Learning points, lines, and plane geometry with Hawgent dynamic mathematics software

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Abstract. Geometry is any shape seen as a set of specific set points, while a plane means a collection of all lines. In mathematics, points, line, and planes geometry is complicated for students to understand a basic concept. This research aims to help teachers explain the concepts of points, lines, and planes and help students understand the basic concepts of points, lines, and planes with Hawgent dynamic mathematics software. The method used in this research is Analysis, Design, Development, Implementation, and Evaluation. The evaluation results of media expert were 82.77\%, and material expert was 84.17\%. The result of the implementation is a positive response from students when learning mathematics uses Hawgent dynamic mathematics software in the classroom and also a positive response from the teacher towards learning media of Hawgent dynamic mathematics software. In further research, elementary school materials can be developed using Hawgent dynamic mathematics software or other dynamic mathematics software to increase students' interest in learning and make students more active in teaching and learning activities.

1. Introduction

Mathematics is a branch of science that is very useful for human life [1], [2], as it plays an essential role in our everyday life. However, mathematics is not only for science but also useful for other things. Teachers should develop an active, creative, and innovative learning system to help students learn mathematics.

Many things or factors in mathematics learning can affect students' learning achievement [3],[4]. These factors often hinder the achievement of learning goals. Therefore, teachers should understand and develop various methods and media in teaching mathematics [5]. The goal is that teachers can master the learning program and convey it to students so that students feel interested in learning mathematics, and this can increase students' mathematical ability and success in understanding the material of points, lines, and planes. Points, lines, and planes are often and always found in learning mathematics, especially in the discussion related to geometry. For this reason, understanding these ideas or concepts is very important if someone wants to be successful in learning mathematics. Apart from studying mathematics, these concepts are often used in everyday life.

Geometry is any shape seen as a set of specific set points, while a plane means a set of all lines[6], [7]. In mathematics, geometry is an abstract object that has a perfect shape and size. To improve students' understanding of the subject position of points, lines, and planes in the three-dimensional figure, the teacher has to use mathematics learning media more effectively with appropriate ICT to make it easier for students to understand.
Developments in information and communication technology have brought significant benefits to the advancement of human life. On this occasion, mathematics learning media can be designed as a learning media that can encourage students' mathematics learning to understand mathematics material. ICT can also help teachers explain abstract mathematical materials that are easy for students to understand [8], [9]. Therefore technology-based learning media can improve students' understanding, material mastery, and students' learning achievement [10], [11]. A lot of research has been done on using ICT to develop learning media [12]–[14]. All such efforts improve students' learning outcomes and mathematical abilities [15], [16].

Hawgent dynamic mathematic software is mathematical software from Guangzhou. It is a vibrant design with facilities to visualize or demonstrate mathematical concepts and a tool to construct mathematical concepts. Based on previous research results, hawgent dynamic mathematics software improves students' mathematical abilities and helps teachers explain material concepts. Good design and easy to use becomes an advantage hawgent dynamic mathematics software. Six questions cognitive model has been implemented in several previous studies to help students understand mathematics subjects' material [17]–[20].

Figure 1. Hawgent dynamic mathematics software.

Based on previous research on students' difficulties when learning points, lines, and planes, researchers then tried to design an ICT-based learning media to help elementary school students understand points, lines, and planes.

2. Method
The research method used in this research is ADDIE (Analysis, Design, Development, Implementation, and Evaluation) [21]. Figure 1 shows the process of developing learning media using hawgent dynamic mathematics software. In the analysis stage, researchers analyzed students' difficulties when learning points, lines, and planes so that they would be able to develop a new learning model. During the design stage, researchers started designing the learning media based on the analysis done. At the development stage, media and material experts validated and gave an opinion on the learning media. After the learning media is declared valid, the learning media are ready to be implemented in schools. In the implementation stage, researchers tried the learning media to 38 students from a school in Bandung, West Java, and saw the students' response towards the learning media. This research used random sampling. An evaluation was carried out initially and at the end of the study using a formative evaluation method.
3. Result and Discussion

a. The Analysis
Based on researchers' observation, one of the problems students face is finding it challenging to master mathematics concepts, especially points, lines, and planes geometry. The point, line, and field materials are fundamental concepts of geometry material that will be studied at the next mathematics lesson. In addition, low interest in learning coupled with teachers who still use unattractive methods causes several problems, including 1) most students find it challenging to ask questions when they even do not understand mathematics lesson, 2) students are also inactive in answering the question given by the teacher; 3). Keep quiet or talking with friends. This fact is because students do not understand and feel that mathematics is a boring subject. There is no innovation and creation from a teacher that causes students who do not understand mathematical materials to discover concepts and build their knowledge actively. That is why researchers are trying to develop learning media using Hawgent Dynamic Mathematics Software on point, line, and planes to increase students' interest in learning.

b. Design
From the observations that have been done, the researcher conducts the learning media. This research's learning media use Hawgent Dynamic Mathematics Software on point, line, and planes geometry materials. The development of technology-based learning media is beneficial for more interesting mathematics learning. It facilitates students' understanding of points, lines, and planes based on their definition following. The point has a position but does not have size or magnitude, so it is said that a point is not dimensional. Often presented with a nocturne and a line is a set of points, and its members consist of more than one point. The points are lined up in both opposite directions to far infinity. The planes geometry is a set of lines whose members also consist of more than one surface line. A field can be widened in all directions and has a length and width, for more details on each step and the following image with Hawgent dynamic mathematic software.

Figure 3. Lines are groups of many points.
From points, lines, and planes in figure 3a and figure 4 using Hawgent Dynamic Mathematics Software, it is expected to make students happy and active in the classroom and no longer bored. Learning media is very interesting, with animations can help students understand the concept of mathematics. Not only that, but the learning media raised students' curiosity more and more.

**c. Development stage**

Two professors from Guangxi regular university and two professors from IKIP Siliwangi, Indonesia, validated learning media. The results of learning media validation can be seen in table 1. Media experts' advice on learning media is to change the language of hawgent dynamic mathematics software to English so that everyone can use it. From the validation results, it can be concluded that learning media can be implemented.

### Table 1. Evaluation results of media expert.

| Validator          | Assessment component | Value | Percentage | Criteria      |
|--------------------|----------------------|-------|------------|---------------|
| Media expert       | Figure               | 2.6   | 86.67      | Valid         |
|                    | Animation            | 2.5   | 83.33      | Valid         |
|                    | Text                 | 2.6   | 86.67      | Valid         |
|                    | Audio                | 2.4   | 80         | Valid         |
|                    | Language             | 2.1   | 70         | Valid Enough  |
|                    | Ease to use          | 2.7   | 90         | Valid         |
|                    | Average              |       | 82.77      | Valid         |
| Material expert    | Concept of lines     | 2.5   | 86.67      | Valid         |
|                    | Concept of planes    | 2.5   | 86.67      | Valid         |
|                    | Curriculum           | 2.4   | 80         | Valid         |
|                    | Concept geometry     | 2.7   | 90         | Valid         |
|                    | Average              |       | 84.17      | Valid         |

d. **Implementation stage**

In this implementation stage, researchers gave learning media to teachers in schools to implement. The implementation results are feedback from students and teachers towards Hawgent dynamic software learning media in point, line, and plane geometry. To see more clearly about student statements can be seen in table 2.
Table 2. Student statements in using Hawgent dynamic mathematics software.

| No. | Students' Statement |
|-----|---------------------|
| 1   | I like to learn math using Hawgent software |
| 2   | I enjoyed learning math with the help of Hawgent software |
| 3   | With the help of this learning media, I can understand the concepts of points, lines, and planes |
| 4   | I want to try another subject by using another dynamic mathematics software |
| 5   | I hope every math subject can use Hawgent dynamic |
| 6   | This learning media helps me more effectively in understanding points, lines, and planes material |

It can be seen in table 2. Students look more confident when participating in teaching and learning activities in class. Students look no sleepy and more active when answering questions from the teacher. Hawgent dynamic mathematics software also stimulates students to comment and provide questions about points, lines, and plane geometry. This finding is consistent with previous research that Hawgent dynamic mathematics software can improve students' abilities in mathematics [8], [22]–[24]. At the implementation stage, the researcher also conducted interviews with choosing a random teacher in the classroom about how they responded to the learning media. Based on the results in table 3, it can be seen that learning media get a good response.

Table 3. Teacher's statement in using Hawgent dynamic mathematics software.

| No. | Teacher's Statement |
|-----|---------------------|
| 1   | This learning media is beneficial for students in understanding mathematical concepts, especially points, lines, and planes in geometry |
| 2   | This learning media makes students focus on learning mathematics in class |
| 3   | This learning media can provide feedback on student questions |
| 4   | Animation of learning media is attractive and easy to understand so that it makes mathematics learning more interesting |
| 5   | Hawgent dynamic mathematics software is exciting so that in the future, it can be used for learning mathematics |

4. Conclusion

The use of technology in teaching and learning activities should be the purpose of improving students' abilities. The use of technology can improve students' mathematical abilities. From the results and discussions of researchers based on the studies, it can be concluded that the teacher can also use the development of Hawgent dynamic mathematics software learning media to learn points, lines, and planes. Hawgent dynamic mathematics software can help teachers explain points, lines, and planes geometry to students. There is a positive response from students when learning mathematics uses Hawgent dynamic mathematics software in the classroom and a positive response from the teacher.
towards Hawgent dynamic mathematics software media. In further research, elementary school materials can be developed using Hawgent dynamic mathematics software or other dynamic mathematics software to increase students’ interest in learning and make students more active in teaching and learning activities.

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