The effectiveness of mathematics software aided learning tool with performance assessment on student independence and student learning outcomes

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Abstract. This study aims to determine the effectiveness of the use of learning tools assisted mathematical software with performance assessment, on learning independence and student learning outcomes. The experimental design used was Posttest Only Control Group Design. The research was conducted in Mathematics Education Department of FMIPA Undiksha in Integral Calculus lecture involving 49 students as members of the study sample taken at random. Data were collected by questionnaires independent learning and achievement test Integral Calculus. Data were analyzed by U-Mann Whitney's Test for learning independence and t-test for learning outcomes. The results showed that the use of the device assisted learning mathematics software with performance assessment effectively improve learning independence but not significantly on student results.

1. Introduction
Integral calculus is a courses are offered in the second semester in the Department of Mathematics Education, Ganesha University of Education. When viewed from the level of the complexity of the material, Integral calculus is not too complex because it is a basic course and a prerequisite for other courses. Recognizing the important role of Integral Calculus to prepare students for lectures in the Mathematics Education Department, as a prospective educator, and face life in society Integral calculus learning is directed to make students able to think rationally, creatively, honestly, consistently and tough in facing problems. Therefore, Integral Calculus courses should be a favorite course, well studied by students.

But the learning of Calculus is often problematic. The low learning outcomes of students because the mastery of calculus concepts is very weak and procedural. This is because Calculus learning so far is still conventional, learning is still oriented towards achieving learning outcomes and often ignoring the process. In addition, the low result is caused by the lack of students’ self-directed learning. The low ability of student problem solving is seen from the result of student's answer analysis on the final exam of semester, where many students fail to solve problems that demand analysis and problem-solving abilities. Independence of learning is very important owned by students. Considering in universities apply semester credit system, and education in universities should be able to establish student independence as stated in the Indonesian Law about Higher Education No. 12 Year 2012 and Permenristekdikti No. 44 Year 2015 which expressly states that the development of higher education should be able to handle the problem such as those related to independent human development.
To meet the needs of students about mathematical knowledge especially Integral Calculus, its learning should take place interesting, fun, meaningful and insightful future. In order for learning to run optimally and meaningfully required learning tools which lecturers and students can use to describe the abstract concept to a more realistic situation [1]. But it seems that lecturers still rarely use instructional materials mathematics software, whereas technology helps to develop all kinds of thinking skills from the most basic level to high level of competence [2]. The technology in question here is mathematical software.

The role of this mathematical software provides an opportunity for students to explore their own abstract concepts learned, especially the concepts in Integral Calculus, this is due to the learning of mathematics in universities more emphasizing mathematics as "science." However, there is little mathematical difference as "science" with school mathematics, one of the differences is at the level of abstraction [3]. Object abstraction level mathematics in college is very high. Therefore the use of mathematics software in learning is very helpful for students. Mathematical software that is used as learning media in learning is Maple and GeoGebra. Some research results that use mathematical software in an effort to improve the quality of learning has been done as can be seen on [4], [5], [6], [7], and [8]. Similarly, the students' learning outcomes using Geogebra's help were higher than those that did not use Geogebra [9] and [10]. The same thing also revealed that students' problem solving skills improved significantly through the application of IDEAL problem solving model based on Maple. Therefore the use of technology helps develop all kinds of thinking skills ranging from the most fundamental level to the level of critical thinking skills including problem solving skills [11]. To explain the concept of integrals, the lecturer should provide a precise introduction of the integral concept. It is also suggested that students need visualization to help them understand the abstract integral concepts well [12] and [13]. This opinion is confirmed in different research which stated that in order to understand abstract mathematical concepts, students need a tool that is to motivate them like the use of mathematical software [14].

There are many factors that affect the independence of learning and student learning outcomes. Based on the study of research results, one dominant factor affecting independence and student learning outcomes is the form of assessment used. The form of assessment is thought to affect student learning outcomes. Because the form of assessment used by the lecturer in making the program plan to make instruction of learning process. The instruction in the learning device determines the interaction of the students in the class that participate in determining student learning outcomes.

Stiggins [15] stated that target performance assessment: knowledge, reasoning, skills, products, and affective. In performance assessment asks students to "complete complex and real tasks, by mobilizing initial knowledge, newly acquired learning, and relevant skills to solve realistic or authentic problems. Furthermore, its is known that adults are more interested in learning from problems than from the content of the course [16]. Acknowledgment, appreciation, and support for the adult learning process need to be created in a learning environment. These opinions basically emphasize that learning independence can be grown by designing learning as problem-solving activities through the use of appropriate forms of assessment.

Thus the use of learning media with performance assessment can reinforce each other's advantages. This is supposed to increase the independence of learning and student learning outcomes. To prove these allegations, the researcher conducting experimental research with the aim to know and analyze the effectiveness of the use of mathematical software-assisted learning tools with performance assessment on the independence of learning and student learning outcomes in Integral Calculus lectures.

2. Methods
This research uses Posttest Only Control Group Design. The effectiveness tested in this study is the use of mathematical software-assisted learning with performance assessment on the independence of learning and student learning outcomes on Integral Calculus lectures. The population of this study is all students of Mathematics Education Department who take Integral Calculus courses in Academic
Year 2015/2016 spread in 4 classes. Samples were taken randomly and randomization result was obtained by class B as experiment group which received treatment in the form of use of mathematical software as its learning media, combined with performance based assessment, while the class C got the conventional learning method.

Data were collected with a questionnaire of learning independence and test for Integral Calculus student learning outcomes. There are 6 indicators used in the preparation of learning independence instruments, namely: Independence of others, self-confidence, discipline, responsibility, self-initiation, and self-control [17] and [18].

All instruments have been validated to determine the validity and reliability of the instrument. Each instrument has a reliability of 0.89 for a learning independence questionnaire and 0.85 for Integral Calculus learning test results. Before the test the hypothesis, first tested the prerequisite.

Data were analyzed using t test for learning outcomes, while for learning independence was used U-Mann Whitney test with 5% significant level.

3. Findings
Summary of research results are presented in Table 1.

| Statistics     | Learning               | A₁Y₁ | A₂Y₁ | A₁Y₂ | A₂Y₂ |
|----------------|------------------------|------|------|------|------|
| N              | 24                     | 25   | 24   | 25   |
| Mean           | 70                     | 75.36| 42.79| 51.84|
| Median         | 70                     | 75   | 40   | 55   |
| Standard deviation | 3,718             | 7,076| 14,188| 20,778|
| Varians        | 13,826                 | 50,073| 201,303| 431,778|
| Span           | 13                     | 25   | 56   | 70   |
| Maximum        | 78                     | 91   | 76   | 90   |
| Minimum        | 65                     | 66   | 20   | 20   |

Description: A1 = control, A2 = experiment, Y1 = learning independence, Y2 = learning outcomes

Before performing the hypothesis test, first tested the assumption, namely: Normal multivariate test.

Hypothesis 1:
H₀: learning independence data comes from normally distributed populations
H₁: learning absence data does not come from normally distributed populations

Hypothesis 2:
H₀: learning result data comes from normally distributed population
H₁: learning result data does not come from normally distributed population

Table 2. Tests of Normality

| Group                | Kolmogorov-Smirnov a | Shapiro-Wilk |
|----------------------|-----------------------|--------------|
|                      | Statistic             | df | Sig. | Statistic | df | Sig. |
| Independence learning| Control               | .208| 24 | .008 | .918 | 24 | .054 |
|                      | experiment            | .224| 25 | .002 | .895 | 25 | .014 |
| Learning outcomes    | Control               | .147| 24 | .193 | .961 | 24 | .458 |
|                      | experiment            | .080| 25 | .200 | .963 | 25 | .488 |
Test the assumption of normality in this study using Kolmogorov-smirnov test, data processing using SPSS software assistance. From Table 2 output, it can be seen that the significant value of learning independence in both control and experimental groups is smaller than 5% significant level, Thus $H_0$ is rejected, this means that the data of learning independence does not come from a normally distributed population. In the dependent variable of learning outcomes, both in the control group and experimental group’s scores significantly greater than 5% significant level, Thus $H_0$ is accepted, this means that the learning result data comes from a normally distributed population. The next step is to test the homogeneity of the variant.

**Table 3. Levene's Test of Equality of Error Variances**

|                      | F     | df1 | df2 | Sig. |
|----------------------|-------|-----|-----|------|
| Independence learning| 4.663 | 1   | 47  | .036 |
| Learning outcomes    | 3.722 | 1   | 47  | .060 |

**Table 4. Test Statistics**

|                      | Independence learning |
|----------------------|-----------------------|
| Mann-Whitney U       | 152.000               |
| Wilcoxon W           | 452.000               |
| Z                    | -2.975                |
| Asymp. Sig. (2-tailed)| .003                  |

The homogeneity test of variance in this study used levene test, the results of data processing using SPSS. The results can be seen in Table 3. From these outputs, it can be seen that the significant value of learning independence is less than 5% significant level, So $H_0$ is rejected, thus the variance of learning independence in experimental and control groups is different. Because the dependent variable of learning independence does not meet assumptions (normality and homogeneity) then the test used U-Mann Whitney Test.

In the learning result data can be seen that the significance value is greater than the significant level of 5%, thus $H_0$ accepted. This means that the learning result variant in the experimental and control groups is different. Therefore, on the dependent variable, the learning outcomes meet the assumption of normality and homogeneity thus the test used is t-test.

Followed by testing the hypothesis as presented below.

Hypothesis I

$H_0$: $\mu_1 = \mu_2$, means that there is no difference in learning independence between the experimental group and the control group

$H_1$: $\mu_1 > \mu_2$, means that the learning independence group experiments higher than the control group

Hypothesis II

$H_0$: $\mu_1 = \mu_2$, means that there is no difference in learning outcomes between the experimental group and the control group

$H_1$: $\mu_1 > \mu_2$, means that the experimental group learning outcomes are higher than the control group

From the output in Table 4 it can be seen that, the significance value is 0.003, this value is smaller than the level of significance applied. Thus $H_0$ can be rejected, so the independence of student learning using mathematics software assisted device with performance assessment, higher than student learning independence using conventional learning device.
Table 5. Summary of Hypothesis Test Results Learning

|                  | Levene's Test for Equality of Variances | Student's Equality of Means | 85% Confidence Interval of the Difference |
|------------------|----------------------------------------|-----------------------------|------------------------------------------|
|                  | F          | Sig | t    | df  | Sig (2-tailed) | Mean Difference | Std Error Difference | Lower  | Upper  |
| Equal variances assumed | 3.722     | .080 | -1.773 | 47  | .083         | -9.048           | 5.104                    | -19.296 | 1.219  |
| Equal variances not assumed | -1.288    | .421 | .081  | -9.048 | 5.086              | -19.287              | 1.170                  |

From the output in Table 5, it can be seen that, the value of significance is 0.083, this value is greater than the significance level of 5%. Thus H0 is accepted, so the learning outcomes of students who use the Integral Calculus device assisted learning mathematics software with performance assessment does not differ significantly from the results of student learning that using conventional learning device.

4. Discussion and Conclusion
The result of the research shows that student's learning independence using mathematics software assisted device with performance assessment is higher than students using conventional learning tool. Thus the use of the device assisted learning mathematics software with performance assessment effectively improve learning independence. Complex tasks demanded in performance assessments have encouraged students to be creative in reading, writing, conveying ideas or arguing, which is believed to contribute significantly in fostering student self-reliance. This is in accordance with Adynana et. al. [19] stated that the performance assessment is able to foster self-confidence, initiative and student motivation which is an important element for the growth of student independence.

While the used of mathematical software-assisted instructional tools are not effective in improving students' Integral Learning Calculus. Judging from the prominent advantage of the use of mathematical software in learning is the student may make visualization of abstract concepts and students get immediate feedback on their work simply by clicking an instruction, this should increase students' motivation and learning activities, but the convenience may lead less active students try different matter, proving the theorem or properties of integral or solving various problems of Integral Calculus. Another possibility that causes is not yet optimal student utilizing learning device assisted by mathematics software with assessment of performance in class.

In this study also elicited student opinions through interview after the experiment ended related to the use of mathematical software-assisted learning tools with performance assessment on Integral Calculus lectures. The results of the analysis of student comments show that 65%, expressing pleasure with the device used, 15% normal and 20% feel burdened. Furthermore, from the analysis of student answers during posttest for the experimental group obtained the results of 40% of students correctly answer the point item C2 level, And 10% correct answer point item C3 or C4,And 20% succeeded in solving point of C5 level. This may be due to student learning accustomed to being given an opportunity to pass arguments and to analyze the problem, and 30% of students failed to perform algebraic manipulations so that students were wrong in choosing the integration techniques used to solve the problem. While for the control group obtained the results of 50% of students correctly answer the point item C2 level, and 15% correct answer point items C3 or C4, And 15% succeeded in solving point item C5 level, This may be due to the fact that when students are accustomed to being given the opportunity to present arguments and analyze problems, But in doing algebraic manipulation only 20% of the control group failed. The number of students who fail in the selection of this integration technique may be influenced by 1) low student retention, this is related to the many existing integration techniques, and requires algebraic manipulation to be accomplished in accordance with applicable properties or theorems, thus making the students forget about the integration techniques. This is in accordance with the expression Deese [20] that someone who has many concepts...
to remember can cause low retention, while someone who has a little concept to remember causes high retention. 2) student ability to perform low algebraic manipulation. Because students are less practice to solve various types of problems or problems, It is also rarely done in the classroom based on the assumption of lecturers that the students are adults who certainly took the initiative themselves to do so. Therefore, the quiz should be implemented by the conceptualists.

These findings suggest that there are other factors that may affect such as factors derived from the students themselves such as the initial knowledge of the students, Student efficacy, and great mathematical logical intelligence of students as well as their contribution to student success. Because in studying the Integral Calculus whose material is abstract, In addition to reasoning required also needed a good understanding of the concept in order to have the skills to do algebraic manipulation. Visualization of the abstract concept would make it easier for students to understand a concept or problem, but without offsetting the practice of using the theorems and concepts will certainly result in less student retention. In addition to student factors, lecturer factors also have a big share in learning.

From several studies that have been done generally still partial, in the sense of the instructional model of mathematical software assisted with the conventional, As well as performance assessments compared to conventional assessments that are objective in nature. The combination of mathematical software-assisted learning tools with performance assessment so far has not been found, so it needs to be studied further fusion between the device assisted learning mathematics software with any suitable form of assessment, which can optimize student learning outcomes. Because practically should the use of mathematics-assisted instructional device promising increased interest, motivation, interest in student learning as well as increasing student participation by actively encouraging them to explore, and apply the knowledge they have acquired.

The use of mathematical software in learning actually has weaknesses also like two sides of the coin can have a positive impact and can have a negative impact. The use of inappropriate and poorly planned math software can have a negative impact, and vice versa. If the use of mathematical software only at the beginning or at the end of the course can lead to lazy students to determine the answers by manual, Students tend to choose a quick way to find answers simply by clicking on one of the commands. In this way it can cause students to have difficulties when faced with problems at a higher level. Such questions require higher order thinking. Of course this can not be allowed to last long because the impact on student learning outcomes. Therefore the use of mathematical software should be integrated with learning.

Based on the results of hypothesis testing and discussion of research results, the findings of this study are 1) student learning independence using mathematical software-assisted learning tools with higher performance assessment than students using conventional learning tools, While the students' Integral learning calculus did not differ significantly between the students using the mathematics-assisted instructional device with higher performance assessment than students using conventional learning devices. Referring to the findings of research results, it can be concluded that the use of mathematical software-assisted learning tools with performance assessment effectively improving and nurturing student self-reliance, but not effectively improving student Integral calculus learning outcomes.

Therefore, lecturers should apply learning-assisted mathematics software with performance assessment as an alternative that can foster student self-reliance. With appropriate media selection and assessment type, student self-reliance can also be developed.

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