials, varied exercises, and learning at an individual pace. Furthermore, 96.4% of students needed immediate feedback, and all students wanted information about the materials they had and had not yet mastered. The use of Banjar local cultural contexts also received positive responses, particularly the Floating Market (89.3%), Sasirangan fabric (85.7%), and traditional Banjar foods (85.7%). These findings indicate that the e-module to be developed should incorporate three key characteristics: interactivity, adaptivity, and contextuality, as a basis for strengthening students' numeracy skills in preparation for the Mathematics TKA.

Keywords: adaptive learning; interactive e-module; Mathematics; needs analysis; numeracy

Abbreviations: TKA, Tes Kemampuan Akademik (Test of Academic Competence).

INTRODUCTION

Numeracy is a fundamental competency that is important not only in mathematics learning but also in everyday life. It encompasses the ability to understand, apply, and reason with quantitative information in various contexts. At the junior high school level, strengthening numeracy is particularly important because previous studies have shown that students still experience difficulties in mathematical modeling, data interpretation, and reasoning for decision-making [1], [2]. Students may also encounter difficulties in understanding information presented in problems, translating it into mathematical models, reading tables, and analyzing data for prediction and decision-making [1]. These conditions indicate that numeracy should not be taught merely as a set of procedural skills but should be strengthened through contextual and active learning that is relevant to the cognitive development of junior high school students [1], [3].

The urgency of strengthening numeracy becomes increasingly relevant in the context of the Mathematics Test of Academic Competence (TKA). The TKA is an assessment used to measure students' academic achievement objectively and in a standardized manner. In mathematics, the demands of such an assessment are not limited to procedural knowledge but also involve numerical reasoning, logic, and problem-solving skills [4]. In studies of teachers' strategies for TKA preparation, numeracy has been identified as an essential competency that needs to be developed systematically to prepare students for mathematical tasks requiring higher-order thinking and the application of mathematical knowledge in various contexts [5].

Appropriate learning materials are needed to support the development of these competencies. At the junior high school level, needs analyses for interactive e-modules have indicated that students may be ready for more independent learning when supported by appropriate media, although their engagement can still

be hindered by low motivation, unattractive learning media, and learning strategies that are not sufficiently engaging. Interactive e-modules can integrate text, images, graphics, audio, animation, video, learning materials, learning activities, and assessment into a practical digital learning resource. Previous studies have also demonstrated the potential of contextual mathematics e-modules for junior high school students [6]. Meanwhile, adaptive learning offers opportunities to personalize learning experiences by adjusting learning pace and material difficulty according to individual students' needs. Its implementation, however, requires an initial analysis of students' characteristics and needs, appropriate content, technological support, and teacher readiness [7].

In addition to interactive and adaptive characteristics, contexts that are closely related to students' lives should also be considered in the development of numeracy learning materials. Local cultural contexts can provide an alternative means of connecting mathematical concepts with students' experiences, thereby supporting more contextual and meaningful learning. Previous research on the traditional Banjar game Basimban, for example, identified mathematical concepts such as arithmetic operations, ratios, and statistics and demonstrated its potential as a contextual learning medium [8]. Such findings indicate that elements of local culture can provide meaningful contexts for mathematical activities without necessarily becoming the sole context of instruction.

Previous studies have developed interactive e-modules for various purposes, including improving numeracy, problem-solving skills, learning activities, and conceptual understanding [3], [6], [9]. Literature also suggests that numeracy can be strengthened through various learning approaches, particularly when mathematical learning is connected to real-life problems [2]. Nevertheless, existing studies have focused predominantly on product development, effectiveness, or particular learning strategies, while systematic evidence regarding teachers' and students' needs as a basis for developing an adaptive interactive e-module specifically for strengthening junior high school students' numeracy in the context of the Mathematics TKA remains limited [5], [6], [7]. Therefore, a needs analysis is necessary to ensure that subsequent product development is aligned with students' characteristics, teachers' needs, numeracy demands, and the context of the Mathematics TKA. Accordingly, this study aimed to analyze teachers' and students' needs as a basis for developing an adaptive interactive e-module to strengthen junior high school students' numeracy skills for the Mathematics TKA.

METHODS

Research Design

This study employed a descriptive quantitative approach using a survey method. The study was conducted to identify and describe teachers' and students' needs regarding the development of an adaptive interactive e-module to strengthen junior high school students' numeracy skills in preparation for the Mathematics TKA. This study was limited to the needs analysis stage and did not include product development or product testing.

Participants

The participants consisted of five junior high school mathematics teachers and 28 junior high school students from five junior high schools located in five different regencies/cities in South Kalimantan, Indonesia. The schools were purposively selected to represent different geographical areas within the province. One mathematics teacher from each school participated in the study, resulting in a total of five teacher respondents. In each participating school, several students were randomly selected, resulting in a total of 28 student respondents.

Research Instrument and Data Collection

Data were collected using two needs analysis questionnaires administered separately to teachers and students. The teacher questionnaire covered perceptions of students' numeracy skills and difficulties, numeracy learning, the use of educational technology, needs for interactive e-modules and adaptive learning, and the use of local culture and local wisdom as contexts for numeracy learning. The student questionnaire covered perceptions of numeracy skills, numeracy learning, the use of educational technology, needs for interactive e-modules and adaptive learning, and preferences regarding the use of local culture and local wisdom in numeracy learning.

The questionnaire items used a four-point Likert scale consisting of Strongly Agree, Agree, Disagree, and Strongly Disagree. The questionnaires were administered to the respective groups to obtain information about their needs and preferences as a basis for identifying the characteristics of the e-module to be developed.

Data Analysis

The data were analyzed descriptively using frequencies and percentages for each questionnaire item. The percentage of positive responses was calculated by combining the Agree and Strongly Agree responses and dividing the total by the number of respondents in each group. These percentages were used to identify patterns in teachers' and students' needs related to numeracy strengthening, interactive digital learning materials, adaptive learning features, and local cultural contexts. The results were subsequently used to formulate the key characteristics to be considered in the development of the adaptive interactive e-module.

RESULTS AND DISCUSSION

Result

Numeracy Learning Needs

The needs analysis showed that strengthening students' numeracy skills remained necessary from the teachers' perspective. All participating teachers (100%) indicated that students' numeracy skills still needed improvement. All teachers also reported that students experienced difficulties with numbers and calculations, contextual numeracy problems, the application of mathematical concepts in everyday life, and mathematical reasoning. Meanwhile, 80% of the teachers indicated that students experienced difficulties in reading and understanding information presented in tables, graphs, and diagrams. In addition, all teachers (100%) identified differences in numeracy ability among students within the same classroom and indicated that preparation for the TKA required continuous strengthening of numeracy skills.

The students provided a somewhat different perspective. Most students rated their own numeracy abilities positively. A total of 96.4% reported being able to solve problems involving numbers and calculations, 89.3% reported being able to understand word problems requiring mathematical calculations, and 92.9% reported being able to read and understand data presented in tables, diagrams, or graphs. Nevertheless, 96.4% of the students indicated that they still needed more practice to improve their numeracy skills. The key findings from the teacher and student questionnaires regarding numeracy learning needs are summarized in Table 1.

Table 1. Key Findings on Numeracy Learning Needs

Indicator	Teachers (%)	Students (%)
Numeracy skills still need improvement/more practice	100.0	96.4
Difficulty/ability in solving contextual numeracy or word problems	100.0	89.3
Difficulty/ability in reading tables, diagrams, or graphs	80.0	92.9

Note: The teacher and student questionnaire items were phrased differently; therefore, the percentages represent the perspectives of each respondent group and are not intended as direct comparisons.

Needs for Interactive and Adaptive Digital Learning Materials

The results demonstrated a strong need for interactive digital learning materials. All teachers (100%) agreed that digital media could increase student engagement in numeracy learning. All teachers also expressed a need for an interactive e-module incorporating videos, illustrations, worked examples, exercises, and discussions. From the students' perspective, 92.9% indicated a need for attractive and user-friendly digital numeracy learning materials, while all students (100%) preferred learning materials containing summaries, worked examples, images, explanatory videos, and practice exercises.

A similarly consistent need was identified for adaptive characteristics. All teachers (100%) expressed a need for an e-module that would allow students to revisit materials they had not yet understood, provide varied exercises, and enable students to learn at their own pace. Similar findings emerged among students. All students (100%) indicated a need for opportunities to revisit materials they had not yet mastered, varied numeracy exercises, and learning materials that could be used according to their individual learning pace. The main findings regarding teachers' and students' needs for interactive and adaptive e-module features are presented in Table 2.

Table 2. Needs for Interactive and Adaptive E-Module Features

Feature	Teachers (%)	Students (%)
Attractive and interactive digital learning materials	100.0	92.9
Learning materials supported by multimedia components	100.0	100.0
Opportunities to revisit unmastered materials	100.0	100.0
Varied numeracy exercises	100.0	100.0
Learning according to individual learning pace	100.0	100.0

Note: The teacher and student questionnaire items were phrased according to their respective perspectives. Multimedia components included videos, illustrations/images, worked examples, exercises, and related learning components.

Furthermore, 96.4% of students indicated a need for immediate feedback after completing exercises, and all students (100%) wanted information about the materials they had and had not yet mastered. These findings further strengthen the need for adaptive features that not only allow students to learn at their own pace but also provide information about their learning progress and level of mastery.

Needs for Local-Culture-Based Numeracy Contexts

In addition to interactive and adaptive characteristics, the results showed support for incorporating Banjar culture and local wisdom as contexts for numeracy learning. All teachers (100%) indicated that integrating Banjar culture could increase students' interest in learning numeracy. All teachers also considered buying and selling activities at the Floating Market and traditional Banjar foods relevant contexts for numeracy learning.

Support for the use of local culture was also evident among students, although the percentages of positive responses were more varied. A total of 82.1% of students wanted numeracy materials that incorporated Banjar culture and local wisdom, while 75.0% indicated that the use of Banjar culture could make numeracy learning more interesting. In addition, 75.0% reported that they found it easier to understand numeracy word problems related to everyday life and Banjar culture. When more specific cultural contexts were presented, 89.3% of students expressed interest in learning numeracy through buying and selling activities at the Floating Market, 85.7% through the context of Sasirangan fabric, and 85.7% through traditional Banjar foods. Students' responses regarding the incorporation of Banjar cultural contexts into numeracy learning are summarized in Table 3.

Table 3. Students' Responses to the Use of Banjar Cultural Contexts in Numeracy Learning

Indicator	Positive Responses (%)
Easier to understand word problems related to everyday life and Banjar culture	75.0
Want numeracy materials incorporating Banjar culture and local wisdom	82.1
Banjar culture makes numeracy learning more interesting	75.0
Interested in learning numeracy through the context of Sasirangan fabric	85.7
Interested in learning numeracy through buying and selling activities at the Floating Market	89.3
Interested in learning numeracy through the context of traditional Banjar foods	85.7

Discussion

The findings demonstrate that strengthening numeracy remains an important learning need, although teachers and students viewed students' current numeracy abilities from somewhat different perspectives. Teachers consistently identified difficulties in several aspects of numeracy and reported differences in numeracy ability among students within the same classroom. In contrast, most students perceived themselves as capable of dealing with numbers, word problems, and data representations. Nevertheless, 96.4% of students still reported needing more numeracy practice. This apparent difference should be interpreted carefully because the present study measured perceptions rather than students' actual performance through a numeracy achievement test. Thus, the findings do not provide evidence of objectively low numeracy achievement but indicate a perceived need for continued numeracy strengthening from both teacher and student perspectives. This finding is consistent with the conceptualization of numeracy as extending beyond computational skills to include the application of mathematical concepts in various contexts, interpretation of information, and reasoning in problem-solving [1], [2], [10], [11].

The strong demand for interactive digital learning materials further indicates that the proposed e-module should provide more than a digital presentation of conventional materials [12], [13], [14]. Teachers emphasized the potential of digital media to increase student engagement, while students expressed a strong preference for attractive and user-friendly materials supported by summaries, examples, images, videos, and exercises. Previous studies have similarly demonstrated the potential of interactive e-modules to support mathematics learning by integrating various forms of digital content and learning activities [3], [6], [9]. Accordingly, interactivity should be considered a central characteristic of the proposed e-module rather than merely an additional technological feature.

The results also provide a strong basis for incorporating adaptive characteristics into the proposed e-module. Both teachers and students expressed consistent needs for opportunities to revisit materials, access varied exercises, and learn according to individual learning pace [15], [16], [17]. Students additionally

expected immediate feedback and information about the materials they had and had not yet mastered. These needs are particularly relevant considering that all participating teachers reported differences in numeracy ability among students within the same classroom. Adaptive learning is intended to accommodate individual differences by adjusting learning experiences, including learning pace and the level of material difficulty, according to students' needs and progress [7]. Therefore, adaptive features in the proposed e-module could be designed to provide differentiated learning pathways, opportunities for repeated learning, varied exercises, and feedback based on students' learning progress.

Another important finding concerns the potential use of local cultural contexts in numeracy learning. Both teachers and students generally responded positively to the incorporation of Banjar culture and local wisdom. This finding is consistent with previous research on the traditional Banjar game Basimban, which identified mathematical concepts such as arithmetic operations, comparison, and statistics and demonstrated its potential as a contextual and meaningful medium for mathematics learning [8]. The present findings extend this contextual perspective by identifying cultural contexts that students themselves considered appealing for numeracy learning [18], [19], [20], particularly the Floating Market, Sasirangan fabric, and traditional Banjar foods.

Interestingly, students' positive responses to Banjar culture in general ranged from 75.0% to 82.1%, whereas their interest in explicitly identified cultural contexts ranged from 85.7% to 89.3%. This pattern indicates that specific and familiar cultural contexts may be more appealing to students than local culture presented in general terms. However, these percentages should not be interpreted as evidence that such contexts are more effective for improving numeracy because this study examined perceived needs and preferences rather than the effects of cultural contexts on learning outcomes. Local culture should therefore be incorporated selectively alongside other real-life contexts rather than serving as the sole context of the e-module. Such an approach can maintain contextual relevance while exposing students to the variety of situations required for numeracy practice and preparation for the Mathematics TKA.

Overall, the findings identify interactivity, adaptivity, and contextuality as three key characteristics that should guide the subsequent development of the e-module. Interactivity is reflected in the need for multimedia-supported materials and learning activities; adaptivity is reflected in the need for repetition, varied exercises, individual learning pace, feedback, and information about mastery; and contextuality is reflected in the need for problems related to students' everyday experiences, including relevant elements of Banjar culture. These characteristics provide an empirical basis for developing an e-module that does not merely digitize learning materials but offers a learning experience that responds to students' different abilities and learning progress while maintaining relevance to meaningful real-life contexts.

CONCLUSION

This study indicates a need to develop an adaptive interactive e-module to support the strengthening of junior high school students' numeracy skills in preparation for the Mathematics TKA. From the teachers' perspective, students' numeracy skills still require strengthening, particularly in contextual problem-solving and mathematical reasoning, while differences in numeracy abilities among students also need to be accommodated in learning. Meanwhile, although most students positively perceived their own numeracy abilities, nearly all still indicated a need for additional practice to strengthen these skills.

The needs analysis further indicates that the e-module to be developed should incorporate three main characteristics: interactivity, adaptivity, and contextuality. Interactivity can be facilitated through engaging learning materials supported by multimedia components and exercises. Adaptivity is needed to enable students to revisit materials, access varied exercises, learn at their own pace, and receive feedback and information about their level of mastery. Contextuality can be incorporated through problems related to students' everyday lives, including Banjar culture and local wisdom. Students' interest in the Floating Market, Sasirangan fabric, and traditional Banjar foods demonstrates the potential of these contexts for selective integration into numeracy activities.

Therefore, the findings of this study provide an empirical basis for the subsequent development of an adaptive interactive e-module to strengthen junior high school students' numeracy skills for the Mathematics TKA. Future research can proceed to the development and evaluation of an e-module based on the needs and characteristics identified in this study.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the Ministry of Higher Education, Science, and Technology of the Republic of Indonesia for the financial support provided through the 2026 Regular Fundamental Research Program. The authors also thank the mathematics teachers and junior high school students who participated in this study.

REFERENCES

- [1] L. Darmastuti, M. Meiliasari, and W. Rahayu, "Kemampuan Literasi Numerasi: Materi, Kondisi Siswa, dan Pendekatan Pembelajarannya," *JURNAL RISET PEMBELAJARAN MATEMATIKA SEKOLAH*, vol. 8, no. 1, pp. 17–26, Apr. 2024, doi: 10.21009/jrpms.081.03.
- [2] N. A. Nurcahyono, "Peningkatan Kemampuan Literasi Numerasi Melalui Model Pembelajaran," *JIPM: Jurnal Ilmu dan Pendidikan Matematika*, vol. 1, no. 1, pp. 19–29, Apr. 2023, doi: 10.33830/hexagon.v1i1.4924.
- [3] I. Kurniawati, S. M. Ekasari, and H. E. Chrisnawati, "Pengembangan E-Modul Matematika Interaktif dengan Canva dan Flipping Book: Meningkatkan Aktivitas Belajar Siswa Materi Geometri," *SJME (Supremum Journal of Mathematics Education)*, vol. 9, no. 1, pp. 149–163, Jan. 2025, doi: 10.35706/sjme.v9i1.184.
- [4] A. Sukamto, B. Bahrani, and N. Nurvayanti, "Tes Kemampuan Akademik (TKA) sebagai Inovasi Evaluasi Pendidikan: Sebuah Tinjauan Naratif," *Journal of Instructional and Development Researches*, vol. 6, no. 1, pp. 54–69, Feb. 2026, doi: 10.53621/jider.v6i1.695.
- [5] A. Ardani, C. A. Putri, N. I. Sholihah, and U. K. Inayah, "STRATEGI GURU DALAM MENINGKATKAN LITERASI NUMERASI SISWA SEBAGAI UPAYA MEMPERSIAPKAN TES KEMAMPUAN AKADEMIK (TKA)," *Pendas: Jurnal Ilmiah Pendidikan Dasar*, vol. 11, no. 03, pp. 331–340, Sep. 2026.
- [6] Silva Yuliana Safitri, Supriyono, and E. P. Astuti, "E-Modul Matematika Berbasis Kontekstual untuk Mengembangkan Kemampuan Numerasi Siswa SMP," *Gammath : Jurnal Ilmiah Program Studi Pendidikan Matematika*, vol. 8, no. 1, pp. 47–54, Jul. 2023, doi: 10.32528/gammath.v8i1.275.
- [7] Rakha Aditya Putra, Wildan Satio Siregar, and Gusmaneli Gusmaneli, "Model Pembelajaran Adaptif: Untuk Meningkatkan Efektifitas Pembelajaran di Era Digital," *ALFIHRIS : Jurnal Inspirasi Pendidikan*, vol. 2, no. 3, pp. 01–09, May 2024, doi: 10.59246/alfihris.v2i3.832.
- [8] S. Djamilah, N. Leha, and Muazizah, "Ethnomathematical Exploration of the Traditional Banjar Basimban Game as a Learning Medium for Mathematics Instruction in Elementary Schools," *Buletin Literasi Budaya Sekolah*, vol. 8, no. 1, pp. 34–41, Jul. 2026, doi: 10.23917/blbs.v8i1.16920.
- [9] P. A. Ningrum and A. Rohim, "Pengembangan E-Modul Interaktif Berbasis Canva Dengan Pendekatan PMRI Untuk Meningkatkan Kemampuan Pemecahan Masalah Siswa," *WAHANA PEDAGOGIKA: Jurnal Ilmiah Pendidikan dan Pembelajaran*, vol. 5, no. 02, pp. 41–50, Dec. 2023, doi: 10.52166/wp.v5i02.5629.
- [10] T. Gula and M. Lovric, "Numeracy Tasks: Inspiring Transfer Between Concrete and Abstract Thinking Spaces," *Numeracy*, vol. 17, no. 1, Jan. 2024, doi: 10.5038/1936-4660.17.1.1447.
- [11] V. F. Reyna and C. J. Brainerd, "Numeracy, gist, literal thinking and the value of nothing in decision making," *Nature Reviews Psychology*, vol. 2, no. 7, pp. 421–439, May 2023, doi: 10.1038/s44159-023-00188-7.
- [12] A. Holisoh, N. Nurhalimah, and N. Hamda, "Analysis of the benefits of using e-modules as distance learning media: can it help students improve cognitive and affective aspects of students?," *Gema Wiralodra*, vol. 14, no. 2, pp. 592–597, Jul. 2023, doi: 10.31943/gw.v14i2.313.
- [13] R. Alyusfitri, N. Gistituati, and A. Fauzan, "The Effectiveness and Relationship of Student Responses toward Learning Outcomes Using Interactive Multimedia-Based E-Modules in Elementary Schools," *International Electronic Journal of Elementary Education*, Sep. 2024, doi: 10.26822/iejee.2024.354.
- [14] N. IfanSyah and C. A. Haris, "Interactive E-Module for Learning Algorithms and Programming in Informatics Education," *Jurnal Minfo Polgan*, vol. 15, no. 2, pp. 2185–2194, Jul. 2026, doi: 10.33395/jmp.v15i2.16265.
- [15] M. Habibi, Sunardi, and Sudiyanto, "Need analysis of e-module development as a 21st-century learning innovation for vocational high school students," 2024, p. 040003. doi: 10.1063/5.0214725.
- [16] M. Irwansyah, I. Sujadi, and I. Slamet, "Need Analysis of Mathematics E-module for Student and Teachers During Covid-19 Pandemic," 2021. doi: 10.2991/assehr.k.211122.023.
- [17] M. Sholeha, "Needs Analysis of the Development of Self-Directed Learning E-Module for the Scientific Writing Course," *Educational Journal of Learning Technology*, vol. 3, no. 2, pp. 167–181, Jan. 2026, doi: 10.58230/edutech.v3i2.83.
- [18] Norhaliza, R. Nurmeidina, and S. Djamilah, "PENGEMBANGAN LEMBAR KERJA PESERTA DIDIK BERBASIS ETNOMATEMATIKA BANJAR MATERI SEGIEMPAT DAN SEGITIGA," *Hipotenusa Journal of Research Mathematics Education*, vol. 5, no. 2, pp. 2–105, 2022.
- [19] Y. Ita, R. Nurmeidina, and S. Djamilah, "Development of learning comic with Banjar culture on two variable linear equations system," *Hipotenusa Journal of Research Mathematics Education (HJRME)*, vol. 9, no. 2, 2026, doi: 10.36269/hjrme.v9i2.5537.
- [20] S. Aminah, S. Djamilah, and A. Lazwardi, "ANALISIS KEMAMPUAN BERPIKIR KREATIF SISWA DALAM MENYELESAIKAN SOAL BERBASIS PERMAINAN TRADISIONAL BANJAR PADA MATERI PELUANG DITINJAU DARI GENDER," in *Prosiding Nasional 2023 Universitas Abdurachman Saleh Situbundo*, 2023.