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An Implementation of Game-Based Learning using Alice Programming Environment

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Abstract - The basic of programming is a very crucial competency for bachelor students in Information Technology major. However in reality many students find it difficult to understand the basic principles of programming due to the gap between high school curriculum and bachelor degree curriculum. These difficulties faced by students also worsened by the instant life style happened nowadays where many students expect to see fast result first, before they gain interest in knowing the process. Game-Based Learning adds fun factors when learning programming subjects so that students will gain more interest and resulting in deeper understanding of programming concept compared to conventional methods. This paper describes the experience of Department of Information Technology at Ciputra University in applying Game-Based Learning for Object Oriented Programming subject using Alice and statistical data of informal observations are summarized to show evidence of student performance as a result of this learning.

Keywords - Alice, Game-Based Learning, Higher Education, Java, Object Oriented Programming

I. INTRODUCTION

Nowadays, information technology is increasing rapidly and also requires many IT people with high competency. Department of Information technology at Ciputra University realizes to produce IT graduate with high competency according to market need. One of crucial competency for IT graduate is programming skill.

In reality, many lectures face similar challenges in providing programming lesson to students. Many students find it difficult to understand principle of programming. These difficulties may result low success rate in many programming subjects and even high drop-out rate which caused by student’s bad experience in learning programming.

The student’s bad experience in learning programming could make some students avoid programming subjects and bring a negative impression of programming subject as something that they fear and hate. Department of information technology at Ciputra University considers it necessary to give more attention to help students in learning programming.

Department of information technology at Ciputra University tried to solve these problems by using game-based learning as another alternative learning method in delivering programming subject. The authors used Alice 2.2 in Object-Oriented Programming subject to introduce object-oriented concept before programming using Java.
The result gave better impact in delivering Object-Oriented Programming subject. The failure rate dropped from 36 percent to 20 percent and gave better impression for student in learning programming course.

II. DIFFICULTIES IN DELIVERING PROGRAMMING COURSE

Regardless of students and lecturers general limitations in learning programming subject, many lectures face similar challenges in providing programming lesson to students. Many students find it difficult to understand principle of programming. Based on authors’ observation and experience in delivering programming subject, authors found some reasons that may cause difficulties in delivering programming subject.

First problem is the gap between high school curriculum and bachelor degree curriculum. Many students have not ever had experience in learning programming in high school. Most high schools in Java island usually introduce some document processor applications (such as Microsoft Word, Excel, Power Point) and some desktop publishing applications (such as Adobe Photoshop, Freehand), not programming subject such as Pascal or C language. Based on authors’ observation, we found some high schools outside Java island only introduce Microsoft Word and Microsoft Power Point to their students.

Second problem is programming skill is not included as mandatory requirements in applying as an information technology student. This condition makes the students, who never had programming experience in their high schools, give more effort to understand programming subject.

Third problem is the students find it difficult to imagine programming concept in their minds. It is hard to imagine variable, data type, conditional and looping concepts even though they usually deal with it in their daily activities.

The fourth problem is difficulties to implement their logic into block of codes. The students have found the solution to solve the problems but do not know how to start in writing code.

The fifth problem is tendency of instant life style nowadays where many students expect to see fast result first, before they gain interest in knowing the process. To be good at programming, the student go through the series of processes by doing many exercises which this process will take many resources such as time and effort. Many students used to be excited at the beginning but easily discouraged after dealing with programming subject.

Some problems as described in above must be solved soon, both in terms of lecturer or students. Those problems could lead to motivation decline to study and increasing failure rate of the subject, even drop-out rate.

III. GAME-BASED LEARNING METHOD

Game-based learning is another alternative learning method to achieve the goal by using a game as media to help the learning process. Game-based learning is a natural evolution from traditional methods of teaching, which include static, non-interactive elements, such as textbooks, chalkboards, and lecturing at students rather than exploring with students [4].

Games in education provide a vehicle by which students can explore, solve problems, attempt challenges, make decisions, and educational games contribute to learning broadly. Games allow a learner to work at his or her own pace in safe environments. Even failure can provide feedback and motivation for the learner to master difficult tasks [4].

The students who use digital media, in the form of educational games, will have a deeper content understanding and a longer retention rate of the course material than those that employ traditional methods of lesson delivery. Game- based learning will enable students to take ownership of their learning experience and connect with
information in a way that traditional methods simply cannot.

IV. ALICE 2.0

Alice is an innovative 3D programming environment that makes it easy to create an animation for telling a story, playing an interactive game, or a video to share on the web. Alice is a freely available teaching tool designed to be a student's first exposure to object-oriented programming. It allows students to learn fundamental programming concepts in the context of creating animated movies and simple video games. In Alice, 3D objects (e.g., people, animals, and vehicles) populate a virtual world and students create a program to animate the objects.

In Alice's interactive interface, students drag and drop graphic tiles to create a program, where the instructions correspond to standard statements in a production oriented programming language, such as Java, C++, and C#. Alice allows students to immediately see how their animation programs run, enabling them to easily understand the relationship between the programming statements and the behavior of objects in their animation. By manipulating the objects in their virtual world, students gain experience with all the programming constructs typically taught in an introductory programming course.

There are three benefits of using Alice to learn object-oriented programming.

- Alice helps students understand object-oriented programming environment (such as class, object, method, property, function, sequence programming, looping and conditional) visually as seen in figure 1.
- Alice adds fun factor in learning process which could increase student motivation in learning programming.
- Alice could run the result in animation according to student’s block of codes which this could teach student about the consequences in coding (whether the write code correctly or not) as seen in figure 2.

Alice also allows students to modify the pre-defined animations of the object by creating a new method and putting block of codes in the method to produce an complicated animation according to student’s imagination. This will enforce student to think logically as seen in figure 3.

V. IMPLEMENTATION

Authors applied this game-based learning method using Alice 2.2 to introduce object-oriented programming concept in object-oriented programming subject. The subject had 14 weeks for studying process and 2
weeks for mid-term test and final-term test. A student must pass algorithm and programming subject before taking this subject.

Alice 2.2 was introduced as introduction to object-oriented programming concept before the student writing coding in Java. Authors introduced class, object, method, property, sequence programming, conditional, looping visually as basic concept of object oriented programming using Alice 2.2 by creating a story animation. Authors let student to make their own animations according to student’s imagination. Alice 2.2 was delivered for 7 weeks starting from week 1 until week 7.

As a mid-term assignment, the student had to produce an animation fairy-tale movie and had to be presented in their classroom. The movie duration was about 5-10 minutes. Some of student’s mid-term assignment can be seen at figure 4.

![Fig. 4 “Jack dan Pohon Kacang Ajaib” and “Bravery” movie are some example of student’s mid-term assignment using Alice 2.2](image)

### VI. ANALYSIS

As seen in table 1, applying game-based learning in object-oriented programming subject could motivate student in learning programming. Table 1 shows us failure-rate in object-oriented programming subject since 2007 until 2009.

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<th>Year</th>
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<th>No of failed students</th>
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<tr>
<td>2007-2008</td>
<td>33%</td>
<td>11 students</td>
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<tr>
<td>2008-2019</td>
<td>37%</td>
<td>10 students</td>
</tr>
<tr>
<td>2009-2010</td>
<td>36%</td>
<td>14 students</td>
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Based on authors’ observation and experience in teaching object-oriented programming subject, there are five problems founds.

- the gap between high school curriculum and bachelor degree curriculum.
- programming skill is not included as mandatory requirements in applying as an information technology student.
- the students find it difficult to imagine programming concept in their minds.
- difficulties to implement their logic into block of codes.
- tendency of instant life style nowadays where many students expect to see fast result first, before they gain interest in knowing the process.

In 2010, authors tried another approaching in delivering object-oriented programming subject by applying game-based learning using Alice 2.2 as introduction to object-oriented programming concept before programming using Java.

Based on authors’ observation while delivering object-oriented subject, student motivation increased and learning atmosphere in classroom was more excited. Even the students did many programming exercises not only in the classroom or laboratory but also in their homes. This condition helped us to deliver object-oriented programming using Java easily. In addition, the students’ video result as mid-term assignment was beyond our expectation.

Applying game-based method by using Alice 2.2 could give better impact to object-oriented programming subject in year 2010. The failure-rate dropped from 36% percent to 20% percent.
VII. CONCLUSION

By using Alice 2.2 as game-based learning method in delivering object-oriented programming, we can conclude:

- applying game-based learning method could increase student motivation in learning programming, give good impression for the student about programming and make fun atmosphere while delivering programming subject.
- Alice 2.2 is good tool to introduce object-oriented programming concept because it helps student visually to understand object-oriented programming concept in fun way and write block of codes. Then it helps lecturer to deliver programming easily.
- applying game-based learning method could decrease failure-rate of programming subject. Lecture could do some improvisation while delivering programming subject for better result.

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