Primary: Jurnal Pendidikan Guru Sekolah Dasar
journal homepage: https://primary.ejournal.unri.ac.id/
contents lists available at SINTA and DOAJ

Vol. 14 No. 4 (2025): August
http://dx.doi.org/10.33578/jpfkip.v14i4.p485-498

Development of desmos application integrated ethnomathematics on geometry for grade IV UPT SDN 101826 Tuntungan

Frida Marta Argareta Simorangkir[1]*, Lolly Jean C. Simbulas[2], Ferry Indra Sakti H. Sinaga[3]

[1] Universitas Katolik Santo Thomas, Medan, Indonesia, 20134
[2] University of the Immaculate Conception, Davao City, Philippines, 8000
[3] Universitas Negeri Medan, Medan, Indonesia, 20221

Article info

Keywords
ADDIE, desmos, ethnomatematics, geometry, mathematics literacy

Abstract

Ulos, as one of the traditional fabrics of Batak Toba, can be used as a learning resource, especially for geometry. Every motif and colour on ulos has particular meanings and messages related to beliefs, myths, history, and Batak cultural values. Need help from Desmos to visualise the geometric concepts found in ulos. This research aims to develop a learning media using the Desmos application integrated with Ethnomathematics-Ulos to enhance mathematical literacy. The research method used is Research and Development with the ADDIE model. The research instrument uses a rating scale and an essay test. The results of developing material and language on geometry obtained a percentage of 93,69% with a very valid feasibility category. The results of product validation by practitioners as media experts got a very valid category with a rate of eligibility of 91,91%. Moreover, the teacher evaluation results got an efficient category with a percentage of 92,88%. The N-Gain value is 0,80 > 0,7, in the “High” category, meaning that the learning media effectively improve students' mathematical literacy skills.

* Corresponding Author.
E-mail address: frida_simorangkir@ust.ac.id (Frida Marta Argareta Simorangkir)
DOI: http://dx.doi.org/10.33578/jpfkip.v14i4.p485-498
Received 22 July 2025; Received in revised form 30 July 2025; Accepted 31 July 2025
Available online 31August 2025
e-ISSN 2598-5949 | p-ISSN 2303-1514 © The Authors.

1. Introduction

Nowadays, education in Indonesia needs to prepare students to be independent immediately, face challenges, overcome obstacles, and even become agents of change that benefit society, science and technology (Rafiqoh, 2020). The young generation of Indonesia needs to be educated to be resilient and have high resilience in facing challenges and overcoming conflicts, adaptive, and have a growth mindset (Johnson et. al, 2020). This can be

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

done in the learning process. Educators aid learners in acquiring knowledge, mastering skills and behaviour, and developing attitudes and beliefs.

One of the subjects that is important to learn in the learning process is mathematics. Mathematics is a universal science that underlies the development of modern technology today, and mathematics has an important role in solving life problems (Yeo, 2017). Mathematical literacy is understanding and applying mathematical concepts in solving real-world problems. Mathematical literacy certainly has a vital role for students. Mathematical literacy plays a crucial role in understanding the application of mathematics in everyday life, where its use can contribute to solving everyday problems related to mathematics (Gabriel et. al, 2020).

However, Indonesian students' mathematical literacy skills are still low. Education in Indonesia still has to solve several quality-related problems, including the low reading literacy and numeracy (mathematical literacy) scores of Indonesian students as reflected in the results of the TIMSS (Trends in International Mathematics and Science Study). TIMSS data show that the literacy and numeracy of Indonesian students are still below the average of international students (Math: 472, Science: 485, Reading: 476). Indonesian students rank 72nd out of 79 countries with an average score of 379 from a maximum score of 500 (Maysarah et al, 2023).

In addition, students' mathematics learning outcomes are lower than those of other subjects, as shown in Figure 1 below.

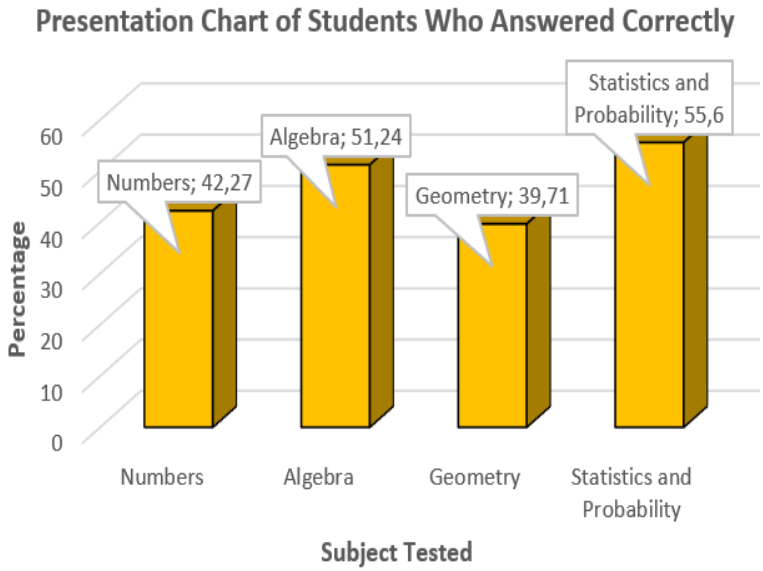

Figure 1. Elementary school students' achievement

Figure 1 shows that the average geometry score of elementary school students is lower than that of other subjects. Not all material in math is easy to understand, for example, geometry. Geometry is considered difficult to understand, especially if it is only taught traditionally or without media that helps with visuals. In addition to the difficulty of student understanding, technology is also a factor in the math learning process (Polly, 2016). With the development of technology, teachers must be able to adapt by continuing to develop their knowledge. In addition to teaching math, teachers need technical knowledge to use it effectively to learn math (Kristanto, 2020). This means that teachers must be able to use technology to facilitate students' mathematics learning (Belnap, et al., 2020).

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

One application that can help with math, especially geometry, is Desmos. The Desmos application can be accessed offline or online through the Desmos website. (Husna et al., 2020; Mungan, 2021). Desmos is a math application that can be used as a learning media tool for solving mathematics-related problems (Fatahillah et al., 2018; Husna et al., 2020). The math tools presented by Desmos are graphs, a scientific calculator, a four-function calculator, a matrix calculator, and other geometry tools. Desmos has a large selection of digital mathematical activities that can be searched, utilised, edited, and arranged as desired by the teacher through its website (Kristanto, 2021). By using Desmos, students will be helped in solving abstract problems and more easily understand math, especially geometry.

In addition to utilising the Desmos application, it is also necessary to adopt the richness of Indonesian culture into mathematics learning. Remembering Indonesia has a diversity of cultures and languages, local wisdom, natural resources, and abundant human resources, which are valuable capital to create more contextual and meaningful learning (Astuti, 2019). One way that can bridge the gap between culture and mathematics education is ethnomathematics. Ethnomathematics is an educational method that considers the relationship of mathematics with cultural and social aspects. Ethnomathematics research on geometry concepts in several cultures (Wikaningtyas et al, 2022). In addition, some researchers have researched ethnomathematics and its implementation in cultural relics such as temples. When associated with education, ethnomathematics is a research field that examines the history and concepts of mathematics, with implications for teaching (D'Ambrosio, 2007).

One of the tribes in Indonesia is the Batak Toba. The Batak Toba is a dispersed Batak ethnic group that is traditionally living in North Sumatra. Almost all traditional ceremonies found in the Batak Tribe must use ulos. Ulos is a customary tool in dalihan na tolu that binds kinship relationships (Jawa, et.al, 2024). The shape of the ulos variety can be related to geometry mathematics, so mathematics can be learned ethnomathematically by integrating the introduction and cultivation of culture in the mathematical concepts taught (Mailani, et.al, 2024). Therefore, cultural integration in the mathematics learning process can provide significant meaning for students and serve as a solution to preserve cultural heritage.

This study investigates mathematical principles in ulos that contain elements of geometry as a source of learning mathematics. The mathematical concepts explored in ulos are then visualised using Desmos as learning media. This can also help students enhance their mathematical literacy and better understand how ethnomathematics is used in their culture. As a result, the research outcomes can be used as a learning resource that enhances mathematics learning while exposing local culture connected to ethnomathematics.

2. Literature Review

Education and culture are two elements that support and complement each other in everyday life. Education plays an essential role in cultural inheritance, so cultural values must be applied in learning (Simorangkir, 2023). The research findings indicate the successful development of a learning media using the Desmos application integrated with Ethnomathematics-Ulos to enhance mathematical literacy. In general, the exploration of cultural products showed significant potential for integration in the mathematics learning process. Ethnomathematics is an approach that connects mathematics with mathematical concepts that exist in local culture (Ninggar et. al, 2024). Ethnomathematics provides space for integrating cultural elements in mathematics learning, allowing students to learn mathematics through contexts that are closer to students' experiences (Zayyadi et. al, 2025).

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

The traditional ulos cloth of the Batak tribe in North Sumatra has deep philosophical meanings and mathematical concepts, and it is also a beautiful work of art. The form of the Batak ulos variety can be associated with geometric mathematics, so mathematics can be studied culturally in ethnomathematics studies by integrating the introduction and instillation of culture in the mathematical concepts taught (Jawa et. al, 2024). Batak ulos has mathematical features such as rectangular and circular symmetry, and other geometric patterns. Rectangular symmetry is considered valuable and respected because it contains cultural and spiritual values passed down from generation to generation, such as symbols of beauty, accuracy, fixity, balance, unity, and spirituality that reflect the identical (Mailani et. al, 2024). Ulos is traditionally made using complex and time-consuming hand-weaving techniques. Every motif and colour on ulos has particular meanings and messages related to beliefs, myths, history, and Batak cultural values. Therefore, the study of ethnomathematics can be observed in the ulos weaving activity (Aziz et al, 2012).

There are many learning platforms available, one of which is Desmos. Desmos is a web-based platform or service that offers a variety of mathematical tools, digital math activities, and curricula to facilitate high-level learning for students in an enjoyable way through the web or application. The mathematical tools provided by Desmos include a graphing calculator, a scientific calculator, a four-function calculator, a matrix calculator, and geometry tools. Desmos provides calculators and offers many digital math activities that teachers can search for, use, or edit through its website. In addition, teachers can develop their own interactive Desmos learning activities through the website and easily share them with other teachers or their students (Kristanto, 2021).

In Indonesia, the use of Desmos as a medium for mathematics learning has not been widely adopted. As a result, the researchers decided to create an online interactive learning media based on Desmos for geometry material. Previous research conducted by Hwang et.al (2015) found that a contextual approach through computer games enables learners to experience meaningful learning and helps connect the concepts they study with real-world scenarios. Desmos has been developed as an online interactive learning medium. However, the Desmos used was only its graphing calculator, not the Desmos Activity Builder, and the material covered was not Geometry. By utilising the advantages of Desmos, which has many features for activities that can help students discover mathematical concepts, the ethnomathematics-based Ulos geometry material contextualised with students' lives is integrated. This is what constitutes the novelty in this research.

3. Method

The research method used is development research (Research & Development) with the ADDIE development model. Development research is an effort to produce a product that can be used in learning. A qualitative descriptive analytic approach was used to handle data from language and material expert evaluations, media experts, student trials, and subject teacher trials. The ADDIE model uses a systems approach. The essence of the systems approach is to divide the planning process into steps, organise the steps into a logical sequence, and then use the outputs of each step as inputs to the next step.

This research was conducted to develop a Desmos application design integrated with Ethnomathematics-Ulos to enhance mathematical literacy. The construction of this application design includes audio-visual material with geometry-based questions to help students improve their literacy skills. The material used is geometry at the elementary school level, which affects

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

mathematical literacy skills. This research was conducted at Grade IV UPT SDN 101826 Tuntungan, Deli Serdang Regency. Small group trials with the number of subjects nine students, and large group trials with the number of subjects 36 students. The Ethnomathematics-Ulos integrated Desmos application provides the material to enhance mathematical literacy skills.

The ADDIE development model consists of Analysis, Design, Development, Implementation and Evaluation (Allen, 2006; Salas-Rueda et al., 2020). The following is a picture of the development media using the ADDIE model:

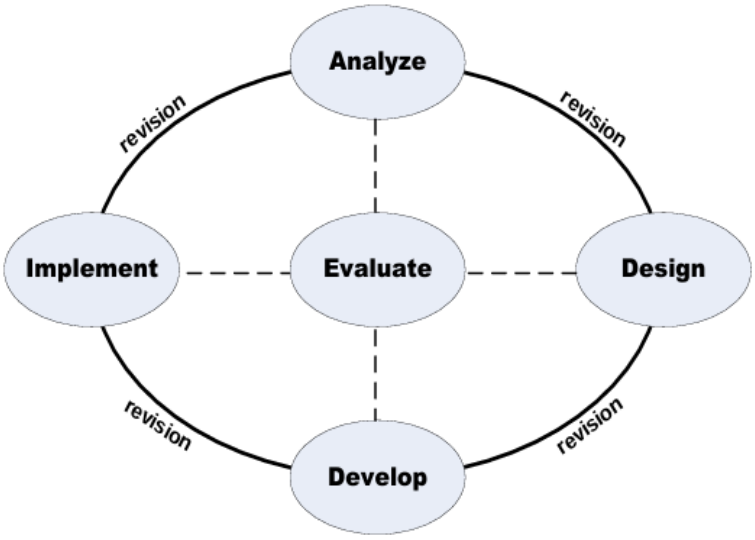

Figure 2. Stages of development with the ADDIE model

Based on Figure 2, the stages in ADDIE can be explained as follows:

1) The analysis stage involves analysing problems and the needs of students at UPT SDN 101826 Tuntungan. Observations were conducted at UPT SDN 101826 Tuntungan to identify problems and analyse needs to determine students' learning needs related to learning media development.
2) The design stage involves drafting a media development plan according to the needs analysis results. This stage also includes collecting materials or sources to be used as a reference when making media. At this stage, researchers design ethnomathematics-based application media based on geometry material.
3) The development stage begins with compiling learning media products according to the design from the previous stage. Material collection and the learning media development process are carried out at this stage. During the development stage, the media is conceptualised and transformed into a product, specifically a Desmos application.
4) The implementation stage begins with testing the draft learning media on teachers and students. Students' comments and suggestions become a reference for improving the media, which is then produced as draft learning media. Furthermore, the draft learning media is tested on large groups of students.
5) The last stage is evaluation. Comments and suggestions obtained from expert validators, teachers, and students become supporting factors used by researchers in improving the media so that it can be improved by researchers in improving the media to produce the final draft learning media (final draft). At the evaluation stage, participants who have used the media are given a response questionnaire to determine the practicality of the media and

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

given a mathematical literacy ability test to determine the effectiveness of increasing their ability and the effectiveness of the use of the media that has been given. Each phase is evaluated and revised from the stages, so the resulting product becomes valid.

In addition, the effectiveness of the media was evaluated through pre-test and post-test questions done by students. The test type used is an essay with as many as four questions. N-Gain is used to assess the improvement of students' mathematical literacy after using learning media.

$$g = \frac{s_{posttest} - s_{pretest}}{s_{max} - s_{pretest}}$$

The results of the N-Gain score calculation are analysed using Hake criteria adapted from (York, 2016; Ayuni, et. al, 2020), as shown in Table 1.

Table 1. N-gain index criteria

Score	Category	Description
g ≥ 0,7	High	Very effective
0,3 ≤ g < 0,7	Medium	Effective
g < 0,3	Low	Not effective

Based on Table 1, the learning media is effective if the N-Gain score is at least “medium”.

4. Results and Discussion

4.1 Experts' validation of learning materials and language

The validation outcomes of materials and language experts are presented in Table 2.

Table 2. Results of validation by material and language experts

Aspect Assessed	Percentage (%)	Category
1. Learning media content	93,45	Convenient
2. Supporting material presentation	94,33	Convenient
3. Contextual Approach	93,29	Convenient
Average	**93,69**	**Convenient**

The validation data from Table 2 indicates that the learning media achieved an average feasibility score of 93.69%, falling into the "Convenient" category. This high rating suggests the Desmos application, enhanced with the proposed features, is well-suited for student use. The consistent scores above 90% across all assessed areas demonstrate the significant potential of this Desmos-integrated ethnomathematics application to improve geometry education for fourth-grade students (Zahara et al., 2023). The thorough validation process ensures the instructional materials are both conceptually robust and culturally relevant, thereby facilitating a deeper grasp of geometric principles through an ethnomathematical framework (Jehurung et al., 2025). Furthermore, the uniform "Convenient" classification reinforces the media's readiness for deployment, pending minor adjustments (Zahara et al., 2023). This rigorous validation process underscores the methodological soundness of incorporating ethnomathematics within a digital learning environment like Desmos, indicating its potential to significantly enhance pedagogical approaches to geometry.

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

The results of practitioner validation can evaluate the Desmos application's practicality as a learning medium. The validation data obtained from practitioners is a basis for assessing the media's practicality before its implementation in the field. The results of validation by Practitioners are presented in Table 3.

Table 3. Results of validation by practitioners

Aspect Assessed	Percentage (%) Practitioner 1	Percentage (%) Practitioner 2	Average	Category
1. Appropriateness of using learning media	90,25	92,33	91,29	Convenient
2. Presentation Technique	93,36	91,45	92,41	Convenient
3. Software Engineering	91,49	92,57	92,03	Convenient
Average			**91,91**	**Convenient**

The practitioner validation results, detailed in Table 3, indicate that the developed Desmos application has an overall feasibility percentage of 91.91%, falling within the 'Convenient' category. This assessment strongly suggests that the Desmos application serves as an effective tool for educational endeavors, a finding consistent with research highlighting the importance of high-quality, practical learning resources for impactful instruction (Agustin & Wintarti, 2021). The uniformly positive feedback from both material/language experts and practitioners validates the integrated Desmos application as a dependable, pedagogically sound tool with substantial potential for broader implementation in elementary geometry education (Pratiwi et al., 2020; Umairoh & Amaliyah, 2022). This thorough validation process establishes a firm groundwork for subsequent development and deployment phases, ensuring the tool's efficacy across varied classroom environments (Hidayati et al., 2020). Furthermore, the consistently high scores across all validation metrics underscore the ethnomathematics-integrated Desmos application's dual strengths in theoretical soundness and practical viability for enhancing students' geometric understanding and engagement (Zahara et al., 2023).

4.2 Practicality based on teacher evaluation result

The following data is presented in the teacher evaluation results.

Table 4. Teacher evaluation results

Aspect Assessed	Percentage (%)	Category
1. Learning media content	92,35	Efficient
2. Supporting material presentation	94,25	Efficient
3. Contextual Approach	93,49	Efficient
4. Linguistics	90,55	Efficient
5. Appropriateness of using learning media	92,37	Efficient
6. Presentation technique	93,58	Efficient
7. Software engineering	93,63	Efficient
Average	**92,88**	**Efficient**

Based on the data in Table 4, which details teacher evaluations of the developed learning media, it can be described that the learning media generally obtained an average feasibility score of 92.88%, categorized as 'Efficient'. The teacher evaluation activity yielded no suggestions or comments on the tested products, indicating the learning media is ready for

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

small-group student testing. This iterative refinement process, moving from expert and practitioner validation to teacher evaluations and finally to small-group student testing, ensures that the Desmos application is not only theoretically sound but also highly practical and effective for its intended users (Kurniawati et al., 2021; Yensasnidar, 2020). This comprehensive validation approach further supports the assertion that the developed resource is a robust and valuable addition to pedagogical tools for geometry education, aligning with similar findings regarding the utility of validated educational software (Cahyani et al., 2025; Surya et al., 2020). The consistent positive feedback across multiple validation stages reinforces the media's potential to significantly enhance students' mathematical understanding and engagement, as observed in similar effective educational interventions (Risnawati et al., 2018).

4.3 Practicality based on student trial results

The implementation stage is carried out in two stages: small group trials (small scale) and large group trials (large scale). The following data is presented as the results of the small group student trials as follows. Based on the data in Table 5 above related to the results of small group student trials on the learning media developed, it can be described that, in general, the learning media developed can be used as a learning tool. Learning media developed can be described in general, the learning media obtain a feasibility percentage of 93,13% with an efficient interpretation. This high percentage indicates strong student acceptance and usability, confirming the media's readiness for larger-scale implementation (Zahara et al., 2023). The consistency in positive evaluations from practitioners, teachers, and small groups of students underscores the robust design and user-friendliness of the Desmos-integrated ethnomathematics application (Uzmi et al., 2023). Such results align with previous research demonstrating that well-validated educational technologies are highly effective in fostering student engagement and learning outcomes.

Table 5. Small group student trial results

Aspect Assessed	Percentage (%)	Category
1. Learning media content	93,53	Efficient
2. Supporting material presentation	93,15	Efficient
3. Presentation technique	93,39	Efficient
4. Use of learning media	92,45	Efficient
Average	**93,13**	**Efficient**

Based on the small group trial results, it can be concluded that Desmos-based online interactive learning media is effective. The learning media developed receive a convenient category or interpretation, and the learning media can be tested on large groups of students after improvement. The following data on the results of the large group student trials are as follows:

Table 6. Large group student trial results

Aspect Assessed	Percentage (%)	Category
1. Learning media content	92,53	Efficient
2. Supporting material presentation	93,35	Efficient
3. Presentation technique	93,59	Efficient
4. Use of learning media	92,15	Efficient
Average	**92,90**	**Efficient**

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

Based on the data in Table 6 above related to the results of the large group student trials on the learning media developed, the learning media achieve a feasibility percentage of 92,90% with an efficient interpretation. In the large group student trial activities, there are no suggestions or comments regarding the products tested. It can be concluded that the Desmos application is developed with an efficient category or interpretation, and the learning media reach the final product.

The last stage in this research and development is evaluation. The following presents the data on the results of the media evaluation at each stage:

Table 7. Media evaluation results at each stage

Aspect Assessed	Percentage (%)	Category
1. Validation by Material and Language Experts	93,69	Convenient
2. Validation by Practitioners	91,91	Convenient
3. Teacher Evaluation Results	92,88	Efficient
4. Small Group Student Trial Results	93,13	Efficient
5. Large Group Student Trial Results	92,90	Efficient
Average	**92,90**	**Efficient**

Based on the data in Table 7 above, at the product validation stage by material and language experts, this learning media gets a very valid feasibility category with a percentage of eligibility of 93,69%. The results of product validation by Practitioners as media experts get a convenient category with a percentage of eligibility of 91,91%. Then, the teacher evaluation results are in an efficient category with a percentage of 92,88%. The results of small group student trials obtain an efficient category with a percentage of 93,13% and a large group trial obtains a practical category with 92,90%. Then the average feasibility obtained from all assessments is 92,90%; if interpreted, this learning media gets an efficient category.

4.4 Exploring ethnomathematical values in ulos motifs

The purposes of digital learning activities developed using Desmos on geometry material are (1) understanding flat shapes, (2) understanding shapes, elements, and properties of flat shapes, and (3) understanding the relationship between flat shapes. Several activities use Desmos in geometry, as follows:

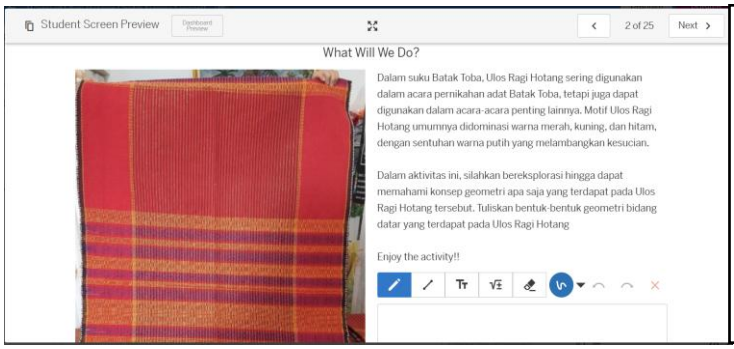

Figure 3 shows the *Ragi Hotang*. In the Toba Batak tribe, *Ragi Hotang* is often used in traditional Toba Batak weddings, but can also be used in other important events. *Ragi Hotang* motifs are generally dominated by red, yellow and black, with a touch of white which symbolizes purity.

Figure 3. *Ragi Hotang*

In Figure 3, students explore until they understand the basic geometric concepts of the Ulos Ragi Hotang, such as points, lines, line segments, rays, rectangles and rhombuses.

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

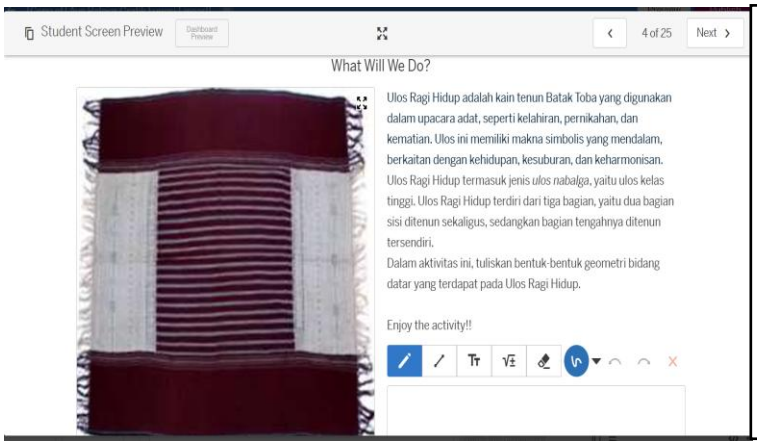

Figure 4 shows the *Ragi Hidup*. *Ragi Hidup* used in traditional ceremonies, such as birth, marriage and death. This ulos has a deep symbolic meaning, related to life, fertility, and harmony. *Ulos Ragi Hidup* is a type of nabalga ulos, which is a high-class ulos. Ulos Ragi Hidup consists of three parts, with the two sides woven together, while the center is woven separately.

Figure 4. *Ragi Hidup*

In Figure 4, students explore until they can understand the basic geometric concepts in the Ulos Ragi Hotang, such as points, lines, line segments, rays, rectangles and squares. The research and development of Desmos-based learning media with ethnomathematics-ulos on geometry material were conducted regarding the ADDIE development model. Based on the research conducted from the analysis stage to the evaluation stage, comments and suggestions were obtained from expert validators, teachers, and students. The comments, suggestions, and guidance became supporting factors used by the researcher in the media revision process, resulting in a good and effective mathematics learning media used to improve the mathematical literacy skills of grade IV elementary school students.

4.5 Effectiveness of the learning evaluation tool

Pre-test and post-test results of mathematical literacy ability can be seen based on the results of the N-Gain test. It can be concluded that seven students (19%) were classified in the category “Medium” and 29 students (81%) were classified in the “High” category with an average N-Gain score of 0,80. Because the N-Gain value was 0,80 > 0,7, it is in the “High” category. The paired t-test (t-test Pair) using SPSS 26 produced a t-value of 11.565, greater than the t-table value (2.030). This result shows a significant difference between the pre-test and post-test scores, meaning that the learning media effectively improve students' mathematical literacy skills. Thus, it can be concluded that developing a learning media using the Desmos application integrated with Ethnomathematics-Ulos proved valid, practical, and effective in enhancing students' mathematical literacy skills.

5. Conclusion and Implications

Based on the research results, Desmos, integrated with Ethnomathematics-Ulos, which the researcher developed, is convenient and practical for geometry as a learning medium to enhance mathematical literacy. The learning media already contain content and context close to students, especially those related to ulos in Batak culture. It can make students actively argue and provide ideas according to their creativity, understanding and learning experience. Using technology in learning media can facilitate students' learning with a good visual representation of geometry based on the animation provided.

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

Geometry concepts in ulos can be integrated into mathematics learning. This shows that ethnomathematics can help students understand mathematical concepts better because of its relevance to contextual life and develop students' mathematical literacy skills. However, in implementing the integration of ulos in mathematics learning, an active role of the teacher is needed to link the patterns in ulos with formal mathematical concepts.

The research implication shows that, to support the development of mathematical literacy, especially in geometry, it is imperative to develop learning media by incorporating elements of local culture, technology, and visualisation, all of which lead to the process of reasoning and literacy. In the motifs of Batak Ulos, mathematical concepts in the form of repeating patterns and geometry are found, allowing for the application of mathematical concepts (ideas) present in Ulos. Ulos is an element of Batak culture that can be used as a medium for teaching mathematics in schools; thus, mathematics education can begin by introducing local culture, such as Ulos. This improves students' mathematical literacy in geometry and prepares them for more complex mathematical literacy.

As such, the ethnomathematics ulos-based Desmos not only preserves local culture but also effectively develops students' mathematical literacy skills. This study has limitations, namely, the scope of the ethnic mathematics of the Toba Batak Ulos woven fabric patterns explored is still small. From the aspect of ethnomathematics studies, it is still limited to examining the geometric shapes in the motifs seen on Ulos. Many other aspects can still be researched, including the production process and the weaving patterns that form images with specific colours. Therefore, further research is needed on the more complex ethnic mathematics of Ulos Batak Toba woven fabric patterns to improve students' mathematical literacy skills and instil a love of culture in the young generation. The abundance of Batak cultural products should be used as a specific recommendation for teaching mathematics in schools to preserve the cultural heritage.

References

Agustin, E., & Wintarti, A. (2021). Pengembangan Media Pembelajaran Mobile Learning Berbasis Android Pada Materi Pola Bilangan. JP2M (Jurnal Pendidikan Dan Pembelajaran Matematika), 7(1), 10. https://doi.org/10.29100/jp2m.v7i1.1860

Allen, W. C. (2006). *Overview and Evolution of the ADDIE Training System*. Advances in Developing Human Resources, 8(4). https://doi.org/10.1177/1523422306292942

Astuti, S. (2019). Eksplorasi Etnomatematika Kain Ulos Batak Toba Untuk Mengungkap Nilai Filosofi Konsep Matematika. *Jurnal MathEducation Nusantara*, 2(1), 45–50. https://doi.org/10.54314/jmn.v2i1.60

Ayuni, Q., Noer, S. H., & Rosidin, U. (2020). Pengembangan Lembar Kerja Peserta Didik Berbasis Problem Based Learning Dalam Meningkatkan Kemampuan Representasi Matematis Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 9(3), 694. https://doi.org/10.24127/ajpm.v9i 3.2747

Aziz, N. M. A., Embong, R., Abd Wahab, Z., & Maidinsah, H. (2012). Konsepsi Pensyarah Matematik UiTM ke Atas Corak Tenunan Songket: Satu Kajian Kes. Menemui *Matematik (Discovering Mathematics)*, 34(1), 113–120.

Belnap, K. J, & Parrott, A. (2020). "Putting Technology in Its Place." doi: http://dx.doi.org/10.5951/MTLT.2019.0073

Cahyani, Y. F. D., Fatayan, A., & Amaliyah, N. (2025). Pengembangan media pembelajaran interaktif berbantuan canva untuk meningkatkan semangat peserta didik pada materi

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

ipas kelas v. SCIENCE Jurnal Inovasi Pendidikan Matematika Dan IPA, 5(2), 441. https://doi.org/10.51878/science.v5i2.4878

D'Ambrosio, Ubiratan. (2007). *Peace, Social Justice And Ethnomathematics*. The Montana Mathematics Enthusiast, Monograph, 1(2007), 25–34

Desmos. (n.d.). About Us. Retrieved from https://www.desmos.com/about

Fatahillah, A., Nisyak, R., Trapsilasiwi, D., & Susanto. (2018). Pengembangan media pembelajaran interaktif online menggunakan shoology berbantuan web desmos materi grafik fungsi kuadrat. Kadikma, 9(2). https://jurnal.unej.ac.id/index.php/kadikma/article/view/10244/6532

Gabriel, F., Buckley, S., & Barthakur, A. (2020). The impact of mathematics anxiety on self-regulated learning and mathematical literacy. *Australian Journal of Education*, *64*(3), 227-242. https://doi.org/10.1177/0004944120947881 (Original work published 2020)

Hidayati, A., Bentri, A., Yeni, F., Zuwirna, & Eldarni. (2020). The Development of Instructional Multimedia based on Science, Environment, Technology, and Society (SETS). Journal of Physics Conference Series, 1594(1), 12016. https://doi.org/10.1088/1742-6596/1594/1/012016

Husna, U., Setiawani, S., & Hussen, S. (2020). Pengembangan Media Pembelajaran Interaktif Menggunakan Classflow Berbantuan Web Desmos pada Materi Penerapan Integral Tentu. *Jurnal Riset Pendidikan Dan Inovasi Pembelajaran Matematika (JRPIPM)*, 4(1). https://doi.org/10.26740/jrpipm.v4n1.p37-52

Hwang, G., Chiu, L., & Chen, C. (2015). Computers & Education A contextual game-based learning approach to improving students ' inquiry-based learning performance in social studies courses. *Computers & Education*, 81, 13–25. https://doi.org/10.1016/j.comp edu.2014.09.006

Jehurung, P., Dominikus, W. S., & Wulakada, H. H. (2025). Pengembangan bahan ajar elemen geometri topik lingkaran berbasis etnomatematika pada sistem lodok di masyarakat manggarai. SCIENCE: Jurnal Inovasi Pendidikan Matematika Dan IPA, 5(2), 996. https://doi.org/10.51878/science.v5i2.6187

Januszewski, A. and Molenda, M. (2008). *Technology: A Definition With Commen tary* (New York: Lawrence Erlbaum Associates). DOI**:** 10.12691/education-2-12-5

Jawa, P. I. J., Sidabalok, A. R. S., Rudhito, M. A. (2024). Etnomatematika pada Pakaian Adat Ulos Batak Toba dan Implementasi dalam Rancangan Pembelajaran Matematika. *Proximal: Jurnal Penelitian Matematika dan Pendidikan Matematika*, 7(1), 180-189. https://doi.org/10.30605/proximal.v7i1.3204

Johnson, H.L., McClintock, E.D. & Gardner, A. Opportunities for Reasoning: Digital Task Design to Promote Students' Conceptions of Graphs as Representing Relationships between Quantities. *Digit Exp Math Educ* 6, 340–366 (2020). https://doi.org/10.1007/s40751-020-00061-9

Kristanto, Y. D. (2020). Teknologi dalam Belajar Mengajar Matematika: Bermatematika Dahulu, Teknologi Kemudian. *SEAMETRICAL*, 1(1), 20–21. http://repository.usd.ac.id/id/eprint/37913

Kristanto, Y. D. (2021). Matematika Digital Dengan Menggunakan Desmos. *Jurnal Pengabdian Kepada Masyarakat*, 27(3), 192–199.

Kurniawati, A. D., Ratnawulan, R., & Fauzi, A. (2021). Practicality of interactive multimedia of natural science integrated with the theme of motion in life using an integrated scientific approach to 21st-century learning. Journal of Physics Conference Series, 1876(1), 12049. https://doi.org/10.1088/1742-6596/1876/1/012049

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

Mailani, E., Lase, J. B. T., Lumban Gaol, M. K., Hutapea, N. P. A., & Rarastika, N. (2024). Kajian Etnomatematika Konsep Geometri dalam Corak Kain Ulos Sumatera Utara. *Jurnal Arjuna : Publikasi Ilmu Pendidikan, Bahasa Dan Matematika*, *2*(6), 135–143. https://doi.org/10.61132/arjuna.v2i6.1320

Maysarah, S., Saragih, S., & Napitupulu, E. (2023). Peningkatan Kemampuan Literasi Matematik Dengan Menggunakan Model Project-Based Learning. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 12(1), 1536. https://doi.org/10.24127/ajpm.v12 i1.6627

Mungan, C. E. (2021). *Using Desmos to Understand the Difference Between Phase and Group Velocity*. The Physics Teacher, 59(1). https://doi.org/10.1119/10.0003012

Ninggar, A. D., Restian, A., Danawati, M.G. (2024). Corrigendum to "Development of congklak-based ethnomathematics media for teaching fractional numbers to grade V students". Primary: Jurnal Pendidikan Guru Sekolah Dasar, 13(4), 171-183. https://doi.org/10.33578/jpfkip-v13i4.p171-183-corrigendum

Nursyeli, F., & Puspitasari, N. (2021). Studi Etnomatematika pada Candi Cangkuang Leles Garut Jawa Barat. *Plusminus: Jurnal Pendidikan Matematika*, 1(2), 327-338. https://doi.org/10.31980/plusminus.v1i2.905

Rafiqoh, S. (2020). Arah kecenderungan dan isu dalam pembelajaran matematika sesuai pembelajaran abad 21 untuk menghadapi revolusi 4.0. *Jurnal MathEducation Nusantara*, 3(1), 58–73. DOI: https://doi.org/10.24127/ajpm.v12i4.8257

Pratiwi, W., Hartono, & Suhery, T. (2020). Development of Chemistry Teaching Materials Based on STEM Problem Based Learning on Solution Chemistry Materials for Students of Chemistry Education Study Program. Proceedings of the 4th Sriwijaya University Learning and Education International Conference (SULE-IC 2020). https://doi.org/10.2991/assehr.k.201230.090

Polly, D. (2016). Exploring the Relationship between the Use of Technology with Enacted Tasks and Questions in Elementary School Mathematics. International Journal for Technology in Mathematics Education, 23(3), 111–118.

Risnawati, R., MZ, Z. A., & Sari, N. (2018). The development of learning media based on visual, auditory, and kinesthetic (VAK) approach to facilitate students' mathematical understanding ability. Journal of Physics Conference Series, 1028, 12129. https://doi.org/10.1088/1742-6596/1028/1/012129

Rosa, M., & Orey, D. C. (2011). Ethnomathematics: the cultural aspects of mathematics. *Revista Latinoamericana De Etnomatemática Perspectivas Socioculturales De La Educación Matemática*, *4*(2), 32-54. https://revista.etnomatematica.org/index.php/RevLatEm/article/view/32

Safitri, R. R., & Sulistyorini, Y. (2023). Studi etnomatematika geometri pada artefak peninggalan sejarah di Kota Malang. *Mathema: Jurnal Pendidikan Matematika*, 5(2), 258-268. https://doi.org/10.33365/jm.v5i2.2876

Salas-Rueda, R.-A., Salas-Rueda, É.-P., & Salas-Rueda, R.-D. (2020). Analysis and Design of the Web Game on Descriptive Statistics through the ADDIE Model, Data Science and Machine Learning. *International Journal of Education in Mathematics, Science and Technology*, 8(3), 245. https://doi.org/10.46328/ijemst.v8i3.759

Simorangkir, F. M. A. (2023). Ethnomatematics exploration on gondang batak musical instruments assisted by Geogebra. *IJEMS: Indonesian Journal of Education and Mathematical Science*, 4(1), 7-13. DOI: http://dx.doi.org/10.30596%2Fijems.v4i1.13113

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]

Surya, E. P., Purba, C., Syahputra, E., Haris, D., Mukhtar, & Sinaga, B. M. V. (2020). Batak Toba culture on mathematics learning process at Medan high school. Journal of Physics Conference Series, 1613(1), 12063. https://doi.org/10.1088/1742-6596/1613/1/012063

Tanjung, D. S., Ambarwati, N. F., Juliana, & Prayuda, M. S. (2024). Application of the Problem Based Learning Model to Improve Students ' Learning Outcomes and Critical Thinking Ability on Mathematics Lessons in Primary School. Jurnal PAJAR (Pendidikan Dan Pengajaran), 8(3), 307–318.

Tanjung, D. S., & Juliana. (2022). Pengaruh Model Pembelajaran Berbasis Proyek terhadap Hasil Belajar Matematika Siswa Sekolah Dasar. Elementary School Journal PGSD FIP Unimed, 12(1), 37–44.

Tanjung, D. S., & Juliana. (2023). The Effect of Giving Rewards on Fifth-Grade Elementary Students ' Mathematics Learning Outcomes Pengaruh Pemberian Reward Terhadap Hasil Belajar Matematika Siswa Kelas V Sekolah Dasar. 12(6), 1396–1406.

Tanjung, D. S., Juliana, & HS, D. W. S. (2023). Improving Fourth-Grade Students' Learning Outcomes Using the Discovery Learning Method in Indonesian at SD Negeri 200111 Padangsidimpuan. Primary: Jurnal Pendidikan Guru Sekolah Dasar, 12(5), 1302–1313.

Tanjung, D. S., Siregar, Y. S., & Juliana. (2025a). Analysis of Most Significant Bit (MSB) Steganography Method in an IoT-Based Keyboard Learning System. Brilliance: Research of Artificial Intelligence, 5(1), 37–43.

Tanjung, D. S., Siregar, Y. S., & Juliana. (2025b). Internet of Things (IoT) Based Keyboard Learning Application Model For Preventing Carpal Tunnel Syndrome. Journal of Information Systems Engineering and Management, 10(16s), 2468–4376.

Tanjung, D. S., Tamba, R. S. H., Sinaga, V., & Tarihoran, A. C. (2025). Penerapan Model Pembelajaran Project-Based Learning Untuk Meningkatkan Hasil Belajar Ipas Peserta Didik Kelas Vi-B SD. School Education Journal Pgsd Fip Unimed, 15(1), 61–70.

Umairoh, S. H., & Amaliyah, N. (2022). Educational Comic-Based Digital Media to Increase Reading Interest of Elementary School Students. Jurnal Ilmiah Pendidikan Profesi Guru, 5(2), 300. https://doi.org/10.23887/jippg.v5i2.50378

Wikaningtyas, C. R., Hayati, N., & Rahmasari, K. N. (2022). *Kajian Etnomatematika Terkait Aspek-aspek Geometri pada Rancang Bangunan Rumah Adat Larik*. Prosiding Seminar Nasional Matematika (PRISMA), 5, 414–422. https://journal.unnes.ac.id/sju/prisma/article/view/54548

Yeo, J. B. W. (2017). Development of a framework to characterise the openness of mathematical tasks. International Journal of Science and Mathematics Education, 15(1), 175–191. https://doi.org/10.1007/s10763-015-9675-9

Yensasnidar, Y. (2020). Validitas Modul Pembelajaran Mata Kuliah Gizi Kulinari Dasar Berorientasi Problem Besed Learning (PBL) Untuk Mahasiswa Gizi di Stikes Perintis Padang. Jurnal Pendidikan dan Keluarga, 11(2), 48. https://doi.org/10.24036/jpk/vol11-iss1/661

York, R. O. (2016). *Statistics for human service evaluation*. Sage Publications.

Zahara, S. L., Suwignyo, H., & Kusumaningrum, S. R. (2023). Development of Applications Media Interactive Based on Articulate Storyline 3 for Early Reading. Jurnal Syntax Admiration, 4(8), 1187. https://doi.org/10.46799/jsa.v4i8.692

Zayyadi, M., Surahmi, E,. Aini, S. D., & Hidayat, D. (2025). Ethnomathematics based traditional games as a pedagogical approach to enhance logical-mathematical intelligence. *Jurnal Elemen*, 11(1), 225-244. https://doi.org/10.29408/jel.v11i1.28350.

Primary: Jurnal Pendidikan Guru Sekolah Dasar is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
[e-**ISSN** 2598-5949 | p-**ISSN** 2303-1514]