TPM Vol. 32, No. R2, 2025
ISSN: 1972-6325
https://www.tpmap.org/

NUMERACY LITERACY REVIEWED FROM MATHEMATICAL REASONING IN CHILD-FRIENDLY MATHEMATICS LEARNING

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Abstract
Numeracy literacy encompasses the comprehension of mathematical symbols and numbers for addressing everyday concerns. In 2003, a study by the Programme for International Student Assessment (PISA) indicated that Indonesia placed 36th out of 41 countries in achievement. Moreover, the most recent PISA results from 2009, released in early December 2010, were particularly alarming, as Indonesia ranked 61 out of 65 participating nations, achieving an average score of merely 371. A component of numeracy is reasoning ability. Mathematical reasoning is crucial for understanding and applying mathematics. Child-centric education for primary pupils is essential to facilitate academic success. The objective of the research was to assess students' comprehension of mathematical literacy. Secondly, it attempted to assess the numeracy literacy level of pupils' mathematical thinking via e-modules. The third objective was to assess the feasibility and efficacy of e-modules in facilitating child-friendly mathematics education. Data were acquired by interviews, questionnaires, assessments, and documentation. The analytical methods included data collection, presentation, reduction, and conclusion formulation or engagement. Data validity employed triangulation methods and sources. The obtained data and its interpretation were qualitative, involving exploration, identification, and description. This paper aims to (1) delineate the numeracy literacy levels in child-friendly schools and (2) assess the feasibility and efficacy of e-modules in promoting child-friendly learning to enhance numeracy literacy in elementary schools.
Keywords: Higher education; Teacher Numeracy Literacy, Child-Friendly Learning, Mathematical Reasoning, Inclusive Elementary School.

INTRODUCTION

Elementary school is a pivotal period in children's development; therefore, it is essential for them to cultivate fundamental literacy skills. Basic literacy encompasses the abilities to listen, talk, read, write, and perform arithmetic (Literacy Movement Guide in Elementary Schools by the Ministry of Education and Culture, 2016). Mastering mathematics entails not only comprehending the concepts but also possessing the ability to use them in solving both mathematical and everyday issues. Many students perceive mathematics as a challenging subject due to their relatively low numeracy literacy skills. The PISA research findings in Mathematics corroborated this; in 2018, Indonesia was positioned 72nd out of 78 participating nations (OECD, 2018). Furthermore, Indonesia achieved a mathematics score of 395, against an average score of 500, in the TIMSS study conducted in 2016, with the AKSI results disseminated on the National Study and Learning Centre website (Ramadhani & Fitri, 2020). The outcomes of PISA, TIMSS, and AKSI underscored that the quality of education in Indonesia remains classified as subpar at both national and international standards. The fundamental skills evident from the substandard education in Indonesia were literacy and composition abilities. Students must possess reading and writing skills as essential competencies for addressing mathematical difficulties and their real-life applications. At a specific level, pupils must possess fundamental or minimal skills. In this instance, these competencies encompass reading and writing literacy. This skill aligns with the 21st-century competencies necessitating pupils to adapt to the advancements of a challenging period. By acquiring 21st-century abilities, students will acquire the ability to learn and develop, effectively use technology and information media, and apply these competencies in everyday life

Numeracy literacy encompasses the knowledge and skills required to (a) employ diverse numerical and symbolic representations pertinent to fundamental mathematics for resolving practical issues across various daily contexts, and (b) evaluate information presented in multiple formats (graphs, tables, charts, etc.) to interpret the results and subsequently make predictions and decisions (Han, 2017). Students' mathematical literacy necessitates advanced logical and numerical thinking (Ni'mah et al., 2017); It suggested that in-person explanations remain essential for conveying numeracy abilities (Neitzel et al., 2020). Learning-related behaviour in one class can forecast literacy assessment performance in the subsequent class (Stipek et al., 2010).

Given the importance of mathematical literacy skills, it is essential to cultivate these abilities. In accordance with the competencies outlined by the four pillars of UNESCO, mathematics education should emphasise the cultivation of students' mathematical prowess, encompassing the abilities to investigate, formulate conjectures, reason logically,

tackle non-routine problems, engage in problem-solving, communicate mathematically, and connect mathematical concepts to other intellectual pursuits. To facilitate the aforementioned mathematics learning, a teacher must possess the skills and dedication to enhance students' comprehension profoundly, guide them in identifying relationships or connecting concepts that have been mastered, and establish connections between mathematical concepts and other subjects, as well as their applications in everyday life. The association between mathematical concepts and those in other disciplines, as well as with real-life problems, is referred to as mathematical linkages (Sudiantini & Shinta, 2018). Many students continued to struggle with using their knowledge to address challenges in diverse circumstances. Individuals proficient in applying their expertise to specific issues are not assured of their ability to apply it to dissimilar challenges (Sari, 2015). Students must engage in the problem-solving process across various circumstances and contexts to utilise their skills successfully. One of the talents pupils must possess to resolve a problem is reasoning ability.

Reasoning abilities constitute one of the elements of the standard framework outlined in the Principles and Standards for School Mathematics, alongside problem-solving, representation, communication, and connection skills. Mathematical reasoning is a cognitive process involving deduction. The proficiency in reading among children significantly impacts their mathematical abilities. Nevertheless, individuals rarely comprehend how linguistic processes facilitate problem-solving in logical-mathematical reasoning. Mathematics and reading abilities exhibit a significant correlation. Prior study has indicated that challenges in arithmetic are associated with the acquisition of reading skills. Furthermore, research concerning the abilities of children with learning disabilities revealed a frequent correlation between reading and mathematical difficulties (Hadianto et al., 2021). Mathematical thinking is essential for understanding and applying mathematics. Reasoning skills enable students to address challenges in their lives, both academically and personally. Utilising reasoning to substantiate our thoughts enhances our confidence in mathematics and mathematical reasoning. Mathematical reasoning activities encompass drawing logical conclusions, employing explanations with models, facts, properties, and relationships; estimating answers and solution processes; utilising patterns and relationships; analysing mathematical situations; drawing analogies and generalisations; constructing and testing conjectures; providing counter-examples; adhering to inference rules; verifying the validity of arguments; formulating valid arguments; constructing direct and indirect proofs; and applying mathematical induction (Sumarmo, 2003).

Education is a deliberate and systematic endeavour aimed at fostering an effective and efficient learning environment and process, enabling students, particularly children, to actively cultivate their potential. This development is anticipated to result in the emergence of elevated spiritual and religious strength, intelligence, self-discipline, character, ethical values, and skills beneficial to themselves, society, the nation, and the state. Achieving this educational process necessitates support from all stakeholders. The objective of the Child-Friendly School Policy is to uphold, safeguard, and ensure children's rights while enabling educational institutions to cultivate children's interests, talents, and skills, thereby preparing them for a responsible, tolerant, respectful, and cooperative existence conducive to progress and a spirit of peace. Educational institutions are anticipated to cultivate not only an intellectually astute generation but also one that is emotionally and spiritually enlightened.

As stated by Papalia et al. (2009:534-536), the psychosocial development of children in elementary school include the abilities to internalise emotions of shame and pride, enhance understanding, and manage unpleasant emotions. Children of elementary school age generally allocate less time to their parents. Nonetheless, the relationship with their parents continues to be significant. The significant peer group typically comprises children who share similarities in age, gender, ethnicity, and socioeconomic level, residing in the same neighbourhood or attending the same school (Papalia, Diane, & et.al, 2009).

In a child-centric environment, three fundamental elements of learning are provision, protection, and involvement. Provision refers to the availability of children's essential requirements, including affection, nutrition, health care, education, and recreation. A genuine, affectionate relationship between educators and students can eradicate fear. The dread that develops in children will impede their freedom to express themselves, form opinions, enquire, respond, or interject. Child protection encompasses threats, discrimination, punishment, mistreatment, and other sorts of harassment and unsuitable policies, as provided by the UN Convention on the Rights of the Child, November 1989. Participation constitutes the entitlement to engage, utilised by students to articulate thoughts, pose enquiries, debate, and assume an active position in the classroom and school environment. The principles of freedom of expression, inquiry, and response should be cultivated from a young age, as this is when individual character begins to develop. In a child-centric setting grounded in 3P, the proactive engagement of kids in self-expression, inquiry, response, debate, and even interjecting teachers is emphasised (Abdullah, 2013).

Peer groups facilitate the development of social skills in children, enable them to explore and internalise values independent of parental influence, provide a sense of belonging, and contribute to the formation of self-concept and gender identity. Researchers engage in mathematical thinking through specialisation (focussing on multiple cases or examples), pattern recognition, and belief formation (establishing convictions regarding the truth of propositions), all within the framework of problem-solving in mathematics.

Interview results indicated that students were unaccustomed to active and autonomous learning through modules, relying predominantly on teachers as the sole source of knowledge. The primary reason of this issue was the insufficient facilitation by teachers in the learning process, which failed to guide students towards a mentality capable of applying mathematics to everyday problems; consequently, their mathematical literacy abilities were notably deficient.

Mathematics education has seen transformations in pedagogical methods concurrent with the advancements of the Industrial Revolution 4.0 (Tubb et al., 2020; Widjaja, 2013). This alteration mostly pertains to the utilisation of technology by educators (Karaoglan-Yilmaz et al., 2018). This efficacy arises from the adaptability of electronic-based technology to students' learning surroundings (Nasrudin et al., 2018). Moreover, electronic-based technology can enhance student abilities more effectively than other forms of technology (Higgins et al., 2016). The learning process is excellent, resulting in active student engagement. One method involves the utilisation of instructional resources in education. A learning module exemplifies the creation of educational content. Electronic modules in mathematics education are anticipated to assist students in attaining learning objectives and are intended to facilitate analysis in resolving contextual issues (Hadiyanti et al., 2021).

An e-module refers to a digital guide or resource for learning (Rokhmania & Kustijono, 2017). An electronic module, or e-module, is a technology-driven educational resource that encompasses materials, methodologies, constraints, and assessment techniques, systematically and appealingly constructed to attain the desired competences corresponding to varying levels of complexity in digital format. The content of the e-module is methodically structured according to a designated curriculum and organised into concise learning units, facilitating autonomous study within a specified timeframe (Purwanto & Lasmono, 2007). E-modules possess attributes that enable autonomous user engagement, featuring cohesive content, independence, adaptability, and user-friendliness (Daryanto, 2013). E-modules possess numerous advantages over printed modules; specifically, they offer enhanced interactivity, facilitating navigation for both students and educators, support the integration of images, audio, video, and animations, and include formative assessments that provide instantaneous feedback (Agustin, 2020). Learning can transpire both within and beyond the classroom using e-modules. The e-modules are designed primarily to facilitate self-directed learning for readers (Daryanto, 2013). Consistent with the aforementioned assertion, this e-module was also designed to facilitate individual learning among students.

Applications that can be used to create e-modules include Exelearning (Pilt1 et al., 2007); Kvisoft Flipbook Marker (Sugianto et al., 2017); Pembalik Halaman 3D Profesional (Ferdianto et al., 2019); and Flip PDF Professional. The Flip PDF Professional application stands out among e-module apps for its user-friendliness, making it accessible to novices without proficiency in HTML development. PDF Flip Professional is a comprehensive flipbook creator that includes a page editing capability. This tool enables the creation of interactive book pages by incorporating multimedia elements such as photos, YouTube videos, MP4 files, audio clips, hyperlinks, quizzes, and Flash content.

The researchers aimed to perform this study due to the inadequate level of mathematical literacy, particularly in mathematical reasoning, among elementary school students, as well as the insufficient use of educational media. This research aims to assist students in addressing mathematical literacy challenges through mathematical reasoning, thereby serving as an effective solution for enhancing their mathematical literacy skills.

This research included innovation in the creation of e-modules utilising Flip PDF Professional, aimed at enhancing mathematical literacy via mathematical reasoning. In contrast to earlier e-modules that primarily served as digital learning materials, the e-module created in this research incorporated enhanced interactivity through the presenting of questions grounded in real-life circumstances. The multimedia-supported conceptual comprehension and automatic feedback elements enhance students' reflective processes. The e-module was developed systematically, adhering to instructional design principles grounded in the constructivist learning model, hence facilitating students' comprehension of mathematical topics.

The research urgency stemmed from the inadequate mathematical literacy skills of primary school children, which adversely affected their ability to apply mathematical concepts in everyday situations. Extensive research has indicated that a primary factor contributing to inadequate mathematical literacy is the absence of engaging and interactive learning media, coupled with restricted access to resources that facilitate independent practice for pupils. The implementation of this Flip PDF Professional-based e-module has enhanced students' learning experiences while also fostering their own critical thinking and problem-solving abilities. This research aims to significantly enhance the quality of mathematics education at the elementary level and serve as a reference for the future development of digital learning resources.

METHOD

This study employed a qualitative methodology with a descriptive framework. The research participants consisted of 21 fifth-grade children from Srumbung II Elementary School. The methodologies employed by researchers for data collection encompassed interviews, questionnaires, written assessments, and documentation. Interviews were conducted to assess students' mathematical literacy skills about mathematical reasoning, evaluate the implementation of applied learning, identify encountered hurdles, and propose strategies to address these challenges. Questionnaires were utilised to assess students' mathematical literacy skills, specifically in mathematical reasoning, based on their perspectives. Written assessments were employed to enhance pupils' mathematical literacy skills on mathematical reasoning. Documentation served as supplementary data, comprising RPP, test results, and supporting photographs throughout the research operations.

Researchers employed an interactive model for data analysis, incorporating components such as data gathering, data reduction, data display, and conclusion drawing or verification. Researchers employed the triangulation method to assess the validity of the research data. Triangulation in credibility assessment involved verifying data from multiple

sources and at different times (Sugiyono, 2007:273). The researcher employed triangulation techniques and source triangulation methods in this study.

2.1 Research site, participants, and data collection

This research employed a qualitative approach to investigate, delineate, and elucidate the attainment of numeracy literacy skills concerning mathematical reasoning in primary schools. The initial phases of this research were preliminary and theoretical investigations. Preliminary study was conducted through observation to identify research gaps.

2.2 Data Collection

This research employed interview protocols, surveys, and assessments for data collecting. This written assessment is a type of cognitive evaluation designed to ascertain students' numeracy proficiency. The assessment consisted of descriptive questions necessitating students to structure and articulate their responses in complete sentences. Interviews were held with educators and primary school children involved in the organisation of child-centric educational practices. Interviews served as a framework for researchers to collect data directly from respondents. This data will subsequently augment the research dataset. The indicators of this interview instrument were derived from the study formulation and categorised into two sections: interviews for teachers and questionnaires for students. The questionnaire consisted of statements designed to gather information from 5th-grade student responders.

2.3 Data analysis

The tertiary phase involved the systematic collection of data through assessments, interviews, and questionnaires, followed by the execution of qualitative data analysis. The data gathered were of a qualitative nature; consequently, the analytical methodology employed was qualitative descriptive analysis. The displayed data were subsequently subjected to qualitative interpretation, articulated through linguistic descriptions to derive conclusions. The process of data analysis commenced concurrently with data collection, after which the data were categorized to facilitate conclusion drawing. The conclusions derived from the research were articulated in descriptive formats. The four sequential stages of data analysis encompassed data collection, data reduction, data presentation, and verification or conclusion. The empirical data were directly accrued utilizing assessment techniques, interviews, and observational methods. Data reduction constitutes the procedure of selecting, concentrating on the principal discourse, abstracting, and transforming the information obtained in the field. The data were presented as a compilation of organized information that afforded the opportunity for conclusion drawing and subsequent action. Subsequently, the acquired data were utilized to formulate objective conclusions. The ensuing stage aimed to generate hypotheses and research findings that addressed the articulation of the problem. Hypotheses were derived through the analytical examination of test outcomes, interviews, and questionnaires to investigate students' numeracy literacy within elementary educational settings. The research outcomes sought to achieve were a comprehensive depiction of the implementation of child-centric learning approaches and an analysis of e-module learning media designed to enhance students' numeracy literacy in elementary schools.

2.4 Research Subjects

This study was carried out with a cohort of fifth-grade elementary school pupils. The focal point of the investigation was the assessment of numeracy literacy among students in elementary educational settings characterized by child-centered pedagogical approaches. The duration of the research took place during the even semester of the 2023/2024 academic year. The participants in the study comprised a sample of 21 fifth-grade elementary school students.

In the present study, the rigor of the research instrument's validity emerged as a pivotal element to ascertain that the gathered data authentically encapsulated the students' numeracy literacy competencies. Consequently, prior to the implementation of data collection, the research instruments, which comprised tests, questionnaires, and interview protocols, underwent a validation process conducted by subject matter experts, focusing on both content and linguistic accuracy. The validation process was executed through expert appraisal by distinguished faculty members specializing in mathematics education, as well as experienced elementary school educators proficient in numeracy literacy-oriented pedagogy. The outcomes of the validation were employed to amend the instrument in alignment with the research objectives and the specific characteristics of the student population.

In conjunction with the validity of the instruments, the integrity of the research data was further reinforced through the utilization of methodological and source triangulation. Methodological triangulation was implemented by juxtaposing the outcomes derived from written assessments, questionnaires, and interviews to ensure the coherence of the findings. Simultaneously, source triangulation was conducted by aggregating data from diverse stakeholders, including students, educators, and academic documentation, to acquire a more holistic understanding of the students' numeracy literacy capabilities. This methodological framework is anticipated to enhance the dependability of the research and yield more precise insights regarding the phenomena under investigation.

RESULTS AND DISCUSSION

The empirical findings of the research yielded significant insights that may guide mathematics educators in their endeavors to enhance students' mathematical literacy (Fang & Chapman, 2020). The development of numeracy skills and reading proficiency within the home environment is essential for children to progress at their individual pace (Napoli & Purpura, 2018). The attainment of students' mathematical literacy necessitates elevated degrees of

logical reasoning and numeracy competencies (Ni'mah et al., 2017).

Face-to-face elucidations remain essential when disseminating graphical and quantitative information (Neitzel et al., 2020). In the realm of mathematics education, instructional methodologies are predominantly focused on the learners (Legette & Kurtz-Costes, 2020). The foundational principle of the Child-Friendly School pertains to activities that prioritize the learner's centricity (Nang & Chanseangsee, 2022). The pedagogical approach employed by educators may involve the strategic design of tasks aimed at optimizing the transmission of educational content within the classroom environment (Pomerantz & Condie, 2017). Educator assessments regarding social misconduct and the accuracy of academic performance have been shown to influence the manner in which students are perceived by their peers during collaborative classroom engagements (Wullschleger et al., 2020). Furthermore, the engagement of school personnel, parents, and the broader community is pivotal in the advancement of child-friendly educational institutions (Hajaroh et al., 2020).

The analysis indicated that numeracy literacy within elementary educational institutions is of paramount importance. Numeracy literacy equips elementary school pupils with the essential skills to comprehend numerical concepts and effectively apply mathematical abilities in practical contexts to address real-life challenges. Regrettably, the implementation of numeracy literacy in elementary schools continues to exhibit deficiencies, specifically due to the suboptimal educational media utilized in child-centric educational environments. Findings from additional research underscored that the intrinsic value of numeracy literacy is derived from the introduction of innovative and engaging tasks as opposed to mundane and repetitive activities**.** Teachers who apply this tend to have high expectations of students, and they like to present work that is not only interesting but also cognitively challenging. We interpreted this aspect of teacher thinking as part of a more general motivational factor that could be described as enthusiastic and challenging teaching. Only one other thinking pattern, preference for 'individual study rather than working with others', was helpful in predicting mathematics value-added and second important in predicting reading value added (but not significant enough) (Schmoll et al., 2003). The findings derived from the researcher's prior observations indicated a compelling need for further investigation into the facilitation and implementation of child-centered learning approaches for numeracy and literacy within elementary educational settings.

Numerous scholars have conducted various prior investigations pertaining to e-modules (Sriwahyuni et al., 2019) created electronic instructional resources utilizing the Flip Pdf Professional application specifically for optical materials, which demonstrated that the media received validation results from specialists and practitioners categorized as excellent, with an average presentation score of 79.45%. (Agustin & Pratama, 2020) developed an e-module employing a scientific approach through Flip PDF Professional focused on square and rectangular material at SMP Muhammadiyah 3 Malang. The findings of this research revealed that the module achieved a validation score of 86.67%, thereby classifying it within the very valid criteria.

The findings of Seruni et al.'s (2020) underscored that the implementation of the lipid metabolism e-module through a problem-based learning framework significantly enhanced the critical thinking capabilities of students in chemistry education. The results of the pre-test indicated that a substantial proportion of students fell within the poor critical thinking category (91.7%), whereas only a minority exhibited adequate critical thinking skills (8.3%). A considerable number of students failed to satisfy the established critical thinking criteria, which emphasize an inquiry-based approach that involves questioning, agreement, and the identification of solutions to the posed problems. The outcomes of the post-test revealed a notable improvement in the categorization of students' critical thinking abilities, progressing from a moderate level to an exemplary one. The majority of students successfully satisfied the critical thinking indicators, which include focusing on questions, identifying underlying assumptions, and ascertaining solutions to the identified problems. Additionally, several students demonstrated the capability to propose alternative methods for addressing the issues presented in those questions. Furthermore, students were able to articulate responses supported by scientific rationale in accordance with the principles of lipid chemistry.

Moreover, the investigation conducted by Hadiyanti et al.'s (2021) elucidated that the evaluative outcomes from media experts, material specialists, and pedagogical authorities determined that 74.07% of the electronic modules were categorized as "Excellent," while 25.93% were classified as "Good." In accordance with the feedback obtained from students, an overwhelming 90% of participants expressed strong agreement regarding the efficacy of utilizing electronic modules in enhancing their motivation to engage in mathematical learning. Furthermore, 96.67% of the respondents indicated strong agreement with this assertion. The analysis of student feedback demonstrated that the implementation of electronic modules facilitated the development of digital literacy competencies among students through detailed accounts of both student and educator activities. The utilization of electronic modules fostered a heightened interest in classroom learning, as evidenced by 93.33% (nearly all) and 83.33% (almost all) of students exhibiting a proactive attitude towards participating in learning activities through the electronic modules. Subsequently, a significant majority (63.33%) of participants were characterized as active and enthusiastic learners engaged in the educational process involving electronic modules.

Gistituati & Atikah's (2022) investigation revealed that e-modules could be effectively utilized as online worksheets accessible to students. The findings from the validation assessment conducted by media experts, subject matter specialists, and pedagogical practitioners indicated that 74.07% of e-modules were categorized as "Excellent," while 25.93% were classified as "Good." According to the feedback obtained from students regarding their engagement with e-modules, 90% of participants expressed strong agreement that e-modules could enhance their motivation to learn mathematics, with 96.67% of respondents indicating a strong agreement. The analysis of student feedback demonstrated that the utilization of e-modules facilitated the application of digital literacy skills among students, as

evidenced by the descriptions of both student and teacher activities. Furthermore, the implementation of e-modules fostered a significant interest in classroom learning, with 93.33% (almost all) students exhibiting engagement, and 83.33% (almost all) students were found to be motivated to actively participate in learning activities utilizing e-modules; additionally, a majority (63.33%) of participants displayed active and enthusiastic involvement in the learning process facilitated by e-modules.

Furthermore, Aulia & Prahmana's (2022) study demonstrated that the e-module met great requirements for media quality and content validity. Based on the evaluation of student responses using sound criteria, the e-module was also useful. Lastly, the rise in students' mathematical literacy skills following e-module instruction suggested that the e-module had the potential to enhance students' mathematical literacy abilities. Based on average pre-test and post-test scores, the e-module test results from the field test stage demonstrated a significant difference in students' mathematical literacy skills following e-module use. Additionally, given adequate criteria, pupils' mathematical literacy skills improved by 32%.

74.07% of the e-modules were deemed "Excellent," and 25.93% were deemed "Good," according to the findings of the validation test conducted by media experts, material experts, and practice experts Aulia & Prahmana (2022). Ninety percent of students said they strongly agreed with using e-modules for learning, according to the findings of their responses. E-modules may boost students' motivation to learn arithmetic; 96.67% of respondents said they highly agreed. Students' digital literacy abilities were implemented through the description of student and instructor activities in e-module learning, according to the results of student replies. 93.33% of students expressed greater interest in learning in class while using e-modules (almost all). The majority of student participants (63.33%) were engaged and excited about the learning activities using e-modules, and 83.33% (almost all) of students were not lethargic in following them.

QUANTITATIVE RESULTS

One of the government's and the education government's worries was the poor PISA scores of the kids. According to studies, kids were still having trouble answering mathematical literacy problems. According to the findings of observations and interviews conducted with SDN Srumbung 2's class V teachers, students' ability to reason their way through mathematics issues remained weak. Test results for grade V pupils at SDN Srumbung 2 demonstrated this, with 19.04% of students receiving scores that met sufficient and fewer criteria. The others, however, were given scores that were higher than adequate.

Table 1. Numeracy Literacy Test Results

Classification	Pre-test	Post-test	Pre-test Percentage	Post-test Percentage
Excellent	3	12	14,3	57,1
Good	14	9	66,7	42,9
Sufficient	3	-	14,3	-
Less	1	-	4,7	-
Poor	-	-	-	-
Total	21	21	100	100

Based on the data presented in the preceding table, the pre-test outcomes prior to the implementation of the e-module indicated that the mathematical reasoning dimension achieved a percentage of 14.3%, categorizing it within an excellent classification. A percentage of 66.7% was recorded within the good classification. Furthermore, a percentage of 14.3% was noted in the sufficient classification. In the less category, the percentage was recorded at 4.7%. For each individual student, fluctuations in percentage were observed, encompassing both increases and decreases across a total of 10 questions. Following the post-test administered subsequent to the utilization of the e-module, the mathematical reasoning aspect attained a percentage of 57.1%, thereby being classified as excellent. In the good category, a percentage of 42.9% was recorded. Similar to the pre-test, variations in percentage were observed for each student, reflecting both increases and decreases across a total of ten questions. Consequently, it can be inferred that a significant disparity existed between the pre-test and post-test results, indicating that the e-module effectively enhanced students' mathematical reasoning competencies.

The efficacy of the Mathematics E-Module is evidenced by the outcomes derived from the Paired Sample T-test. Prior to executing the Paired Sample T-test, it is imperative that the data under consideration exhibit a normal distribution; hence, an initial prerequisite assessment (normality test) is essential. The results of the pre-test normality assessment, as determined by the Kolmogorov-Smirnov Test, yielded a significance value of 0.200, while the Shapiro-Wilk Test produced a significance value of 0.176, as both significance values from the Kolmogorov-Smirnov and Shapiro-Wilk Tests exceeded the threshold of 0.05. Therefore, it can be concluded that the pre-test results conformed to a normal distribution, given that the significance value surpassed 0.05. Subsequently, the researcher proceeded to conduct a Paired Sample T-test, the significance value of which determined the outcomes of the analysis. The significance value (2-tailed) was recorded at 0.000 ($p < 0.05$), indicating that the pre-test and post-test results underwent significant (meaningful) alterations. Based on the descriptive statistics for both the pre-test and post-test, it was substantiated that the post-test exhibited a superior average. Hence, it can be concluded that

the Mathematics E-Module serves as an effective resource for instructional purposes, as evidenced by the enhancement in student performance prior to and following the engagement with the Mathematics E-Module.

The questionnaire instrument was employed to gather data concerning the practicality of e-modules as pedagogical tools for fifth-grade elementary school pupils, thereby promoting a child-centric educational approach. Prior to their application in research, the developed learning media must undergo a rigorous validation process. The viability of such media can be ascertained through an evaluation of both the material quality and the media characteristics of the product under development. The validation process was conducted by two specialists, namely, material experts and media specialists, who assessed the outcomes. According to the evaluation conducted by material experts on the Mathematics E-Module in its entirety, a percentage score of 78% was achieved, which falls within the percentage range of 75% - 84%. Additionally, a B grade was awarded, categorizing the material as Good. Consequently, the Mathematics E-Module teaching material, in relation to its material attributes, demonstrated commendable quality standards and was deemed appropriate for educational use following revisions. The assessment provided by media experts yielded an overall percentage score of 82%, which also corresponded to the Good category. Thus, it can be inferred that the Mathematics E-Module teaching material was deemed feasible and satisfied the criteria for good quality.

Based on the findings from observations and interviews, certain students exhibited mathematical literacy competencies in the domain of mathematical reasoning, categorizing them within the good range. When addressing numeracy challenges, students demonstrated the ability to articulate mathematical statements in written form, execute mathematical manipulations, albeit with occasional inaccuracies in numerical operations, and draw conclusions, despite some inaccuracies in their written conclusions. Upon conducting interviews, several students expressed that they did not encounter significant challenges in comprehending the material presented by the educator or in resolving the associated problems. In tackling numeracy issues, a number of students successfully articulated mathematical statements in writing. However, for specific problems, certain students were unable to formulate mathematical statements. While some students accurately performed mathematical manipulations and reached conclusions, albeit incorrect, others demonstrated mathematical literacy skills in the domain of mathematical reasoning categorized as sufficient.

In addressing numeracy challenges, these students were capable of articulating mathematical assertions in written form; they demonstrated proficiency in executing mathematical operations and deriving conclusions consistent with the documented answers. Nevertheless, discrepancies were observed in the computation of results pertaining to the numeracy problems presented by the researcher. Concurrently, a subset of students exhibited commendable mathematical literacy competencies, particularly in the realm of mathematical reasoning. While students generally succeeded in articulating mathematical statements in written form when addressing numeracy problems, there were instances in which they failed to do so effectively in particular scenarios. Overall, they demonstrated the ability to perform mathematical operations, despite the inaccuracy of their resulting answers, and were capable of formulating conclusions, albeit incorrectly. In light of the aforementioned analysis, it can be inferred that a segment of students possessed mathematical literacy skills classified within the commendable category, while others fell into the adequate and inadequate categories. The mathematical reasoning abilities as exhibited by the students were delineated as follows:

1. In general, students were able to articulate mathematical statements and execute mathematical operations, although some individuals exhibited errors in the execution of mathematical manipulations involving certain numerical values. They also demonstrated the capacity to draw logical conclusions, although several students erred in their written responses when concluding certain numerical analyses.
2. Throughout the instructional process, educators predominantly employed the lecture method without any alterations to the pedagogical model or educational media. Consequently, numerous students encountered challenges in assimilating the mathematics curriculum within the classroom setting. Under such circumstances, the classroom environment became less conducive to comfort and failed to foster a child-friendly atmosphere.
3. The foundation and advancement of schools conducive to the well-being of children were predicated upon the following principles: non-discrimination, specifically the assurance that every child is afforded the opportunity to experience the right to education without any form of discrimination based on disability, gender, ethnicity, religion, or parental background. The paramount consideration in all decisions and actions undertaken by educational administrators and organizers concerning students is the best interests of the child; life, survival, and development, which entails the creation of an environment that honors the dignity of children and guarantees the holistic and integrated growth of each individual child; respect for the opinions of children, which pertains to acknowledging children's rights to articulate their views on all matters that impact them within the educational setting; and sound management, which encompasses the assurance of transparency, accountability, participation, accessibility of information, and adherence to the rule of law within educational institutions. Educational institutions bore the responsibility of fostering and establishing a child-friendly environment (Maslang et al., 2022). The execution of a model for a child-centered educational institution that operates effectively may yield beneficial outcomes for both the institutions and the pupils (Fitriani et al., 2021). The child-centered school model embodies an educational framework that adopts a pedagogical approach aligned with the psychological maturation of children by ensuring their safety, comfort, and equity in accordance with principles of fairness (Muarifah et al., 2020). Students are afforded the freedom to engage in circumstances where they recognize that educators serve as collaborators in their educational journey. It is the dynamics of interaction, mutual esteem, and reciprocal support in each other's

endeavors that foster an environment wherein all students are encouraged to express their diverse perspectives.
Mathematics constitutes a discipline that systematically examines quantities, structures, spatial dimensions, and transformations, which can be applied to various facets of human civilization through the advancement of logical reasoning and abstraction. The education of mathematics has the potential to enhance cognitive abilities, enabling individuals to think critically, logically, systematically, and creatively. Mathematics serves as a linguistic medium that employs symbols and notations to articulate numerical values, geometric configurations, and graphical interrelations. It embodies a human endeavor that encompasses the observation, representation, and exploration of quantitative patterns and interrelations within both physical and social phenomena, as well as among mathematical entities themselves. This discipline fosters the development of cognitive processes that augment logical and critical thinking, precision, and problem-solving capabilities, thereby contributing to informed decision-making (Department of Basic Education, 2011:13). Consequently, the pedagogy of mathematics ought to facilitate learners in establishing their connections and conceptual frameworks (Szydlik, 2000; Tarlow, 2008). Learners are required to engage in problem-solving, articulate ideas both verbally and in written form, participate in mathematical reasoning, and pursue mathematical interconnections. As learners forge connections between and within diverse representational systems, their cognitive processes and reasoning abilities are likely to enhance (Maher, 2005). The objectives of mathematics education delineated by the NCTM (2000) comprise five competencies, namely mathematical problem-solving, mathematical communication, mathematical reasoning, mathematical connections, and mathematical representation. The capabilities encompassed within these five competencies can be articulated through the concept of mathematical literacy.
Mathematical literacy is characterized as an individual's capacity to formulate, apply, and interpret mathematical concepts across various contexts, incorporating mathematical reasoning skills and utilizing concepts, procedures, and factual information to describe, elucidate, or estimate phenomena or events. Mathematical literacy is deemed proficient if a student can analyze, reason, and effectively communicate their mathematical knowledge and skills, in addition to solving and interpreting mathematical solutions. A student is considered capable of resolving problems if they can apply previously acquired knowledge to novel and unfamiliar circumstances. This ability is commonly referred to as high-level cognitive skills.
The challenges associated with student learning can be effectively mitigated through the provision of motivation to children. Motivation, whether conveyed through verbal affirmations or physical actions, is critically paramount for children, particularly those enrolled in elementary education who are navigating the initial stages of their developmental journey; consequently, it is imperative for elementary school educators to possess a comprehensive understanding of their students' unique characteristics and needs in order to adequately support them in addressing the challenges encountered within the classroom environment. The level of numeracy literacy among students can be classified into three distinct categories: low-level literacy, indicating that students lack foundational comprehension of numeracy and thus require increased motivational support to enhance their enthusiasm for learning; sufficient literacy, wherein children gradually begin to grasp mathematical concepts and continue to receive guidance and encouragement; and, ultimately, a proficient level of literacy, characterized by students' ability to comprehend numeracy concepts effectively. Nevertheless, it remains essential for children to receive ongoing guidance and motivation to foster their enthusiasm for learning and encourage active participation in their educational endeavors.
The manifestation of numeracy literacy is of paramount importance for children, enabling them to effectively apply mathematical concepts in their everyday lives, thereby facilitating problem-solving capabilities both at home and in academic settings, while simultaneously promoting active engagement in the learning process. Nearly all challenges encountered in daily life necessitate a mathematical reasoning process for their resolution. The ability to engage in mathematical reasoning is crucial for addressing the myriad of issues that may arise in real-world contexts. In light of findings from prior research, it is essential for educators to consistently monitor and guide students' mathematical reasoning processes. This oversight aims to reduce the incidence of student errors in tackling mathematical challenges and to enhance students' overall mathematical reasoning capabilities.
The cognitive process of mathematical reasoning is facilitated through the presentation of diverse contextual challenges that are pertinent to the lives of students, allowing for optimal resolution by students within the framework of engaging mathematics education (Celik & Ozdemir, 2020). Mathematical literacy transcends mere quantitative application of mathematical principles; rather, it encapsulates the comprehension of mathematical knowledge in its most expansive definition. For instance, as an individual from a foreign nation frequently navigating various states within the United States, foreigners often exhibit deficiencies in what I term navigational competencies: the cognizance of one's location both in relative and absolute terms (Lange, 2003). Such competencies encompass the abilities of reading and interpreting maps, possessing spatial awareness, comprehending the concept of "grasping space" (Freudenthal 1973), recognizing great circle routes, and interpreting architectural plans, among others. All manifestations of visualization are integral to the dimension of mathematical literacy and constitute vital elements of this literacy, as convincingly demonstrated by Tufte's trilogy of publications (1983, 1990, 1997)
An individual endowed with proficient mathematical literacy skills must exhibit sensitivity to mathematical constructs that are pertinent to the dilemmas they encounter (Andes et al, 2017). This cognizance subsequently evolves into the capability to articulate the problem in its mathematical representation for resolution. This undertaking encompasses activities such as exploration, connection, formulation, determination, reasoning, and

other facets of mathematical cognition. The cognitive process inherent in mathematical literacy necessitates advanced thinking abilities. This cognitive process can be delineated into three principal categories: formulating, utilizing, and interpreting. The formulation phase constitutes a critical cognitive activity, wherein the act of formulation is predicated upon the outcomes of observations, experiences, reflections, considerations, and dialogues that will inform the decisions and actions undertaken by students. Consequently, when students engage in problem formulation, they arrive at decisions that are grounded in meticulously considered deliberations. The utilization process engages students' creative thinking capabilities. Through innovative ideation, students are able to harness their skills to yield unconventional outputs or devise solutions to complex challenges. Moreover, the interpretation phase involves the application of problem-solving abilities. By leveraging (transferring) pre-existing knowledge, students are equipped to address unresolved inquiries or navigate challenging scenarios.

Due to the critical significance of mathematical literacy competencies, it is imperative to undertake initiatives aimed at fostering these capabilities. In practice, a substantial number of students continue to encounter challenges when attempting to utilize their knowledge for problem-solving across diverse contexts. While students may demonstrate the ability to apply their knowledge to a specific problem, they may not be equipped to transfer this application to a different problem (Sari, 2015). To employ their skills proficiently, students must engage in the problem-solving process across a variety of situations and contexts. One of the essential competencies that students must develop to address problems effectively is reasoning ability.

The indicators of mathematical reasoning encompass the oral and written presentation of mathematical assertions, the use of figures and diagrams; the formulation of conjectures; the execution of mathematical manipulations; the derivation of conclusions; the compilation of evidence; the provision of rationales or evidence supporting solutions; the inference of conclusions from statements; the assessment of the validity of arguments; and the identification of patterns or properties of mathematical phenomena to facilitate generalizations. In evaluating an individual's numeracy literacy competencies, clear indicators are requisite to accurately delineate each skill encompassed therein. Han et al. (2017) assert that the indicators of numeracy literacy skills are articulated in the subsequent table:

No	Indicators of Literacy and Numeracy Ability
1	Solving difficulties in a range of everyday situations by applying a variety of numbers and symbols associated with basic arithmetic.
2	Examining data presented in a variety of formats, including tables, sections, diagrams, graphs, and more.
3	Interpreting the findings of the analysis in order to forecast and decide.

The inadequate mathematical reasoning capabilities exhibited by students are further evidenced by the pedagogical approach, which remains predominantly reliant on the lecture method, a notable deficiency in student motivation towards the study of mathematics, suboptimal academic outcomes, and insufficient proficiency in mathematical learning. Instruction that predominantly employs the lecture method tends to hinder students' comprehension of the underlying concepts necessary for problem-solving within mathematics curricula, resulting in an inability to assimilate the instructional content delivered by educators, and consequently, students' competencies in addressing mathematical problems fall short of anticipated standards.

In response to the identified issue, scholars have opted for an alternative approach by implementing electronic modules in pedagogical practices to enhance mathematical reasoning capabilities. Interactive multimedia facilitates the conveyance of concepts through an integration of visual elements, animations, and auditory components. The utilization of this format mitigates student disengagement that often arises from monotonous learning experiences; consequently, learners become more motivated and exhibit a heightened interest in comprehending the material presented (Wiana et al., 2018). Through the use of such media, it is anticipated that students will be able to cultivate effective learning environments (Nusir et al., 2013) and attain a more profound understanding of the material's concepts in practical terms (Osman & Lee, 2014). Moreover, a robust conceptual understanding is crucial in the educational process, as it enables students to refine their competencies within each instructional content area. Additionally, it fosters motivation within the context of academic pursuits. One exemplary form of interactive media is the electronic module (Adawiyah et al., 2021).

The five primary features of modules self-instructional, self-contained, stand-alone, adaptable, and user-friendlymake them potentially beneficial. Furthermore, e-modules are useful since students may readily access them at any time and from any location. According to research findings, e-modules were among the most user-friendly learning resources since they could be studied at any time and from any location, were more engaging and interactive, and had the potential to enhance learning outcomes (Setyanandaru, Wahyuni, & Pramudya, 2017).Furthermore, e-modules are given in an electronic format with animation, voice, and navigation, allowing for autonomous use and increasing user interaction during the learning process learning (Sugianto et al., 2017). The ability to play movies directly and integrate with the internet are two benefits of adopting E-modules (Puspitasari, 2019). E-modules may enhance students' critical thinking abilities and motivation to learn, according to research (Perdana, Sarwanto, & Sukarmin, 2017) (Kurniati et al., 2021).

Multimedia creation for education is gaining popularity these days. There are numerous benefits to the application itself. The benefits include enhancing the development of fundamental math skills (Barendregt et al., 2012),

decreasing formality in the learning process (Attewell & Enhanced, n.d.), and boosting children's learning performance (Bonsignore et al., 2013)

The assimilation of multimedia applications and learning activities increases children's interest during the learning process because it succeeds in attracting children's attention with multimedia elements included in the application (Ibrahim et al., 2015). In addition, many studies have proven that by adopting appropriate learning rights and theories into multimedia applications, children will be able to learn more effectively (Kittidachanupap et al., 2012; Nusir et al., 2011).

Because the multimedia components in the application are successful in grabbing children's attention, integrating multimedia applications with learning activities raises their interest throughout the learning process (Ibrahim et al., 2015). Furthermore, numerous research have demonstrated that children can learn more efficiently when multimedia programs incorporate suitable learning rights and theories (Kittidachanupap et al., 2012; Nusir et al., 2011).

Students can now learn at any time and from any location by using mobile devices as a learning tool. Additionally, programs with multimedia components like animation, graphics, and videos help parents use these resources to capture their kids' interest. Children can study more effectively when they use gadgets like tablets and cellphones. Children's performance has been shown to improve both before and after using multimedia mobile applications as a teaching aid in numerous research. Children differ from adults in their motor abilities and overall development, so it is important to consider their unique behavioral and cognitive traits and limitations while creating multimedia mobile applications (Ibrahim et al., 2015).

Youngsters are exposed to technology and portable gadgets like smartphones and tablets, and as these devices becoming more affordable and accessible, they use them more frequently. At a very young age, children begin using touchscreen gadgets, and they have grown accustomed to it. They are able to use their parents' cellphones and tablets with ease, despite not having their own. Additionally, children and adults use touchscreen devices differently. The majority of touchscreen devices are not made with users in mind, and kids frequently find them too challenging to use.

Using electronic modules as a teaching tool can make it easier to address difficulties supplied by the teacher by presenting real-world problems in the form of things that are not immediately witnessed. While teachers support students as facilitators who actively solve problems and expand their knowledge in groups, students are the learning center. Students can learn independently and gain practical problem-solving experiences by utilizing e-modules in learning models (Seruni et al., 2020).

Following this analysis, the researcher used the Mathematics E-Module to conduct teaching and learning activities. Students were then given a post-test to compare their learning achievement before and after utilizing the module. The findings of the expert material and media validator questionnaire, as well as the rise in student scores both before and after utilizing the Mathematics E-Module, demonstrated that the module was both practicable and successful for use as teaching materials.

CONCLUSION

The study's findings included the following: (1) the reasoning skills of fifth-grade elementary school pupils were analyzed to determine their level of numeracy literacy, and the results were categorized as good, sufficient, and poor. Lack of instructional media that helps students grasp the content was one of the contributing factors (2). Child-friendly learning has not been implemented correctly, particularly since it has not been able to support and facilitate students' literacy and numeracy in elementary schools. (3) Fifth-grade students' numeracy literacy level increased when they used e-modules to reinforce mathematical reasoning skills.

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