Using Hawgent Mathematics Software to Help Primary School Students to Read Clocks

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Abstract. Clock reading is a very important skill for students however there are still students that finds clock reading difficult to understand. Technology can help students to understand mathematics concepts. This research developed a learning media using the research and development method and the ADDIE framework. The sample of this research are 87 students from Bandung, Indonesia. The learning media is made based on the analysis of teachers’ and students’ difficulties on clock reading. The result of this research shows that Hawgent dynamic mathematics software can help students to understand clock reading. The learning media also received a positive response from the students. During the teaching and learning process, students were more active in answering the teachers’ questions and were able to follow the instruction given. This research proved that technology can help students in various aspects that includes getting students’ attention so that they more focused in learning mathematics. The use of technology can be used for various topics in various grades.

1. Introduction
Primary school is one of the levels of education that lasts for 6 years and is the lowest level of formal education that will greatly determine the students’ character [1]. In this early stage students get the knowledge and cultivates values they need in their life because basic education aimed to develop the minimum quality that must be possessed by every human in accordance to the demand of changes in the local, national and global community. This is why it is necessary to carry out a reformation for the education field in a planned, directed and sustainable manner.

Due to the importance of primary school education in preparing the students’ character, hence we can’t emphasises on the quantity while ignoring quality. On the other side, the quality of human resources is determined by the quality of education.

Clock reading skill is taught in primary school however [2], they still have difficulties in reading clocks. In Indonesia, clock reading is taught in the 2nd grade and when they get into the 3rd grade, they taught a more complex clock reading. Clock reading is one of the basic knowledges that should
be present in primary school students. This skill can be use in our daily life so that we will be able to manage our time wisely.

A rapid growth in technology made the Mirsha and Kohler’s theory on Technological Pedagogical Content Knowledge (TPACK) in 2006 to continue developing until today [3], [4]. The TPACK theory explained the teachers’ ability in integrating technology into their teaching method [5], [6]. This theory also includes how teachers can develop a technology-based learning media that is suitable for the students so that in the future, we can use technology to teach students various topics [7], [8]. In 2006, the TPACK theory was developed into a smaller scope which focuses on mathematics and it is called the Technological Pedagogical Mathematical Knowledge (TPMK) [9]. This TPMK talks about the use and the development of a technology-based learning media based on the teachers’ needs in explaining basic [10].

In this 21st century, most children are able to use technology in fact they can use it even better than their parents [11]. There has been a lot of researches that proved the benefit of using technology if it is used properly [12]–[13]. The use of technology in learning can boost the students’ learning interest and improve students’ mathematical thinking ability [14]–[15]. Technology can also make students to be more active in class [16]. There has been other research about various learning approach but there are only a few that uses technology to explain clock reading.

Hawgent is a dynamic math software from Guangzhou China. It was created to help teachers explain the basic concepts of mathematics, especially elementary until university mathematics subjects. There have been many studies on the development of learning media and analysis of its effect on students' abilities [17]–[19]. The researchers continue to develop learning media to help students understand the basic concepts of mathematics.

Our challenge now is how to find and develop a learning media to help students to understand a mathematics concept because is one of the hardest subject to understand. However, mathematics is needed in our daily life that is why mathematics is important is needed to build up students’ basic knowledge that can train children’s brain so they would be more knowledgeable about the world of mathematics[20]. Hawgent dynamic mathematics software is one of the learning media that uses technology. Hawgent is mainly used by high school teachers to help them in explaining various mathematics concepts such as geometry and trigonometry [21]–[23].

Mathematics knowledge in primary school such as clock reading will not go far from our daily life. The clock has three main needles which are the long needle and the short needle. The short needle shows the hour while the two long needles shows the minute and seconds. However, most students can’t understand this concept because of the boring teaching method from the teacher. In this research, researchers developed a learning media using Hawgent based on the difficulties faced by students on clock reading.

The results of this study contribute to help elementary school students. Helping the elementary students learn the clock material in an easy and a fun way. Therefore, it is necessary increasing the elementary school students' interest in mathematics. In previous research, there has been no research
that has developed learning media about clock reading. Furthermore, get used to elementary school teachers using technology when math subjects being taught in class.

2. Methodology

The research method that is used is the research and development method using the ADDIE framework (Analysis, Design, Development, Implementation and Evaluation) [24], [25]. This framework has a complete and systematic step in designing a learning media. The ADDIE framework can be seen in figure 1.

![ADDIE Framework](image)

The ADDIE model (figure 2) explains the steps in developing learning media using Hawgent on clock reading. In the analysis stage, the main purpose is to analyse the need of developing a new learning method, analyze the worthiness and requirements to develop a new learning media. This is an important stage because in order to develop a learning media, there should be a problem in the current teaching method. In the design stage, researchers start to design a new learning method that help students to understand mathematics concepts. In the next stage, researchers developed a learning media based on the TIK model. In the implementation stage, researchers implemented the learning media but researchers observed the students’ reaction and opinion towards the learning media. In the last stage, researchers evaluated the learning media. The learning media also validated by the media and material experts to know the effectiveness of the learning media. The validation criteria from the media and material experts can be seen in table 1.

| Interval     | Category  |
|--------------|-----------|
| 3.60-4.00    | Very Good |
| 2.60-3.59    | Good      |
| 1.60-2.50    | Average   |
| 0.00-1.59    | Bad       |

The sample of this research are primary school students from Bandung, Indonesia. There is a total of 87 3rd grade students. All of them have learned clock reading in the 2nd grade and they will learn a more difficult concept of clock reading.
3. Results and Discussion

1) Observation

Based on the initial observation (table 2), researches can see that during the teaching and learning process, students are not active as teachers were unable to get the students attention. As a result, the students sitting in the front row were more active while the ones sitting at the back were chatting among themselves. When the researchers asked the teacher about using a technology-based learning media, teachers answered they don’t have the ability to design a technology-based learning media.

| No  | Difficulties faced by teacher                                                                 |
|-----|---------------------------------------------------------------------------------------------|
| 1   | Teachers were unable to trigger students’ activeness in class.                                |
| 2   | Teachers have no preparation in providing a learning media to support the teaching-learning process. |
| 3   | Teachers still use the conventional teaching method so it did not dig up the students’ capability. |
| 4   | Teachers have never joined a training about new learning media that is why teachers do not use a Information Communication Technology (ICT) based learning media. |

Based on the difficulties faced by mathematics teachers when teaching clock reading material in school, teachers hope that researchers can develop a creative technology-based learning media so that it can help students to understand the clock reading material. Researchers also made an observation on the students’ homework to know the difficulties faced by students when learning clock reading. The researchers’ observation result is shown in table 3.

| No  | Difficulties faced by student  | No. of Student | Percentage  |
|-----|-------------------------------|----------------|-------------|
| 1   | Students were unable to change from digital to analog | 54             | 62.07%      |
| 2   | Students have difficulty in reading 24-hour clock mode | 61             | 70.11%      |
| 3   | Students still make mistakes in reading clocks | 57             | 65.52%      |

Based on the observation result on the students’ difficulties, we can see that students still haven’t master the clock reading this is why when teachers gave them word problem, students were still confused how to solve the problem. Based on the analysis result, researchers developed a learning media using Hawgent to help teachers explain clock reading to the students.

2) Design

In the design stage, researchers developed a technology-based learning media using Hawgent on clock reading for primary schools that includes animation and steps as shown in figure 3a and 3b.

There are 4 buttons in the learning media in which each button has a function to change the hour, minute, seconds and to make it back to the original state. Each of the needles are given a different color which will enable students to know the difference between hour, minutes and seconds. The learning media is also equipped with an interesting back sound which would increase the students’ learning interest.
Figure 3. Figure 3a. The clock shows 00.00.07 and 3b. The clock shows 10.09.56

1. Validation result from the media and material expert

After designing the learning media using Hawgent for primary school students on clock reading, the learning media was validated by media and material experts. The result of the validation from the material and media experts can be seen in Table 4 and Table 5 respectively.

| Assessment aspect | Number of indicators | Grade | Percentage |
|-------------------|----------------------|-------|------------|
| curriculum        | 5                    | 3.7   | 92.5%      |
| content           | 5                    | 3.8   | 95%        |
| interaction       | 5                    | 3.8   | 95%        |
| Error reduction   | 5                    | 2.6   | 90%        |
| Average           |                      |       | 93.13%     |

The learning media is designed based on the 4-assessment aspect that can be seen in Table 3. The content and interaction aspect got the highest score which means that the content became more interesting and get into deeper detail when it’s explained through Hawgent. When the teacher teaches using Hawgent, researchers can see that the students became more active and the atmosphere of the class became livelier. The average score from the material expert on Hawgent is 93.13% which means it passed the validation test.

| Assessment aspect       | Number of indicators | Grade | Percentage |
|-------------------------|----------------------|-------|------------|
| Color                   | 5                    | 3.5   | 87.5%      |
| Text layout             | 5                    | 3.5   | 87.5%      |
| Easy to use             | 5                    | 3.6   | 90%        |
| interface               | 5                    | 3.6   | 90%        |
| Average                 |                      |       | 87.75%     |

The average validation score from the media expert is 88.75%. The easy to use and interface aspect got the highest score. Hawgent is designed as easy as possible so that it will be easier for teachers to use and develop. Animation and layout can also be customized easily by user.

3) Implementation

When the learning media was implemented in school, students can see that there is a new learning media that is used. The learning media made the class’s atmosphere to be livelier. When the teacher explains the clock reading concept, students were serious and active when answering questions.
Students were also more active to ask questions when they don’t understand. A technology-based learning media really increase the students’ learning interest. After the teaching-learning activity finished, the researchers interviewed the teachers to know their feedback towards Hawgent and the result can be seen in table 6.

**Table 6.** Teacher feedback toward the learning media

| Aspect assessment               | answer                                                                 |
|--------------------------------|------------------------------------------------------------------------|
| Teaching-learning activity     | 1) The use of media is interesting and made the students be more motivated |
|                                 | 2) The media is relevant to what the students should be studying       |
| Curriculum                      | 3) The purpose and benefit are delivered clearly                       |
| Material content                | 4) The material content has a correct and appropriate concept         |
| Feedback                        | 5) The material content is according to the core competency           |
|                                 | 6) The material content is according to the basic competency          |
| Handling errors/error reduction | 7) Interaction/Interactive Bad                                         |
|                                 | 8) The media is easy to use Bad                                       |
|                                 | 9) Users do not feel boring using the media                            |
|                                 | 10) The media includes illustration and sample questions               |
|                                 | 11) In the practice question, the media encourage students to answer the correctly |

Based on the interview with the teachers, they can see that Hawgent is easier to use than other dynamic mathematics software. After seeing students being very active in class, the teachers also feel motivated to learn on how to develop the learning media using Hawgent.

### 4. Conclusion

A technology-based learning media can be use to help students in understanding the clock reading concept. Based on the research, Hawgent passed the validation from the experts and can be use in class. Hawgent also receives a positive response from the teachers. Future researches can be about the effect of Hawgent in improving the students’ mathematical ability.

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