Jurnal Pendidikan Matematika
Volume 16, No. 1, January 2022, pp. 1-14
P-ISSN: 1978-0044, E-ISSN: 2549-1040, DOI: https://doi.org/10.22342/jpm.16.1.14694.1-14
Website: https://ejournal.unsri.ac.id/index.php/jpm
Accredited by SINTA 2: http://sinta2.ristekdikti.go.id/journals/detail?id=1811

Development of E-Module Based on HOTS Questions on Distance Material for High School Students

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Abstract

This research aimed to develop a valid and practical electronic module that potentially affected the HOTS of grade 12 students during distance learning in Xaverius 1 High School, Palembang. This study employed the Alessi Trollip model orienting towards multimedia products consisting of three stages: planning, designing, and developing. The data collection techniques were validation sheet instruments, questionnaires, and tests. Meanwhile, the data analysis method were validation sheets and questionnaires through average scores and comments and test sheets through student work. The success criteria of this research were to obtain valid and practical geometry distance teaching materials with HOTS by considering experts' and clients' reviews. The expert validity revealed a score of 4.72 and was considered very valid. The questions' score was 55.5% and was revised. Meanwhile, the questionnaire was categorized practical with a score of 79.3. The e-module potentially influenced HOTS exercises with an average score of 83.5 or very good. This research concludes that the developed e-module has valid and practical characteristics and can influence the HOTS thinking abilities to create and analyze. Thus, the module significantly supports the needs of teaching materials and increases the students' HOTS.

Keywords: Electronic Module, Distance, Development Research, HOTS

Abstrak

Tujuan dari penelitian ini adalah untuk mengembangkan modul elektronik yang valid, praktis dan memiliki efek terhadap kemampuan berpikir HOTS dalam pembelajaran materi jarak siswa kelas 12 SMA Xaverius 1 Palembang. Penelitian ini menggunakan pengembangan model Alessi Trollip berorientasi pada produk multimedia yang memiliki tiga tahapan yaitu perencanaan, perancangan, dan pengembangan. Pengumpulan data menggunakan instrumen lembar validasi, angket dan tes. Teknik analisa data lembar validasi dan angket melalui rata – rata dan kualitatif, lembar tes melalui hasil jawaban siswa. Kriteria keberhasilan penelitian ini adalah memperoleh materi ajar jarak jauh geometri yang valid dan praktis dengan kemampuan berpikir tingkat tinggi berdasarkan masukan dari tinjauan ahli dan klien yang diperoleh. Berdasarkan hasil validitas dengan ahli didapat skor 4,72 sangat valid dan 55,5% soal direvisi, angket 79,3 kategori praktis, dan e-modul memiliki pengaruh potensial terhadap latihan Higher Order Thinking Skill dengan rata-rata skor 83,5 atau sangat baik. Hal ini menunjukkan e-modul yang dikembangkan memiliki karakteristik yang valid dan praktis serta memiliki efek terhadap kemampuan berpikir HOTS dalam hal mengkreasi dan menganalisis soal, sehingga dapat berperan dalam kebutuhan bahan ajar maupun peningkatan kemampuan berpikir HOTS peserta didik.

Kata kunci: Modul Elektronik, Jarak, Penelitian Pengembangan, HOTS

How to Cite: Tobing, H. E. L., Somakim, & Susanti, E. (2022). Development of e-module based on HOTS questions on distance material for high school students. *Jurnal Pendidikan Matematika*, *16*(1), 1-14.

INTRODUCTION

The 21st century learning requires an e-module about ICT skills and HOTS thinking. This statement agrees with (Pisanu, 2014; Murati, 2017), arguing that current education needs technological innovation. HOTS-oriented learning supported by technology, such as e-learning, is necessary to convey theory by considering students' levels, contexts, background interests, and potentials (Huang, 2019). Such a learning model can answer distance learning challenges due to the

Received June 9, 2021; Revised July 9, 2021; Accepted December 30, 2021

Covid-19 pandemic. The Ministry of Education and Culture has issued a home learning policy that requires teachers to prepare digital teaching materials, instructions independently conducted on online and offline classes based on teacher directions, and feedbacks (Kemendikbud, 2020).

Today distance learning challenges teachers to design more creative learning programs in the 21st century and the 4.0 education era by developing cores of 21st-century skills (Hussin, 2018), such as creativity and innovation in applying educational technology (Daggol, 2017; Alismail, 2015). Students' learning motivation, literacy skills, and comprehension of distance geometry in spatial shapes, including point-to-point, point-to-line, and point-to-plane distances, can be developed by observing and exploring a media (Yanuarti, 2018). Other factors influencing students' difficulties in learning geometry are lack of visual ability, unavailable teaching media, contexts in use, and comprehension of distance concepts training students to simplify problem skills (Fabiyi, 2017). It can saw students with low achievements in the national exam have an average score of the distance determination indicator in geometry to 40.125% (UN, 2018). One of the reasons for this low achievement is that students' visual intelligence is only limited to visualization on the blackboard provided by the teacher during the learning process (Tyaningsih, 2015). As a result, students do not like, misunderstand, ignore geometry (Melo, 2015).

To overcome these problems, teachers can design blended learning, accommodates different characteristics include speed, learning atmosphere, place, and time (Laal, 2012). Independent learning using e-modules requires assistance like video display material, problem-solving skills, and HOTS (Johnson, 2014), which asserts that video can motivate and increase the students involved in learning and make challenged to solve problems (Peteros, 2020). E-modules enable teachers to focus on results and verify process results (Argaswari, 2018). The available problem-solving videos in e-modules significantly affect student's motivation and self-confidence, more motivate them to involve in the learning, exercise with the supports of direct feedbacks and learning concepts; these methods create more significant effects than a conventional method (Yeh, 2019; Rini, 2020). Learning through HOTS exercises can improve student's higher-order thinking skills (Sagala, 2018) and helps them discover the geometry principles through informal and formal activities (Yanuarti, 2018). This model is beneficial because students frequently fail precisely understand the problems (Kurniawan, 2018).

Therefore, researchers are very interested in developing an e-module, with characteristic material and video with EPUB format, interactive, motivation in learning, offline and online learning, use computer or cellphone technology. This e-module supporting teachers to present HOTS material through solving videos, contextual problems, and pictures to stimulate HOTS and student competence in mathematics. Teachers and practitioners can better construct students' mathematical knowledge through the habit of using contextual problem-based mathematics e-module, which is the contextual problem-based mathematics e-module is an effective solution to improve competence in mathematics (Rochsun, 2020). This study develops electronic modules using the Sigil software program, a superior and free software (Wiana, 2018). Sigil is an application for managing and designing digital books

using EPUB offline, supports text and HTML (Fitri, 2021). This study aims to develop a valid and practical electronic module that can affect the HOTS of grade 12 students during distance learning at SMA Xaverius 1 Palembang.

METHODS

The subject of this research was 12 students in Xaverius 1 High School, Palembang, for the 2020/2021 academic year. This study involved 34 students, consisting of 18 males and 16 females, with medium and high abilities.

This research employed the developmental method to produce a product and test the effectiveness of the product (Alessi, 2001). The product of this research was an electronic module-operated Sigil software program with an electronic publishing format. The development stage is presented in Figure 1.

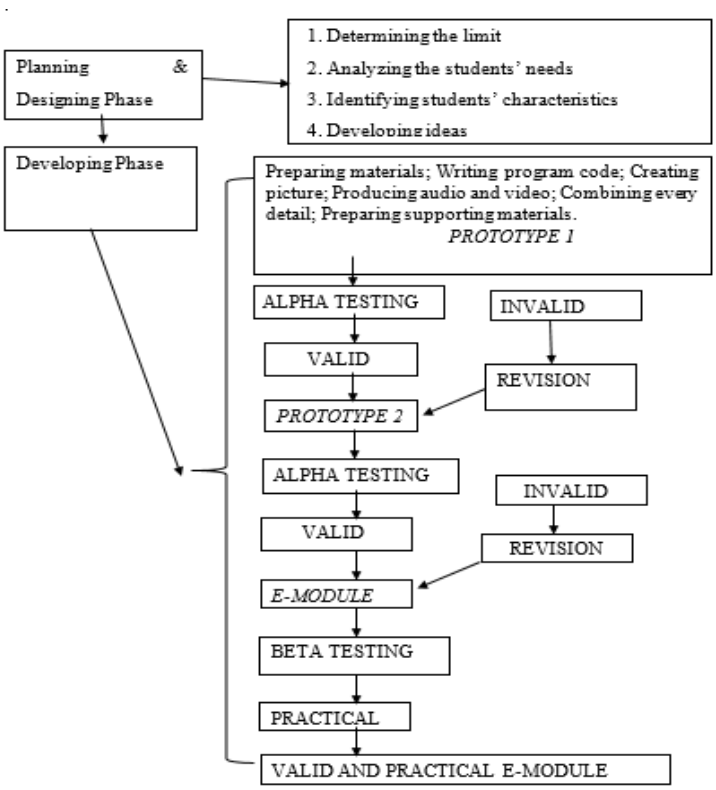

Figure 1. The development phase (Alessi, et al, 2001).

Figure 1 shows that the first and second stages were planning the design to determine the required material limits, analyze student needs, and identify student characteristics. The third stage was the development consisting of preparing the necessary materials to support prototype one. When prototype one was produced, the researchers conducted an alpha test to determine its validity and suitability with the HOTS items. If the result was invalid, the researchers revised and improved the

product. The next step was conducting the alpha test to produce a valid e-module. The last step was conducting the beta test on students and model teachers to explore the e-module practicality in the learning process.

Data collection techniques of this research were validation sheets, questionnaires, and tests. The validation used in the alpha test to validate the developed e-module prototype employed two validation sheets. The first sheet contained questions from the material aspect and learning media. The assessment provided qualitative assessment and inputs in the form of comments functioning as a reference to revise the e-module prototype. The material elements investigated 1) The content suitability includes completeness of the e-module format, subject matter, content of the developed questions. 2) Assessment feasibility includes content that makes it easier for students to learn, various learning facilities, Feedback. 3) Language including use of Indonesian clarity of questions, elements in the language. 4) graphics include image quality, text accuracy. 5) Color suitability. 6) Interactions include the accuracy of video, animation, the effectiveness of the navigation command, and media used. 7) Sound suitability.

The second validation sheet included HOTS items and consisted of eight questions. The assessments provided qualitative assessment and inputs in the form of comments functioning as a reference to revise the questions in HOTS. The framework of the instrument validation including the suitability of question with indicators, between questions and HOTS, between question and interior context, between question and interesting stimulus, between question and contextual stimuli, the suitability of the question measures the cognitive level of reasoning, the implicit answer to stimulus, conclusion of the overall aspect of the study.

The questionnaire sheets were distributed during the beta test to examine the e-module practicality. The questionnaire used two aspects: practices and motivation generated by 10 question indicators. Questionnaires on Google form were distributed to students to investigate their responses to the e-module with two acpects including practicality and motivation.

The test sheet was distributed during the trial after the e-module was declared valid and practical. The test aimed to examine the potential effects of HOTS on students, create items in an image design, and analyze the completion.

The validation test obtained an e-module prototype, comments, suggestions, and qualitative assessment. The formula (1) to calculate the average score of the assessment results is as follows.

$$\mathrm{R} = \frac{\sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{Vi}}{n} \text{ , with } V_i = \frac{score\,obtained}{\max imum\,score} \quad (1)$$

Information:

R = The average score of the assessment results from the validators

Vi = The average score of each validator assessment results

n = The number of validators

The calculation results were adjusted with the description in Table 1.

Table 1. Validity categories of interactive multimedia (Sugiyono, 2015)

Average	Description
4.21-5.00	Very valid
3.41- 4.20	Valid
2.61 – 3.40	Sufficiently Valid
1.81 – 2.60	Invalid
1.00 – 1.80	Very invalid

The results of the validation test were analyzed descriptively. This analysis resulted in suggestions and comments from eight questions about the suitability of the HOTS items.

The research analysis revealed that the response questionnaire adopted a Likert scale with four qualitative assessment categories: SS (strongly agree) with score 4, S (agree) with score 3, TS (disagree) with score 2, and STS (strongly disagree) with score 1. The questionnaire results were rated on a scale of 100 using the following formula (2).

$$Score = \frac{score\,obtained}{\max imum\,score} x100 \quad (2)$$

The calculation results were interpreted with the description in Table 2.

Table 2. Predicates of the practicality responses (BSNP, 2019)

Scores	Predicates
85< N ≤ 100	Very practical
70 < N ≤ 85	Practical
55 < N ≤ 70	Pretty practical
N ≤ 55	Less practical

The test analysis was conducted once to measure the effectiveness of the e-module in emerging HOTS. In distance learning, the students used Google form to provide short answers and Google classroom to provide detailed answers. The test consisted of three multiple-choice questions and two description items. The students' final scores calculated by the formula (2) were then categorized, as shown in Table 3.

Table 3. HOTS assessment categories

Students' Final Scores	Categories
$81 < N \leq 100$	Excellent
$61 < N \leq 81$	Good
$41 < N \leq 61$	Fair
$21 < N \leq 41$	Poor
$0 < N \leq 21$	Very bad

(Source: International Center for the Assesment of Higher Order Thinking Skills)

RESULTS AND DISCUSSION

The developed distance materials limited the topics on determining the distance of the point and point, point to the line, and point to the plane. The students required e-module during the distance learning because they were accustomed to using technology, and the e-module facilities supported the distance learning. The e-module was created in the design and development stages and was ready for the validity check. These products were available on links for prototypes 1 and 2: https://s.id/emrev1 and https://s.id/geometrisma. Moreover, the e-module contained the appropriate characteristics, as shown in Figure 2.

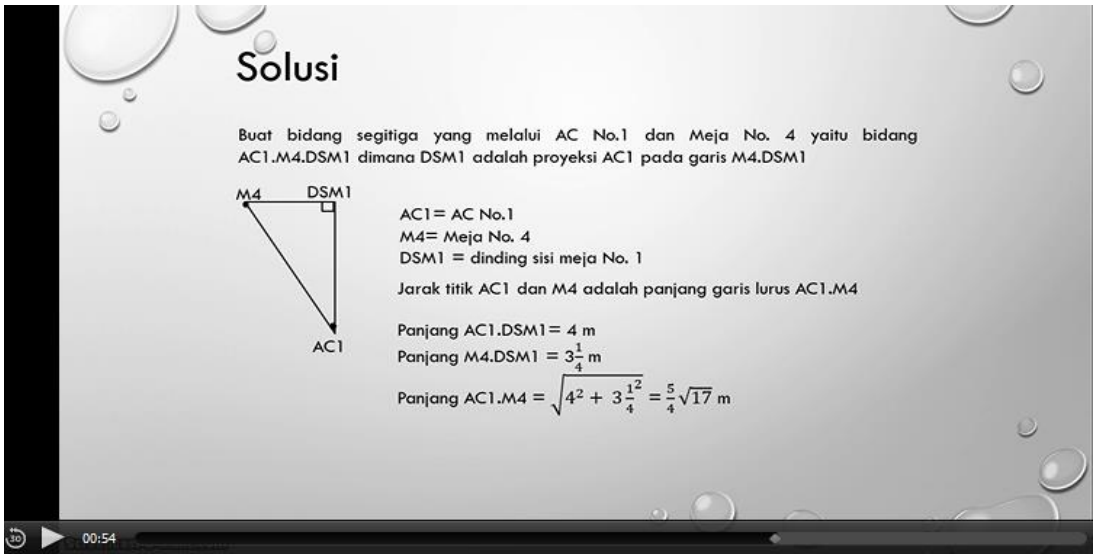

Figure 2. Video display of problem solutions

The second figure shows that video can play in e-module, which means students check the result of their work, so they want to learn further. This video help improves students' reasoning in thinking HOTS because videos provide clear solutions and are easy to use. After prototype 1 had been created, the research conducted an alpha test to determine the validity of prototype 1 and examined the suitability of the developed HOTS items. The next similar step was conducted in prototype 2.

The experts validated the e-module's material aspects, including content feasibility, feasibility assessment, and language assessment. Moreover, experts validated media aspects, including graphics, colors, interactivity, and sound. The validators stated three points about the material aspects. First, the contents in the e-module were complete and met the e-module characteristics: the table of contents, cover, glossary, introduction, learning activities, summary, exercises, and literature study. Second, the assessment was complete and consisted of assignments, worksheets, evaluations, and self-assessments. Third, the module applied good Indonesian. The material aspect validation revealed an average increase from 4.04 in prototype 1 to 4.66 in prototype 2.

The validators state four points about the media aspect. First, the graphics, such as covers, photos, and images, in the e-module, was good because they were clear. Second, the colors in the e-module, were attractive and comfortable to see. Third, the interactivity in the e-module was attractive because they were available on links that enabled students to answer the question, watch the videos, check the answer keys after completing the exercises. Consequently, the e-module could support HOTS-characterized learning. Fourth, the voice in the e-module was clear. The media aspect validation showed an average increase of 0.635, from 4.12 to 4.77. The validation results are presented in Table 4.

Table 4. Validation results

		Validator 1		Validator 2		Validator 3		Rata - rata	
No	Indicator	P.1	P.2	P.1	P.2	P.1	P.2	P.1	P.2
1	Theory	4,125	4,875	3,875	4,875	4,125	4,25	4,04	4,66
2	Media	4,5	4,77	3,77	5	4,11	4,55	4,12	4,77
								4,08	4,715

Validator's commented that the e-module was good because it was complete. Thus, e-modules can help students learn independently during distance learning. However, the question must be more realistic, complex, and authentic, such as questioned determining the distance of the point to the line in the shape of cube space. The validator suggests the question replace, so the researcher replaced it with a question to determine the length of the cable needed by officers to install electricity in a cubical space. In addition to reproducing the question, examples and materials should be more detailed. The validator agrees with Risanti (2019), proposing that e-modules should consist of accurate content, consistent format, interest, understandable language to create meaningful teaching materials. Meanwhile, Setiyani (2020) argues that narration and illustrations, including photos and pictures, help students' reasoning. Abadi (2017) explains that because teaching materials motivate students to learn, the development of materials must be appropriate to improve their abilities.

The suitability of the HOTS items consisted of eight aspects: 1) the suitability between the questions and indicators, 2) the suitability between the questions and HOTS contents, 3) the suitability between the questions and the interior context, 4) the suitability between the questions and the exciting stimuli, 5) the suitability between the questions and contextual stimuli, 6) the suitability of the questions measuring the cognitive level of reasoning, 7) the suitability between the implied answers and the stimuli, and 8) the conclusion of the research aspects. The results of the question investigation are presented in Table 5.

Table 5. Results of the questions investigation

Question	Worksheet	Duty	Practice	Evaluation	Total
Be accepted	1	5	5	1	12
Revision	5	1	5	4	15
Total	6	6	10	5	27
Revision Percentage	83,3	16,7	50	80	55,5

The validators commented that not all stimuli and ideas of the e-module agreed with HOTS. The module had to consider contexts, add questions, develop HOTS levels, and investigate items. Then, the researcher revised 15 items (55.5%) by developing more HOTS questions, improving grammar, and changing points of study into eight aspects. This comment agrees with Setyawati (2017) postulating that less attention to standard Indonesian and sentence structures makes students interpret the e-module differently.

The alpha test validation discovered that the e-module had valid characteristics and was feasible to use. These findings agree with Laurencia (2018). Furthermore, the research conducted a beta test on students to explore the practicality and motivation of the e-module. The beta test resulted in a questionnaire, as presented in Table 6.

Table 6. Questionnaire results

Aspects	Indicators	% Students			
		Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly Disagree (1)
Practicality	E-module display	11,8	76,5	11,7	-
	E-module facilities	26,5	64,7	8,8	-
	E-module instructions	29,4	67,6	3	-
	HOTS exercise items	35,3	58,8	5,9	-
	Readability of e-module	47,1	47,1	5,8	-
Motivation	Interests in learning activities using the e-module	23,5	64,7	11,8	-
	More interest in learning activities using the e-module than books	41,2	50	8,8	-
	Students' activeness	11,8	73,5	14,7	-
	Motivation to follow e-	17,6	67,6	14,7	0,1

Aspects	Indicators	% Students			
		Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly Disagree (1)
	module learning				
	Current conditions of studying with the e-module	17,6	73,5	8,9	-
average percentage agree		89,95		10,05	
score percentage		79,3		20,7	

Table 9 showed that 10.05% of students disagreed that the e-module was practical and could motivate them to learn because its questions were difficult, and the students were more interested in face-to-face learning. In contrast, 89.95% of students agreed that the e-module was practical and raised their motivation to learn. This finding agrees with Koparan (2017), asserting that teaching materials create a learning environment, and technology contributes positively. Mamolo (2019) explains that the practicality of teaching materials is necessary to conduct the mathematics learning process. The advantage of this e-module was the existence of images on the blackboard easily prepared and displayed by the teacher. Consequently, the learning process became more communicative, and the materials were easily understood. The e-module trial was conducted simultaneously with the beta test. The test revealed the average score of students with correct answers, as presented in Figure 3.

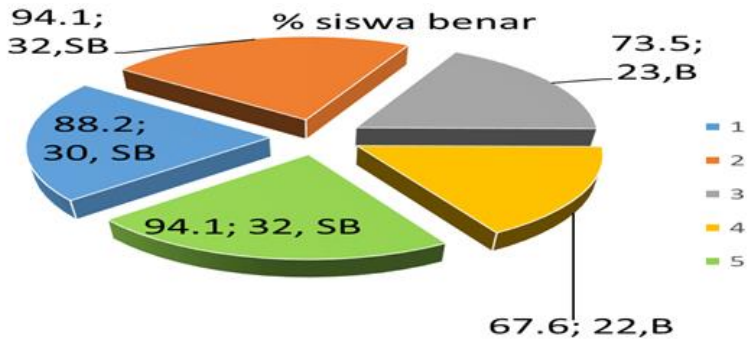

Figure 3. Diagram of the percentage of students who answered correctly

The evaluation of five HOTS items discovered the average percentage of students with correct answers was 83.5 and was considered very good. This finding corresponds to the analysis of student characteristics finding the middle-level students' percentage of 52.9 (80 – 89) % and high-level students of 47% (90 -100). For example, the test results indicate that one student is in the medium category and is actively working on a question by applying HOTS, like reasoning in terms of the location of the point. These findings are like in Figure 4.

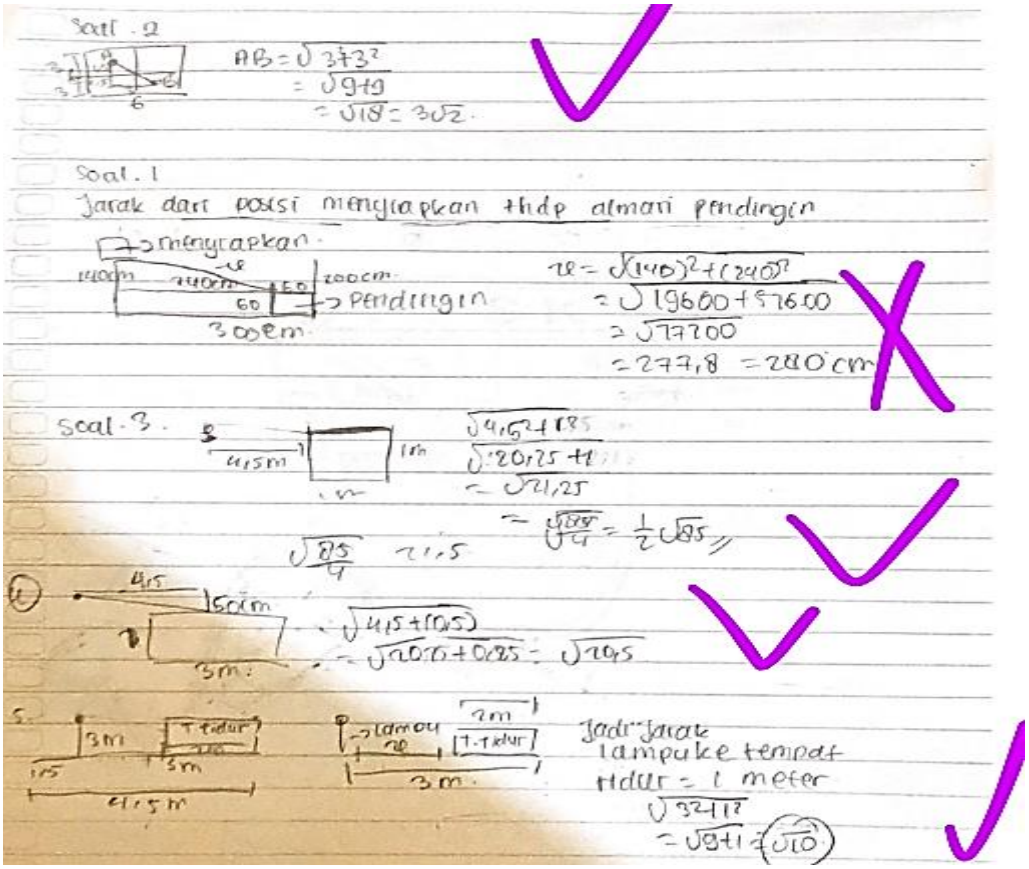

Figure 4. Documentation of student work

Based on Figure 4, the questions according to the geometric competence that determines the distance from a point to a point, students seem to have the ability to reason by analyzing the problem in question and making image illustrations. The analytical ability is still not maximally carried out, so students make mistakes in determining the length of one side to be 140 cm which should be 100 cm, making the final answer still wrong. Requires student reasoning as part of thinking HOTS overall the percentage of correct answers for question number one is 88.2, or good category. In addition, students have been seen to demonstrate problem-solving skills to answer question number five. However, the conclusion is wrong and less thorough. The percentage of correct answers for question number five is 94.1 or good category.

The e-module of this study has three valid and practical characteristics. First, the HOTS-based learning materials agree with Andriani (2018), postulating that HOTS-oriented e-modules can improve student responses and learning outcomes. Second, the interesting photos of interior designs agree with Setiyani (2020), stating that photos in teaching materials, such as e-modules, help and simplify students' reason, motivate, do assignments, and explore HOTS. Third, videos provide clear problem solutions, encourage them, and increase their learning independence. Peteros (2020) asserts that video can motivate and increase students' involvement in learning; thus, they are challenged to solve problems. According to Yuliati (2018), problem-solving consists of several sequential steps that

disable students to apply HOTS in multiple-choice questions without analysis. This study has developed an e-module to improve students' ability to apply HOTS (Sagala, 2018).

CONCLUSION

The validation of this study shows that the e-module has valid characteristics. The questionnaire and beta test found that the e-module was practical, and the test results show that the e-module affects students' HOTS. In conclusion, the prototype meets the valid and practice characteristics of the e-module has the potential effect on the implementation of HOTS, especially in terms of reasoning in determining the size of the distance competency is a very good category.

This study suggests four main points. First, high school students must use electronic modules with valid and practical characteristics to support their independent learning and improve HOTS skills in reasoning like as the https://s.id/geometrisma e-module. Second, educators should be using an electronic module with the characteristics valid and practical as an alternative to support teaching materials, such as the example https://s.id/geometrisma. Third, schools must have computers or laptops and use electronic modules with valid and practical characteristics to improve the quality of HOTS-oriented learning. Fourth, other researchers should continue this research to improve the quality of the developed electronic modules and make the material more valid, practical, and diverse.

ACKNOWLEDGMENTS

The researchers would like to thank the expert reviewers who validated the e-modules, colleagues who helped as informants and model teachers, and the principal of SMA Xaverius 1 Palembang, who allowed the researcher to collect data in the school.

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