Development of nano physics learning media (physics monopoly game) based on software

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Abstract. This study aims to develop NaNo Physics learning media (Physics Monopoly Game) on work and energy topic. The type this research was research and development (R&D) with the ADDIE model. Data were analysed using the descriptive statistical analysis. The results indicated that the physics monopoly was feasible to be used as a learning media. The overall results of the assessments of material and media experts, and students from individual trials, small group trials and field trials showed that they had met the eligibility requirements of the developed physics monopoly learning media. In addition, according to the field testing, the developed product can increase students' learning motivation from an average score of 3.19 which was in the "enough" category and increased to 4.39 in the "very high" category.

1. Introduction

Learning activities are complex. It is a system that is composed of components that are interrelated with each other. These components are materials, methods, media, and evaluation [1]. Accordingly, teaching media has become a core of learning activities. It helps teachers in providing maximum, effective, and efficient teaching [2]. Learning media that is suitable with the learning objectives and students’ characteristics can improve students’ learning experiences and outcomes. An interesting and fun media that can be integrated in classroom activities can be carried out by adopting some simple games [3]. Previous research has found that the use of games in the learning process can improve engagement, motivation and learning performance [4–6].

The Monopoly game is one of the simple games that can be used as learning media in the teaching and learning process [7]. The use of monopoly game in physics learning has not been widely implemented despite its potential in increasing students’ involvement in learning. As stated by Firdaus [8], due to its uniqueness and interesting ways of playing, the integration of the monopoly game in science lessons could improve students’ enthusiasm and confidence in learning. In line with the previous study, Irawan [9] also found that the monopoly game could foster students' enthusiasm for learning, thus the learning processes become more active, innovative, creative, effective, and fun. Since science subjects are known to be difficult and full of complex concepts, including games in learning activities could turn the lesson to be more exciting and fun. However, the monopoly games that contain science lessons, especially Physics, are still limited. Accordingly, game-based learning media in Physics learning is required.

The use of information technology (IT) in the education sector in Indonesia has become mainstream, especially these couple years due to the Covid-19 situation. Teachers and students were
forced to conduct learning activities online regardless of their capacities and facilities on online learning. The utilization of Android or PC-based learning is implemented on a daily basis. Therefore, the existence of learning media based on games and software is necessary to help teachers in providing and delivering the lesson and students in acquiring and comprehending the topics being taught.

Accordingly, this study aimed to develop NaNo Physics learning media (Physics Monopoly Game) on Work and Energy topics based on software. The game adopted the rules of monopoly game in general and a study of Irawan [9]. There some modifications have been done to suit the purposes of the study. For example, if the previously developed monopoly game contains topics about cell sub-materials for high school students, we modified the contents into work and energy materials. This product could contribute to filling a scarce of game-based learning media in physics. Also, since this product was software-based, it can be utilized in any learning situation, not limited to school-learning context. Students could play the game by themselves or with their peers anytime.

2. Methods
This research was research and development (R&D) and referred to the analyze, design, development, implement, and evaluation (ADDIE) model. The procedures were a modification of the Borg & Gall development model. The research was conducted in one of the public senior high schools in Central Sulawesi. The research subjects in this study included 3 students in individual trials, 7 students in small group trials, and 14 students in field trials. Meanwhile, the validator consists of two content experts and a media expert. The object of the experiment was the quality of the NaNo Physics learning media (Physics Monopoly Game) including the learning aspects, media manufacturing aspects, and visual communication aspects.

For the sake of product assessment, the questionnaires about product quality and feasibility were distributed to the media experts, material expert, teacher, and students. The instrument used a Likert scale with 5 alternative answers, which were very good, good, enough, less, and very poor. Data were analysed quantitatively by creating a score for each response, starting from 5 points for the “very good” answer, to 1 point for the “very poor” answer. The product trial consisted of validation, one-to-one tryout, small group tryout and field-testing. The data were analyzed using descriptive statistics.

3. Results and Discussion
3.1 Learning Media Product Development
The validation of content experts obtained an average score of 5.0, with the “very good” category. It was a perfect score, thus there was no further revision made on the contents of the product. Moreover, based on the results of the media expert, the feasibility of both the media engineering and visual communication aspects were “very good” with the average score of 4.36 and 4.22, respectively. Data from individual (one-on-one trial), small-group and field-testing can be seen in Table 1.

| Assessed Aspects   | Product trials |                            |                            |        |        |
|-------------------|----------------|---------------------------|---------------------------|--------|--------|
|                   |                | individual               | Small-group               | Field-testing |
|                   |                | (one-on-one)             |                          |            |
| Media engineering | 4.72           | Very good                | 4.76                      | Very good |
| Visual communication | 4.61         | Very good                | 4.67                      | Very good |
| Learning          | 4.72           | Very good                | 4.41                      | Very good |

During the field trial stage, the comments given by students were generally positive. However, we decided to not follow some students’ suggestions, such as adding pictures to the media. We believed that the media have had enough pictures, thus adding it would be redundant and overwhelming and could result in overlapping the provided texts. This decision was also made after considering the results of the content expert which obtained the perfect score. The detailed comparison assessments of all trials in the media engineering aspect can be seen in Figure 1. Meanwhile, the comparison of the
results of the assessment of visual communication are presented in Figure 2. Overall, all indicators of media engineering and visual communication aspects were in a very good category.

![Figure 1. Average score of media engineering aspect in each indicator](image1.png)

![Figure 2. Average score of visual communication aspect for each indicator](image2.png)

The comparison of the results of the assessment of learning aspects for each indicator is presented in Figure 3. The average score of each indicator was above 4.0, which indicated that all indicators were “very good” category.

![Figure 3. Average score of learning aspects for each indicator](image3.png)

3.2 Feasibility of the Product as Learning Media

The feasibility of the product as learning media were evaluated based on the assessment of content and media experts. The results of the media engineering aspect show an average score of 30.5 with the "very good" category. Meanwhile, the aspects of visual communication and learning resulted the average score of 33.75 and 55 in the "very good" category. These data and the comments of the experts indicated that the product has met the eligibility requirements of learning media. The
appearance of final product can be seen in Figure 4.

![Figure 4. Final product](image)

**3.3 Influence on students' learning motivation**

Field-test was used to examine the impact of the developed product on students’ learning motivation. Learning media could increase learning motivation only if the average score of each indicator has increased after its implementation. The average score of students’ learning motivation increased from 3.19 in “enough” category to 4.39 in “very high”. It denotes that the use of the monopoly game in physics learning can increase students' learning motivation. It is in accordance with the results of previous studies which state that game-based learning can increase students' motivation and learning outcomes [10–12]. The use of monopoly games or games in general in learning has a positive effect on learning because it allows student-centered learning [13]. In addition, the feeling that students are the center of the actor as a player unconsciously increases students’ engagement with the topic being played [14,15].

**4. Conclusion**

Based on the results, the product of NaNo Physics learning media (Physics Monopoly Game) on work and energy concept was in the "very good" category. It means that the media is suitable for learning. In addition, its application gives a positive impact on students' learning motivation. Accordingly, the NaNo Physics learning media (Physics Monopoly Game) is recommended to be integrated in physics learning, especially in delivering the work and energy topic.

**Acknowledgement**

We highly acknowledge the support of the Program Kompetisi Kampus Merdeka (PK-KM) Grant of the Education, Culture, Research, and Technology of the Ministry of the Republic of Indonesia, with funding identity: 119/E1/KM.05.03/2021.

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