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Microsoft Form as a Scaffolding-Based Geometry Learning Media in Online Learning

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Abstract

Geometry learning outcomes are lower than other mathematical fields, so media are needed to overcome students' difficulties solving geometry problems. This study aims to produce a product in online learning media for scaffolding-based geometry materials using Microsoft Form. There are three stages of Research and Development research, namely preliminary research, prototyping, and assessment. The validation results show that the scaffolding-based media developed is valid with a percentage of 76%. Field notes show that the scaffolding-based media developed can be used easily and practically by lecturers and students. A positive response was also given by 30 third semester students who used media in learning circle material. The test results showed that 73% of the total number of students scored no less than 70. Therefore, the scaffolding-based media developed was declared valid, practical, and effective in learning circle material.

Abstrak

Hasil belajar geometri lebih rendah dibandingkan bidang matematika lainnya, sehingga diperlukan media untuk mengatasi berbagai kesulitan siswa dalam menyelesaikan permasalahan geometri. Penelitian ini bertujuan untuk menghasilkan produk berupa media pembelajaran online materi geometri berbasis scaffolding menggunakan Microsoft Form. Tiga tahapan penelitian Research and Development penelitian ini yaitu penelitian pendahuluan, pembuatan prototipe, dan asesmen. Hasil validasi menunjukkna bahwa media berbasis scaffolding yang dikembangkan valid dengan persentase 76%. Catatan lapangan menunjukkan media berbasis scaffolding yang dikembangkan dapat digunakan dengan mudah dan praktis oleh dosen maupun mahasiswa. Respon positif juga diberikan oleh 30 mahasiswa semester 3 yang menggunakan media pada pembelajaran materi lingkaran. Hasil tes menunjukkan bahwa 73% dari jumlah mahasiswa mendapatkan nilai tidak kurang dari 70. Oleh karena itu media berbasis scaffolding yang dikembangkan dinyatakan valid, praktis dan efektif dalam pembelajaran materi lingkaran.

Keywords*: Development; Geometry; Learning Media; Microsoft; Scaffolding.*

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INTRODUCTION

Geometry is essential to master because it is one of the fields that connect mathematics with real life, becomes a form of representation of mathematical ideas, and provides non-single examples of mathematics (Hadiyanto & Wulandari, 2019).

As an essential scientific branch in mathematics, Geometry is not supported by good learning outcomes by students. The test results in geometry are the lowest compared to other mathematics fields (Kresna et al., 2017; Mulyadi & Muhtadi, 2019). The observations also show that student learning outcomes in Analytical Geometry lectures in the Mathematics Education Study Program are still dominated by average scores. This low learning outcome can be caused by many mistakes made by students, both conceptual, procedural or technical errors (Mulyadi & Muhtadi, 2019). Conceptual errors and calculation errors are the types of errors that are most often made in solving mathematical problems (Utami et al., 2019).

Giving scaffolding or assistance suitable for student's abilities and needs can minimize students' errors (Prayitno et al., 2018; Widjajanti et al., 2019). Wood, Bruner and Ross stated that the concept of scaffolding is to describe how students can have more ability to solve problems with someone's help (Reiser & Tabak, 2014). Furthermore, Reiser & Tabak (2014) state that there are several forms or techniques of scaffolding, including direct interaction with other people and data sources or by providing an environment or facility that supports problem-solving. The state of scaffolding or assistance provided to students can be in the form of instructions, encouragement, warnings, giving examples, and other actions that can make students think about the process to achieve results (Fatahillah et al., 2017; Prayitno et al., 2018; Intan & Masriyah, 2020). Lecturers need to provide scaffolding to help students solve problems on their own. However, there are not many studies that discuss the provision of scaffolding in online mathematics learning.

The provision of scaffolding in online mathematics learning can be provided through synchronous meetings through zoom meetings or other meeting applications so that students get a direct response from the lecturer (Salyers et al., 2014). However, financial problems and the availability of networks in online learning in Indonesia do not allow the dominance of synchronous learning when learning online (Agus & Hadi, 2020; Lubis et al., 2020; Puspitasari, 2020). Another alternative in providing guidance or scaffolding to students is through learning media in the form of modules. The module is one of the teaching materials with specific criteria (Yasa, 2018) that can assist the implementation of learning activities. Fonna & Mursalin (2018) said that the module could help students both individually and in groups. Ekawati et al., (2019) also stated that the module is designed systematically and contains information about materials, methods, limitations, and evaluations to help students achieve the competencies set. However, there are not many modules or electronic media containing scaffolding to help students learn mathematics in online learning.

Previous research related to scaffolding learning media has been carried out. Pratama & Saregar's (2019) study developed scaffolding-based worksheets on heat material used in classroom learning. However, worksheets are still designed for online learning and physics material. A valid, practical and effective e-scaffolding media was developed by Ayu et al., (2017) by using a website, but the media still has

weaknesses which include writing relatively complicated mathematical physics equations on the website. Therefore, the researcher sees the need for the development of scaffolding-based learning media using Microsoft Form. One of these Microsoft facilities is developed and used online through the website (Microsoft, 2021a) by logging in first. One of the Microsoft Form facilities is a branching menu that can link one question to another (Microsoft, 2021b) according to the need for providing scaffolding.

Media use in learning has an essential role for students and teachers to achieve learning success (Junaidi, 2019). Learning media can also be an alternative source of learning to provide more opportunities for students to play an active role in learning (Hardjito, 2019). The use of learning media is still needed at the university level. Inganah & Zukhrufurrohmah, (2020), in their research, stated that the use of printed worksheets characterized by guided discovery could help students find ways to solve systems of linear equations n variables. Utilization of media in learning in higher education has various forms and benefits in learning in higher education; use of GeoGebra media to increase interest in learning (Wondo et al., 2020) and problem-solving abilities (Dwijayani, 2020), use of learning management systems (LMS) (Pratiwi & Silalahi, 2021; Mardiana & Faqih, 2019), and use evaluation applications to improve student learning outcomes and valuation (Wijayanti et al., 2021).

Learning media is increasingly visible in learning during the COVID-19 Pandemic due to the implementation of online learning. At the university level, the use of media is essential, especially in mathematics. Media that are often used during online learning are podcast Sortify (Susilowati et al., 2020), google classroom or WhatsApp (Agus & Hadi, 2020), google form (Lestari & Putra, 2020) or Quizizz (Wijayanti et al., 2021) for learning evaluation, and learning videos (Ario et al., 2020). In addition, for face-to-face virtual meetings, zoom meetings or google meet are used (Hadiyanto & Wulandari, 2019).

Research related to Microsoft Form for mathematics learning media has not been widely developed, especially in online learning. Therefore researchers are interested in developing valid, practical and effective learning media containing scaffolding using Microsoft Form. In addition, this article also conveys the characteristics of the scaffolding-based learning media developed. The results of this study are expected to be a reference for student self-study in improving problem-solving skills related to the field of geometry, especially in the Analytical geometry course. The development of this scaffolding-based media can also be a reference for learning analytical geometry and other lessons in providing scaffolding and variations of online learning activities or distance learning to students.

METHOD

The development of Microsoft Form as a scaffolding-based learning medium on geometry material is carried out through 3 stages of development (Plomp et al., 2010): Preliminary research, prototyping, and assessment stage. Preliminary research begins by making observations on learning activities, problems with learning outcomes of geometry, then reviewing the literature to find alternative solutions to problems and determine the differentiator of the research carried out. At this stage, the researcher prepared research's instruments in the form of media validation sheets, student response questionnaire sheets, field notes on the implementation of learning, and test sheets to test the effectiveness of the developed media.

The next step is prototyping. A video link for learning circle material is prepared at this stage, which includes equations, elements, and tangents to circle families. The section on the media contains student identities and problems as well as scaffolding prepared according to the student's ability to solve the problems given. After the circle material learning media is complete, validation and revision are carried out until it is ready to learn. The validation of the learning media developed was carried out through 2 stages: validation to media experts who are lecturers in the field of developing mathematics learning media and small group testing on 40 students in different classes with research subjects.

The last stage is a summative assessment where the revised learning media according to the validator's suggestion and the lecturer uses small group test in analytic geometry. The subjects in this study were 30 students of the 3rd-semester mathematics education study program taking Analytical Geometry courses. The subject of using learning media using Microsoft Form is different from the subject of the small group test. Media is said to be practical if the results of field notes by observers show a positive response. At the same time, the learning media is effective if not less than 70% of all students get a minimum score of 70.

Analyzing data from the validation sheet and student response questionnaire follows some steps: 1) adding up the scores for each indicator given by the respondents, 2) dividing the total score (each indicator) with the maximum score, and 3) concluding based on the scores obtained. Researchers analyzed the field observation results by considering the outline of the implementation of learning and important notes of the observer. At the same time, the test sheet is analyzed by determining each student's score and then counting the number of students who get a minimum score of 70.

RESULTS AND DISCUSSION

Research Result

Preliminary Research

The results of observations related to learning activities in analytical geometry lectures show that lectures are carried out online. While adjusting to the conditions of the COVID-19 pandemic, learning is carried out online or remotely. The supporting application used by lecturers and students during the teaching of analytic geometry courses is the learning management system (LMS), elmu.ac.id, with a discussion feature (question and answer) related to learning materials, a video upload feature of learning materials made by researchers and task or quiz collection. During learning activities, evaluation is carried out by technically sending questions that the lecturer has made to the LMS, then students send the answers that have been typed or scanned through the LMS.

The problem observed during learning activities is that most of the student learning outcomes during distance learning have not reached the minimum standard. This is because students make mistakes in solving problems and students still have difficulty choosing the right problem-solving steps. Therefore, learning media is needed that can also aid students in solving problems.

The literature study results show that providing assistance or scaffolding to students can help solve problems and still give students an active role as problem solvers (Wijayanti et al., 2021). The provision of scaffolding is given according to students' errors or responses (Intan & Masriyah, 2020). In this design, scaffolding is given if the student gives the wrong

answer to the given problem. The scaffolding given is a question of guiding questions related to the basic concepts needed to solve the problem. If in the first scaffolding the student answers incorrectly, then a question is given as the second scaffolding. If students can answer the scaffolding correctly, students are asked to answer the problems given again.

Based on literature studies, the media that are widely used as evaluation media are Google Form (Susilowati et al., 2020), Quizizz (Wijayanti et al., 2021) and Edmodo (Pratama & Ismiyati, 2019). However, on Google Form, writing mathematical symbols can be an obstacle in choosing Google Form and Quiziz as the media used in this study. At the same time, Edmodo does not have the facility to display the scaffolding that has been implemented. So the Microsoft Form application was chosen which can display mathematical symbols correctly and has branching facilities to adjust the location of the given scaffolding.

The instrument consists of a media validation sheet, a student response questionnaire sheet, a learning observation sheet, and a test sheet. The media validation sheet measures the suitability of the material presented with learning outcomes, clarity of images and sound of learning videos attached to Microsoft Form, clarity of images and correctness of symbols and answer keys to questions on Microsoft Form. The student response questionnaire sheet measures students' responses and impressions after using Microsoft Form media through aspects of problem sentence clarity and the scaffolding provided, the suitability of the scaffolding provided with problem-solving, the benefits of scaffolding and learning videos, and clarity of instructions on the media. Aspects that are measured from the implementation of learning using the media are the flow of learning activities, the smooth use of media and the implementation of tests after using the media. Lecturers provide direction through LMS related to the flow of learning activities and the duration of each activity that students need to pay attention to. Student activities begin by accessing online media on the link provided and then listening to learning videos whose links are presented on the media. After watching the video material, students returned to the Microsoft Form link to fill in their identities and solve existing problems. After using the Microsoft Form media, the lecturer directed the students to fill out a student response questionnaire in a Google Form. The lecturer asks students to study the material through the provided learning videos and practise solving problems on Microsoft Forms again. At the next meeting, there will be a test. The question sheet contains four analytic geometry questions, which include the equation of a circle, a family of circles, the equation of a circle that passes through the intersection of two or more circles. Students upload questions and collect answers via LMS. Processing time is 75 minutes.

Prototyping Phase

The design of scaffolding-based learning media contains work instructions, student identities, problems, and scaffolding. The learning video provided includes an explanation of lecture material about the equation of a circle to determine the equation of a circle through the intersection of two circles. Learning videos are made by the lecturer concerned in collaboration with researchers. In the learning video, there is a PowerPoint display and an explanation voice from the lecturer. Students are asked to listen to the learning videos prepared via the link written in the work instructions. After watching the learning

video, students return to the Microsoft Form link and fill in their identities. After filling in the identity, students are faced with problems that have been prepared. Students can only access the second problem if the first problem is correct, and so on so that if students can answer the scaffolding correctly, students will be directed back to the main problem. Scaffolding in each problem has a different amount depending on the difficulty level of the problem. Figure 1 below shows the flow of problems and scaffolding presented in the learning media.

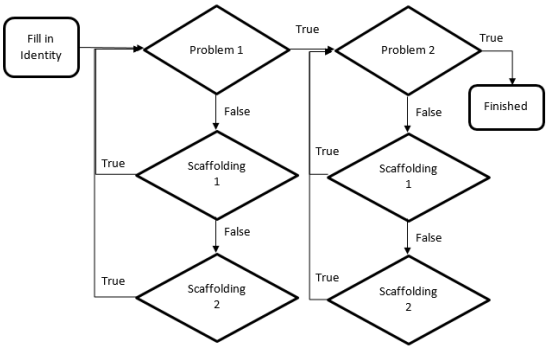
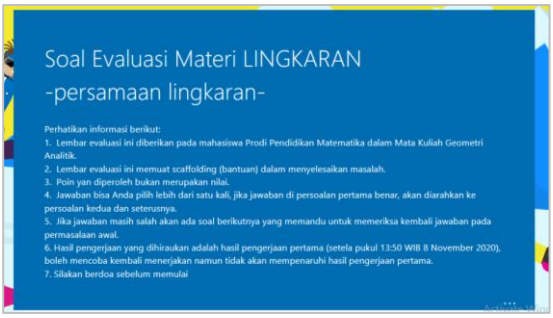


Figure 1. The flow of scaffolding problems in learning media

Scaffolding-based learning media is designed based on the circle material in the Analytical Geometry course. Learning media is prepared using the Microsoft Forms online platform. Microsoft Form was chosen to compile this media because it has a branching feature, which can direct students if they choose the wrong answer. The form consists of questions equipped with scaffolding in prompting questions that direct students to the correct concepts and answers. The initial display on the media contains the title, spelling instructions and student identity fields, as shown in Figure 2.

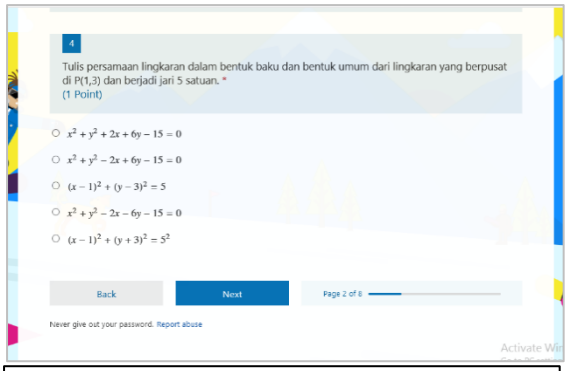


Translation
CIRCLE Material Evaluation Question
-equation of a circle-
Pay attention to the following information:

1. This evaluation sheet is given to students of the Mathematics Education Study Program in Analytical Geometry.
2. This evaluation sheet contains scaffolding (assistance) in solving problems.
3. Points earned are not grades.
4. You can choose the answer more than once; if the answer in the first question is correct, it will be directed to the second question and so on.
5. If the answer is still wrong, there will be a next question to re-examine the answer to the initial problem.
6. The work results that are ignored are the first work (after 13:50 WIB 8 November 2020); you may try to work again, but it will not affect the results of the first work.
7. Please pray before starting.

Figure 2. Home Page View

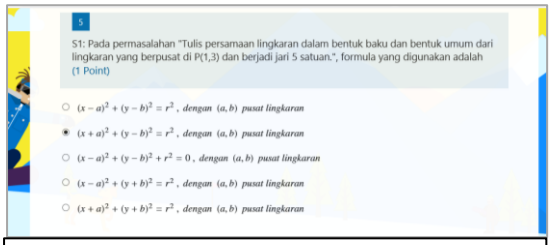
After filling in their identity, students are directed to the first problem. If the student can answer the initial problem correctly, then the student can proceed to the next problem by selecting the next button. The display in Figure 3 shows an example of initial questions on the media. There were seven initial problems which was contained in media with three submaterials: circle equality form, the graph of circle equality and the standard form of circle.



Problem 1: Write the equation of a circle in standard form and the general form of a circle with centre at P(1,3) and radius 5 units. general form of a circle with centre at P(1,3) and radius 5 units. n of a circle in standard form and the general form of a circle with centre at P(1,3) and radius 5 units. the equation of a circle in standard form and the general form of a circle with centre at P(1,3) and radius 5 units.

Gambar 3. Example of the display of questions on the media

If students choose the wrong answer to the initial problem, the system will display scaffolding or first aid in guiding questions. If the students' first aid is incorrect, the system will display a second aid where the second aid is a guiding question based on information or concepts in the first aid.



S1: In the problem "Write the equation of a circle in standard form and the general form of a circle with center at P(1,3) and radius 5 units.", the formula used is ...

Figure 4 Example of first scaffolding display (S1).

Formative Evaluation

Validation is carried out by lecturers of mathematics education study programs who are experienced in the development and manufacture of learning media. The validation results show that the scaffolding-based media developed is valid, and it is recommended to be tested in small groups. The percentage value of media validation obtained from media experts is 76%. The changes made based on the validation results from media experts are presented in Figure 5.

Analytical Geometry
CIRCLE material
Part A
Activity Instructions:
1. Before using the media, it is expected to read or listen to the circle material via: https://youtu.be/wb2ZLG3GxII.
2. This media will present problems related to circles.
3. If the answer to the main problem (PU) is correct, it will continue to the next problem.
4. If the answer to the main problem (PU) is not correct, a help question (S) will appear to check the steps or ensure the concept used to solve the given problem.
5. If the help question (S) is correct, no new questions will appear. However, the main problem (PU) needs to be answered correctly.
6. You can choose the answer more than once. If the answer in the first question is correct, it will be directed to the second question and so on.
7. Points earned are not grades.
8. Pray before starting.

Figure 5. The display of media before revision (top) and after revision (bottom).

In the last scaffolding for each problem, it is recommended to provide one source as a reference for learning rather than only providing suggestions for re-learning. The references were from YouTube Channel which consist of specific materials. This reference videos is open acces so everyone could use it to study. Figure 6 shows the media before and after being revised in the final scaffolding section. Last help is given if the student cannot answer correctly the most uncomplicated service that leads to the basic concepts of circle material.

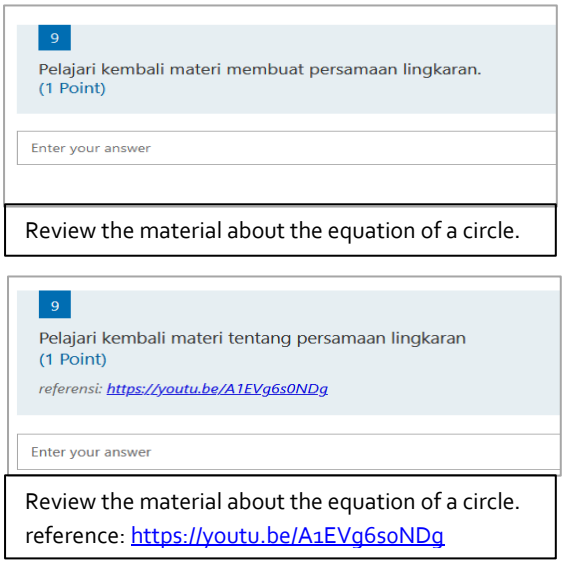


Figure 6. Final scaffolding display before revision (top) and after revision (bottom).

Small group trials were conducted on students in other classes to examine media use from the user's (student) point of view. Based on the results of small group trials, there are improvements in the formula for finding the radius of a circle. Figure 7 shows the improvement in formula writing before and after the revision based on the results of small group trials. The formula to find the radius was written as $r = \frac{1}{2}\sqrt{A + B + 4C}$ before the correction and became $r = \frac{1}{2}\sqrt{A^2 + B^2 + 4C}$ after revision. The validation and small group test results showed that the media was suitable for classroom learning with corrections that the researcher had made. Therefore, the media is used in Analytical Geometry learning after revision.

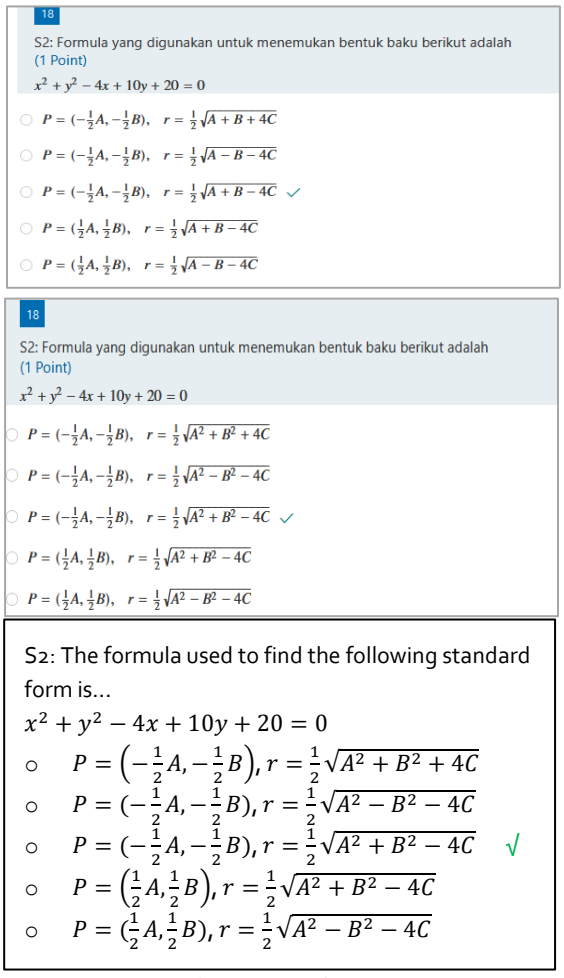


Figure 7. Writing formulas before revision (top) and after revision (bottom)

Learning activities show that lecturers and students can use the scaffolding-based learning media developed easily and practically. The lecturer's field notes show that scaffolding-based media is easy to use because there is a link that media can open on a smartphone or laptop. The material contents contained in the learning media are equations of circles, families of circles and equations of tangents. If you

want to add material or questions, lecturers can do it easily through their existing Microsoft account. The use of media in learning is by learning conditions that require not face-to-face like during this pandemic.

A positive response was also given by 30 third semester students who used media in learning circle material. Student responses showed that 78% of 30 students stated that this media helped students understand the material well, the media was easy to understand and the images presented were clearly visible. More than 80% of 30 students stated that the scaffolding provided was suitable for the given problem and could help understand the circle material. In addition, students also said that they could use scaffolding-based media easily online. Existing references and learning videos help explain the material and are clear, but students prefer to do learning by using zoom meetings in learning mathematics. Another aspect students feel is lacking is that the clarity of the images displayed is still not large enough. The lacking of clear figures was conveyed by students who use smartphones in using media.

Assessment Phase (Sumative Evaluation)

The development of scaffolding-based media aims to help students develop spatial thinking skills in understanding the material in analytic geometry, especially in the circle material. The recapitulation of student test results shows that 73% of students get a score of not less than 70. Figure 8 shows a recap of the number of students based on test scores. The test results show that the media developed is effective to help students in learning analytic geometry of circle material in online learning.

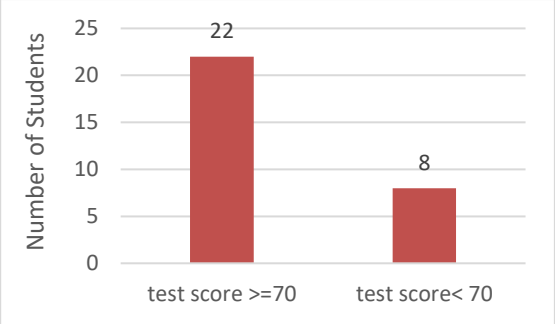


Figure 8. Recap the number of students based on test scores.

Discussion

The Microsoft Form as an e-survey has been used by Hikmah (2020) in collecting research data regarding the benefits of e-learning. However, the use of Microsoft Form as a learning medium such as this research has not been widely carried out. The use of other applications as student worksheets using Google Form has been carried out by Iqbal et al., (2018). However, the facility on Google Forms is not easy to write mathematical equations properly and correctly (Lindsay, 2020), so Microsoft Forms facilities can overcome this deficiency of Google Forms (Microsoft, 2021a). The findings of this development research resulted in electronic learning media with scaffolding characteristics that were valid, practical and effective. The scaffolding-based learning media developed can be appropriately used and easily by lecturers and students. Electronic media characterized by scaffolding in a website is also practical and effective in learning (Ayu et al., 2017). The provision of scaffolding helps students solve the main problem by recalling concepts related to the problem (Yunus et al., 2017). In line with Ayu et al., (2017) and Miatun & Khusna (2020), research findings show that providing online scaffolding through learning media can support student learning outcomes in online learning or distance learning.

CONCLUSION

Scaffolding-based media on analytic geometry circle material was created using existing facilities in Microsoft Form. The development of media in scaffolding-based learning media was declared valid by the validator and the results of small group trials. After being revised based on suggestions from the validator and small group trials, scaffolding-based learning media is used in learning by lecturers who teach analytic geometry courses. Field notes show that scaffolding-based learning media can be used easily and both by lecturers and students. Student responses indicate that the scaffolding-based learning media used is quite helpful for students in understanding the circle material in online learning. The results of filling in student responses also show that scaffolding-based learning media makes online learning exciting. However, students still feel that the delivery of material needs to be done using a web meeting. The tests' results showed that 73% of the 30 students scored no less than 70. Therefore, the scaffolding-based media developed was declared valid, practical, and effective.

The images presented on the media are clear enough. Still, it would be better if they were presented in a simulation so that the object of the problem can be observed thoroughly from various sides. In addition, this learning media can be formed into learning applications to be used on smartphones. The provision of scaffolding in this research is based on the problems given to be different from different problems. In further research, the scaffolding provided can be adapted to the concept of the material to be studied to be used in general.

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