



Integrating Sundanese Culture and Digital Technology: Designing an Ethnomathematics-Based Worksheet Using GeoGebra for Conic Sections

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ABSTRACT

Students struggle to determine simple equations when given the asymptotes and vertices or the equation of a hyperbola and the length of the major axis. This difficulty stems from the limited learning resources educators use when teaching conic sections. This study aims to develop GeoGebra-assisted worksheets that contextualize the concept of conic sections in a way that is valid and practical for high school students. This is a development study based on the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The test subjects in this study were 16 students from a private high school in Cianjur during the 2024–2025 academic year. The results of this study indicate that the GeoGebra-assisted worksheets for pupils, featuring contextual problems on the topic of conic sections, are valid and practical. The average expert validation score was 83.3%, meaning the average expert validation score falls within the “Highly valid” category and is suitable for testing. Meanwhile, the percentage of student responses to the GeoGebra-assisted worksheets developed was 75%, falling into the “Practical” category. This indicates that the developed material can be used as a teaching aid for senior secondary school students on the topic of conic sections. Developing mathematics teaching materials in the form of GeoGebra-assisted worksheets on the topic of conic sections for senior secondary school students, which have been tested for validity and practicality. The results of the development show that (1) the assessment of the GeoGebra-supported worksheets regarding the aspect of presentation suitability, using the Guttman scale, yielded an average of 83.3%, meeting the criterion of “highly valid.” (2) The results of the practicality test, based on student assessments in the student response questionnaire, yielded an average of 81% for indicator 1, meeting the criterion of “highly practical”; 79% for indicator 2, meeting the criterion of “practical”; and 67% for indicator 3, meeting the criterion of “practical.” Thus, it can be concluded that the worksheets teaching materials supported by the GeoGebra application on the topic of Conic Sections for senior high school/vocational school students have been proven to be valid and practical.

Keywords: conic sections; GeoGebra; sundanese culture

INTRODUCTION

One of the main challenges in improving pupils’ understanding of the concept of conic sections is the difficulty in visualising complex geometric shapes and understanding the relationship between these sections and the resulting shapes, such as circles, ellipses and parabolas (Siregar et al., 2024). Many students studying conic sections are still unable to determine the equation of a simple conic section, such as a cone, a parabola, or the length of the major axis of an ellipse. They are also unable to determine simple equations when they know the asymptotes and vertices, or the equation of a hyperbola when they know the length of the major axis. Furthermore, many students are still unable to answer questions on the topic of conic sections correctly and accurately (Sadidah & Sudihartinih, 2023). Because educators use monotonous, teacher-centred learning models, students’ retention of material

on conic sections is low (Pertiwi et al., 2023). Due to a lack of understanding and an inability to recall material that has been studied, many students are still unable to identify the elements present in a diagram of a conic section. The main difficulty lies in explaining how the elements of a conic section relate to one another (Pasaribu & Suratman, 2022).

A common problem encountered in the topic of conic sections is that students are unable to determine the equation of a simple conic section when they know the asymptotes and the vertex, or the equation of a hyperbola when they know the length of the major axis. Furthermore, many students are still unable to answer questions on conic sections correctly and accurately. To address the problems arising in the topic of conic sections, the GeoGebra application is used to enhance students' understanding of the subject. Of the three journals identified, all three focus on the development of GeoGebra-based learning resources. To improve students' ability to learn independently, the GeoGebra software is used as a learning tool that can be utilised by both teachers and students during the learning process. To begin creating this learning resource, teachers must determine which material is appropriate to use as the main topic. Conic sections, which include text and graphics, as well as practice questions and simulations, were the chosen material (Monalisa et al., 2023). GeoGebra is one of the applications used to help students learn mathematics, particularly geometry (plane figures). It is a dynamic and interactive geometry software that can improve student learning outcomes. GeoGebra is a computer program used to teach mathematics, particularly algebra. GeoGebra software enables the use of points, vectors, line segments, lines, conic sections and functions to build dynamic geometric systems. For students wishing to learn how to create geometric constructions, GeoGebra software is extremely helpful. GeoGebra features a menu for constructing various geometric shapes (particularly two-dimensional ones) (Kepemimpinan et al., 2024). With GeoGebra, students can directly visualise examples of the three-dimensional shapes they are studying. Furthermore, GeoGebra allows users to draw and determine equations and coordinates directly, which is highly beneficial for long-term learning (Rahadyan & Diah, 2019).

Various previous studies have shown that the use of GeoGebra in teaching conic sections can improve spatial ability (Pasaribu & Suratman, 2022), reasoning skills (Wahyuni et al., 2017), and critical thinking (Mulyati Mustika Sari et al., n.d.). Furthermore, GeoGebra has been widely applied to a variety of subjects, including calculus, statistics, algebra, geometry and solid geometry. Other research also demonstrates that GeoGebra-based worksheets are valid and practical when used in other geometry topics such as 3D geometry (Sugiarni et al., 2025).

Meanwhile, Pratama et al. (2024) show that the use of worksheets designed using the GeoGebra application with a basketball context which is close to everyday life can help students understand mathematical concepts. These findings suggest that presenting familiar experiences to students is a strategic step towards bridging abstract concepts. This principle of contextualisation is not only relevant to the use of everyday objects but can also be extended to deeper and more meaningful cultural contexts. In line with this, ethnomathematics research confirms that integrating culture into learning can facilitate the understanding of abstract concepts whilst fostering local cultural values (Muzaki et al., 2022). Thus, both everyday and cultural contexts essentially serve as bridges that enrich the learning experience; however, a culture-based approach offers greater depth of meaning.

On the other hand, studies on ethnomathematics confirm that cultural elements can serve as a meaningful context for building an understanding of mathematical concepts whilst integrating local cultural values (Sugiarni, 2025b). Indeed, the ethnomathematics approach has proven effective when integrated into worksheets on number patterns using the context of Sunda Pupuh (Aulia et al., 2025). However, there has been little research explicitly integrating Sundanese culture into the development of GeoGebra-based worksheets on conic sections, despite this topic being recognised as abstract and challenging, and the limited availability of contextual learning resources. Based on the above, the objective of this development is to integrate Sundanese culture and digital technology in the creation of a valid and practical GeoGebra-assisted ethnomathematics worksheet on the topic of conic sections for senior secondary school students.

RESEARCH METHODS

The research method employed in this study is the R&D (Research and Development) method, which is a research method used to investigate and develop new products and subsequently test the effectiveness of those products (Sugiyono, 2013).. This study utilized the ADDIE development model. The ADDIE development model comprises five stages: Analysis, Design, Development, Implementation, and Evaluation (Hamzah, 2021). The aim of this study is to integrate Sundanese culture and digital technology in the creation of a valid and practical Geogebra-assisted ethnomathematics worksheet on the topic of conic sections for 16 students at a private senior high school in Cianjur. The development procedure is illustrated in Figure 1.

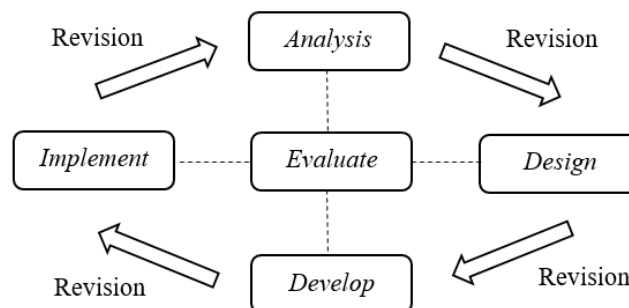


Figure 1. Research Flowchart

Development took place from the design of the GeoGebra application on 9 September 2024 until the pilot testing of the GeoGebra application on 10 December 2024. The pilot test sample consisted of 16 secondary school students selected at random. The instruments used were the GeoGebra application validation instrument and the GeoGebra application usability instrument, both in the form of questionnaires. The validation questionnaire was completed by expert validators to determine the validity of the GeoGebra application in terms of presentation suitability, instructional design criteria, technical quality, media display and communication indicators, with the indicators for each aspect presented in Table 1.

Table 1. Matrix of the Validation Sheet for GeoGebra-assisted Worksheets

Aspect	Indicators	Item Number
Instructional	Choice of typeface and font.	1
	Selection of colour schemes and screen display	2
	Geometric images	3
	Consistency of scrolling	4
Design Criteria	Language usage	5
	Clarity of usage instructions in the LK	6
	Ease of use	7
	Screen usage efficiency	8
Technical Quality	Clarity of terminology	9
	Text efficiency	10
	Visual clarity	11
Criteria Aspek	Accuracy of content	12
	Alignment with learning objectives.	13
	Clarity of content description	14

The presentability aspect was measured using a Guttman scale, employing two scoring alternatives and assessment categories: a score of 1 for the “Yes” category and a score of 0 for the “No” category. The validity of the GeoGebra application was assessed in terms of instructional design criteria, technical quality criteria, media presentation criteria, and communication indicator criteria using a five-point Likert scale, ranging from a score of 1 (poor), 2 (fair), 3 (good), 4 (very good), and 5 (excellent). The student response questionnaire was completed by students to ascertain their assessment of the GeoGebra-assisted worksheets in terms of usefulness and ease of use, comprising indicators in the matrix presented in Table 2.

Table 2. Outline of the Student Response Questionnaire

No.	Indicator
1	Shows enthusiasm for mathematics lessons
2	Demonstrates a serious attitude towards classroom activities
3	Shows enthusiasm for learning mathematics using the Geogebra-based math app.
4	Demonstrates enthusiastic engagement with the learning process
5	Shows interest in the subject matter
6	Demonstrates a good grasp of the topic of conic sections with the aid of Geogebra

The scores and rating categories in the student feedback questionnaire use a 5-point Likert scale, with categories ranging from ‘disagree’ to ‘strongly agree’. The data analysis techniques applied to the data obtained from the instruments encompass both qualitative and quantitative data. Qualitative data analysis techniques were used to present general comments and validators’ suggestions for improving or revising the worksheets supported by the Geogebra application. Meanwhile, quantitative data analysis techniques were used to present the results from the validation sheets and the student response questionnaires in Table 3.

Table 3. Categorisation of the Practicality of Worksheets Assisted by the GeoGebra Application

No	Practical Criteria	Practicality
1	80.01% - 100%	Very practical
2	60.01% - 80.00%	Practical
3	40.01% - 60.00%	Not very practical
4	20.01% - 40.00%	Not practical
5	00.00% - 20.00%	Very impractical

RESULTS AND DISCUSSION

The results of the development of the GeoGebra application, which contains high school-level material on conic sections, aim to assess its validity and practicality. The results of the GeoGebra application development at each stage are explained as follows:

Analysis Stage

The analysis stage is the initial step, involving literature reviews and field studies. This activity aims to collect and analyze information regarding the problems and needs of students in the current learning process, specifically in mathematics and particularly concerning the topic of conic sections, the characteristics of students during the learning process, and the teaching materials used. Many students struggle to grasp abstract geometric concepts when learning about conic sections using GeoGebra. Shapes such as parabolas, ellipses, and hyperbolas can be formed by the intersection of a cone with a plane. Without a sufficient understanding of how these sections are formed, students often find it difficult to visualize them, even though GeoGebra can provide a clear visual representation. Because small changes in the angle of intersection can produce very different cross-sectional shapes, students are often confused when adjusting the position and plane of the cone's intersection. For students who are not yet familiar with this software, it will also be difficult to master tools such as drawing cones or determining points of intersection.

Students also face an additional challenge when they have to understand the mathematical symbols that appear in GeoGebra and relate them to the geometric shapes they produce. Students must understand the basic concepts of conic sections theoretically before using GeoGebra to visualize these problems. Students can gain a better understanding of how changes in scale affect the shape of the section by experimenting directly with GeoGebra's tools and using video tutorials. This will help students gain a better understanding of the topic of conic sections.

Design Stage

During this stage, we compiled the learning materials and designed the GeoGebra application, starting by aligning the learning objectives with the school's existing curriculum. We then sought out the best references from various sources to design the cone section. This ensured that our design was grounded in relevant and robust theoretical foundations. This process involves studying digital learning materials that cover the design of conic sections comprehensively and in depth. By combining the available information, we are able to create a design of conic sections that is accurate and mathematically sound while also making the design engaging and easy for students to understand. This method will facilitate a learning process that offers high-quality, interactive learning materials relevant to students' needs. We explored the application of mathematics to the topic of conic sections using the GeoGebra application, tailored to our objectives. The application we designed is shown in Figure 2.

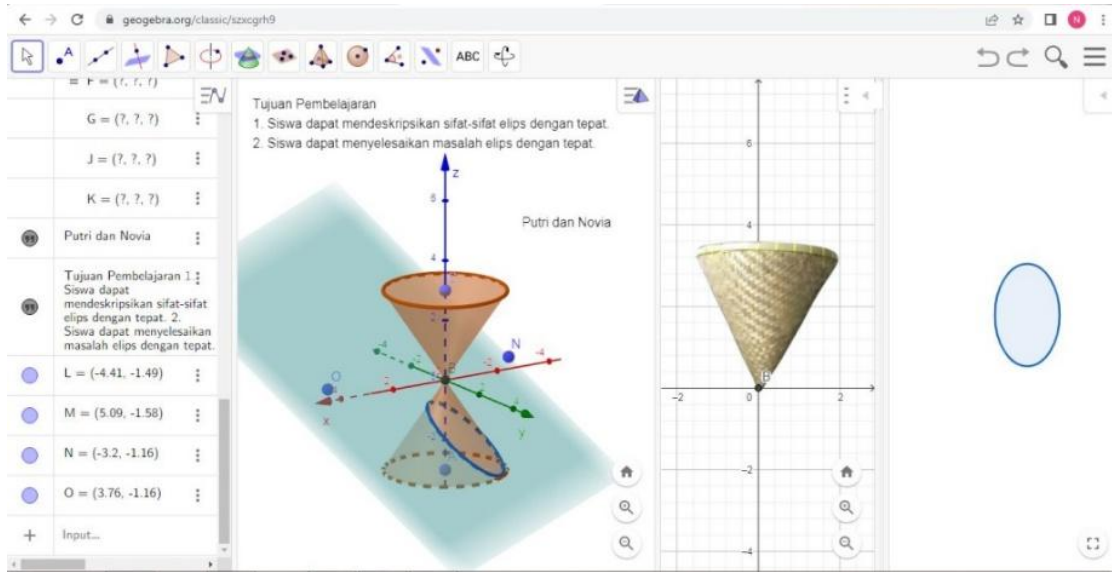


Figure 2. Design of Cone Slices in the GeoGebra Application

During the design phase, we explored this within the context of a single learning objective for the topic of conic sections, which we subsequently supplemented with a student worksheet to enhance understanding of the topic, as shown in Figure 3.

Fase E (SMA kelas XI)

Kurikulum Merdeka

LKPD

(Lembar Kerja Peserta Didik)

Irisan Kerucut

Nama: _____

Kelas: _____

TUJUAN

Pembelajaran

1. Siswa dapat mendeskripsikan sifat-sifat elips dengan tepat.
2. Siswa dapat menyelesaikan masalah elips dengan tepat.

Petunjuk Kerja

1. Tekan titik tiga (☰) lalu pilih 3D.
2. Kemudian klik kanan dan klik munculkan bagian 2D untuk memunculkan bentuk 2D. kemudian buat sebuah bidang dengan mengisi $ax + by + cz + d = 0$ pada kolom yang tersedia (input bar).
3. Tekan gambar piramida lalu akan banyak pilihan 3D dan pilih yang bentuk cone.
4. Setelah itu, kalian tekan titik -3 di sumbu y negatif dan tekan di titik 0 lalu kalian isi jari-jarinya 2, maka akan muncul bentuk kerucut, begitupun di sumbu y positif.
5. Jika kalian tekan slider dan mengeser sesuai ukuran akan membentuk lingkaran, elips, parabola atau hiperbola.
6. Selanjutnya kalian tekan intersect two surfaces (memotong dua permukaan), lalu klik pada garis perpotongan kerucut.
7. Kemudian klik kanan dan klik munculkan bagian 2D untuk memunculkan bentuk 2D - nya.
8. Kembali ke slider, lalu arahkan slider ke titik $a = -1,1$; $b = 1,7$; $c = 2,4$; $d = 3,1$ maka akan membentuk elips.

Petunjuk

1. Siswa di arahkan untuk berdo'a sebelum mengerjakan LKPD.
2. Buka GeoGebra (<https://www.geogebra.org/classic>)
3. Amati, dan ikuti langkah-langkah yang sesuai petunjuk kerja.
4. Coba sebutkan sifat-sifat elips pada gambar yang ada di GeoGebra.

SCAN ME

Barcode ke web GeoGebra

Latihan Soal

1. Pada saat kalian mengeser slider, maka amati ketika posisi pias nya horizontal, maka irisan yang di peroleh berbentuk (a)
- Ketika posisi nya miring tidak sampai ujung maka bentuk yang di peroleh (b)
- Ketika posisi nya miring dan sampai ke ujung atau alas kerucut maka akan membentuk (c)
- Sedangkan ketika posisinya vertikal atau tegak lurus, maka bidang potongnya akan berbentuk (d)

Latihan Soal

3. Sebuah kerucut lalu lintas memiliki tinggi 60 cm dan diameter alas 40 cm. Pada permukaan samping kerucut terdapat lubang ventilasi berbentuk elips untuk mengurangi tekanan angin agar kerucut tidak mudah terjatuh. Lubang ventilasi tersebut memiliki sumbu utama sepanjang 30 cm dan sumbu minor sepanjang 16 cm. Tentukan persamaan elips yang menggambarkan bentuk lubang ventilasi jika pusat elips dianggap berada di titik (0, 0) dan sumbu utamanya sejajar dengan sumbu y.

Penyelesaian

1. (a) (b)
- 6) (d)

2. Diketahui:

- Tinggi kerucut (t) = cm
- Diameter alas (d) = cm
- Panjang sumbu utama 2a = cm, dan a = cm
- Panjang sumbu minor 2b = cm, dan b = cm

Ditanya:

- Persamaan elips yang mewakili bentuk lubang ventilasi jika pusat elips dianggap berada di titik (0, 0) dan sumbu utamanya sejajar dengan sumbu x.

Jawab:

• Bentuk persamaan elips:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Substitusi a = dan b =

$$\frac{x^2}{\dots} + \frac{y^2}{\dots} = 1$$

Sehingga,

$$\dots + \dots = 1$$

Jadi, persamaan elips yang mewakili bentuk lubang ventilasi adalah:

Kesimpulan

SELAMAT MENGERJAKAN

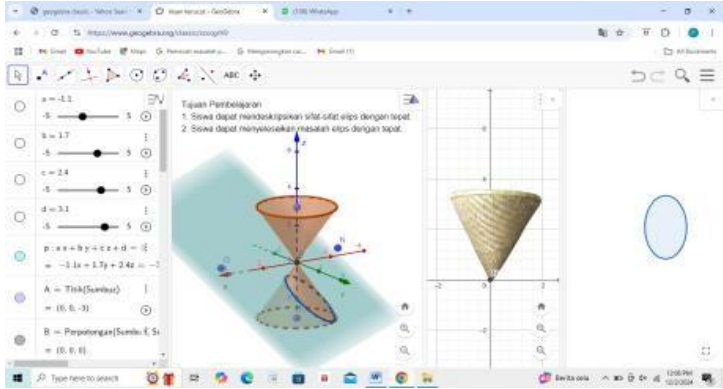
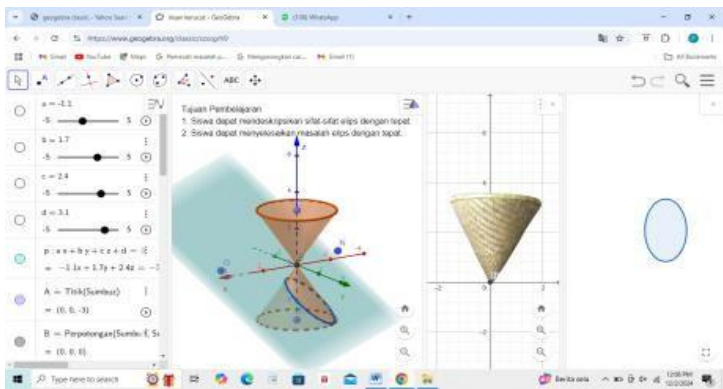
Figure 3. Student Worksheet on Cone Slices

Development Stage

The worksheet, which has been designed and saved as a document, is then developed further by incorporating animations, backgrounds and images relevant to the explanation of the topic of cone slices.

During this development stage, the results of the application developed using GeoGebra received feedback and suggestions from experts. The suggestions and improvements for the GeoGebra application are shown in Table 6, and those for the worksheet in Table 4. Display the development of the GeoGebra application in the form of screenshots/images.

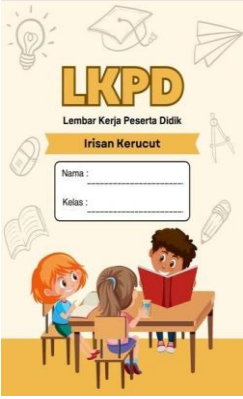



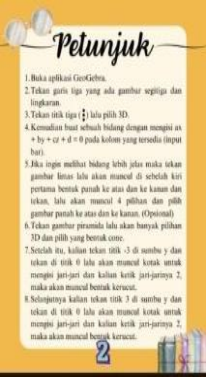

Table 4. Suggestions and Improvements for the GeoGebra Application

GeoGebra Figure	Suggestions and Improvements
Before Revision	
	
After Revision	
	<p>P1: The GeoGebra application is already good.</p> <p>P2: The GeoGebra is already Good</p> <p>P3: The GeoGebra is already good</p>

In Table 5, we describe the development of a GeoGebra application for teaching the topic of conic sections using a contextual approach. This method was chosen because it links mathematical concepts to real-life situations, making it easier for students to understand the material. This development uses GeoGebra to visualize the shapes of conic sections—such as circles, ellipses, parabolas, and hyperbolas—while linking them to everyday objects commonly used in the local community. This method allows students to learn how the shapes of conic sections can appear in the real world. This makes learning more engaging and beneficial. Students can also learn interactively with GeoGebra by manipulating the elements of the conic sections directly within the application. This enables them to observe the relationship between changes in the shape of the cone and the resulting sections.

Therefore, by using GeoGebra to implement the contextual approach to aseupan, students not only gain a better understanding of geometric concepts but can also incorporate local culture into their learning process

Table 5. Suggestions and Improvements to the Worksheets

Worksheets		Suggestions and Improvements
Before Revision	After Revision	
		<p>P1: The worksheet requires some minor improvements. Firstly, the instructions should be condensed, and the questions should be formulated in line with the objectives.</p> <ol style="list-style-type: none"> 1. Questions should identify the properties of the observed ellipse in GeoGebra. 2. Identify issues relating to ellipses, supported by step-by-step solutions. 3. Provide Exercises 1–2 4. a conclusion.
		<p>P2: It would be better to include a barcode in the worksheets to access the web application, so that it is easier for students to access it. Also, if possible, provide physical examples that can be brought into the classroom during lessons so that students can see them first-hand.</p>
		


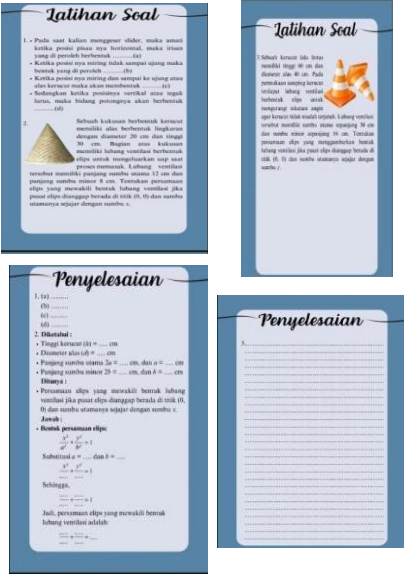
Worksheets		Suggestions and Improvements
Before Revision	After Revision	
		<p>P3:</p> <ol style="list-style-type: none"> 1. It would be advisable to include the phrase 'accurately' in the learning objectives. For example: Pupils can describe the properties of an ellipse accurately. 2. The worksheets must state the class/year group and the school's name. 3. The instructions or steps at the beginning of the worksheet should include a prayer first.

Table 5 above is a worksheet. A worksheet is a learning tool designed to help students understand the material independently or with the guidance of a teacher. Worksheets typically include learning objectives, activity steps, and practice questions related to the subject being studied. The LKPD enables students to follow a systematic learning pathway due to its structured format. The LKPD is vital for enhancing student engagement in the learning process when used effectively. It helps students think critically, analyze, and solve problems. Furthermore, the LKPD assists teachers in directing learning activities to achieve learning objectives. Additionally, the LKPD allows students to learn independently outside the classroom, enabling them to study and deepen their knowledge as required. Careful planning is required to design worksheets that are appropriate to students' abilities and needs. Good worksheets should use simple, engaging language that is age-appropriate. Furthermore, the activities presented must be contextual so that students can relate them to their daily lives. In this way, worksheets can become an effective learning tool that enhances students' understanding of the subject matter.

The validation sheets completed by the validators were then analysed to determine the level of validity criteria for the GeoGebra application developed. The validation results for the GeoGebra application, based on each validator's assessment, are presented in Table 6.

Table 6. Validation results for the GeoGebra application and worksheets

Validator	Empirical Score	Maximum Score	Average Validity Percentage for Each Validator	Validity Criteria
Validator 1	4	5	83%	Highly Valid
Validator 2	4	5	84%	Highly Valid
Validator 3	4	5	83%	Highly Valid
Overall Average Percentage			83.3%	Highly Valid

Table 6 shows that the validation results for the GeoGebra application regarding the suitability of presentation yielded an average combined percentage from the three validators

of 83.3%, meeting the ‘Highly Valid’ criterion. This demonstrates that the GeoGebra application developed has been structured in accordance with the format and mandatory components required for a GeoGebra-assisted worksheet packaged in electronic form.

Validator	Empirical Score	Maximum Score	Average Validity Percentage for Each Validator	Validity Criteria
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Implementation Stage

Once the validity of the developed LKPD and GeoGebra had been tested and revisions made in accordance with the validators’ suggestions, the next step in the implementation stage involved conducting a limited trial of the LKPD and GeoGebra with a small group comprising five senior secondary school students.

The pilot study began by teaching students how to use GeoGebra and explaining the activities and components available within the software. Students were then invited to undertake several learning activities presented in the worksheets, including completing the exercises and problems in the worksheets and practicing using GeoGebra. Finally, the students were given a student response questionnaire. The assessments in the student response questionnaire were then analyzed to determine the data on the practicality of the worksheets and GeoGebra in the form of the combined average percentage of 16 students and the practicality criteria, which are presented in Table 7.

Table 7. Data on the Practicality of the Worksheets and GeoGebra

Indicator	Score Total Group	Percentage	Category
1	228	81%	Very practical
2	443	79%	Practical
3	140	67%	Practical

It was found that the average percentage of student assessment results for the worksheets and GeoGebra on the topic of conic sections at the senior secondary school level, for indicator 1, was 81% with the criterion “Very practical”; for indicator 2, it was 79% with the criterion “Practical”; and for indicator 3, it was 67% with the criterion "Practical." Based on the responses provided by students in the student feedback questionnaire whilst using the GeoGebra application and worksheets, it was found that they were not yet familiar with the GeoGebra application and had not yet mastered the topic of conic sections in depth; furthermore, when presented with questions regarding conic sections, they were still unsure about the types of conic sections. The students then suggested that, before working on the worksheets, the presentation of the conic sections material should be clarified further. The GeoGebra application is designed to be interactive and intuitive, as well as practical and easy to understand, thanks to its features that support visual learning and its ease of use for both teachers and students. Furthermore, through engaging simulations and explorations, the learning activities presented by GeoGebra can also help students understand mathematical concepts in greater depth. By using this application, students can enhance their understanding of various mathematical topics, including calculus, geometry, and algebra.

Evaluation Stage

The evaluation stage in this study was limited to formative evaluation only, namely evaluation aimed at improving the worksheets and GeoGebra activities developed based on the results of the validity and practicality tests. The worksheets and GeoGebra activities were revised based on the suggestions provided by the validators on the validation sheets. Areas requiring improvement in the worksheets include: simplifying the instructions; ensuring questions align with the objectives; including questions to identify the properties of the observed ellipse in GeoGebra; providing step-by-step solutions to help solve ellipse-related problems; and including 1–2 practice questions and a conclusion. Furthermore, it would be preferable to include a barcode in the worksheets to access the web application, thereby making it easier for students to access the web application. Additionally, physical examples, if available, should be brought into the classroom during lessons so that students can observe them directly. Furthermore, the learning objectives should ideally include the phrase “accurately”. For example: Students can describe the properties of an ellipse accurately. The worksheet must include the class/year group and school details, and the instructions or initial steps should begin with a prayer. As for GeoGebra, there is nothing that needs to be improved, as all three validators have provided positive feedback, so no changes are required. Based on the results of the GeoGebra development, the products created in GeoGebra for the high school-level topic of ‘Conic Sections’ fall into the categories of ‘Highly valid’ and ‘Highly practical’.

Teaching mathematics through the integration of Sundanese culture and digital technology offers a new, more contextual and meaningful approach, particularly when covering the topic of conic sections. The use of ethnomathematics in the design of Student Worksheets enables pupils to link mathematical concepts to cultural objects that are close to their lives, as explained by Sugiarni (2025) who emphasises the importance of culturalising mathematics in learning. Within the Sundanese cultural context, various objects such as the *angklung*, the *geulis umbrella*, or *batik patterns* can be used to illustrate parabolas, ellipses, or hyperbolas, enabling students to see the direct relevance between mathematical forms and cultural representations. This integration is further strengthened when combined with GeoGebra technology as an interactive visual learning tool. A number of previous studies have demonstrated the effectiveness of using GeoGebra in supporting mathematical understanding, such as visual media in linear programming material (Sugiarni et al., 2025), basketball-based contextual media for quadratic functions (Pratama et al., 2024), and the integration of GeoGebra into worksheets for 3D geometry, which has been shown to enhance students’ mathematical engagement (Sugiarni et al., 2025). Further findings by (Sugiarni, 2025a) also confirm that the transformation of digital teaching materials based on local wisdom becomes more meaningful, particularly when presented using GeoGebra, as it facilitates independent exploration of concepts.

In the development of GeoGebra-based ethnomathematics worksheets on the topic of conic sections, the results regarding validity and practicality indicate that the integration of technology with the Sundanese cultural context is a key factor in the success of the product. GeoGebra’s interactive nature enhances students’ creativity (Yulianti et al., 2025) and enables students to visualise concepts of conic sections clearly. Its comprehensive features, ranging from geometry to 3D graphics, align with the findings of Sugiarni et al. (2025), which demonstrate that the use of GeoGebra in worksheets can enhance student

engagement and understanding through direct exploration. Consequently, the integration of GeoGebra with the Sundanese cultural context can serve as an effective learning alternative for teachers to deliver a more meaningful and contextual learning experience. Consequently, teachers can utilise these worksheets as a supporting tool to enrich culture- and technology-based mathematics learning. This model encourages pupils to learn more actively and independently, and to connect mathematical concepts with elements of local culture. In addition to enhancing conceptual understanding, this approach also strengthens pupils' cultural and digital literacy. However, this study has limitations as it has not empirically tested the effectiveness of the worksheets in improving learning outcomes. Therefore, the recommendation for future research is to test its effectiveness through experimental or quasi-experimental designs, as well as to evaluate the implementation of this worksheet in various classroom settings and educational levels.

CONCLUSION

Teaching conic sections, particularly ellipses, using the GeoGebra application with a contextual approach has proven effective in enhancing students' understanding. By using GeoGebra to visualize the shapes of conic sections interactively, concepts such as the ellipse become easier to understand and more engaging for students. This approach also improves students' retention and boosts their motivation to learn. Students can observe changes in shape in real-time using GeoGebra's slider feature. This makes learning easier to grasp and less monotonous. To ensure the material is suitable for use, the development process also involved validation by experts, who provided feedback on the effectiveness of the visualizations and the clarity of the explanations presented in the software. Overall, through a relevant contextual approach and engaging visualizations, GeoGebra can help students become more engaged and better understand the subject of conic sections.

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