

Developing Gamified Learning Models for Vocational Schools to Enhance Programming Skills and Motivation

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Abstract. This study aims to develop gamified learning models for vocational students, especially in web programming subjects. The overall projected result of this research will be an innovative learning method that aims to facilitate learners in learning web programming more effectively and to promote deeper learning. In broader impact, the learning model will be able to be implemented to those in vocational high schools throughout Indonesia. We use ADDIE model to develop the learning model that has 5 major steps, however in this paper we just discuss until the third step of ADDIE model (development). We also provide the results of the evaluation from some experts to ensure that the learning model is well developed and ready to be implemented in vocational schools. The data collection instrument that used was a structured questionnaire. Based on data analysis that has been performed, the percentage of the test results obtained by media experts is 98%, material experts is 94.5%, and an instructional model expert is 98.4%. The average overall rating of experts is 97% which indicates that the gamified learning model that has been developed has met the criteria as a good and feasible model for use in learning activities.

Keywords: Gamification, vocational education, programming skill, informatics education, motivation

I. INTRODUCTION

Development of dynamic web technologies, requiring the student's ability to adapt to web technologies. The ability to adapt and self-directed learning habits in students need to be trained so that students are able to adapt in the workplace, especially at work in the field of information technology that always required to update their competence in accordance with the latest technological developments.

Empirical observations conducted by Ministry of Education (2011) showed that the majority of graduates of vocational schools in Indonesia is not only less able to adapt to the development of science and technology, but also less able to develop themselves and their career in the workplace. The problem of the low student achievement,

especially in web programming competence, and also the low ability of students to develop their skills, can not continue to be ignored. There needs to be an innovative learning model that is not limited to face-to-face in classroom activities. Learning model that can encourage students to always develop skills in the workplace and motivate students to learn independently.

Reviewing several previous studies that have been done and some educational theory, there are several alternative solutions to these problems. One such alternative is "Gamification". Gamification is the use of game elements and game-design techniques in non-game contexts to engage people and solve problems (De-Marcos et al., 2014). Results of research conducted by Barata (2015) reveal that learners are more active in gamified courses and also show that the gamified courses are more interesting and motivating than non-gamified courses. It is true that gamification has been implemented in several educational contexts (Su, 2015), however, there are lack of research that focused on the design of gamified learning model for vocational education and also its implementation to vocational education especially in web programming subject. Based on these problems, researchers aim to discover and design the learning models based on gamification and evaluate the effectiveness of this learning models to enhance learning outcome and improve motivation and programming skills in vocational education especially in web programming subject.

II. PREVIOUS STUDIES

2.1 Gamification in Engineering Context

Some previous studies about gamification have evaluated how effective gamification in several engineering contexts. One of the studies is concerned about how gamification can improve the collaborative work in software engineering teamwork (Hernández, 2016). The study presents a comparison among the different gamification elements that can be applied to

create a teamwork, reducing its integration time, and therefore, improve its performance (Hernández, 2016).

In addition, Eunsik Kim (2016) reveals that gamification have a positive effect in student's performance, engagement and motivation. Eunsik Kim (2016) has divided his students who enrolled in engineering lab activities into two groups, one group uses Gamification website and the other group uses non-Gamification website. The findings is quite impressive, where the gamification group not only gains higher score in the exams but also performs more active interaction, indicated by the number of answers submitted and days of participation.

2.2 Gamification Application

Gamification application such Jigsaw (educational game which provide virtual jigsaw puzzles) has been an effective learning medium that can augment demonstration-based tutorials (Dong et al., 2012). The other gamified application is GamiCAD (Li et al., 2012), a gamified tutorial system for first time AutoCAD users. Li et al. (2012), reveal that using the gamified system reported higher subjective engagement levels and performed a set of testing tasks faster with a higher completion ratio. In addition, Khalil M., Ebner M. & Admiraal W.F. (2017) have done a research related to implementation of gamification in MOOC, where the findings states that the students' engagement and attention have inclined while using the MOOC which implements gamification concepts.

2.3 Gamification in Teaching Computer Programming

Previous studies reported that using gamification in teaching computer programming resulted in a better understanding of the programming concept, skills improvements and motivation (Moreno, 2012). Another study has developed an innovative educational environment based on virtual reality and gamification for learning search algorithms (Grivokostopoulou, 2016).

The research has been conducted in real classroom conditions and the findings suggest that the gamified learning activity can motivate students and enhance learning efficiency (Grivokostopoulou, 2016). Furthermore, gamification has a great chance to facilitate learners to enhance their competencies (Barata, 2015). The combination of gamification and game based-learning promotes learning innovation processes and strengthen student motivation (Cózar-Gutiérrez, 2016).

2.4 State of the Art

According to the background, rationale and previous studies, the researcher will discuss how to develop the gamified learning model in vocational education, especially in web programming subject. The purposes of the research are (1) to analyze the gamification concept in teaching web programming; (2) to design and model the gamification learning model in vocational education; (3) to analyze the effects gamification learning models on learning outcomes, motivation and student skills. The overall projected result of this research will be an innovative learning method that aims to facilitate learners in learning web programming more effectively and to

promote deeper learning. In broader impact, the learning model will be able to be implemented to those in vocational high schools throughout Indonesia. However, in this paper the researchers just describe about the design of gamified learning model for vocational education.

III. METHOD

Developing gamified learning model is a complex process that requires an appropriate method and model. The two fundamental models to develop gamified learning are "ADDIE" and "Scrum" (Kapp, 2012). In this study, we use ADDIE model that has five main steps: Analysis, Design, Development, Implementation and Evaluation. In this paper we just discuss until the third step of ADDIE model (development) and provide some assessment results from several experts to ensure that the instructional model is well developed.

3.1 Analysis

At this stage, researchers identify the data needed for the learning model development and the general objectives to be achieved from the creation of the learning model. In addition, we also analyze learning objectives and analyze the entry behaviors needed by students to begin learning activities.

3.2 Design

In this step, we design learning scenarios and integrate several gamification techniques (Chang, 2016) namely: Thropies, Badges, and Leader board. These gamification techniques are applied in the Learning Management System (LMS) that students can access the materials and monitor their progress everytime and anywhere (Figure 1).

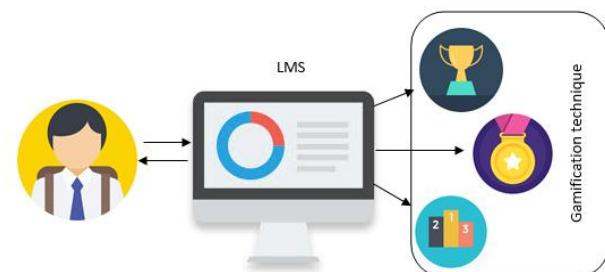


Figure 1. Learning management system that implements several gamification techniques

Figure 1 depicts the design of gamified learning models assisted by the LMS that implements several gamification techniques namely thropies, badges and leaderboard. One of the reason we use 3 gamification techniques stated before is based on the research conducted by Chang (2016) that analyze several gamification techniques, as the findings reveal that thropies, bagdes and leaderboard are the best approach to encourage student motivation. How those gamification techniques applied will be described below.

a) Thropies

We use thropies to motivate students to be the winner in several tests provided in the learning management system. The system will give the tropies for the student that has the best score in test. This trophy can be seen by all of the students, this honour will make the champion feel proud, and motivate other students to be the winner.

b) Badges

In this research, we provide several badges for students namely achievement badges and awards. Achievement badges will be awarded for the student who can complete one training topic, and awards will be granted to the most active students in the discussion forum provided in LMS.

c) Leaderboard

The leaderboard is used to indicate the ranking of each student based on the badges and achievements obtained in the learning management system.

3.3 Development

After designing the learning scenarios and gamification techniques that will be used, we develop the learning materials, learning medias and also learning management system that implements gamification technique. While this stage was completed, we involve several experts to evaluate our learning models to ensure that the gamified learning models is well developed.

IV. RESULTS AND DISCUSSION

4.1 Result of Instructional Media Expert Reviews

Validation data obtained from two lecturers from Universitas Negeri Malang who are experts in instructional media, multimedia and web programming. Data validation results are shown in Table 1.

Table 1. Results of Instructional Media Expert Reviews

No.	Aspects of Assessment	Number of aspects of assessment	The average percentage
1.	Effectiveness of instructional media	8 aspects of assessment	97 %
2.	The attractiveness of instructional media	5 aspects of assessment	99 %
3.	Efficiency of instructional media	4 aspects of assessment	98 %
Total		17 aspects of assessment	98 %

As we can see from Table 1, the average yield of all aspects of assessment received from both media experts is 98%, it means that the learning media (LMS) has been valid and do not need to be revised.

4.2 Result of Instructional Materials Expert Reviews

Based on Table 2, the average percentage of the overall aspect from the material expert is 94.5%. From

this data we can stated that the material on the basis of dynamic web programming competence have been valid and ready to be implemented in the learning process.

Table 2. Result of Instructional Materials Expert Reviews

No.	Aspects of Assessment	Number of aspects of assessment	The average percentage
1.	appropriateness, clarity, simplicity, the attractiveness and depth of the material	10 aspects of assessment	94,5%
2.	consistency and availability of feedback on test	3 aspects of assessment	96%
3.	efficiency and effectiveness of learning support materials	7 aspects of assessment	93%
Total		20 aspects of assessment	94.5%

4.3 Result of Instructional Model Expert Reviews

Expert evaluation of design and learning model aims to evaluate the design of gamification learning model. Summary of outcome data validation from learning model expert shown in Table 3.

Table 3. Result of Instructional Model Expert Reviews

Aspects of Assessment	Objective (%)	Contents (%)	Technology (%)	Interface (%)	Average (%)
Effectiveness	100	98	100	100	99.5
Appeal	95	100	100	100	98.8
Efficiency	100	98	90	100	97
Total Average (%)					98.4

The results gained from the instructional model expert, stating that Gamified learning model that has been developed has fulfilled the criteria for assessment. The average percentage obtained is 98.4 %, so, we can conclude that the design of Gamified Learning Model is well developed and ready to be implemented in real classroom activities.

Table 4. Overall Results

No	Reviews	Results
1	Instructional Media Expert Reviews	98 %
2	Instructional Materials Expert Reviews	94.5%
3	Instructional Model Expert Reviews	98.4%
Average		97%

Furthermore, Table 4 provides the average results of the overall assessment of instructional media experts, learning material experts and learning model experts. Based on these results, where the overall average is 97%, it can be concluded that the learning model that has been

developed in this study has met the criteria of a good learning model and can be used in classroom learning activities.

V. CONCLUSION

Based on the development process and the data analysis results of trials that have been conducted by researchers, it can be concluded:

- 1) The learning media that implement several gamification techniques as a major component of the Gamified Learning Model is in compliance with the criteria as an effective and efficient instructional media, with an average percentage validity of instructional media experts is 98 % .
- 2) Learning material that has been developed in the learning model has met the criteria "create basic dynamic web pages" with the average percentage of the validity from material experts is 94.5 % .
- 3) The design of Gamified learning model has been developed very well, with the average percentage of the validity from instructional model expert by 98.4 %.
- 4) The design of Blended Learning and the components of the model such as the LMS and learning tools are well developed with the average percentage of all test results performed at 97%.

VI. FUTURE WORK

There are several things that need to be done for future research, namely the implementation and evaluation of the gamified learning model that has been developed and then see the effectiveness of the model in real learning activities particularly in vocational school. In addition, it is possible to add several gamification techniques so that students get a more varied and more enjoyable experience in learning activities.

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