

Implementing E-Modules Based on Tana Toraja Local Wisdom to Improve Digital Literacy and Learning Outcomes for Junior High School Students

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ABSTRACT

Digital literacy and learning outcomes are essential competencies in supporting students' understanding and adaptation to technology-based learning environments. However, students still experience difficulties in developing digital literacy skills and achieving optimal learning outcomes in science learning. Therefore, innovative learning media integrating technology and contextual learning are needed to address these challenges. This study aimed to determine the level, improvement, and significance of digital literacy skills and learning outcomes of Grade VII students at UPT SPF SMP Negeri 33 Makassar after implementing Tana Toraja local wisdom-based e-modules on the topic of classification of living things. This study employed a pre-experimental design using One Group Pretest–Posttest Design. The population consisted of 288 students from nine classes, while 28 students from Class VII.A were selected through purposive sampling. Data were collected using a 20-item digital literacy questionnaire and a 20-item learning outcomes test and analyzed using descriptive and inferential statistics. The findings showed moderate improvement in digital literacy skills (N-Gain = 0.40) and learning outcomes (N-Gain = 0.48). Furthermore, the t-test results indicated a significance value of 0.000 (<0.05), demonstrating significant improvement in both variables. These findings suggest that Tana Toraja local wisdom-based e-modules effectively improve students' digital literacy and learning outcomes.

Keywords: E-Module, Local Wisdom, Tana Toraja, Digital Literacy, Learning Outcomes.

I. Introduction

The rapid development of science and technology has significantly influenced various aspects of life, including education. Education plays an important role in human life because through education individuals can gain experiences, knowledge, skills, and attitudes that contribute to personal development. In addition, education has an important role in the process of national development (Yandi et al., 2023). Digital literacy movements in schools should be developed as integrated learning mechanisms within educational systems or at least connected to teaching and learning processes. Students' skills need to be improved, teachers should enhance their knowledge and creativity in implementing digital literacy learning, and school leaders should facilitate teachers and educational staff in developing a school digital literacy culture (Ginting et al., 2022). Digital literacy refers to the ability to understand and utilize digital technology to obtain information effectively and openly (Fahira et al., 2024). Improving students' digital literacy skills can be achieved by introducing various technologies that support learning processes (Soraya et al., 2023). In addition, Indonesia's younger generation is expected to possess literacy competencies in various aspects to live independently in society, and these competencies should be introduced through formal education assisted by teachers and

parents (Safira et al., 2023). Furthermore, Generation Z, who grow up in the digital era, require learning media that suit their learning characteristics, and mobile-based interactive e-modules are considered effective learning tools in the current educational environment (Muharram & Wahid, 2024).

According to CNBC Indonesia (2023), Indonesia's digital literacy rate is only 62%, which is lower than the average literacy rate of other ASEAN countries at approximately 70% (Fahira et al., 2024). Previous studies also reported that digital literacy positively affects students' learning outcomes, meaning that better digital literacy skills contribute to better learning achievement (Soraya et al., 2023). Science learning is closely related to natural phenomena and aims not only to help students memorize theories but also to enable them to understand concepts and apply them in real-life situations. Science learning also aims to develop cognitive, psychomotor, and affective competencies among students (Hikma et al., 2022). However, science learning, particularly on the topic of classification of living things, often remains teacher-centered. Students tend to be passive during learning activities and rely heavily on teachers as primary learning sources (Puspitasari, 2025). Furthermore, learning processes frequently cause students to feel bored because they mostly listen, write, memorize, and receive information passively (Sunandar et al., 2022). Limited use of technology in learning activities has become an additional challenge despite its potential to provide more attractive and diverse educational resources (Alfaruqi & Nurwahidah, 2025).

Based on observations and interviews conducted with Grade VII science teachers at UPT SPF SMP Negeri 33 Makassar, information revealed that students' digital literacy skills and learning outcomes have been introduced and developed during learning activities. However, the achievement of these aspects still requires improvement. One of the main challenges is the limited optimization of technology utilization by students to independently access learning resources and improve learning outcomes. In addition, science learning has not maximally integrated local wisdom, particularly Tana Toraja culture, which has the potential to strengthen contextual learning experiences. Previous studies found that e-modules can improve students' learning outcomes and support independent learning (Idayanti & Suleman, 2024). The implementation of e-modules also assists teachers during learning activities and enhances students' motivation and engagement (Sholeh et al., 2023). Moreover, local wisdom-based learning is important because it can improve students' understanding, strengthen their appreciation of local culture, and build positive values based on regional wisdom (Rummar, 2022). However, teaching materials based on local wisdom adapted to regional and cultural contexts remain limited, especially those related to Toraja culture (Ero et al., 2024). Therefore, this study aims to determine the levels, improvement, and significance of students' digital literacy skills and learning outcomes before and after the implementation of Tana Toraja local wisdom-based e-modules on the topic of classification of living things among Grade VII students at UPT SPF SMP Negeri 33 Makassar. This study is expected to contribute to the development of innovative learning media integrating technology and local wisdom to improve students' digital literacy skills and learning outcomes.

II. Literature Review and Hypothesis Development

2.1 Electronic Module (E-Module)

Electronic modules (e-modules) are digital learning materials developed from printed modules and designed to facilitate students in learning independently through electronic devices. According to Azkiya et al. (2022), e-modules are developments of printed modules converted into digital forms, while Sureni et al. (2023) explained that e-modules utilize electronic devices and incorporate multimedia components that make learning more interesting and easier for students to access anytime and anywhere. E-modules present learning materials systematically and interactively through various formats such as text, images, animations, audio, and video. Compared to printed modules, e-modules provide several advantages in learning processes. According to Mutmainnah et al., (2021), e-modules are more practical because they can be accessed through electronic devices, have lower production costs, and can integrate multimedia elements such as audio and video. In addition, Sureni et al., (2023) stated that e-modules facilitate students in accessing learning materials

anytime and anywhere, while Sholeh et al., (2023) explained that the use of interactive e-modules provides more flexible learning experiences for students.

As suggested by Gunawan (2022), effective e-modules possess several characteristics, including self-instruction, self-contained, stand-alone, adaptable, and user-friendly features. Self-instruction enables students to learn independently without depending on others, while self-contained means that all learning materials are presented comprehensively within a module. Stand-alone refers to the ability of e-modules to function independently without relying on other learning media. Furthermore, adaptable characteristics enable e-modules to adjust to technological developments, while user-friendly characteristics facilitate students in understanding learning materials through communicative language and clear instructions. Previous studies reported that e-modules support independent learning and positively contribute to students' motivation, learning activities, and learning outcomes. Sholeh et al. (2023) found that interactive e-modules can increase students' learning engagement and motivation, whereas Idayanti & Suleman (2024) indicated that e-modules improve learning effectiveness and students' learning outcomes. Therefore, e-modules are considered innovative learning media that support effective and flexible learning processes.

2.2 Local Wisdom

According to Rummar (2022), local wisdom consists of ideas, values, norms, cultures, beliefs, and habits that continuously develop in society. Furthermore, local wisdom serves as a cultural identity and guideline that influences people's interactions within social life (Lumbaa et al., 2023). Integrating local wisdom into education is important because it helps students understand and appreciate cultural values in learning contexts (Ero et al., 2024). In this study, Tana Toraja local wisdom was integrated into learning materials through three cultural traditions, namely Ma'Nene, Rambu Solo', and Rambu Tuka'. According to Sapan, Bahzar, and Asnar (2024), cultural traditions in Toraja society continue to be preserved and inherited across generations. Ma'Nene is a ritual tradition in which the bodies of deceased family members are removed from their resting places and dressed in new clothes by family members as a form of respect toward ancestors (Pane et al., 2024).

Rambu Solo' is a traditional funeral ceremony in Toraja society. According to Sapan, Bahzar, and Asnar (2024), Rambu Solo' is closely related to beliefs, social values, and traditions inherited across generations. In addition, Azwiendasari, Ihsan, & Yatim (2022) explained that the implementation of Rambu Solo' involves various ritual practices based on traditional beliefs inherited from ancestors. Meanwhile, Rambu Tuka' is a traditional ceremony associated with gratitude and joyful events in Toraja society. Rahmad (2018) explained that Rambu Tuka' refers to rituals dedicated to expressions of gratitude and blessings, while Sapan, Bahzar, and Asnar (2024) stated that Rambu Tuka' forms part of Toraja cultural traditions that continue to be preserved. The integration of Ma'Nene, Rambu Solo', and Rambu Tuka' into the developed e-module was intended to provide contextual learning experiences by connecting learning materials with students' cultural environments. These local wisdom elements were integrated into the topic of classification of living things through examples related to plants, animals, and cultural practices associated with Toraja traditions. According to Ero et al. (2024), the integration of local wisdom in learning helps students understand and appreciate cultural values within learning contexts.

2.3 Local Wisdom-Based E-Module

According to Azkiya et al. (2023), a local wisdom-based e-module is a non-printed digital teaching medium that is systematically designed to help students understand learning content by relating it to cultural characteristics and local wisdom inherited from generation to generation. Local wisdom is also considered noble values contained in cultural wealth in the form of traditions, proverbs, life mottos, and community knowledge that have developed over time through reciprocal processes between society and the surrounding environment. As suggested by Ero et al. (2024), the development of local wisdom-based teaching materials in

learning processes is important because it functions as a guide for students from an early age. Cultural heritage containing local wisdom elements indicates that Indonesian society has long possessed values and moral guidelines reflected through traditional ceremonies that strengthen unity and togetherness. Furthermore, the substance of local wisdom-based teaching materials consists of Toraja cultural elements that help students recognize their identities. The local wisdom elements integrated into teaching materials include Rambu Solo', the meaning of Rambu Solo' ceremonies as a medium for sharing affection and strengthening unity, the meaning of Alang architecture, and Gusean philosophy. Furthermore, Annisha (2024) stated that the use of local wisdom values in education is not only intended to preserve cultural identity but also has broader implications in strengthening educational pillars within the Merdeka Curriculum, including character, cognitive, emotional and social, and aesthetic aspects. In addition, structured and continuous evaluation is important in the implementation process because it can provide a deeper understanding of progress, challenges, and opportunities that may arise.

2.4 Digital Literacy

Glitsner (1997), explained that digital literacy is the ability to understand and use information in various formats from different sources when presented through computers. Furthermore, UNESCO explained that the concept of digital literacy serves as an important foundation in understanding technology, information, and communication devices. One aspect of digital literacy is ICT literacy, which refers to technical abilities involving communities in accordance with cultural developments and digital-based public services (Ginting et al., 2022). Bawden and David (2025) stated that information literacy and digital literacy are central topics in information science because they are associated with various issues such as information overload, lifelong learning, knowledge management, and the growth of information societies. Furthermore, Dewi et al. (2023) explained that digital literacy transforms individuals from passive information recipients into active participants. Digital literacy also refers to the ability to understand and use information broadly through digital assistance within the scope of norms, ethics, and culture.

Silalahi (2022), stated that digital literacy is one of the indicators in education and culture for developing students' critical and creative thinking. To wisely implement digital literacy in education, students need to consider several fundamental bases, including cultural, cognitive, constructive, communicative, responsibility, creative, critical, and social responsibility aspects. Based on several references above, digital literacy can be understood as an important ability to understand, manage, and utilize technology, information, and communication wisely. Digital literacy does not only emphasize technical skills but also includes critical understanding of information, ethical use, and contributions to cultural development and digital-based public services. In educational contexts, digital literacy becomes an important indicator for developing critical, creative, and responsible thinking patterns. Therefore, digital literacy plays a role in transforming students from passive recipients of information into active, reflective, and adaptive individuals in responding to technological developments.

Ng (2012), explained that digital literacy consists of three dimensions: technical, cognitive, and social-emotional dimensions. The technical dimension refers to the ability to operate digital tools and manage files and data. The cognitive dimension is related to individuals' abilities to critically process, understand, and evaluate information obtained from digital sources. Meanwhile, the social-emotional dimension refers to individuals' abilities to use digital information responsibly in communication and social interactions. Furthermore, Hildawati (2024) explained that the objectives of digital literacy include encouraging healthy technology use, promoting inquiry and reading culture through technology, expanding knowledge through digital information, improving understanding of online information, providing current information, developing critical assessment of online content, and strengthening personal values through reading and writing activities from internet sources.

Digital literacy abilities may also be influenced by several factors. According to Syabaruddin & Imamudin (2022), differences in digital literacy levels can occur due to digital gaps reflected in ownership and

the ability to use information and communication technology devices. Naufal (2021) explained that factors influencing digital literacy include functional skills, communication and interaction, and critical thinking abilities. Digital literacy provides benefits by enabling individuals to access, select, understand, and utilize information to improve quality of life. However, challenges in digital literacy still exist. Ali (2025) explained that one challenge is the lack of explicit and systematic integration of digital literacy into curricula. In addition, Syabaruddin & Imamudin (2022) stated that unstable internet networks, limited internet access, economic constraints, and difficulties in summarizing large amounts of information can become obstacles in implementing digital literacy effectively.

2.5 Student Learning Outcomes

Learning outcomes are defined as a final assessment of learning and recognition processes that have been carried out repeatedly. Learning outcomes may also be retained for a long period or may even remain permanently because they contribute to shaping an individual's personality and encouraging the achievement of better results, thereby influencing ways of thinking and producing better work behavior (Sulastris et al.,). According to Fahira et al., (2024), learning outcomes refer to the abilities acquired by students after obtaining learning experiences that can be represented in numerical form. Learning outcomes are also considered as changes experienced in learning events (Mboa & Ajito, 2024). Meanwhile, Yandi, Putri, and Putri (2023) stated that learning outcomes can also be interpreted as a reflection of students' learning efforts. The better the students' learning efforts, the better the learning outcomes they are expected to achieve. Therefore, learning outcomes can be used as one of the references for assessing the success of the learning process experienced by students. Based on several references above, it can be concluded that learning outcomes are changes obtained by students after going through the learning process in the form of knowledge, skills, and attitudes. Learning outcomes also reflect students' learning efforts and can be used as indicators of learning success.

According to Mahmudi et al. (2022), learning outcomes include three main domains in education, namely cognitive, affective, and psychomotor domains. The cognitive domain consists of behaviors emphasizing intellectual aspects, such as knowledge, understanding, and thinking skills, including functions related to information processing, knowledge, and mental skills. The affective domain consists of behaviors emphasizing aspects of feelings and emotions, such as interests, attitudes, appreciation, and self-adjustment, and is related to emotional responses toward tasks. Meanwhile, the psychomotor domain consists of behaviors emphasizing motor skills, such as handwriting, typing, swimming, and operating machines, and is related to aspects of physical skills. According to Anderson and Krathwohl (2014), students' learning outcomes can be reflected through two main dimensions, namely cognitive process dimensions and knowledge dimensions. The cognitive process dimension explains how students process information, whereas the knowledge dimension is related to the types of knowledge being learned, such as factual, conceptual, procedural, and metacognitive knowledge.

The indicators of learning outcomes include remembering (C1), which refers to students' ability to recognize or recall previously learned information; understanding (C2), referring to the ability to explain concepts using one's own words or provide examples of principles; applying (C3), which refers to using acquired knowledge to complete tasks or solve problems; analyzing (C4), which involves breaking down information into important components and understanding relationships among those components; evaluating (C5), which refers to assessing arguments, theories, or procedures based on clear criteria; and creating (C6), which refers to designing, developing, or producing new ideas based on acquired knowledge. Low learning outcomes among students are associated with two main factors, namely teacher-related and student-related factors. From the teacher's perspective, these include limited opportunities for students to participate actively in learning, insufficient encouragement of students' imagination and creativity, and limited practice opportunities to strengthen students' confidence in communicating in public. From the students' perspective, factors affecting learning outcomes include low participation in learning activities,

underdeveloped imagination and creativity, and lack of self-confidence in public communication (Rahmatia, Nurhikmah, & Rasima, 2024). Electronic modules may contribute positively to students' understanding because they provide structured learning activities, self-evaluation opportunities, and interactive learning experiences that encourage students to become more active during the learning process. Based on previous studies, learning outcomes can be influenced by various factors related to teachers, students, and the learning media used during instruction.

2.6 Classification of Living Things

The material discussed in this study is the classification of living things for seventh-grade students in the first semester. At the end of Phase D, students are expected to distinguish living things from non-living things, explain the basis for classifying living things according to similarities and differences in their characteristics, and use simple determination keys to identify living things in the surrounding environment. The learning objectives include explaining the characteristics of living things, distinguishing living things from non-living things based on their characteristics, analyzing the relationship between cultural traditions and scientific concepts in the classification of living things, identifying the basis of classifying living things according to similarities and differences in their characteristics, explaining the importance of classification in studying living things, classifying simple living things based on morphology and habitat, explaining taxonomic levels in living things, describing the characteristics of the five-kingdom classification system, and classifying living things according to their characteristics.

Local wisdom is integrated into the learning process at each meeting. The Ma'nene tradition is related to the concept of distinguishing living things from non-living things because this tradition teaches the Toraja community to respect the bodies of deceased ancestors. Scientifically, this concept can help students understand the differences between living things and non-living things based on characteristics of life. The Rambu Solo' tradition is associated with the classification of living things because the Toraja community recognizes different types of buffaloes based on skin color, horn shape, and body size, which is consistent with biological classification based on similarities and differences in morphological characteristics. Furthermore, the Rambu Tuka' tradition reflects biodiversity through the use of different plants, animals, and agricultural products, helping students understand the importance of maintaining biodiversity and ecosystem balance. The classification of living things material consists of three subtopics taught in three meetings. The first meeting discusses living things and non-living things, the second meeting discusses why living things need to be classified, and the third meeting discusses the diversity of living things.

Previous studies reported that e-modules can improve students' learning outcomes and support independent learning (Idayanti & Suleman, 2024). In addition, the implementation of e-modules can increase students' motivation and engagement during learning activities (Sholeh, Hufad, & Fathurrohman, 2023). Studies also indicated that local wisdom-based learning improves students' understanding and strengthens their appreciation of local cultural values (Rummar, 2022). Furthermore, digital literacy has a positive influence on students' learning outcomes (Soraya *et al.*, 2023). However, studies integrating Tana Toraja local wisdom-based e-modules to improve both digital literacy skills and learning outcomes in science learning remain limited (Ero *et al.*, 2024). Therefore, this study attempts to fill this gap by implementing Tana Toraja local wisdom-based e-modules on the topic of classification of living things among Grade VII students at UPT SPF SMP Negeri 33 Makassar.

2.7 Conceptual Framework

The utilization of technology in the learning process is an important step in improving learning effectiveness and increasing students' engagement. One of the learning media that can be utilized is an electronic module (e-module), which enables students to learn independently, flexibly, and interactively. However, the implementation of digital learning has not been optimally integrated with local contexts, which

may reduce students' understanding and engagement with learning materials. In addition, the limited use of innovative learning media may affect students' digital literacy skills and learning outcomes.

The local wisdom of Tana Toraja has considerable potential to be integrated into science learning, particularly in the topic of classification of living things. Traditions such as Ma'nene, Rambu Solo', and Rambu Tuka' can provide contextual learning experiences that help students understand scientific concepts through cultural perspectives. By relating learning materials to local culture, students are expected to become more engaged and better understand the concepts being studied. Therefore, this study implements a Tana Toraja local wisdom-based e-module as an innovative learning medium to improve students' digital literacy skills and learning outcomes among seventh-grade students at UPT SPF SMP Negeri 33 Makassar. The conceptual framework of this study was developed based on previous studies indicating that e-modules can improve learning outcomes and support independent learning (Idayanti & Suleman, 2024), digital literacy contributes to students' learning achievement (Soraya *et al.*, 2023), and local wisdom-based learning enhances students' understanding and engagement (Rummar, 2022). Therefore, integrating Tana Toraja local wisdom into e-modules is expected to improve students' digital literacy skills and learning outcomes. Based on the explanation above, the conceptual framework of this study is presented in Figure 1.

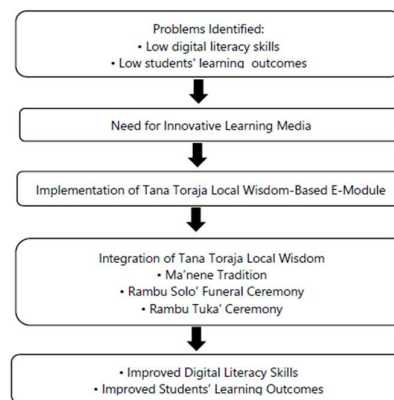


Figure 1. Conceptual Framework

2.8 Research Hypothesis

Based on the conceptual framework described above, the implementation of a Tana Toraja local wisdom-based e-module is expected to improve students' digital literacy skills and learning outcomes. Therefore, the research hypothesis is formulated as follows:

H1: There is a significant improvement in digital literacy skills and learning outcomes among seventh-grade students at UPT SPF SMP Negeri 33 Makassar after the implementation of a Tana Toraja local wisdom-based e-module.

III. Research Method

3.1 Research Setting and Participants

This study was conducted at UPT SPF SMP Negeri 33 Makassar during the second semester of the 2025/2026 academic year. The population consisted of all seventh-grade students at UPT SPF SMP Negeri 33 Makassar, totaling 288 students from nine classes. The sample was selected using a purposive sampling technique based on specific criteria, namely students who had access to digital technology and possessed

basic skills in using digital devices to support learning activities during the implementation of the e-module. Based on these criteria, 28 students from class VII.A were selected as the research sample.

Table 1. Research Participants Characteristics (N = 28)

Measurement	N	%
Grade VII.A	28	100

3.2 Research Design and Procedure

This study employed a pre-experimental method using a One Group Pretest–Posttest Design to investigate the effectiveness of an e-module based on Tana Toraja local wisdom in improving students' digital literacy skills and learning outcomes. The research design is presented as follows:

Table 2. One Group Pretest–Posttest Research Design

Pretest	Treatment	Posttest
O ₁	X	O ₂

Where:

O₁ = Pretest before treatment

X = Learning treatment using an e-module based on Tana Toraja local wisdom

O₂ = Posttest after treatment

The study was conducted in three stages. First, students completed a pretest to measure their initial digital literacy skills and learning outcomes. Second, the learning process was implemented using the e-module based on Tana Toraja local wisdom through three learning sessions using the ReCODE learning model, which consisted of Reading, Connecting, Observing, Discussing, and Evaluating stages. Finally, students completed a posttest to determine their digital literacy skills and learning outcomes after treatment.

3.3 Research Instruments

The instruments used in this study consisted of a digital literacy questionnaire and a learning outcome test. The digital literacy questionnaire consisted of 20 statement items adapted from Ng (2012), covering three dimensions, namely technical skills, cognitive skills, and social-emotional skills. The questionnaire was administered before and after treatment to determine the level of students' digital literacy skills. The learning outcomes instrument consisted of 20 multiple-choice questions with four answer choices covering cognitive levels C1 (remembering), C2 (understanding), C3 (applying), and C4 (analyzing). Each correct answer was scored one point, while incorrect answers received zero points.

3.4 Data Analysis

The collected data were analyzed using descriptive and inferential statistics using Statistical Package for the Social Sciences (SPSS) version 22. Descriptive statistics were used to describe students' digital literacy skills and learning outcomes after implementing the e-module based on Tana Toraja local wisdom. The improvement in students' performance was analyzed using the Normalized Gain (N-Gain) test proposed by Hake (1999), using the following formula:

$$N\text{-Gain} = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Maximum score} - \text{Pretest score}}$$

Description:

Pretest score = students' initial test score
Posttest score = students' final test score
Maximum score = maximum possible score

The N-Gain categories are classified as follows:

Table 3 Criteria Indeks Normalized-Gain

Score Interval	Normalized Gain Index Criteria
$0.7 \leq N\text{-Gain} \leq 1.0$	High
$0.3 \leq N\text{-Gain} < 0.7$	Medium
$N\text{-Gain} < 0.3$	Low

Inferential statistical analysis was conducted to test the research hypotheses. Before hypothesis testing, a normality test was performed using the Shapiro-Wilk test at a significance level of $\alpha = 0.05$. Hypothesis testing was conducted using a Paired Sample t-test to determine whether there was a significant improvement in students' digital literacy skills and learning outcomes after implementing the e-module based on Tana Toraja local wisdom. The testing criteria were established at $\alpha = 0.05$ and degree of freedom (df) = N – 1. Since the total sample consisted of 28 students, the degree of freedom in this study was 27. If $t_{\text{count}} > t_{\text{table}}$, H_0 was rejected and H_1 was accepted, indicating that there was a significant improvement in students' digital literacy skills and learning outcomes after implementing the e-module based on Tana Toraja local wisdom. Conversely, if $t_{\text{count}} < t_{\text{table}}$, H_0 was accepted and H_1 was rejected, indicating that there was no significant improvement.

IV. Result and Discussion

4.1 Digital Literacy Skills Results

The descriptive statistical analysis results of students' digital literacy skills before and after implementing the e-module based on Tana Toraja local wisdom are presented in Table 4.

Table 4. Descriptive Statistics of Students' Digital Literacy Skills

Descriptive Statistics	Pretest	Posttest
Sample Size	28	28
Ideal Score	100	100
Maximum Score	86	100
Minimum Score	40	61
Mean	70.00	81.71
Standard Deviation	10.17	12.14
Variance	103.63	147.47

Based on Table 4, the mean score of students' digital literacy skills increased from 70.00 during the pretest to 81.71 during the posttest. This finding indicates that implementing the e-module based on Tana Toraja local wisdom contributed positively to improving students' digital literacy skills. The increase may be associated with students' active participation during learning activities through the ReCODE stages, where students were encouraged to access, understand, and utilize digital learning resources throughout the learning process.

4.2 Learning Outcomes Results

Table 5 presents the descriptive statistical analysis results of students' learning outcomes before and after implementing the e-module based on Tana Toraja local wisdom.

Table 5. Descriptive Statistics of Students' Learning Outcomes

Descriptive Statistics	Pretest	Posttest
Sample Size	28	28
Ideal Score	20	20
Maximum Score	16	20
Minimum Score	5	5
Mean	9.60	14.57
Standard Deviation	3.03	4.18
Variance	9.21	17.51

Based on Table 5, students' learning outcomes increased from a mean score of 9.60 during the pretest to 14.57 during the posttest. These results suggest that students achieved better understanding and mastery of the learning content after using the e-module based on Tana Toraja local wisdom.

4.3 N-Gain Analysis Results

The N-Gain analysis was conducted to determine the level of improvement in students' digital literacy skills and learning outcomes after implementing the e-module based on Tana Toraja local wisdom.

Table 6. N-Gain Analysis Results

Variable	Pretest Mean	Posttest Mean	Mean N-Gain	Category
Digital Literacy Skills	70.00	81.71	0.40	Medium
Learning Outcomes	9.60	14.57	0.48	Medium

Based on Table 6, the average score of digital literacy skills increased from 70.00 in the pretest to 81.71 in the posttest, with an N-Gain value of 0.40 categorized as medium. Similarly, students' learning outcomes increased from 9.60 during the pretest to 14.57 during the posttest, with an N-Gain score of 0.48 categorized as medium. These findings indicate that implementing the e-module based on Tana Toraja local wisdom resulted in a moderate improvement in both digital literacy skills and learning outcomes.

Table 7. N-Gain Results of Digital Literacy Indicators

Indicator	Pretest Mean	Posttest Mean	N-Gain	Category
Technical Skills	25,39	31,14	0,39	Medium
Cognitive Skills	21,89	25,32	0,42	Medium
Social-emotional Skills	22,71	25.25	0,34	Medium

Based on Table 7, cognitive skills demonstrated the highest improvement with an N-Gain score of 0.42 categorized as medium. This finding suggests that students developed better abilities in understanding, evaluating, and processing information obtained from digital learning resources after participating in learning activities using the e-module based on Tana Toraja local wisdom. The improvement indicates that students were able to process and interpret information more effectively through learning activities designed to promote active engagement and critical thinking.

According to Ng (2012), digital literacy includes technical, cognitive, and social-emotional dimensions that support learners in effectively utilizing digital technologies. Among these dimensions, cognitive skills are essential because they enable learners to critically understand and process digital information. The improvement in cognitive skills observed in this study may be associated with the implementation of the ReCODE learning stages, which encouraged students to actively read, connect information with prior knowledge, observe learning content, discuss ideas collaboratively, and evaluate their understanding.

The contextual presentation of learning materials through the integration of local wisdom may also contribute to improving students' cognitive abilities because students can connect abstract concepts with their cultural experiences and everyday situations. Similar findings were reported by *Sholeh et al.* (2023), who stated that interactive e-modules improve students' thinking abilities and learning engagement. Likewise, *Kurniasih et al.* (2024) explained that e-modules facilitate meaningful learning experiences and support students in understanding learning concepts more effectively. The interactive features integrated into the e-module are presented in Figure 1

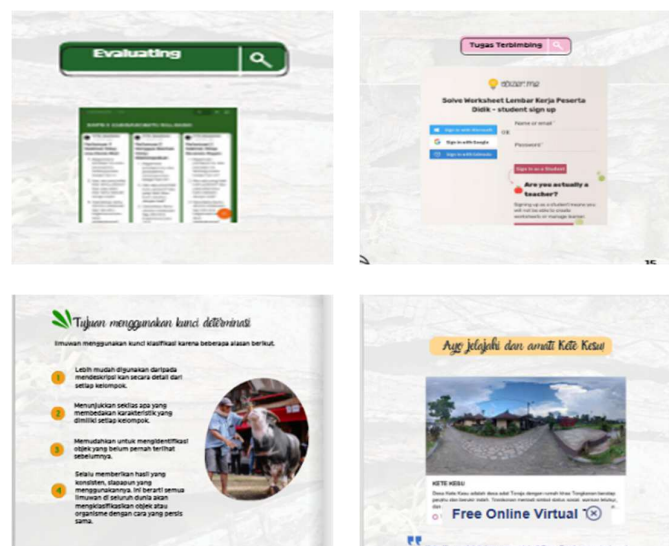


Figure 2. Interface of the e-module based on Tana Toraja local wisdom

Figure 2 presents interactive features integrated into the e-module, including contextual materials, visual illustrations, and learning activities related to Tana Toraja local wisdom. These features may facilitate students in understanding learning concepts more effectively and support their active participation during learning activities.

Table 8. N-Gain Results of Learning Outcomes Indicators

Indicator	Pretest Mean	Posttest Mean	N-Gain	Category
C1 (Remembering)	2,14	4,04	0,66	Medium
C2 (Understanding)	2,29	3,57	0,47	Medium
C3 (Applying)	2,43	3,50	0,41	Medium
C4 (Analyzing)	3,00	3,68	0,34	Medium

Based on Table 8, the C1 (remembering) indicator showed the highest improvement with an N-Gain score of 0.66 categorized as medium. This result indicates that students demonstrated improved ability in retaining and recalling learning materials after using the e-module based on Tana Toraja local wisdom. The increase in the C1 indicator may be associated with the use of contextual examples, illustrations, and multimedia elements integrated into the e-module. Such learning features may help students understand and

retain concepts more effectively because visual and contextual representations support memory formation during learning activities. Muharram & Wahid (2024) explained that interactive learning materials can create more meaningful and engaging learning experiences. Furthermore, integrating local wisdom into learning materials may provide contextual learning experiences because students can relate learning concepts to their own cultural environment and daily experiences. This finding is consistent with *Kumalasari et al.* (2023), who reported that local wisdom based learning materials effectively improve students' learning outcomes and conceptual understanding. Students' learning activities during the implementation process are presented in Figure 3

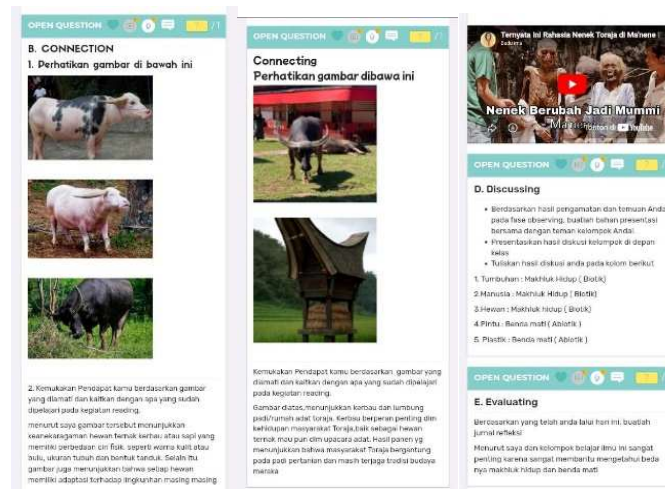


Figure 3. Students' Learning Activities through e-LKPD during ReCODE Implementation

Figure 3 presents students' learning activities through e-LKPD during the implementation of the ReCODE learning stages. The activities include reading, connecting, discussing, and evaluating tasks designed to encourage students' active participation and improve their understanding of learning materials.

4.4 Hypothesis Testing Results

Inferential statistical analysis was conducted to determine whether implementing the e-module based on Tana Toraja local wisdom significantly improved students' digital literacy skills and learning outcomes. Before conducting hypothesis testing, prerequisite testing was performed to ensure that the data fulfilled the assumptions required for parametric statistical analysis. In this study, a normality test was conducted using the Shapiro-Wilk test at a significance level of $\alpha = 0.05$. The results of the normality test are presented in Table 9.

Table 9. Shapiro–Wilk Normality Test Results

Variable	Tests of Normality		
	Shapiro-Wilk		
	Statistic	df	Sig
Pretest Digital Literacy Skills	0,93	28	0,09
Posttest Digital Literacy Skills	0,93	28	0,09
Pretest Learning Outcomes	0,94	28	0,15
Posttest Learning Outcomes	0,93	28	0,06

Based on Table 9, all significance values obtained from the Shapiro-Wilk test were greater than 0.05. The significance values for digital literacy skills were 0.09 for both pretest and posttest scores, while the significance values for learning outcomes were 0.15 and 0.06 for pretest and posttest scores, respectively.

These results indicate that all data were normally distributed and fulfilled the assumptions required for parametric statistical analysis.

Since the normality assumption was satisfied, further analysis was conducted using a Paired Sample *t*-test to determine whether there was a significant difference between students' scores before and after implementing the e-module based on Tana Toraja local wisdom

Table 10. Paired Sample t-test Results

Variable	t _{count}	df	Sig. (2-tailed)
Digital Literacy Skills	-6.96	27	.000
Learning Outcomes	-5.76	27	.000

Based on Table 10, the significance values for both variables were lower than 0.05 (.000 < 0.05), indicating statistically significant differences between the pretest and posttest scores. Therefore, H_0 was rejected and H_1 was accepted, indicating that implementing the e-module based on Tana Toraja local wisdom significantly improved students' digital literacy skills and learning outcomes.

V. Conclusion

The findings of this study indicate that implementing the e-module based on Tana Toraja local wisdom improved students' digital literacy skills and learning outcomes. The results showed that the mean score of digital literacy skills increased from 70.00 during the pretest to 81.71 during the posttest, while the mean score of learning outcomes increased from 9.60 to 14.57. The N-Gain analysis indicated moderate improvement in both variables, with an N-Gain score of 0.40 for digital literacy skills and 0.48 for learning outcomes. Furthermore, the Paired Sample *t*-test results revealed significance values of .000 < 0.05 for both variables, indicating that implementing the e-module based on Tana Toraja local wisdom significantly improved students' digital literacy skills and learning outcomes. Therefore, the integration of local wisdom into digital learning materials can be considered an effective approach for creating meaningful and contextual learning experiences.

This study contributes to the development of educational theory by supporting the concept that integrating local wisdom into digital learning materials can improve students' digital literacy skills and learning outcomes. The findings also support the digital literacy theory proposed by Ng (2012), which emphasizes technical, cognitive, and social-emotional dimensions as essential competencies in digital learning environments. In addition, this study strengthens previous findings regarding the effectiveness of contextual and technology-based learning materials in improving students' engagement and conceptual understanding. The findings of this study provide practical implications for teachers and schools regarding the implementation of digital learning media. Teachers may utilize local wisdom-based e-modules as an innovative learning resource to create more engaging and contextual learning experiences that support students' active participation. Schools are also encouraged to support technology-based learning by providing adequate digital facilities, internet access, and relevant learning resources. Furthermore, integrating local wisdom into learning activities may contribute not only to improving learning quality but also to preserving local cultural values.

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