COMPUTER-BASED PORTFOLIO ASSESSMENT TO ENHANCE STUDENTS' SELF-REGULATED LEARNING

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ABSTRACT

The aim of this study is to elaborate the impact of computer-based portfolio assessment to improve the students' self-regulated learning. The population of this research was the students of Mathematics Education Department, Universitas Pendidikan Ganesha, who followed the Integral Calculus course in academic year 2015/2016. From those, 88 students were chosen randomly as the sample. Pretest-Posttest Control Group Design was employed as the method of the present study. The data were gathered from a self-regulated learning questionnaire with 19 positive and 18 negative statements. The collected data were analyze using descriptive and inferential techniques using t-test. The result showed that there is an improvement of the students' self regulated learning after following the course with computer-based portfolio assessment. The finding implies that when using computer-based portfolio assessment in the classroom, it is better in team teaching format.

Keywords: *Computer-Based Portfolio Assessment, Self-Regulated Learning*

1. INTRODUCTION

Integral Calculus is one of the basic primary courses for mathematics education department students on Mathematics and Natural Sciences Faculty, Universitas Pendidikan Ganesha. It is appear in the second semester and be used to give students' foundation before they enter many other mathematical courses. Previously, the assessment for Integral Calculus is taken from the assignments which is given occasionally, mid-test and final test. Therefore, it can be concluded that the process assessment for Integral Calculus is hardly take into account.

The use of assessment which less focus on process is caused by the "convergence" way of thinking of the lecturer. It means, the lesson give only a little respect to the variance in individual learning. This condition contradicts to the new paradigm of mathematics education as is written in Competence Based Curriculum with Indonesia National Curriculum Framework orientation. The new curriculum asked for the innovative, integrative and sustainable learning process. Therefore, the assessment system also need to be fit into the learning organization, which is sustainable and focus on cognitive, affective and psychomotor domain of the students. Related to that, Palm [1], said that authentic assessment can be used to assess the students' cognitive and conative dimensions. Conative is a personal desire, tendency and impulse of the students to learn.

As an adult learner, the undergraduate students should be able to be independent in learning to optimize their abilities. However, the previous study conducted by Suarsana & Mahayukti [2], found that students' behavior indicated the students' self-regulated learning are still limited. It is showed by the fact that there are 75% of students who did not know the syllabus and lesson plan of

the course for the whole semester even though the lecturer gave the access for having it. Also, from 25% of the students who have the syllabus only 10% of them who used it properly as their preparation to enter the course.

Another important result is found on the students' initiative in learning. Sumarmo [3], stated that initiation is one of the factors which affect students' self-regulated learning. During the course, the students were frequently asked to do exercises at home as the supplement of face-to-face meeting at the university. Unfortunately, they did not working on the task diligently and mostly copying their friends' assignments. It indicates that the previous task and assessment are less likely able to develop students' initiative in learning.

Based on these problems, it is necessary to evaluate to get the right recommendations to overcome them, because in principle according to Divayana [4-7]; Divayana & Sanjaya [8]; Divayana, *et.al.* [9-12]; Arnyana, *et.al.* [13]; Divayana, Ardana & Ariawan [14]; Sanjaya & Divayana [15]; Ariawan, Sanjaya & Divayana [16]; Divayana, Adiarta & Abadi [17-20]; Suandi, Putrayasa & Divayana [21]; Divayana & Sugiharni [22]; and Jampel, et.al. [23]; stated that evaluation is the activity of collecting and analyzing data to obtain appropriate recommendations in making a decision.

The appropriate recommendations are given based on the results of the evaluation of the existing problems is the use of computer-based portfolio assessment as one tool that can be used to develop students' independency in learning is using formative assessment in the learning process.

The study of Hidayat, *et.al.* [24], revealed that one factor that contributes to the students' lack of initiative in learning is the inappropriate or less challenging assessment tools used by the educator. The research used essay assessment in experimental group and conventional assessment in control group. The results showed that the group which is assessed using essay assessment gained better learning outcomes compared to the group with conventional assessment. Meanwhile, Supardi in 2011 [25], conducted a study about intensity of formative assessment in form of essay. The result showed that the intensity of formative assessment affect the learning outcomes of students in Calculus course.

In higher education, the use of semester credit system facilitated the face-to-face meeting and structured assignment outside the classroom without lecturer's direct observation. It actually helps the students develop their self-regulated in learning. To encourage students' motivation and initiation, they need to be assigned in such kind of complex task [26]. The formative assessment with complex problems are prospective tools as it requires the students' self-regulated learning. One of the useful formative assessment with complex task is authentic assessment with the form of essay, portfolio, project and etc.

In line with that, the current *KKNI* based Indonesia national curriculum are lookng for the alternative assessment. It means, the assessment should facilitate the lecturer to elaborate about students' way of thinking and why they need to do that. Hence, the lecturers will not only assess the final result, but also the process, the goals, and the reflection steps of the students [27]. Hence, the alternative assessment for process and learning outcomes is needed. The alternative assessment develop the students' construction, demonstration, and performance. Ths assessment is focused and centered on the students. One of the assessment which is appropriate to the requirement of *KKNI* based curriculum is portfolio.

The portfolio assessment is an informal procedure of gathering information about the students' development and abilities using certain criterias [28]. In line with that, Santrock stated that portfolio assessment can be used to give students' opportunities to make a decision and self-reflection, and also to motivate them to think critically and deeply [29]. In term of the target goals orientation, the portfolio assessment is appropriate and answer the *KKNI* based curriculum. In addition, Gunay & Bekiroglu [30] is considered portfolio as one type of formative assessment.

In practice, the portfolio assessment is based on four pillars of education which are *learning to do, learning to know, learning to be, learning to live together* [31]. It can be explained as follows. First, learning to do, measn students are empowered to be sensitive and able to do something to enrich their learning experiences by increasing their interaction with physical, social and cultural environment. Second, learning to know, means students are empowered to be able to construct their understanding and knowledge about their world. Third, learning to be, means the students are facilitated to construct their self-confidence. Fourth, learning to live together, means the students are given the chance to interact with a number of different group or people with many differences, to help them learn about diversity and be able to interact and positively responses toward it.

The mathematical portfolio model consists with the example of students' works including: (1) the written report of mathematical practices or investigation, (2) pictures and report about problem analysis, (3) the explanation and diagram of problem solving process, and (4) statistical and graphical data organization.

Some previous studies which were using the portfolio assessment in their teaching and learning processes [30],[32],[33] found that the students who were assessing using portfolio assessment method gained more knowledge rather than the students who were not. Also, the use of portfolio assessment motivates students and able to show students' characteristics, beliefs, and willingness to learn. The similar result found by Abrami, *et.al.* [34], who stated that the use of electronic portfolio assessment in long time are able to encourage students to regulate themselves in learning. However, the study of Bures, *et.al.* [35], and Juhanda, *et.al.* [36], revealed the difficulties in using portfolio assessment in classroom, due to two reasons: (1) it takes much time and (2) it is not easy to measure the students' self-regulated learning.

The use of portfolio assessment in several countries such as Turk, Iran, Swedish and Indonesia are successfully improve the students' learning outcome. However, there is no guarantee that it can be used in all of subjects in school and all level in education, since different subjects and level of students' age may have different characteristics.

Related to the characteristics of Mathematics in higher education, such as Integral Calculus, the focus of the course mostly about proving the theorem. To prove a mathematical theorm and to solve the mathematical problems are using a rigorous procedures. It means, each step should be true and logic mathematically [37]. The proof of a theorem could be different one to another, but the steps should be correct. To be able to do this, the students should be diligent, discipline and trustworthiness, which are strongly related to the self-regulated learning.

Self-regulated learning was firstly defined by Bandura in his background for socio-cognitive theory as the social, cognitive and behavior factors of a person play important roles in his/her learning process. Bandura said that a person has an ability to control their learning style, to develop him/her self-observational steps, to evaluate and to responses to his/her personal characteristics [38]. Furthermore, Zimmerman and Martines-Pons [39], declared that self-regulated learning is a metacognition level and a person's behavior in learning. Meanwhile, Winne [40] stated that self-regulated learning includes the cognitive skills, learn how to learn, and lifelong learning. The dimension of self-regulated learning is about the prior understanding, control and self-reflection [39],[41]. There are two primary conditions that determine the construction of students' self-regulated learning, which are social environment and the opportunities to develop it. A lecturer as an adult in the students' social environment should be able to facilitate and to give students' chance to learn through the use of appropriate authentic assessment [42].

Considering the characteristics of self-regulated learning, one question appear: why it is need to be developed in a person who learn Integral Calculus. The answer is related to the origin and the vision of mathematics as a subject. Mathematics have many different meanings, depend on a person who use it. One of its definition is a knowledge which is concerned about deductive process, logical and axiomatic reasoning, have an inductive process, mathematical model, generalization and analogical process. The implication of different meaning of mathematics contribute to the aim of learning mathematics, to: (1) develop a mathematical thinking, (2) develop mathematical disposition and high quality attitude in learning [3].

Self-regulated learning is very important to develop by the students as a human being and as a teacher to be. By using a computer-based portfolio assessment, the time required to assess faster and the assignment for written work can be varied, so that computer-based portfolio assessment is a good breakthrough in an assessment. Related to that, the questions in this study are: 1) How the visualization of a computer-based portfolio assessment application?; 2) Does the use of computer-based portfolio assessment effects the students' self-regulated learning?

2. RESEARCH METHODOLOGY

This study was an experiment with pre-test-post-test control group design. It was done in the middle of March until August 2016. The population of this study was all students of Mathematics Education Department, Universitas Pendidikan Ganesha, who following Integral Calculus class in academic year 2015/2016. The total population was 153 people and were distributed in four classes. The sample of this study was 88 people who were chosen using random sampling technique to represent the population.

The experiment was done by using computer-based portfolio assessment in experimental group and essay assessment in control group. In the beginning and in the end of the study, a self-regulated learning questionnaire was given to the students. The students in the experimental group were also be interviewed about their comments after being assessed using computer-based portfolio assessment.

The data about students' self-regulated learning were gathered by using questionnaire with 19 positive statements and 18 negative statements. Before it been used for testing the students, the validity and reliability of the questionnaire were tested and it is known that the reliability of it was 0.89. The questionnaire consists of 37 questions with five choices of agreement, which are: strongly agree, agree, not really agree, disagree, strongly disagree. The points for positive statements are 5, 4, 3, 2, 1 and the points for negative statements are 1, 2, 3, 4, 5 respectively.

The gathered data were analyzed descriptively. After that, the score were categorized by using conversion guideline as follows.

Table 1: Score Conversion Criterion for Students' Self-Regulated Learning

Score	Category
$X_p \geq M_i + 1.5\ SD_i$	Very High
$M_i + 1.5\ SD_i > X_p \geq M_i + 0.5\ SD_i$	High
$M_i + 0.5\ SD_i > X_p \geq M_i - 0.5\ SD_i$	Moderate
$M_i - 0.5\ SD_i > X_p \geq M_i - 1.5\ SD_i$	Low
$M_i - 1.5\ SD_i > X_p$	Very Low

Note:

X_p : The students' mean score for self-regulated learning

M_i : $\frac{1}{2}$ (ideal highest score + ideal lowest score)

SD_i : $\frac{1}{6}$ (ideal highest score + ideal lowest score)

Before testing the hypotheses, the normality and homogeneity of the data were tested first. The normality tested using Kolmogorov-Smirnov test while homogeneity tested using Levene test. Then, the data were analyzed using inferential technique.

3. RESULTS AND DISCUSSION

The display of computer-based portfolio assessment applications can be seen in Figure 1 to 4 below.
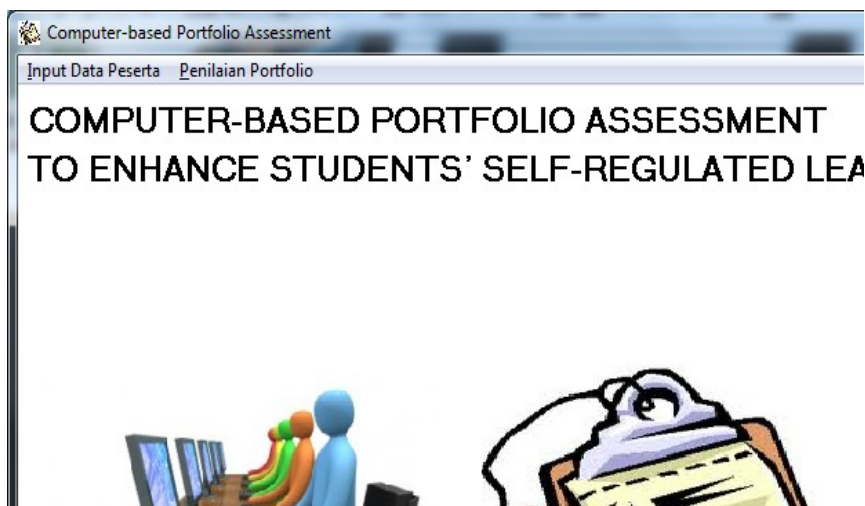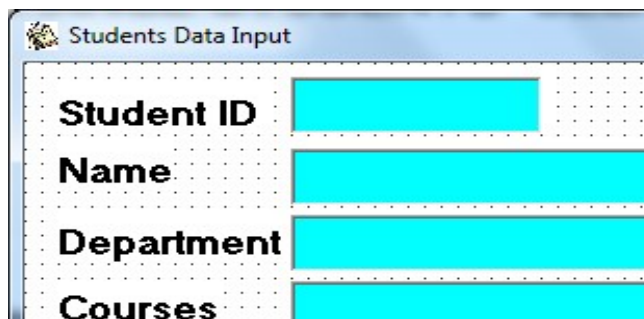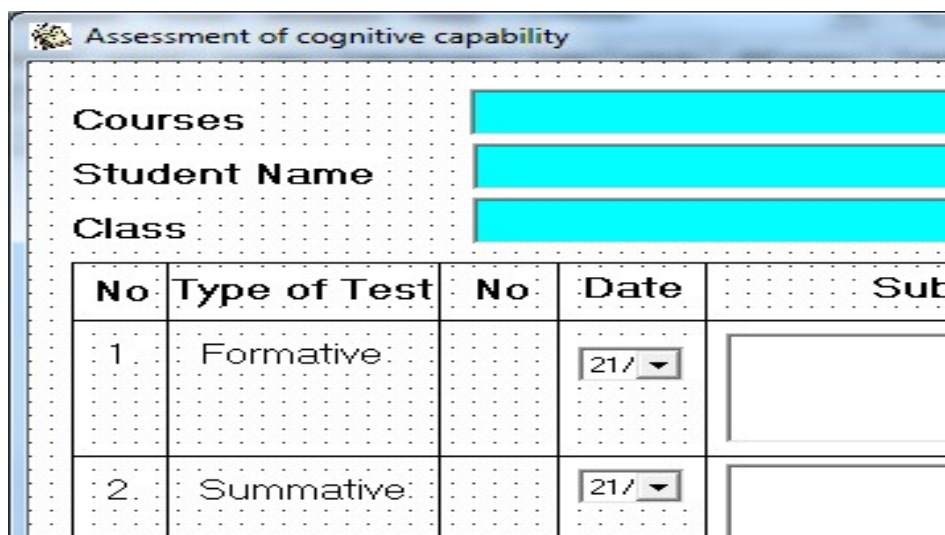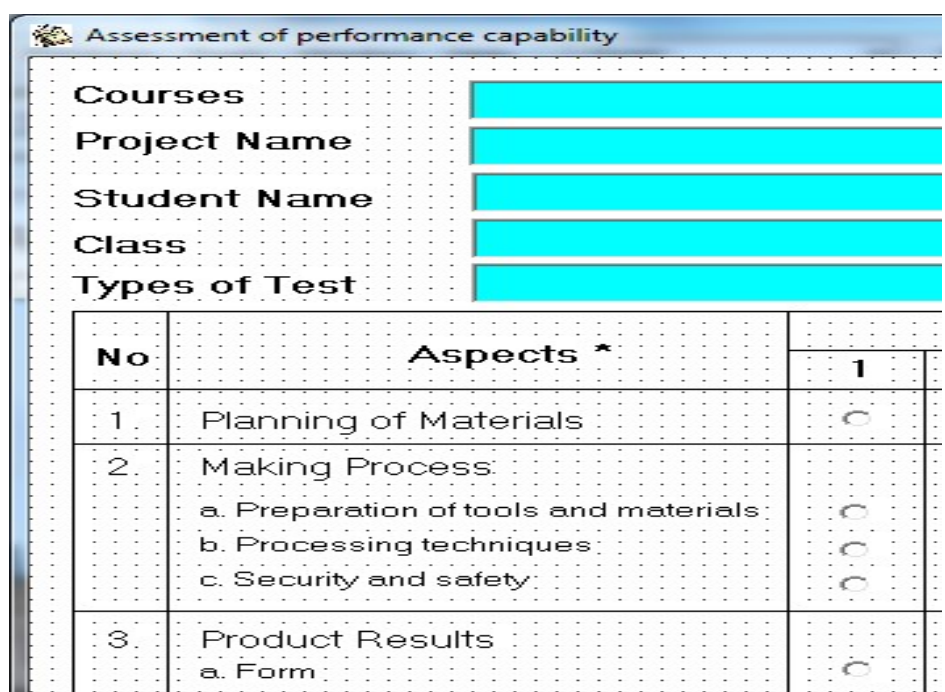

Figure 1: The Display of Main Menu

Figure 2: The Display of Students Data Input

Figure 3: The Display of Assessment of Cognitive Capability

Figure 4: The Display of Assessment of Performance Capability

The frequency distribution of the students' self-regulated learning score before and after the experiment can be observed in the following Table 2.

Table 2: Relative Frequency Distribution of the Students' Self-Regulated Learning

Score	Category	Relative Frequency			
		Experimental Group		Control Group	
		Pre-test (%)	Post-test (%)	Pre-test (%)	Post-test (%)
Score > 166.5	Very High	0	0	0	0
129.5 < Score ≤ 166.5	High	70.45	81.82	65.91	70.45
92.5 < Score ≤ 129.5	Average	29.55	18.18	34.09	29.55
55.5 < Score ≤ 92.5	Low	0	0	0	0
Mean		132.73	140.86		

From Table 2 we can observe that the mean of the students' self-regulated learning score in experimental group were increasing from 132.73 in the pre-test into 140.86 in the post-test. Furthermore, the result for normality and homogeneity test can be seen in the Table 3.

Table 3: The Normality Test Result

	Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Gain Score	Control	0,153	44	0,011	0,960	44	0,131
	Experiment	0,113	44	0,192	0,965	44	0,198

a. Lilliefors Significance Correction

Table 4: Homogeneity Test

		Levene Statistic	df1	df2	Sig.
Gain Score	Based on Mean	11,324	1	86	0,001
	Based on Median	11,174	1	86	0,001
	Based on Median and with adjusted df	11,174	1	71,229	0,001
	Based on trimmed mean	11,336	1	86	0,001

From Table 3 and Table 4 it can be observed that the data of self-regulated learning were not satisfying the normality and homogeneity assumption, since the significant value were less than 0.05. Hence, the research hypotheses should be tested using Mann Whitney U test. In the following Table 5 and Table 6, the result from Mann Whitney U test in SPSS 23.0 were given.

Table 5: Ranks

	Group	N	Mean Rank	Sum of Ranks
Gain Score	Control	44	35.77	1574.00
	Experiment	44	53.23	2342.00
	Total	88		

Table 6: Hypotheses Testing Result

	Gain Score
Mann-Whitney U	584.000
Wilcoxon W	1574.000
Z	-3.225
Asymp. Sig. (2-tailed)	.001

From Table 6, the significant value is less than 0.05. Hence, the null hypothesis which is: there is no difference of self-regulated learning between the students who followed the computer-based portfolio assessment and the students who followed the essay assessment, is rejected. Therefore, the self-regulated learning of the students who followed computer-based portfolio assessment is higher than the students who followed essay assessment.

In other words, we can say that the use of portfolio assessment is useful to improve the self-regulated learning of the students. Its improvement is caused of the students' opportunities in organizing their learning and structuring the information they get to their cognitive structure to create a meaningful knowledge [43]. During learning activities, the students were not only receive knowledge from teacher, but as the subject of learning, they are able to create a connection between new ideas with their existing knowledge. Therefore, they will be able to actualize their potencies to be a better person.

In the classroom with computer-based portfolio assessment, the individual differences is highly appreciated. Therefore, each student is allowed to develop his/her abilities. The students will be motivated since they got direct feedbacks which encourage their curiosities to find the logical solution of a problem by themselves. Moreover, the self-reflection activities in portfolio assessment is asking for students' independency in learning. It means, portfolio assessment is a good tools to facilitate the growth of students' self-regulated learning [30].

Besides that, portfolio assessment can also be used as a model to help the students to monitor their own development. It is caused by the core of portfolio assessment which focus on students' construction and inquiries which only can be done if the students can be independent and confident learner [44]. In the constructivism view of learning, portfolio assessment is an urge to be used in the classroom since the students will able to find and transfer a complex information if it become their, not other people (such as teacher)'s knowledge. Related to that, Dantes [45] agreed that portfolio assessment is a comprehensive approach due to the following reasons: (1) it includes the cognitive, affective and psychomotor aspect of the students, (2) its orientation is on the process and the result of

learning, and (3) it facilitated the need and the progress of students individually.

Students' self-regulated learning can be developed by inserting problem solving and open-ended tasks as an alternative for students' learning experiences [3]. Those tasks can be a topic for portfolio assessment since the assessment can measure how far the process of a student. In line with that, Herman [44] agreed that portfolio assessment contributes to give the educator information about students' motivation and difficulties or struggles in learning. Those data are strongly important to help a lecturer manage an appropriate learning materials for the students. Plimmer in 2000 mentioned the benefits of using portfolio assessment as follows: (1) guide the students to choose the best future carrier and (2) in higher level it can be in line with the core of assessment in mathematics which focus on the learning improvement and abilities of the students, where assessment is not only to give a score for final result but more about process [46].

There are some reasons of using portfolio assessment in mathematics teaching and learning as written in Stiggins [47], which are to help the students to: (1) appreciate mathematics, (2) confidence in solving mathematical problems, (3) be a problem solver, (4) learn to communicate in mathematics, (5) find a mathematical reasoning. This is possible due to the characteristics of portfolio assessment which give an evidence in students' works based on their actual knowledge and comprehension.

Computer-based portfolio assessment also have a benefit since the students can track their record in learning and do a self-assessment activities. Hence, the students are able to notice their strength and weakness and develop it better in the future. Self-assessment also helps the students to gain satisfaction when they are able to achieve what they should.

During the learning process and assessment, students are allowed to revise their works twice. Hence, it is needed for the lecturer to give feedback after the students submit their works. By receiving a feedback, students will be able to reflect their works and notice their possible errors or misconception, revise it and become more understand. This helps the students to develop their self-control and responsibilities which are the characteristics of self-regulated learning.

The process of computer-based portfolio assessment will be benefit for students' trustworthiness in reflecting their own learning progress. Besides that, the communication between lecturer and students are more open in asking question, giving remarks and suggestions, and evaluate the assessment results based on the agreed criteria. This is a powerful impact of computer-based portfolio assessment, since compare to conventional assessment using essay form, the students are hardly notice their struggles and misconception. Hence, the students in control group are less engage in learning process.

Related to the competencies which have to be mastered by the students, we suggest to use the computer-based portfolio assessment in continue and keep it authentic. Therefore, the lecturer will gain enough information about students' conceptual understanding development during the learning process. The point is, the assessment should be focused on the process of how the students learn, not only the final result. Logically, a good result will be started by a good process.

Another important finding of this study is the increased number of percentage of the students in the indicators of learning strategy (81.8%), independency from others (72.7%), self-confidence (77.3%), discipline (84.1%), responsibility (79.5%), initiative (75%), self-control (70.5%). The aforementioned improvements are happened due to the characteristics of computer-based portfolio assessment.

From the analysis of students' written works, the students who assessed using computer-based portfolio assessment are better in evaluate, analyze, and create/construct. It can be seen by the value of correct answer which is 70% from total items. Meanwhile from the questionnaire given to the students after the semester, it is found that 80% students gained support to learn through the use of portfolio assessment, 15% said it just ordinary and other 5% felt difficult about it. After checking the students' self-regulated learning score, it is found that most of the students with low score were expressing their displeased toward the portfolio assessment. When the reason was asked, some students responses that it is caused of a number of task they need to work on.

This findings support the previous studies from Gunay and Bekiroglu [30], and Lubis, Hasruddin, and Mahmud [48] which stated that the use of portfolio assessment is able to develop students' self-confidence which is the key to develop their self-regulated learning. In line with that, Suarsana & Mahayukti [2] also found the benefit of complex task in Statistics Course is able to develop students' self-regulated learning. However, the difference with previous research conducted by Gunay & Bekiroglu is a form of portfolio assessment, where

in this study the form of computer-based while in Gunay & Bekiroglu research is not computer-based.

4. CONCLUSIONS

Based on the results and discussion, it can be concluded from the current research that: 1) the form of computer-based portfolio assessment application is a desktop application created using Delphi programming language; 2) the use of portfolio assessment can improve students' self-regulated learning. The students assessed using computer-based portfolio assessment have better self-regulated learning rather than those who use conventional assessment in essay form. However this study also have some limitations, because it only compare the portfolio and the essay assessment. Therefore, the authors recommend future prospective researchers to compare other type of authentic assessment, for instance performance based assessment for the course subject which is not the pre-requisite of advance courses.

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