

## DESIGN AND DEVELOPMENT OF PROGRAMMING LEARNING PLATFORM BASED ON HEURISTIC APPROACH IN GAMIFICATION MODULE WITH ITERATIVE AND INCREMENTAL METHOD

Adelia Chitra Sazkia, Soni Fajar Surya Gumilang, Muhammad Azani Hasibuan  
Information System Study Program, Industrial Engineering Faculty, Telkom University  
[achitras@students.telkomuniversity.ac.id](mailto:achitras@students.telkomuniversity.ac.id), [mustonie@telkomuniversity.ac.id](mailto:mustonie@telkomuniversity.ac.id),  
[muhhammad.azani@telkomuniversity.ac.id](mailto:muhhammad.azani@telkomuniversity.ac.id)

**Abstract** - e-learning usually managed with administrator. They cannot easily to edit e-learning with their perspective. The research aims to develop a platform learning based on heuristic approach focussed on gamification especially in programming algorithm course. For this platform development, it will use iterative and incremental methodology. By using the learning platform, lecturer and student can joy experience learn programming algorithm with attractive course.

**Keyword** : Gamification, Heuristic Learning, Iterative and Incremental, Programming Algorithm

**Abstrak** – e-learning pada umumnya dikelola oleh administrator. Mereka tidak dapat menubah e-learning sesuai dengan perspektif mereka. Penelitian ini bertujuan untuk membangun platform pembelajaran berdasarkan pendekatan heuristic berfokus pada gamification terutama pada mata kuliah algoritma dan pemrograman. Pada pengembangan platform ini, akan menggunakan metodologi iterative dan incremental. Dengan menggunakan platform pembelajaran ini, dosen dan mahasiswa dapat menikmati pengalaman belajar algoritma dan pemrograman dengan menarik

**Kata Kunci** : Gamification, Pembelajaran Heuristik, Iterative and Incremental, Algoritma dan Pemrograman

### 1. INTRODUCTION

Computer science students are required to take programming course. However, many of the students assume that programming course is convoluted. The adversities that the students faced during the course are various. Based on a research, the average students had adversities in understanding programming characteristic. It happened because novice level programmers prefer to use “line by line” approach than program structure meaning. Moreover, there is other research result that claims students had adversities in understanding programming because they cannot visualize the processes flow of the program. Whereas a human has better capability in processing information visually.[1]

To carry out teaching and learning process in the present, there are already many facilitators that utilize electronic learning or often called e-learning which is a form of information technology that implemented in education in a form of electronic application that aims to ease the material delivery in teaching and learning process. Under the existence of e-learning, teaching and learning processes might not use the conventional learning method which teachers should be face to face with the students, by using e-learning facilitators can also evaluate students learning outcomes.

The contents and features of e-learning could be adapted to students' learning style so that students could be motivated to explore java programming material. At first novice programmers had adversities in understanding the syntax, programming language, and logic to solve the problems that can be implemented in a programming language. Furthermore there are merely few students who understand the concept of the material being learned and adversities in implementing problems in java programming language syntax.

In the process of teaching and learning of programming course that usually done in the class, there are many students who are bored with it. Based on a research that focusing on game based learning with the aim to transform teaching and learning activities become more fun, there are two approaches are considered effective, there are learning games and gamification. Gamification refers to the application of game design elements to non-gaming activities that applied to different contexts. There are elements used in the gamification that useful to increase user engagement such as badges, storyline, and leader boards.[2]

Based on the same survey, the lecturer's problem when teach algorithm programming course same. The survey for 188 students in Telkom University, Information System major. The classification students who take algorithm course 44 % student knows about knowledge of algorithm programming but when the lecturer gave a new problem with same solution , some of student confused to answer the question as shown in Figure 1.

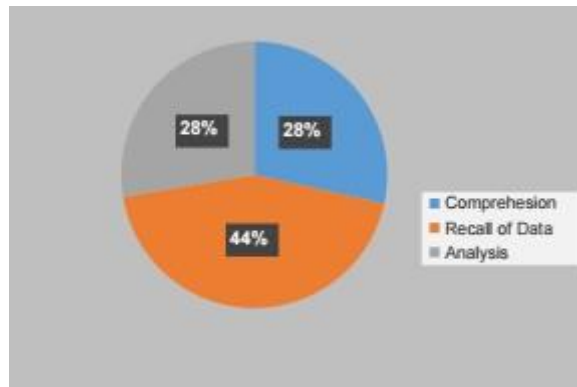


Figure 1. Students Classification in Programming Algorithm

A novice programmer needs a lot of practice problems programming algorithm [5]. When student doing the exercise, the tutor has an important role in guiding a novice programmer. But one of the problems tutor to guide novice programmers that limitations of distance and time [6]. Tutor cannot always face to face when the programmers doing programming algorithms exercises. In addressing this issue, we need a new learning method that can guide the programmer [7].

E-learning is a new transformation concept in education learning into digital form, both in terms of content and system [8]. One of the reasons why university staffs hesitate to utilize e-learning system is that it is not easy to use. Usability of the technology-based system is quite unfamiliar to lecturer whose generation has trouble to follow rapid movement of technology [9].

## 2. HEURISTIC LEARNING METHOD AND GAMIFICATION

Heuristic learning method is a method that place the students as the inventor. It could make the students learn more than merely told a lot of things. In heuristic method, students will be placed ad an independent inventor. There are no assistance from the teachers. In this method, teachers will give a problem that will be solved by the students and the teachers will not involve themselves when the students seek for the answer from the problem.

By using heuristic learning method which is based on the important psychological principle of learning by doing, it may helping the students to develop their research skills such as habits of neatness and patiently attending to details. Besides that, this method lays stress on individual practical work, careful observations and independent thinking which makes the students more reliant. Since this method lays stress on individual practical work which is pays more attention to skills than on knowledge. In consequence, heuristic learning method could lead to an imparity in learning since this method puts knowledge as secondary consideration.

Since the teachers are not involved when the students solve the problems, the teachers have to give appropriate problems to the students. Moreover, the teachers would be better give the students detailed instructions sheets in order to give the students better understanding. Teachers also have to keep thinking about the age, ability, level of the students and existing facilities.[3]

Gamification is using game-based, mechanics, aesthetics, and game-thinking to engage people, motivate action, promote learning, and solve problems. There are two types of gamification, the first type is structural gamification and the second is content gamification. Structural gamification is the application of game elements to propel a learner through contents with no alteration or changes to the contents. The focus structural gamification is to motivate learners to go through the contents and to engage them in the process of learning through rewards. Elements that commonly used in this type of gamification are points, badges, achievements, and levels. The second type, content gamification is the application of game elements and game thinking to alter contents to make it more game-like. The focus of content gamification is to provides activities that are used within games and adds them to the content being taught. Elements that commonly used in this type of gamification are storyline, challenges, and objectives.

Gamification can be used to accomplish goals related to learning contents. Gamification is effective when it used to encourage learners through contents, motivate action, influence behavior, drive innovation, skill building, and knowledge acquisition.[4]

## 3. RESEARCH METHODOLOGY

Iterative and incremental method is an object-based system development method. Iterative and incremental method has

two dimensions. The first dimension is the dimension that represent dynamic aspects of software development. This aspects are translated in the development stage or phase where each phase will have a major milestone marking the end of one phase at a time beginning to the next phase. While the second dimension is the dimension that represent aspects - static aspects of the software development process.

There are four main phases in the iterative and incremental methods, there are inception, elaboration, construction and transition.

1. Inception  
This phase has focused on the early development of the system. In this phase the developer identifies the activity limitation, conduct user needs analysis, and perform preliminary design software.
2. Elaboration  
In this phase is to design the software, ranging from specifying the software features until the release of the prototype beta version of the software. Moreover, in this phase is done anyway project plan preparation and analysis of requirements and risks.
3. Construction  
In this phase to implement a software design that has been made. At the end of this phase, the latest version of the software that has been approved by an administrator will be released together with documentation software.
4. Transition  
In this phase carried out several processes: installation, deployment, and dissemination software. This phase is also useful to provide a system end user of the system and create what has been modeled into a finished product.

Besides the main phases, iterative and incremental method also has workflow that should be done, there are :

1. Business Modelling  
Business modelling is a workflow where business modelling is represented.
2. Requirement  
Requirement is a workflow where identification for the platform requirement is made.
3. Analysis and Design  
Analysis and design is a workflow where the analysis of system requirement is made.
4. Implementation  
Implementation is a workflow where the design is implemented.
5. Testing  
Testing is a workflow where the testing of the designed platform is conducted.

#### IV. ANALYSIS AND DESIGN

This research focused on the gamification module. There are another three modules for this programming learning platform there are content management module, live code module, and assessment module. The programming learning platform in gamification module called CIDEK. CIDEK is a platform for programming learning which helps students who learns basic programming course in Information System major on Telkom University. Besides that, this platform also helps the teacher to monitor the students.

##### A) APPLICATION FUNCTIONALITY

These are the main feature of programming learning platform in gamification module:

- Play the mission. This is the main feature for the students. The students can play the mission that the lecturer has made before. Every mission contains several levels. The students have to finish the mission to get score and badges.
- Get Badges. Based on previous discussion, badge is one of a gamification elements. Therefore after the students done with their mission, they will get the badges.
- Make mission. This is the main feature for the lecturer. The lecturers have to make a mission first before they post it to their students. The lecturer can make more than one mission.
- Insert Badges. Besides make mission, the lecturers can also insert badges to every mission to reward the students who has done the mission.
- See students' progresses. This is another main features for the lecturers. The lecturers can see what are their students have done.

B) CORE BUSINESS PROCESS

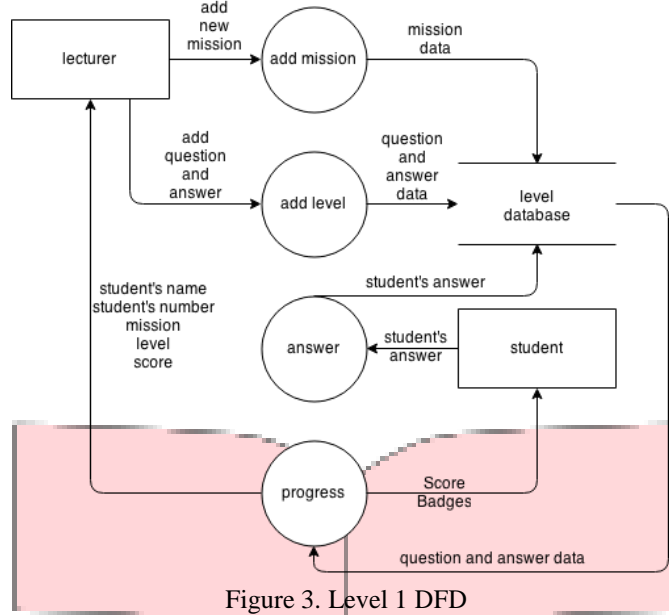


Figure 3. Level 1 DFD

Level 1 DFD above explains more the detail-processes that happen on gamification module.



### C) RESULT OF APPLICATION

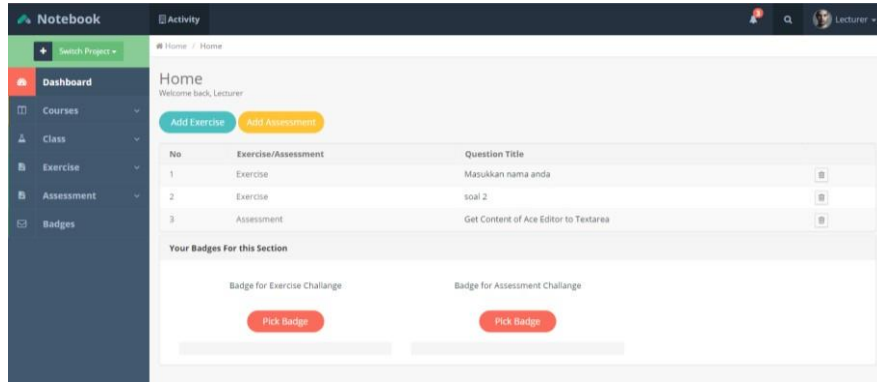


Figure 4. Lecturer Mission Page

Figure 4 above shows lecturer mission page to add exercise, add assessment and pick badge for the mission.

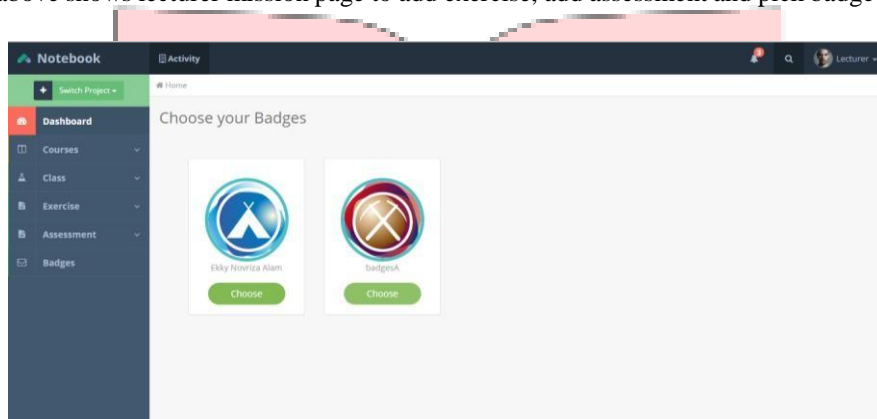


Figure 5. Pick Badges Page

Figure 5 above shows choose badge on lecturers' side.

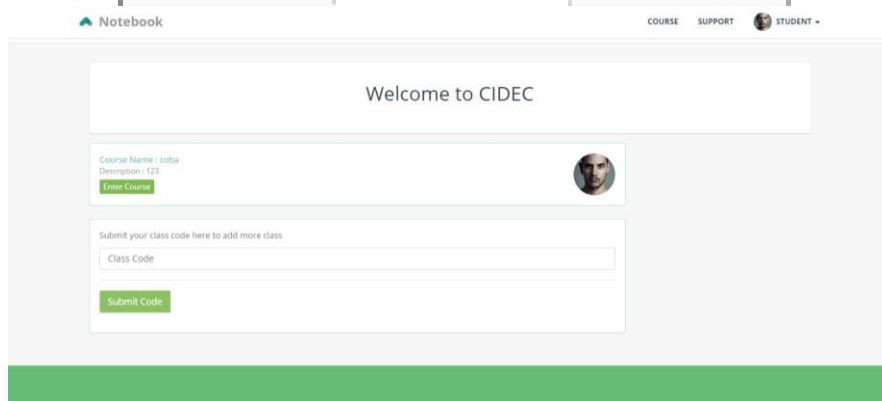


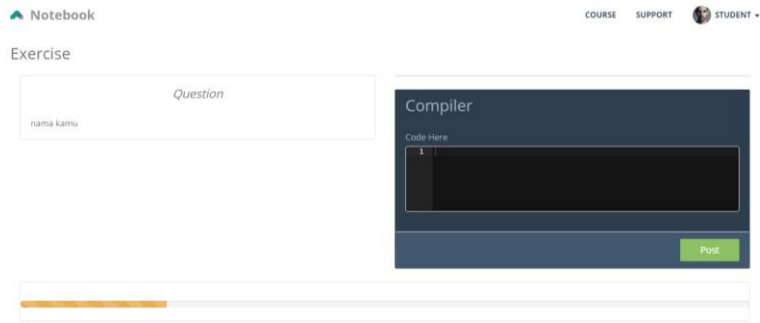
Figure 6. Students Home Page

Figure 6 shows students' home page. It shows course name and a field for students to enter the course room.



Figure 7. Section Page

Figure 7 shows students' section page. The students may click on the section to start the course.



Section 8. Students Mission Page

Figure 8 shows students mission page. In this page students have to do several missions by doing the code on the compiler.

D) APPLICATION AND TECHNOLOGY ARCHITECTURE

To build platform learning based on heuristic approach for e-learning, it cannot stand alone without centralized database center. That is because this platform need to get validation data in system that already registration in database system. When lecturer and student access platform web server must validate data in database. The web server verified user's data who already registration in system. In lecturer side and student side will access same platform but in different interface.

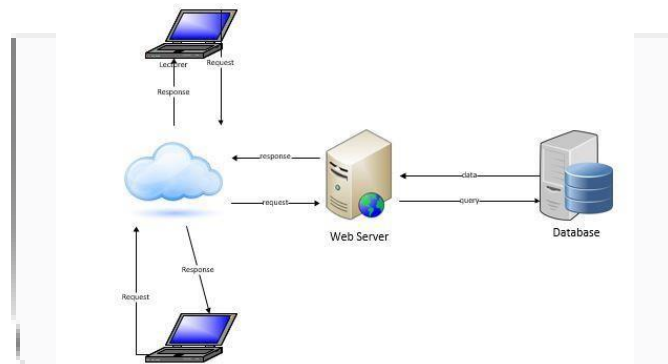


Figure 9. Application Architecture

V. TESTING

| No | User     | Test         | Expected Result  | Result |
|----|----------|--------------|--|--------|
| 1  | Student  | Do Mission   | The student can play the mission that the lecturer have made             | Passed |
| 2  | Student  | Get Badges   | The student can get a badges after finish a mission                      | Passed |
| 3  | Lecturer | Add Mission  | The lecturer can add a mission for the students                          | Passed |
| 4  | Lecturer | Add Level    | The lecturer can add a level for the students                            | Passed |
| 5  | Lecturer | Add Badges   | The lecturer can pick a badges for the students if they finish a mission | Passed |
| 6  | Lecturer | See Progress | The lecturer can see the progress of their students                      | Passed |

Table 1. Testing Result

## VI. CONCLUSION

Conclusions for this research are as follows:

- 1) Programming learning platform helps the students to learn basic java programming by using heuristic method where the students have to solve all of the problems that the lecturer has given before. This method also helps the students to develop their research skills.
- 2) Programming learning platform helps motivate the students to learn basic java programming with gamification which give students rewards after finish doing a mission. Besides that, gamification also help to engage the students to learn continuously.
- 3) Programming learning platform helps the lecturers to monitor the students' progress. The lecturer can see the missions and levels that the students have done and also the badges that they got.

## REFERENCES

- [1] S. R. Md Derus and A. Z. Mohamad Ali, "Integration of Visualization Techniques and Active Learning Strategy in Learning Computer Programming : A Proposed Framework," p. 2, 2014.
- [2] B. Monterrat, E. Lavoue and S. George, "A Framework to Adapt Gamification in Learning Environment," p. 578, 2014.
- [3] R. Mohan, *Innovative Science Teaching : For Physical Science Teachers*, New Delhi: Prentice Hall of India Private Limited, 2007.
- [4] K. M. Kapp, L. Blair and R. Mesch, *The Gamification of Learning and Instruction Fieldbook*, San Francisco: Wiley, 2014.
- [5] S. O. Choy and S. C. Ng, "An Interactive Learning Environment for Teaching and Learning of Computer," *IEEE*, p. 2004.
- [6] R. S. Wahono, "Pengantar E-Learning dan Pengembangannya," *Peneliti Lembaga Ilmu Pengetahuan Indonesia*, 2003.
- [7] J. C. Spohrer and E. Soloway, "Novice Mistakes : Are the Folk Wisdom Correct?," *ACM*, vol. 29, no. 7, pp. 624-632, 1986.
- [8] L. Oneto, F. Abel, H. Eelco and D. Smits, "Making Today's Learning Management Systems," 2009.
- [9] H. J. Lee, "A Strategy to Improve Faculties LMS Usability in a Blended Learning Environment," 2006.
- [10] K. Schwaber, *SCRUM Development Process*, Burlington: Advanced Development Method.