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Development of curved surface building modules assisted by Wingeom using the inquiry method in Grade IX at SMPN 1 Koto Baru, Dharmasraya Regency

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Abstract

The primary issue in this study was the low learning outcomes of students at State Junior High School 1 Koto Baru, Dharmasraya Regency, as the packaged books on curved surface geometry lack guidance and activities that enable students to derive formulas for the material. The minimal use of technology, animation, and graphics in the material also made learning less enjoyable, which results in a lot of learning information not being absorbed by students during the learning process. To address this, there was a need for teaching materials that could improve students' learning outcomes. Therefore, the purpose of this research was to develop a module for curved surface geometry, based on inquiry assisted by Wingeom, to improve students' learning outcomes that was valid, practical, and effective. This type of research was Research and Development (R&D) using the 4D model. This research produced a module containing a module cover, module foreword, table of contents, introduction, learning outcomes, learning objectives, concept map, instructions for use, learning activities, sample questions, practice questions, summary, competency test, glossary, answer key, and bibliography. The module products were validated by experts, and practicality and effectiveness tests were conducted by 21 students in grade IX of SMPN 1 Koto Baru in Dharmasraya Regency. The instruments used in this study included validation sheets, student response questionnaires analyzed using percentage formulas, and the students' learning outcome tests were analyzed using the N-Gain formula. The research findings indicate that the module on curved surface geometry, based on inquiry with the assistance of Wingeom, aims to improve student learning outcomes, as assessed by 3 validators with an average score of 79,44% in the valid category. The practicality was assessed by students at 82,83%, placing it in the very practical category. In terms of effectiveness, a score of 0,74 was achieved, categorized as high improvement.

Keywords: Module on Curved Surface Shapes, Inquiry, Wingeom, Student Learning Outcomes

Abstrak

Masalah utama dalam penelitian ini adalah rendahnya hasil belajar siswa di SMPN 1 Koto Baru, Kabupaten Dharmasraya, karena buku paket tentang geometri permukaan lengkung tidak memberikan panduan dan kegiatan yang memungkinkan siswa memperoleh rumus-rumus untuk materi tersebut. Penggunaan teknologi, animasi, dan grafik yang minim dalam materi tersebut juga membuat pembelajaran menjadi kurang menyenangkan, yang mengakibatkan banyak informasi pembelajaran tidak terserap oleh siswa selama proses pembelajaran. Untuk mengatasi hal ini, diperlukan bahan ajar yang dapat meningkatkan hasil belajar siswa. Oleh karena itu, tujuan penelitian ini adalah mengembangkan modul geometri permukaan lengkung berbasis inkuiri yang dibantu oleh Wingeom untuk meningkatkan hasil belajar siswa yang valid, praktis, dan efektif. Jenis penelitian ini adalah Penelitian dan Pengembangan (R&D) dengan menggunakan model 4D. Penelitian ini menghasilkan sebuah modul yang berisi sampul modul, kata pengantar modul, daftar isi, pengantar, hasil belajar, tujuan pembelajaran, peta konsep, petunjuk penggunaan, kegiatan pembelajaran, contoh soal, soal latihan, ringkasan, tes kompetensi, glosarium, kunci jawaban, dan daftar pustaka. Produk modul telah divalidasi oleh para ahli dan uji kepraktisan serta efektivitasnya dilakukan oleh 21 siswa kelas IX SMPN 1 Koto Baru di Kabupaten Dharmasraya. Instrumen yang digunakan dalam penelitian ini meliputi lembar validasi dan kuesioner tanggapan siswa yang dianalisis menggunakan rumus persentase, sedangkan uji hasil belajar siswa dianalisis menggunakan rumus N-Gain. Hasil penelitian menunjukkan bahwa modul geometri permukaan lengkung, yang berbasis inkuiri dengan bantuan wingeom, bertujuan untuk meningkatkan hasil belajar siswa, yang dinilai oleh 3 validator dengan skor rata-rata 79,44% dalam kategori valid. Kepraktisan dinilai oleh siswa sebesar 82,83%, termasuk dalam kategori sangat praktis. Untuk efektivitas, dicapai skor 0,74 yang dikategorikan sebagai peningkatan tinggi.

Kata kunci: Modul tentang Bangun Ruang Sisi Lengkung, Pendekatan Inkuiri, Wingeom, Hasil Belajar Siswa

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INTRODUCTION

Mathematics learning is a type of learning aimed at training thinking and logic in concluding, honing problem-solving skills, as well as improving the ability to convey information or express ideas through spoken words, writing, images, graphs, maps, diagrams, and various other means, according to the Ministry of Education and Culture (Rizqi & Surya, 2017). According to Content Standards (Minister of National Education Regulation Number 22 of 2006), it is stated that all students, starting from elementary school, need to take mathematics lessons to develop logical, analytical, systematic, critical, and creative thinking skills, and the ability to cooperate (Hasanah & Surya, 2017; Permatasari, 2021).

Based on observations of learning activities conducted at State Junior High School 1 Koto Baru, Dharmasraya Regency, it was found that student learning outcomes were still low. In the initial observation, the researcher directly monitored the learning process and found that teachers provided only formulas and practice questions without allowing students to play an active role in learning. As a result, the students are unable to understand the meaning of the material they are studying. From the mathematics exam results, it appears that the average student score has not yet met the Minimum Competency Criteria set by the school, which is 75.

Another factor contributing to the low learning outcomes of students is the teaching materials used at the school. The teaching materials used by students at State Junior High School 1 Koto Baru, Dharmasraya Regency, are mathematics textbooks from the 2013 curriculum. In the learning process, the use of textbooks as a learning resource is still not optimal because the language used in the books is difficult to understand, and the material in the books is still limited. The weakness of these textbooks is that much of the material presented is abstract and complicated, such as the material on curved shapes, so that students are not interested in reading or studying it.

After the researchers observed and studied the textbooks used by teachers and students for curved surface geometry, they found that, in general, the available textbooks did not provide sufficient guidance and activities for students to derive formulas for the material. The problems given in the textbook on curved surface shapes are not contextual, so students are only bound by the teacher's explanation. The minimal use of technology, animation, and graphics in the material also makes learning less enjoyable, easier, and smoother for students. The form of the material in the source book can be seen in Figure 1.

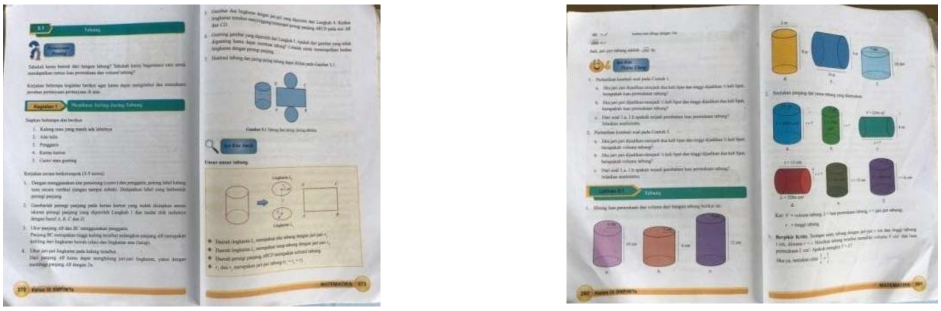


Figure 1. Presentation of material in the source book

For this reason, the researcher was interested in developing a module as additional teaching material for Grade IX students at State Junior High School 1 Koto Baru, Dharmasraya Regency. This became the reason why the researcher chose a learning module because, according to Sanjaya in Ndruru (2022), Lastri (2023), and Jain (2024), the advantage of using modules as a learning medium is that students can learn gradually and at any time. Modules also allow students to learn at their own pace. However, if the material provided in the module is still the same as the material presented in printed books from the library, it will not have any impact on the expected problem-solving. Therefore, teaching materials, namely modules using the inquiry method, are needed.

The inquiry-based learning method is a type of learning that requires students to design and conduct experiments, collect and analyze information, and draw conclusions to solve problems. Therefore, in this inquiry process, students participate directly in finding solutions to the problems posed by the teacher (Budiyono & Hartini, 2016; Ester et al., 2023). Through inquiry-based learning, teachers provide guidance and direction so that students can carry out investigative activities. These activities require students to be very active in learning (Nurdyansyah & Fahyuni, 2016).

Rohmaini et al. (2020), in their research, stated that the development of ethnomathematics-based learning modules, assisted by Wingeom at MTsN 2 Bandar Lampung, showed that these modules meet the criteria of being feasible and interesting to use as teaching material. Kholifah, in her research, stated that ethnomathematics-based mathematics learning modules using the inquiry method contain sample questions, problems, and experimental activities that must be completed by students, with opportunities to formulate problems, formulate hypotheses, conduct experiments, collect data, and analyze data. The module using the inquiry method is expected to facilitate how teachers deliver material, make it easier for students to understand the lessons being taught, make learning activities more engaging for students, and encourage students to think critically and actively (Kholifah, 2021; Angelika et al., 2025). Thus, the research aims to develop a module on Curved-Sided Shapes using Wingeom with the Inquiry Method in Grade IX at State Junior High School 1 Koto Baru, Dharmasraya Regency, to improve student learning outcomes.

METHODS

This study applied the Research and Development (R&D) method, which aimed to develop learning materials in the form of a curved surface geometry module assisted by Wingeom software through an inquiry approach. The research was conducted at State Junior High School 1 Koto Baru, Dharmasraya Regency. The development procedure referred to the 4D model developed by Thiagarajan et al., which included four systematic stages: define, design, develop, and disseminate. The detailed research flow was represented in Figure 2.

As illustrated in Figure 2, the research and development process of the mathematics learning module followed four systematic stages based on the 4D model. The Define stage involved several essential activities to identify educational needs, which included conducting interviews with mathematics subject teachers, analyzing learning objectives, analyzing student characteristics, and analyzing literature regarding mathematics learning modules.

The process then proceeded to the Design stage. During this phase, the core structure of the learning materials was developed. This encompassed designing a mathematics learning module using the inquiry method assisted by Wingeom on the topic of curved surface solid figures. Additionally, the study included the task of designing research instruments, specifically validation sheets and student response questionnaires.

Subsequently, the process entered the crucial Develop stage, which focused on the quality assurance of the module through validation and practicality tests. First, the module was submitted for validation by the experts. Based on their assessment and feedback, necessary revisions were made to the product until it was officially declared as a valid instrument. Following this, a practicality test was performed to evaluate ease of use, and an effectiveness test was carried out to measure students' learning outcome improvements. Finally, the development journey culminated in the Disseminate stage, producing the final version of the Curved Surface Geometry Module Assisted by Wingeom Using the Inquiry Method.

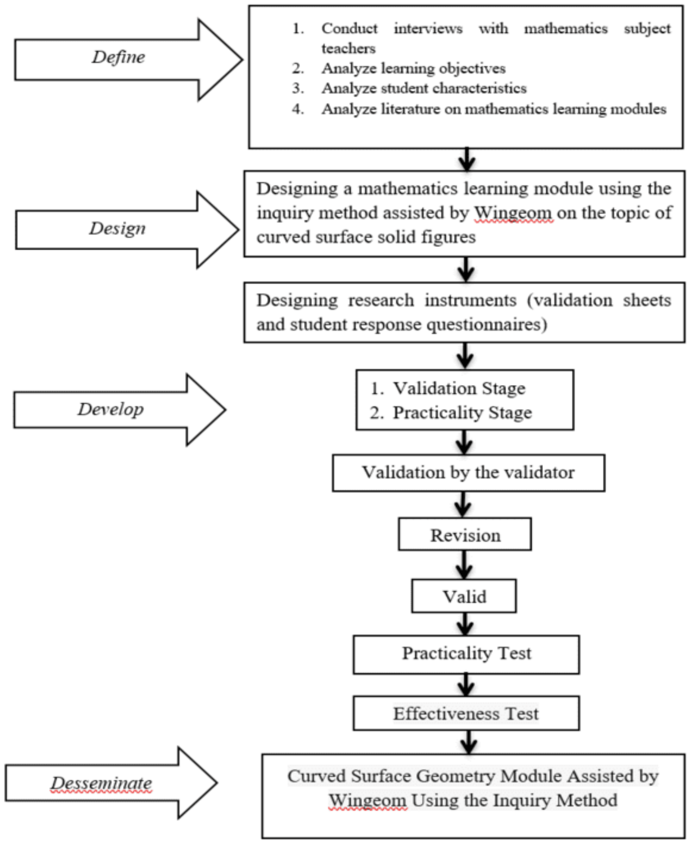


Figure 2. Research method flowchart

The define stage included interviews with mathematics educators and students, an analysis of student characteristics, and a literature review regarding the module. The research subjects were students of a class at State Junior High School 1 Koto Baru, Dharmasraya Regency, with a total sample of 21 students selected using the Total Sampling technique. Subsequently, the Design stage encompassed the selection of teaching materials, format selection, and the initial design of the mathematics learning module.

The next stage was the Development of the module. The data analysis technique in IX.A class, this study was conducted using descriptive quantitative methods to evaluate the quality of the teaching materials developed. Data obtained from the validation sheets and practicality questionnaires were calculated using Formula 1.

$$P = \frac{\sum score\ for\ each\ item}{maximum\ score} \times 100\% \quad (1)$$

Furthermore, the practicality of the module was evaluated based on student responses. The data collected through questionnaires were interpreted as: very valid/practical ($80\% - 100\%$), valid/practical ($61\% - 80\%$), fairly valid/practical ($41\% - 60\%$), less valid/practical ($21\% - 40\%$), and invalid/inpractical ($0\% - 20\%$).

The effectiveness of the module was evaluated based on the Normalized Gain (N-Gain) score, which measures the improvement in student learning outcomes by comparing pre-test and post-test results. The N-Gain was calculated using Formula 2.

$$N\text{-}Gain = \frac{(Post-test\ Score)-(Pre-test\ Score)}{(Maximum\ Score-Pre-test\ Score)} \text{ x } 100\% \quad (2)$$

The obtained N-gain values were then interpreted according to the classification established by Awal (2022), as shown in Table 1. This classification determines the intensity of the increase in students' mathematical understanding after using the Wingeom-assisted module.

Table 1. Normalized Gain Categories

Normalisation Gain Coefficient	Category
$g \geq 0{,}70$	High
$0{,}3 \leq g < 0{,}7$	Medium
$g < 0{,}3$	Low

In addition to the effectiveness percentage, the improvement in student learning outcomes was analyzed using the normalized gain coefficient. According to the classification established by Awal (2022), the N-Gain results were categorized into three levels of improvement, as shown in Table 2. An N-Gain coefficient of $g>0.7$ was classified as High, while a coefficient between 0.3 was categorized as Medium. Conversely, any score below 0.3 fell into the Low category. This classification was utilized to determine the intensity of the increase in students' mathematical understanding after using the Wingeom-assisted module at State Junior High School 1 Koto Baru.

RESULTS AND DISCUSSION

Results

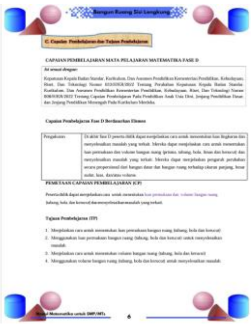
The development of the curved surface geometry module assisted by Wingeom using the inquiry method was analyzed through four systematic stages. The first stage, the Define stage, was conducted to identify the fundamental needs for developing teaching materials at State Junior High School 1 Koto Baru, Dharmasraya Regency. The results of the situational analysis through interviews revealed that the mathematics learning process was still dominated by conventional approaches and a heavy reliance on textbooks, which led to low student engagement. A significant discrepancy was found between the students' diverse learning styles (visual, auditory, and kinesthetic) and the availability of technology-based learning media. The lack of Wingeom software integration resulted in limited visualization of abstract geometric concepts, causing students to rely on rote memorization of formulas rather than achieving a comprehensive conceptual understanding.

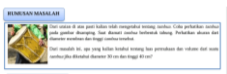
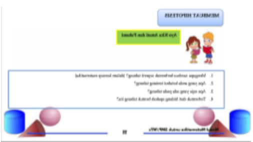
A more in-depth analysis of the 2013 Curriculum and the Merdeka Curriculum textbooks revealed that the available teaching materials lacked exploratory (inquiry) activities and showed minimal integration of multimedia components. Based on these findings, and supported by a literature review on the effectiveness of digital tools, the researcher designed an inquiry-based learning module assisted by Wingeom. This module was structured systematically, incorporating key components such as an introduction for apperception, concept discovery activities guided by Wingeom explorations, and self-evaluation to measure competency achievement. The development of this module aimed to provide a more interactive and contextual learning resource, thereby facilitating students' independent learning and fostering a deeper conceptual understanding of geometry.

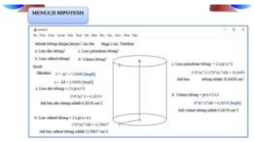
Based on the findings from the define phase, the research proceeded to the design phase, which focused on developing a teaching module on curved-sided three-dimensional shapes for ninth-grade students at State Junior High School 1 Koto Baru, Dharmasraya Regency. This module was designed using an inquiry-based approach supported by the Wingeom software and aligned with the Learning Outcomes and Learning Objectives of the Merdeka Curriculum. The product design process was carried out using Canva and Microsoft Word, integrating supporting visual assets from digital sources to enhance the module’s appeal. Systematically, this module is structured to include standard components consisting of an introductory section (cover, preface, table of contents), a core section (introduction, inquiry-based learning activities, sample questions, exercises, and summary), and an evaluation section (competency test, glossary, answer key, and bibliography). The detailed structure and visual representation can be viewed in Table 2.

Table 2. Presentation of a Teaching Module on Curved-Surface Geometric Shapes Using Wingeom and the Inquiry Method

No.	Display	Description
1		**Cover** The module cover was designed using the Canva application, utilizing a white base color combined with dark blue, gray, and orange accents to enhance its professional aesthetic. The cover integrated visual elements such as *Wingeom* illustrations and geometric objects (cylinders, cones, and spheres) to represent the characteristics of curved surface geometry materials. Institutional identity was established by placing the UIN Mahmud Yunus Batusangkar and *Kurikulum Merdeka* logos in the

		upper left corner. The module's title, 'Mathematics Learning Module with Inquiry Method Assisted by *Wingeom*,' and the specific topic, 'Curved Surface Geometry,' were positioned centrally to emphasize the learning focus. Furthermore, the researcher's name was included on the cover as a formal attribution for the development of this inquiry-based teaching material
2	 KATA PENGANTAR	**Foreword** One of the essential structural components of the learning module was the foreword. This section contained the researcher's expressions of gratitude to God Almighty and extended formal appreciation to the parties involved in the development of the inquiry-based learning module assisted by *Wingeom*.
3	**Module Introduction**  PENDAHULUAN  	**a. Module Description** The module description section provided a comprehensive overview of the content and instructional objectives. This section functioned to orient readers regarding the learning scope and the specific competencies to be achieved through the module. **b. Module User Guide** The usage instructions provided operational guidance and systematic procedural steps for utilizing the module. This section functioned to offer general procedural directions, ensuring the effective use of the module throughout the learning process. **c. Learning Outcomes and Learning Objectives** The Learning Outcomes and instructional objectives in this module were formulated in reference to the standards established by the *Kurikulum Merdeka*. This alignment was conducted to ensure that the developed Curved Surface Geometry materials remained relevant and consistent with the current national curriculum framework.

		**d. Concept Map in the Module** The concept map was presented as a visual organizer aimed at providing a systematic cognitive structure for students. Through this map, students were able to identify the interconnections between sub-topics and map out the key concepts to be studied throughout the module comprehensively.
		**e. Description of the Wingeom app** The *Wingeom* application description presented comprehensive information encompassing the software's technical identity, its primary functions as a geometry exploration tool, and an analysis of its strengths and limitations. This section was intended to provide a foundational understanding for users regarding the technological capabilities integrated into the module, ensuring optimal utilization for visualizing geometric objects.
4	**Learning Section**   	**a. Problem Statement** In this section, students were presented with contextual problems relevant to daily life to stimulate critical thinking. Subsequently, students were guided to identify the essential information and key variables required as a foundation for formulating systematic problem-solving strategies. **b. Problem Statement** In this stage, students were guided to synthesize and formulate the core problem based on the data and information collected in the previous step. This process was aimed at developing students' analytical skills in constructing clear and structured problem statements before proceeding to further investigation. **c. Formulating Hypothesis** In the Formulating Hypothesis stage, the module provided an 'Ayo Mengamati dan Pahami' (Let's Observe and Understand) activity designed to stimulate students' initial reasoning. During this task, students were instructed to formulate hypotheses or preliminary conjectures and outline initial problem-solving steps based on their previous observations.

	   	**d. Data Collection Through Experiments** In the Data Collection Through Experiments stage, the module presented the 'Ayo Mencoba' (Let's Try) activity, which was integrated with the use of *Wingeom* software. Through this activity, students were directed to conduct visual explorations and digital experiments to gather the empirical information required to verify the geometric concepts under study. **e. Testing Hypotheses** The Testing Hypothesis stage was a crucial phase for students to validate their previously formulated conjectures. In this section, students verified their initial hypotheses through exploration activities using *Wingeom* software to ensure consistency between their predictions and the empirical data obtained during the experimental process. **f. Drawing Conclusions** In the Drawing Conclusions stage, students were instructed to formulate comprehensive conclusions based on the entire sequence of inquiry activities they had completed. This process was aimed at consolidating student understanding, enabling them to derive general principles from the results of experiments and hypothesis testing conducted on curved surface geometry materials.
5	 	**Practice Questions** The practice test contains multiple-choice and fill-in-the-blank questions on curved-sided three-dimensional shapes, designed to assess students' understanding of each lesson.
6	 	**Competency Test** The competency test section presented a series of evaluation instruments designed to measure students' mastery of the material at the end of the learning session. This component functioned as an assessment parameter to evaluate the effectiveness of the inquiry process and the extent to which students' cognitive competencies had been achieved regarding curved surface geometry.

7	 KUNCI JAWABAN	**Answer Key** The answer key section provided solutions for all practice exercises and competency tests within each learning unit. This component was intended to serve as a self-feedback mechanism for students, enabling them to conduct self-assessment and independently monitor their learning progress regarding the materials they had studied.
8	 DAFTAR PUSTAKA	**Bibliography** The bibliography section contained all scientific references and citations that served as the theoretical foundation during the development of the material. The inclusion of these references served to ensure academic accountability and to inform readers about the authoritative literature that underlay the development of this curved-surface geometry learning module.

The development phase was conducted with the aim of producing a valid final product through a series of validation and revision processes based on expert recommendations. The feasibility of this module was comprehensively tested by three validators with expertise in their respective fields, consisting of two Mathematics Education lecturers from State Islamic University Mahmud Yunus Batusangkar, as well as one practicing mathematics teacher from State Junior High School 1 Koto Baru, Dharmasraya Regency. Validity assessment was conducted using a validation sheet instrument covering four main dimensions: content, presentation, language, and graphics. The accumulated scores and qualitative feedback from these validators served as the primary basis for determining the level of validity and making product improvements before proceeding to the field trial stage.

Table 3. Product Validation Results

Aspects Assessed	Validator			Total	Max Score	%	Note
	1	2	3				
Content Suitability	34	36	41	111	144	77.08	Valid
Presentation Suitability	15	15	19	49	60	81.66	Very Valid
Language Suitability	18	18	20	56	72	77.77	Valid
Graphical Suitability	24	24	30	78	96	81.25	Very Valid
Total						317.76	
Average						79.44	Valid

Based on the data in Table 3, the expert validation result for the inquiry-based curved surface geometry module assisted by Wingeom showed an average percentage of 79,44%, categorized as valid. Specifically, the graphic suitability aspect achieved the highest score of 81,25% (very valid), driven by design quality, visual imagery, attractive animations, and harmonious color composition. Meanwhile, the content suitability aspect obtained a percentage of 77,08% (valid), despite being the lowest average score among the other aspects. This achievement indicated that the product met the development quality criteria proposed by Nieveen, namely validity, practicality, and effectiveness. In addition to quantitative assessment, the researcher also performed qualitative product refinements based on constructive feedback from the validators. Following a comprehensive revision process, the module was subsequently tested to measure its practicality and effectiveness in a real classroom context to improve student learning outcomes.

Table 4. Results of Product Practicality Tests by Students

Number	Evaluated Aspects	Survey Average	Description
1	The module has an engaging design that aligns with its objectives	84.52	Very Practical
2	The instructions in the module are clear and easy to understand	81.90	Very Practical
3	Student-friendly module	83.62	Very Practical
4	The module helps students understand the material being studied	80.65	Very Practical
5	The module enhances students' interest and enthusiasm for learning	86.30	Very Practical

Based on the data presented in Table 4, the overall results of the module's practicality test fell into the very practical category. The highest average score was achieved in the indicator of enhancing students' interest and enthusiasm for learning, with a score of 86,30. This indicated that the integration of the inquiry method and Wingeom software within the module successfully created a motivating learning experience for students. Furthermore, the engaging module design (84,52) and its student-friendly nature (83,62) contributed to the ease with which students understood the material. Collectively, the scores across all aspects, which remained above 80,00, demonstrated that the module was feasible and practical for use as a learning medium for curved surface geometry. Once the practicality of the module was confirmed through positive user feedback, the subsequent analysis focused on testing the product's effectiveness to observe its real impact on student learning outcomes. This stage served as a crucial parameter to determine the extent to which the integration of the inquiry method assisted by Wingeom within the module was able to contribute significantly to the achievement of students' mathematical competencies.

The effectiveness test was conducted to measure the impact of the Wingeom-assisted curved surface geometry module on student learning outcomes. The procedure began with a pre-test to map the students' initial mathematical abilities before the intervention. Subsequently, the effectiveness of the module was measured through a learning outcome test administered to grade IX A students at State Junior High School 1 Koto Baru Dharmasraya. The quantitative data presented in Table 5 summarizes the significant improvement in student learning outcomes, where the average post-test score increased significantly compared to the pre-test score.

Table 5. The Effectiveness of A Curved-Face Three-Dimensional Shapes Module, Assisted By Wingeom And Using The Inquiry Method, Improved Students' Learning Outcomes

Statistical Indicators	Pre-test	Post-test	N-Gain
Minimum Score	16.00	73.00	0.48
Maximum Score	63.00	94.00	0.88
Mean	36.95	83.90	0.74
Standard Deviation	16.04	5.34	0.11

Data analysis of 21 students yielded an N-Gain score of 0.74, which fell into the high-improvement category. Furthermore, the classical mastery level exceeded the Learning Objective Achievement Criteria of 78, meeting the standards for effective mathematics instruction. This is consistent with Yani's (2022) criteria, which state that mathematics learning is considered effective if the average N-Gain score is ≥0.30 and at least 75% of the students achieve mastery. The final product of this research can be accessed via https://s.id/inkuiriwingeom.

Discussion

The definition stage revealed a disparity between the availability of technological facilities and the school's actual learning patterns. Despite the accessibility of computer laboratories, mathematics instruction remained dominated by conventional, static textbooks. A heavy reliance on the teacher's procedural explanations, without the support of dynamic visualization, limited students' understanding of geometry and made it less contextual (Wardana, 2022). This lack of student engagement in concept discovery activities serves as a primary barrier to achieving meaningful learning mastery.

The development of an inquiry-based module assisted by *Wingeom* software serves as a strategic solution to mitigate these cognitive hurdles. The integration of the inquiry model, particularly in the hypothesis formulation phase, plays a vital role in constructing geometric understanding. In this phase, students are encouraged to perform cognitive estimations or preliminary conjectures regarding the relationships between the elements of curved surface objects before proceeding to the proof (Sukarelawan et al., 2024). This phase is crucial, as it forces students to activate their prior knowledge actively. Subsequently, the use of Wingeom as a digital laboratory allows students to verify these hypotheses through precise object manipulation. This aligns with the perspective that the use of dynamic geometry software can transform abstract understanding into more visual and measurable representations (Fatmawati & Yahfizham, 2024; Sati et al., 2024). Consequently, the developed module not only provides content but also facilitates the students' mental processes in discovering concepts independently.

The design stage focused on integrating the phases of the inquiry learning model into the module's structure to stimulate independent concept discovery among students. The module design encompasses six essential phases: problem orientation, problem formulation, hypothesis formulation, data collection through experimentation, hypothesis testing, and conclusion drawing. This structure was systematically developed to ensure that students do not merely act as passive recipients of information but instead function as active subjects in constructing their understanding of geometric concepts (Putu et al., 2023; Mardiah et al., 2018).

The primary strength of this module's design lies in the synchronization between the Wingeom software and the critical inquiry phases, specifically from hypothesis formulation to testing. Wingeom serves as a dynamic visualization instrument that allows students to manipulate geometric objects with precision, a process that is theoretically difficult to represent through static media such as conventional textbooks. The integration of technology in this design aims to bridge the students' cognitive transition from concrete understanding to abstract reasoning regarding curved surface objects.

Furthermore, the module design provides alternative problem-solving approaches through both manual methods and software assistance. This dual approach is intended to provide a comprehensive understanding, allowing students to validate manual mathematical calculations with digital simulations. This comprehensive design aligns with the findings of Nurhanifa (2022), who stated that mathematics modules assisted by Wingeom for geometry materials not only meet the criteria for validity and practicality but are also effective in significantly improving student learning outcomes through a more explorative learning experience.

The development stage was conducted to produce a final product that meets the standards of feasibility through a series of systematic tests. This section outlines the results of a comprehensive data analysis, covering expert validation, the level of practicality based on user feedback, and the effectiveness of the module in improving student learning outcomes. The primary focus of this stage is to empirically demonstrate that the integration of inquiry strategies and the use of Wingeom within the module provides a positive impact on the quality of mathematics instruction. The development of the inquiry-based module, assisted by *Wingeom,* was evaluated through rigorous validation and practicality testing. Expert validation from three specialists yielded an average score of 79,44%, categorizing the module as "Valid." The highest scores were observed in the aspects of presentation (81,66%) and graphics (81,25%), indicating that the integration of dynamic animations and a well-structured layout successfully met professional educational standards. This is consistent with the findings of Akmal (2022), who emphasized that diverse, media-assisted teaching materials simplify the delivery of complex geometric concepts by providing realistic visual impressions.

In terms of practicality, student responses reached a high score of 82,83% (Very Practical). Students reported that the module's instructions were clear and that the interactive nature of the Wingeom software significantly increased their motivation to learn. This high level of practicality suggests that the module effectively shifted the learning atmosphere to be more student-centered and engaging, fulfilling the requirements of an independent learning tool (Putu et al., 2023; Putri & Aswar, 2024).

The primary objective of this development was to enhance students' mathematical understanding. The effectiveness analysis showed a significant increase in learning outcomes, with the mean score rising from 36,95 in the pre-test to 83,90 in the post-test. The calculated average N-gain was 0,74, which falls into the "High Improvement" category according to Hake's criteria. This result surpasses the effectiveness threshold of $g \geq 0.30$ and meets the mastery requirement where more than 75% of students achieved the minimum proficiency score (Yani, 2022).

This significant improvement is attributed to the inquiry model's stages, which guide students toward autonomous formula discovery. The hypothesis formulation and experimental stages, assisted by Wingeom, allowed students to bridge the gap between abstract geometric properties and concrete visual proof. As highlighted by Mardiah et al. (2018), inquiry-based modules empower students to construct their own mathematical concepts, leading to deeper cognitive retention. Furthermore, the use of Wingeom mitigated the limitations of static textbooks, providing a "digital laboratory" where students could explore curved surface objects dynamically. Consequently, the module proved to be an effective instrument for improving both the process and the results of mathematics learning at State Junior High School 1 Koto Baru. Building upon these successful validations and effectiveness results, the research proceeded to the final stage of the 4D model to ensure the practical application of the developed product.

The dissemination stage is the final stage of product development, which is carried out by distributing the curved-sided spatial module product, assisted by Wingeom, using the inquiry method to the school studied in this research, namely State Junior High School 1 Koto Baru, Dharmasraya Regency, so that it can be used by teachers in learning. The module is provided to mathematics teachers in the form of a printed document, so it can be handed over.

CONCLUSION

This research successfully developed an inquiry-based mathematics module assisted by Wingeom software, specifically designed for curved surface geometry. The module integrates essential learning components ranging from problem orientation to independent concept discovery to facilitate active student engagement. Evaluation results demonstrate that the module is highly feasible for educational use, achieving a "Valid" status with an average score of 79.44% and a "Very Practical" rating of 82.83%. Furthermore, the module is proven highly effective, as evidenced by an average N-Gain score of 0.73 (High), with the majority of students successfully surpassing the minimum proficiency threshold of 78. These findings confirm that the synergy between inquiry methods and dynamic geometry software significantly enhances students' mathematical understanding and learning outcomes.

Based on these results, it is suggested that educators adopt this module as a supplementary resource to foster a more explorative and technology-integrated classroom environment. Teachers are encouraged to adapt this framework for other mathematical topics to diversify teaching materials. For future researchers, it is recommended to expand the scope of this study to different educational contexts and levels to further validate the long-term impact and scalability of the developed product. This transition from research-based evidence to practical application is expected to contribute to the modernization of mathematics pedagogy at SMPN 1 Koto Baru and beyond.

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