



Ethnomathematics-Based *Flipbook* E-Module

Clarine Aurellia ^{1,*}, Yumira Simamora ², Israaq Maharani ³, Anjeli Malika Devani Tarigan ⁴

^{1,2,3,4} Universitas Al Washliyah Medan, Medan, Indonesia

*Corresponding Author: clarineurellia1402@gmail.com

Submitted: 10-05-2026

Revised: 01-06-2026

Accepted: 02-06-2026

Published: 05-06-2026

ABSTRACT

Mathematical literacy skills are an essential competency of the 21st century that demands innovation in digital teaching materials. Based on the needs analysis in the field, the use of interactive, self-contained web-based learning media still requires variations and has not explicitly integrated local cultural elements in the Data Centrality Measurement material. This study aims to produce a digital learning media prototype in the form of a flipbook e-module based on Deli Malay ethnomathematics assisted by the Heyzine platform integrated with the Discovery Learning flow, and to test the theoretical feasibility of the product. This type of research is a research and development (R&D) using the 4D model. In accordance with the limitations of the initial feasibility objectives, the development procedure is limited to the Develop stage in the theoretical validity testing phase by experts. Data collection techniques are carried out through structured interviews with teachers, and the distribution of Likert scale assessment questionnaire instruments to experts. The assessment data are then analyzed quantitatively using the Aiken's V agreement index formula. The results of the development stage research indicate that the accumulated average content validity index of all learning device instruments is 0.92 with the criteria of Very Valid. In detail, the validity values were obtained from the Teaching Module instrument (0.88), LKPD (0.90), material aspects (0.91), flipbook media (0.94), cultural context (0.92), and the mathematical literacy ability test instrument which achieved the highest coefficient of 0.96. The conclusion of the study confirms that this ethnomathematics-based flipbook e-module product is declared valid, theoretically feasible, and recommended as a variation of independent teaching materials to support the achievement of 21st-century competency mathematics learning.

Keywords: e-module; heyzine flipbook; ethnomathematics; mathematical literacy; theoretical validity

INTRODUCTION

Education in the era of globalization is a learning process that focuses not only on mastering academic knowledge but also on developing skills that can address the challenges that arise with changing times. Therefore, education in the era of globalization requires students not only to master academic knowledge but also to possess 21st-century skills that can address the challenges of the complex modern world (Sigiro et al., 2023). The integration of technology, information, and critical thinking skills is the main foundation in forming a generation that can compete globally (Nasution et al., 2023). One of the essential competencies within this framework is mathematical literacy, namely the individual's ability to formulate, apply, interpret, and evaluate mathematics in various real-world contexts (Hayuning et al., 2023).

However, international assessment results show that Indonesian students' mathematical literacy achievement remains low. PISA 2022 reported that Indonesian students' mathematical literacy scores were far below the average of other countries, with

only 18% of Indonesian students achieving Level 2 of the minimum proficiency level, while 82% of Indonesian students were still below the standard (OECD, 2023). This fact indicates a significant challenge, with the majority of students still experiencing difficulties when faced with non-routine problems that require logical reasoning and solution evaluation (Wahyun et al., 2023). This indicates that mathematics learning in schools is often taught abstractly and separated from the realities of life in the surrounding environment (Widad & Hadi, 2025). This condition emphasizes the need for innovative teaching materials that can bridge abstract concepts with the realities of students' daily lives.

One relevant learning approach to strengthen students' mathematical literacy is through ethnomathematics with mathematical activities rooted in the social and cultural practices of the community. (Sartika et al., 2026). The role of ethnomathematics is crucial in providing contextual learning because it encourages students to understand that mathematical concepts exist in everyday activities (Widodo & Astuti, 2026). The integration of ethnomathematics in learning enables the transformation of informal mathematics into meaningful academic mathematics for students (Yanti, 2025). Ethnomathematics can be found in identified cultural communities. These activities are not always formal symbols, but rather concrete actions (Dari & Jatmiko, 2024).

In the local context of Medan City, the socio-cultural activities of Deli Malays have great potential to be explored as an authentic database on the Data Centralization Measure material. In order for this cultural integration to work, the material is presented through a Discovery Learning flow to encourage students to actively construct their own knowledge in mathematical literacy skills (Zahra et al., 2025). Through the Discovery Learning approach, students are encouraged to construct their understanding by examining the interconnectedness of the material structure, which ultimately makes it easier for students to internalize the concepts learned (Prawitasuri et al., 2025).

In line with the application of ethnomathematics, learning media are needed that can support activities in mathematical literacy interactively and contextually (Taihuttu et al., 2025). One relevant innovation is the use of Heyzine format e-modules. Flipbooks. E-modules are one solution because they can present material systematically, flexibly, and engagingly (Noverisa et al., 2022). The use of interactive e-modules can also adapt learning to student capacity, thus supporting independent learning (Sholeh et al., 2023). Heyzine Media Flipbooks in learning aim to increase student engagement in understanding the material because they are more dynamic and easily accessible (Fauzy et al., 2024). The integration of Canva's intuitive design platform with the Heyzine Flipbook format facilitates the transformation of visual learning materials into dynamic, interactive digital media, thus providing a more immersive literacy experience for students (Elya & Lestari, 2025).

Several previous studies have examined the development of digital media, but there are still research gaps. Gesty & Leonard (2025) focused on developing Betawi culture-based ethnomathematics e-modules for flat-sided geometric shapes but did not integrate mathematical literacy into discovery learning. Meanwhile, Widodo & Astuti (2026) focused on designing interactive ethnomathematics-based e-modules for slow learners and basic numeracy but did not examine mathematical literacy. On the other hand, Supriyadi et

al. (2024) focused on developing Sundanese Gamelan -based ethnomathematics e-modules for junior high school students but with different materials. Therefore, this study offers an innovative solution by integrating Deli Malay ethnomathematics, Discovery Learning learning flows, and Heyzine flipbook technology to support high school students' mathematical literacy.

Unlike conventional modules, which tend to be formal and rigid, this ethnomathematics-based flipbook e-module is designed with a more communicative approach and is comfortable for students to read. The choice of soft colors, contextual illustrations, and narratives based on Deli Malay culture make learning more humanistic and enjoyable. With the interactive flipbook format, students not only learn the concept of central velocities but also feel connected to the local culture that is close to their lives. This approach is expected to increase learning motivation and strengthen mathematical literacy in high school students.

The formulation of the research problem is to analyze and design an ethnomathematics-based flipbook e-module on high school students' mathematical literacy, as well as to test the level of validity of the product content based on expert assessment. The purpose of this study is to describe the results of the validation of the ethnomathematics-based flipbook e-module content, so that a prototype of digital teaching materials is obtained that is suitable for use as an alternative for mathematics learning.

RESEARCH METHODS

This type of research is Research and Development (R&D) with a 4D model adapted from Thiagarajan, Semmel, and Semmel. This model consists of four stages, namely Define, Design, Develop, and Disseminate . However, in line with the research objective to test the theoretical feasibility of the initial product, the development procedure in this study is limited to the Develop stage , namely the validation test phase by experts, without conducting field trials and the Disseminate stage .

This research was conducted with the involvement of a private Islamic high school (Maidan Aliyah) in Medan. The choice of this partner location was based on geographic accessibility, as it is close to the Malay cultural heritage site, Maimun Palace, making it easier for researchers to explore and transform relevant local cultural objects into data centralization measurement materials in the developed e-module.

The development procedure was carried out through three operational stages. First, the definition stage, which included an analysis of curriculum needs and Data Centralization Measure materials through structured discussions with partner mathematics teachers. Second, the design stage, which focused on developing a framework and prototype design for an integrated Discovery Learning syntax e-module using the Canva and Heyzine Flipbook platforms. Third, the development stage, which focused on testing the product's theoretical validity.

Data collection techniques in this study were conducted through curriculum documentation studies, structured interviews with mathematics teachers, and distribution of product assessment questionnaires to experts. The research instruments used were a material validation sheet, a media validation sheet, and a cultural component validation

sheet. These validation sheets were compiled using a Likert scale with a score range of 1 to 5 to measure the quality of the e-module's suitability, as shown in Table 1. (Gulo & Harefa, 2022).

Table 1 Validation Score

Score	Information
1	Very bad
2	Not good
3	Pretty good
4	Good
5	Very good

The assessment data obtained from the validators were then analyzed quantitatively using the Aiken validity index formula to determine the level of validity of the instrument items comprehensively. The Aiken index formula is as follows (Sukma et al., 2025).

$$V = \frac{\sum S}{[n(C - 1)]}$$

Information:

V = Item validity index.

s = Score set by the validator minus the lowest score (r - lo).

n = Number of validators (experts).

c = Highest rating number (for example on a scale of 1-5, then c = 5).

r = Score given by the validator.

lo = Lowest score on the rating scale (e.g. 1)

Aiken index values to ensure the e-module prototype met content validity standards before being suitable for use. Determining the eligibility criteria is presented in Table 2.

Table 2 Content Validity Categories

Average	Eligibility Category
0.81-1.00	Very Valid
0.61-0.80	Valid
0.41-0.60	Quite Valid
0.21-0.40	Less Valid
0.00-0.20	Invalid

RESULTS AND DISCUSSION

The results of the development of an ethnomathematics-based flipbook e-module in high school students' mathematical literacy skills follow the stages of the 4D model (Four-D Model) suggested by Thiagarajan, Semmel, and Semmel. The following is an explanation of the stages presented.

Step in the initial definition stage is to identify the need for teaching material development through a preliminary analysis. Based on the results of initial observations of

students in the diagnostic test using contextual story problems, it shows that students' abilities in formulating and evaluating mathematical solutions still need strengthening. (Wulandari et al., 2025).

The use of digital-based independent interactive learning media in the field still requires room for optimization to enrich student learning variations (Kosandi, 2026). Based on interview results, the application of innovative model groups such as Discovery Learning has actually been done. However, its implementation has not been specifically integrated into contextual story problem activities that contain elements of local wisdom, both in the structure of the main material and the Student Worksheet. Through task and concept analysis, an in-depth study of the Data Centralization Measure material was conducted which was then transformed into ethnomathematics content based on Deli Malay culture. This definition stage ended by synthesizing the results of concept mapping and tasks into the formulation of operational learning objectives oriented towards strengthening students' mathematical literacy comprehensively.

The second step in the design stage, the media is arranged according to the needs and then converted into a media draft. This stage produces a structured digital product design that integrates three main components: mathematical material with mathematical literacy indicators, Discovery Learning learning syntax and the contextual content of Deli Malay ethnomathematics. The e-module structure is designed dynamically through the selection of easy-to-read fonts, as well as a green and golden yellow color scheme that represents the visual identity of Deli Malay culture. The e-module design in this study uses the Canva application which is arranged in such a way as to include material activities, examples, student worksheets and practice questions in an orderly and attractive manner, so that it can support students in mastering the desired competencies. The e-module design is presented in Figure 1.



Figure 1. E-Module Design Based on Ethnomathematics

the bottom to accommodate the embedding of dynamic multimedia elements on the Heyzine platform with interactive PPT presentation links. The arrangement of the learning

activity flow in the LKPD is adjusted sequentially based on the five syntaxes of Discovery Learning. The Stimulation and Problem Statement phases are presented through the guiding narration of a fictional character named "Deri" who invites students to explore cultural sites. By utilizing the Heyzine platform, this e-module design is able to display a realistic three-dimensional page- flip effect and is responsive to online access, thus creating a fun independent mathematics learning experience without burdening the storage memory of students' devices.

The third step in the development stage focuses on testing the theoretical feasibility of the initial product draft (prototype I) that has been designed. This feasibility testing is carried out through a content validation test by experts (expert judgment) consisting of material experts, media experts, and cultural experts using a Likert scale questionnaire instrument. The components evaluated include the entire learning device, including the Teaching Module, LKPD, material suitability content, aspects of the usefulness of flipbook media, relevance of cultural content, and mathematical literacy ability test instruments. Quantitative data from the assessment results from the validators are then calculated using the Aiken's V agreement index formula. A summary of the results of the content validity analysis for all instruments is presented in Table 3.

Table 3 Expert Validation Results

No	Learning Device Instruments	Average Aiken's V Index	Eligibility Category
1	Teaching Module Device	0.88	Very Valid
2	Student Worksheet (LKPD)	0.90	Very Valid
3	Substantial Aspects of Material	0.91	Very Valid
4	Flipbook Media Aspects	0.94	Very Valid
5	Aspects of Deli Malay Cultural Context	0.92	Very Valid
6	Mathematical Literacy Test Instrument	0.96	Very Valid
Accumulative Average		0.92	Very Valid

Based on the data presented in Table 3, the average accumulated Aiken's V index reached 0.92, categorized as Very Valid. This figure proves that the designed e-module prototype has a solid theoretical foundation and is relevant for 21st-century mathematics learning. The high validity value on the mathematical literacy test instrument (0.96) and the flipbook media aspect (0.94) occurred because the integration of the Canva and Heyzine Flipbook platforms was able to present dynamic, interactive, and non-monotonous data visualizations. This sparked students' logical interest through the Discovery Learning flow that guided them to construct an understanding of the Data Center Measurement material independently. The combination of green and golden yellow, typical of Deli Malay, also gave a humanistic impression, so that mathematics was no longer considered an abstract and intimidating subject.

The findings of this study extend those conducted by Gesty & Leonard (2025) , who developed an e-module based on Betawi culture but did not integrate mathematical literacy skills into the learning syntax. These high validation results also support the research of Widodo & Astuti (2026). regarding the effectiveness of interactive

ethnomathematics modules. However, the novelty of this research lies in the use of local Deli Malay cultural heritage objects as an authentic database presented digitally without burdening students' device storage memory through the Heyzine platform's 3D page-flip effect and designed with a more communicative approach and comfortable for students to read. This integration successfully bridges the gap between formal mathematical concepts and the local cultural realities surrounding the partner school environment.

The implications of this research provide alternative new digital teaching materials for teachers at partner madrasas in optimizing students' numeracy literacy based on ethnomathematics. However, this research has limitations, namely the development procedure is limited to the theoretical feasibility stage (Develop) without conducting large-scale field trials and dissemination stages (Disseminate). Therefore, the empirical effectiveness of the use of this flipbook e-module in improving student learning outcomes in the classroom still requires further experimental research.

CONCLUSION

This development research successfully produced a prototype of a mathematics learning device in the form of a flipbook- based e-module assisted by the Heyzine platform that integrates the Discovery Learning flow and the context of Deli Malay ethnomathematics in the Data Centralization Measure material. In line with the limitation of the 4D model development procedure which is focused on the feasibility stage, the results of the content validity test by experts indicate a very high level of product validity. This is evidenced by the accumulative average of the Aiken's V index of 0.92 which is in the very valid criteria. In detail, this theoretical validity is supported by the validity of the teaching module device of 0.88, student worksheets of 0.90, material substance content of 0.91, flipbook media design quality of 0.94, suitability of the content to the local cultural context of 0.92, and the student mathematical literacy ability test instrument which achieved the highest validity coefficient of 0.96.

Based on the results of the data analysis, it can be concluded that the e-module device The developed flipbook has met the quality standards of methodological, conceptual, and technical feasibility to be used as an innovative medium for 21st-century interactive digital mathematics teaching materials. The theoretical advantage of this product lies in its ability to present formal statistical material through visual stimulation of cultural objects close to the student's environment without burdening offline device storage. Through this theoretical feasibility test, the e-module prototype was declared valid and recommended for use in the next implementation or field trial stage to empirically measure its effectiveness in improving students' mathematical literacy abilities.

REFERENCES

- Dari, S. W., & Jatmiko. (2024). Analisis Peran Etnomatematika dalam Pembelajaran Matematika. *Seminar Nasional Sains, Kesehatan, Dan Pembelajaran 3*, 3(1), 269–278. <https://doi.org/https://doi.org/10.29407/wv109q65>
- Elya, & Lestari, P. (2025). Pengembangan modul digital berbasis canva dan heyzine flipbook untuk pembelajaran matematika siswa smp Pendahuluan Perkembangan

- teknologi informasi dan komunikasi di era digital telah memberikan. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu (PME)*, 04(02), 331–344. <https://doi.org/https://doi.org/10.31980/pme.v4i2.2874>
- Fauzy, F., Jesmin, M., Sahrudin, A., Nasir, & Makarim, M. A. (2024). Implentasi Media Interaktif Berbasis Heyzine Flibook terhadap Motivasi Belajar Siswa smp Negeri 12 Barru. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 09(04), 342–350.
- Gesty, H. A., & Leonard. (2025). Development Of Mathematics E-Module Based On Ethnomathematics. *JKTP: Jurnal Kajian Teknologi Pendidikan*, 8(2), 94–106. <https://doi.org/10.17977/um038v8i22025p094>
- Gulo, S., & Harefa, A. O. (2022). Pengembangan Media Pembelajaran Interaktif Berbasis Powerpoint. *EDUCATIVO: JURNAL PENDIDIKAN*, 1(1), 291–299. <https://doi.org/https://doi.org/10.56248/educativo.v1i1.40>
- Hayuning, M., Pribadi, P., Diah, N., Lestari, S., & Oktavianingtyas, E. (2023). Literasi Matematis Siswa SMA dalam Menyelesaikan Soal PISA Ditinjau dari Adversity Quotient. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 07(37), 2530–2542. <https://doi.org/https://doi.org/10.31004/cendekia.v7i3.2232>
- Kosandi, D. (2026). Pemanfaatan Media Pembelajaran Berbasis Teknologi di Sekolah Dasar. *Jurnal Pendidikan Guru Sekolah Dasar*, 1(2), 57–63.
- Nasution, A. G. J., Meilyani, Ramadhani, N., & Lismayani, S. (2023). Konsep Globalisasi Dalam Buku Pelajaran PKN di MI/SD. *EduInovasi: Journal of Basic Educational Studies*, 3(2), 190–199. <https://doi.org/47467/eduinovasi.v3.i2.3165>
- Noverisa, E. J., Setiawati, N., Prasetyo, V. M., Studi, P., Bahasa, P., & Jakarta, U. N. (2022). Pengembangan E-Modul Interaktifberbasis Android Dalam Mata Kuliah Bunpou I. *Jurnal Pendidikan Dan Bahasa Jepang*, 13(1), 64–78.
- OECD. (2023). *PISA 2022 Results: Factsheets – Indonesia*. OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/11/pisa-2022-results-volume-i-and-ii-country-notes_2fca04b9/indonesia_0e09c072/c2e1ae0e-en.pdf
- Prawitasuri, C. D., Shodiqin, A., & Prasetyowati, D. (2025). *Efektivitas Model PBL dan Discovery Learning Berbantuan Wolfram Mathematica Terhadap Kemampuan Literasi Numerasi Siswa Program PISA (Programme for International Student Assessment) yang pendekatan pembelajaran yang masih didominasi oleh metode konvensional yang*. 3(1), 59–69.
- Sartika, D., Lasmawan, W., Parmiti, D. P., & Syarifuddin. (2026). Ethnomathematics Based Project Based Learning Model In Mathematics Education. *Jurnal Pemikiran Keislaman Dan Kemanusiaan*, 10(1), 187–199. <https://doi.org/10.52266/tadjud.v10i1.6081>
- Sholeh, B., Hufad, A., & Fathurrohman, M. (2023). Pemanfaatan E-Modul Interaktif dalam Pembelajaran Mandiri Sesuai Kapasitas Siswa. *Risalah: Jurnal Pendidikan Dan Studi Islam*, 9(2), 665–672. https://doi.org/https://doi.org/10.31943/jurnal_risalah.v9i2.458
- Sigiro, A., Sukestiyarno, & Mulyono. (2023). Analysis of Mathematical Literacy viewed from Student Learning Independence in Problem-based Learning assisted by e-Modules with a Local Culture Themes. *Jurnal Pendidikan MIPA*, 24(3), 670–689. <https://doi.org/http://dx.doi.org/10.23960/jpmipa/v24i3.pp670-689>
- Sukma, Y. H., Rahmahtrisilvia, R., Iswari, M., Mahdi, A., & Setiawan, R. (2025). Analisis Indeks Aiken pada Uji Validitas Isi Instrumen Validasi Emotion Detection Tool bagi Anak Gangguan Spektrum Autisme. *Jurnal Pendidikan Kebutuhan Khusus*, 9(2), 93–103. <https://doi.org/https://doi.org/10.24036/jpkk.v9i2.1154>
- Supriyadi, E., Turmudi, T., Dahlan, J. A., Juandi, D., & Indonesia, U. P. (2024).

- Development Of Sundanese Gamelan Ethnomathematics E-Module For Junior High School Mathematics Learning. *MALAYSIAN JOURNAL OF LEARNING*, 2(2), 139–178. <https://doi.org/https://doi.org/10.32890/mjli2024.21.2.6>
- Taihuttu, S. M., Dahoklory, A. S. K., Sugiarto, S., Dadiara, Y., Koupon, E., Studi, P., Matematika, P., Pattimura, U., & Pendahuluan, A. (2025). Pengembangan Media Pembelajaran Interaktif Berbasis Etnomatematika Anyaman Daun Koli Menggunakan Aplikasi Canva Pada Materi Bangun Ruang Sisi Lengkung. *Pedagogy*, 10(4), 2531–2544. <https://doi.org/https://doi.org/10.30605/pedagogy.v10i4.7552>
- Wahyun, A., Hoon, T. S., & Choo, K. A. (2023). *Students ' Obstacles in Solving Non-routine Problems : A Case Study in an Islamic Secondary School* (Issue Cless 2023). Atlantis Press SARL. <https://doi.org/10.2991/978-2-38476-196-8>
- Widad, H. D., & Hadi, M. S. (2025). Realistic Mathematics Education , Kemampuan Pemecahan Masalah , dan Pembelajaran Matematika. *JIIP (Jurnal Ilmiah Ilmu Pendidikan)*, 8(2), 2309–2315. <https://doi.org/https://doi.org/10.54371/jiip.v8i2.7146>
- Widodo, W., & Astuti, E. P. (2026). Design: An interactive e-module based on ethnomathematics to improve numeracy skills of slow learners. *Indonesian Journal of Educational Development (IJED)*, 7(1), 96–109. <https://doi.org/https://doi.org/10.59672/ijed.v7i1.5440>
- Wulandari, T., Firsta, R. R., & Hartono, Y. (2025). Analisis Kemampuan Pemodelan Matematika Dan Penalaran Siswa Dalam Menyelesaikan Soal Kontekstual PISA. *Journal of Instructional and Development Researches*, 5(3), 302–312. <https://doi.org/https://doi.org/10.53621/jider.v5i3.538>
- Yanti, S. (2025). The Role Of Ethnomathematics In Enhancing Contextual. *International Journal of Humanity Advance, Business & Sciences*, 2(4), 321–330.
- Zahra, N. A., Rohman, F., & Handayani, I. (2025). Pengembangan LKPD berbasis Model Discovery Learning terintegrasi Etnomatematika Pola Tapis Lampung untuk Melatih Critical Thinking Peserta Didik Sekolah Dasar. *Jurnal Caksana: Pendidikan Anak Usia Dini*, 8(1), 396–409. <https://doi.org/https://doi.org/10.31326/jcpaud.v8i1.2231>