



The Adventure of Formative Assessment with Active Feedback in The Vocational Learning: The Empirical Effect for Increasing Students' Achievement

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Abstract: The use of formative assessment with active feedback in learning greatly contributes to the professional development of educators and student learning, but the use of the formative function of an evaluation has not been maximally applied in learning. In fact, this formative assessment if applied correctly and with active feedback, it can improve the quality of learning. This formative assessment with active feedback is not only to give a rating, but to see how far the students' mastery is and what they have not mastered. Many studies explain the positive and negative effects of applying formative tests at various levels and fields of science. Therefore, this study aims to see the impact of the formative assessment with active feedback on vocational education in higher education. This study is a quasi-experimental, with a pretest posttest control design. Based on research findings, the implementation of formative assessment with active feedback has been found to significantly improve students' academic achievement towards class. The implication of this study is the research findings will contribute to existing knowledge, particularly to determine the effect of formative tests with active feedback on student achievement.

Keywords: Formative assessment, students' achievement, vocational education

1. Introduction

The use of formative assessment in learning greatly contributes to the professional development of educators and student learning (Ozan & Kincal, 2018). Formative assessment provides feedback to students. Based on this, educators can analyse information, comment on it, and use it to examine and organise learning. This formative assessment, if applied correctly, can improve the quality of learning. This formative assessment is not only to give rankings but to see how far the students have mastered and what they have not mastered (Moyo et al., 2022). Based on the survey results, the use of the formative function of an evaluation has not been maximally applied in learning. There are still too many lecturers/educators who do not take advantage of this evaluation function to improve the teaching and learning process. It is not even an exaggeration to say that lecturers/educators rarely develop formative evaluations to obtain information about what has been planned for an interaction. Formative tests have never been carried out, where tests are usually given only at UTS or UAS. If this formative test has not been properly implemented, then the educator cannot know the extent of the students' understanding, so the learning that occurs is not effective.

800 meta-analytical studies on learning quality improvement factors have been evaluated by Babinčáková et al., (2020). Due to the research results, the most influential assessment in improving the quality of learning is formative

assessment. However, currently the application of formative assessment in the context of assessment in learning is not yet up to date concerning reflecting the true characteristics of formative assessment (Chemeli, 2019; Chemeli, 2019), where the core of the formative assessment is feedback.

Therefore, this researcher offers the application of formative assessment. This can contribute to improving the teaching and learning process by developing and improving the quality of learning through constructivist learning approaches and feedback in formative assessment. Formative assessment can improve the educational process by minimising learning deficits through positive feedback. Based on previous research, formative assessment positively impacts the behaviour of many students, especially in relation to learning outcomes. In the literature, formative assessment is at the top of the list of studies comparing educational strategies, methods, and techniques to improve student performance. A related meta-analysis study also shows that formative assessment significantly impacts academic success. Because understanding is often overlooked in the provision of formative assessment in learning. The use of formative assessment can see the extent of student mastery and what things they have not mastered. Even in the literature, this formative assessment lies at the top of the rankings in improving the quality of learning (Melani, 2017). This means that by increasing the quality of learning, the learning outcomes of students will also increase (Buldur, 2014).

In this study, the formative test applied is a formative test with active feedback from students. The concept of feedback is at the core of formative assessment itself (Mills et al., 2017). The power of feedback provided by teachers to students about learning will lead to an effective impact on formative assessment (Andrade et al., 2015). Active feedback on formative assessment is information that must be sent by the teacher to students, so that it will encourage students to be able to behave to improve learning (Wiyaka et al., 2020). Formative assessment with active feedback provides significant benefits for improving the quality of student learning, students' motivation in learning and making their memory stronger (Chemeli, 2019b).

Therefore, this study aims to see the effectiveness of the application of formative assessment with active feedback on the learning outcomes of mechanical engineering educators. So that this research is expected to be able to contribute to science and related literature on the impact of formative tests with active feedback on student learning outcomes and the correct application of formative tests to be applied in learning.

2. Method

2.1 Research Design

This research refers to a quantitative research approach. This type of quantitative research is a positive philosophy that leads to objective phenomena which are studied quantitatively or research that use statistical processes, structures, numbers, and controlled experiments. Quasi-experiment is the type of research used in this study, where research has a control group but cannot fully control the external variables that affect the implementation of the experiment.

This study uses a quasi-experimental pre-test and post-test, with a control-experiment group design. According to Gopalan et al. (2020), the pre-test and post-test are perfectly designed to demonstrate the effectiveness of the formative assessment. It is used particularly to accurately depict the causal and effect relationship between variables, when groups are randomly assigned and one group is administered a treatment (Gopalan et al., 2020; Camphbell & Stanley, 1963; Sirotová & Michvocíková, 2021). Students participating in this study are students of vocational education. Six homogeneous groups will be selected from the sample as experimental group and control group.

Researchers used a quasi-experimental design because in this study there were external variables that the researcher could not control (Ary et al., 2010; Gliner et al., 2009). Because in this study the control group and the experimental group were not chosen randomly, so the best choice was a quasi-experimental design (Robson, 2011). In this study, there were four groups selected from the existing classes, where the selection was carried out randomly assigned as the control group and the experimental group. The class selected as the research sample has almost the same criteria and abilities. They are first-year students at the university, are regular students with a college entrance test, aged around 18-19 years, and after being tested that class have the same ability and the analysis shows that there is no difference in initial ability.

2.2 Study Group

In this study, a research group was formed from students at the Padang State University mechanical engineering education program in the 2020–2021 academic year. There are nine classes in the Mechanical Engineering Education study program. Then randomly, four classes were assigned as control groups and experimental groups. When determining the university where the research will be conducted, the characteristics of the university and the lecturers who teach using formative tests will be considered. This is done to increase the universality of research, private schools, and schools with a high socioeconomic level are not included in the selection. In addition, lecturers are willing to practise which will be carried out for 8 weeks (Burris, 2005). A total of 84 students participated in this study, which consisted of four groups: two groups as experimental group and 2 groups as control group. The four groups are selected by simple random sampling, which nine groups as a population have the same opportunity to be sampled.

The students selected in this study were first year college students and there are two lecturers who will practice teaching, one person in group A and one person in group B. These two lecturers have the same qualifications, in terms

of length of work, educational qualifications, positions and competencies they have. The two lecturers who performed the experimental procedure had seven years of professional experience and had worked in the college for five years. In addition, he has a bachelor's degree from the Mechanical Engineering Educational program and a master's degree in Vocational Education.

2.3 Procedure

This research was conducted in the 2020–2021 academic year at a university for eight weeks (Burris, 2005). There are two lecturers who will practice teaching, one person in group A and one person in group B. Researchers were included as observers in the experimental group and control group. In this study, the experimental group applied formative assessment with active feedback to the scope of the learning process. In contrast, the control group did not apply formative assessment to the scope of the learning process.

Table 1 - Experimental control design research design chart

Class	Pre-test	Treatment	Post-test
Experimental	0 ₁	T	0 ₂
Control	0 ₁	-	0 ₂

Description: 0 = pre-test and post-test; T= formative test

There are four main elements of formative assessment with active feedback: (i) describes objectives of learning and success criteria; (ii) improve the inquiry/dialogue quality; (iii) improve the feedback quality; and (iv) using self/peer review (Ozan & Kınca, 2018; Schildkamp et al., 2020; OECD, 2005; William, 2011; Andersson & Palm, 2017). The four main elements of formative assessment, the following practices, are implemented in the learning process:

(i) Explain objectives of learning and success criteria.

When you want to explain the learning objectives and success criteria, the following practices are used: (a) the teacher explains to the students what will be learned on that day. The teacher does this at every start of learning. (b) The teacher will ask students to discuss what they have learned; this is done by the teacher at the end of the lesson. (c) the teacher will inform students about the success criteria they must achieve so that classroom activities can be considered successful.

(ii) Improve the inquiry/dialogue quality.

When you want to improve the quality of inquiry & dialogue, the teacher must do the following practices: (a) the teacher will ask questions that lead to measuring students' higher-order thinking skills. This is so that students are encouraged to think more often during learning. (b) the teacher gives time for students to think. This is done before they answer the questions. (c) the teacher provides opportunities for students to talk with their friends. This is done when they answer questions that measure their higher order thinking skills.

(iii) Improve the feedback quality.

To improve the quality of feedback, the following methods are used: (a) Classwork and homework will generally use scoring and scoring points. (b) Lecturers will provide opportunities for students so that they can improve their assignments based on suggestions given by the lecturer. (c) At the end of each subject, the lecturer will give assignments to students, so that the next meeting can improve the quality of their learning.

(iii) Use self/peer review.

The following methods are implemented: (a) Regular self/peer review is included at the end of the learning. (b) Students are informed about how to conduct self-assessment and peer-assessment. (c) Discussions were also held between lecturers and students who did not complete the expected learning standards.

In each lesson, learning activities are divided into three activities, namely: 1) Preliminary Activities, 2) Core Activities and 3) Closing Activities. In the Preliminary Activity, the lecturer gives an explanation to the students about what will be learned today, and the lecturer will inform the students about the criteria that they must achieve so that the learning can be said to be successful. Then in the core activity, the lecturer explains the learning material, after that the teacher will give assignments in the form of questions that lead to higher-order thinking questions. Lecturers will provide opportunities for students to think and discuss with colleagues in answering these questions. After students answer questions from the lecturer, the lecturer will provide suggestions related to the answers given and students are given the opportunity to improve assignments according to the suggestions given by the lecturer. In the closing activity, students are given the opportunity to evaluate themselves and evaluate their peers. Students who do not achieve the learning objectives are given the opportunity to discuss with the lecturer and the lecturer will give assignments to students so that at the next meeting, students can improve the quality of their learning.

2.4 Research Instruments

In this study, the instrument used a test sheet intended to be used in the pre-test before treatment and post-test after treatment to measure student learning outcomes in the form of cognitive aspects. As well as a test sheet for formative tests consisting of essays and multiple choice. Students are also given assignments for four weeks of practice learning at each meeting. The weekly assignments are designed according to the lesson plan and course achievements in each meeting material. The pre-test and post test instruments used were in the form of an achievement test. The instrument used must be valid and reliable and to determine the validity and reliability of the instrument, it can be analysed using Pearson Product Moment and Cronbach's alpha.

The test instrument has 35 questions. After the validity test was conducted, 32 questions were classified as valid and 3 questions were considered invalid, namely points 30, 32 and 33, so these invalid items were discarded or no longer used because these invalid items did not interfere with any indicators, which means that each indicator is still represented by more than one question item. After conducting the reliability test on the instrument, the instrument has a reliability coefficient of 0,961, so the instrument is reliable.

2.5 Data Analysis Technique

Descriptive quantitative and inferential statistics are methods used in analysing the data that has been collected. Data processing was carried out using the Social Sciences Statistics Package (SPSS) software. Measuring the central trend and variability data is reported using descriptive statistics. Categorical data is described using frequency and percentage, just like demographic data. The mean, standard deviation, and range are used to describe continuous data.

It also checks the data beforehand to ensure that the data it receives from the device matches the assumptions of the parametric test. The Shapiro Wilk normality test (Rani Das, 2016), which measures the central tendency of kurtosis and the skewness coefficient, was carried out to ascertain whether the data obtained from the two classes followed a normal distribution. The Levine test was implemented to ensure that the data obtained from both classes had the same variance (Field, 2013)

After confirming that the data obtained through collecting the average data follow a normal distribution and the variance is the same, then to analyse the data, it was decided to use a parametric test. Where the test that will be carried out to analyse the data in this study is the independent sample t-test and analysis of covariance (ANCOVA). ANCOVA requires univariate and multivariate normality assumptions, regression curve equations, variance equations, and variance-covariance equations (Field, 2013; Pallant, 2013; Tabachnick & Fidell, 2014). All ANCOVA assumptions are in accordance with the results of the statistical analysis, with an accepted significance level of 0.05.

3. Results and Discussions

In this study, there were 84 totals of participants' students, consisting of more males than females in both classes in groups A and B. So that male students were the majority in each control group and experimental group. Further analysis showed that in Group A there were 69% (20) experimental students' group and 65.5% (19) control students' group, and in Group B there were 61.5% (8) experimental students' group, and 77% (10) control students' group were provided with technical training from the previous Vocational School. The students from the experimental and control class in both groups came from other streams, namely: Science, Social and so on. The background of students' educational details is presented in Table 2.

Table 2 - The background of students' education

educational background	Group A		Group B	
	Experimental	Control	Experimental	Control
Technical	20	19	8	10
Non-technical	9	10	5	3
Total	29	29	13	13

Table 3 shows the statistics on the results of the pre-test and post-test student learning outcomes both in the control and experimental groups.

Table 3 - The scores descriptive statistics

Grouping			mean	SD
Group A	Experimental	Pre-test score	73.37	12.042
		Post-test score	84.37	9.568
	Control	Pre-test score	71.93	12,572
		Post-test score	75.30	7.502
Group B	Experimental	Pre-test score	72.71	11.004
		Post-test score	85.30	9.568
	Control	Pre-test score	71.09	4.221
		Post-test score	73.67	4,536

Based on Table 3, the pre-test scores of students in Group A's academic achievement in the control group were 71.93; the post-test score was 75.30. The students in the experimental group got scores for pre-test were 73.37; the post-test score was 84.37. The pre-test scores of the control group students were 71.09; the score for post-test was 73.67. In group B, the students in the experimental group got scores for pre-test were 72.71; score for post-test was 85.30. Before the independent sample t-test was conducted, a prerequisite test was carried out to determine whether the data had met the prerequisites for the parametric test.

Table 4 - The test of normality

Variables (post-test)	Statistics (W)	P value
Group A	.880	.391
Group B	.427	.310

The normality of the data distribution was carried out using the Shapiro-Wilk test. The post-test score distribution for mean scores of group A did not differ statistically significantly [$p > 0.05$, $W = 0.880$] from the normal population. The post-test score distribution for mean scores mean scores of Group B also did not differ statistically significantly [$p > 0.05$, $W = 0.427$] from the normal population. Therefore, the distribution of sample is assumed to be normal and requires to uses using parametric tests for statistical analysis.

Table 5 - Levene's test of homogeneity

Mean score (pre-test)	Levene's statistics	P value
Group A	3.818	.060
Group B	.370	.545

The homogeneity test is done to compare the two pre-tests' data from the two control groups and the experimental group, Levene's test was used, this was done on each variable. From the processing results, it was found that the results of the pre-test (variance) between groups A and B were not statistically significant, this comparison was carried out in the experimental and control groups ($p > 0.05$). Therefore, we can maintain this assumption and perform an independent sample t-test and ANCOVA. In the independent sample t-test, the purpose of this test is to find out whether there is a significant difference between the control group and the experimental group in both groups, as seen from the pre-test scores.

Table 4 - Independent Sample t-test of the academic achievement pre-test scores

Group	Independent sample t-test	
	t-value	P value
Group A	.355	.253
Group B	.352	.563

As shown in Table 4, the conclusion was no significant difference that found between the students' pre-test scores of academic achievement, [$t_{(\text{group A})} = .355$; $p > .05$); ($t_{(\text{group B})} = .352$; $p > .05$] The conclusion was the students' academic achievement was similar before the experimental procedure was carried out.

Table 5 - The results of ANCOVA for post-test

Source	df	F	Sig.
Corrected Model	2	8.231	.008
Intercept	1	7051.124	.000
Class	2	8.590	.003
Error	81		
Total	84		
Corrected Total	83		

Based on the comparison of the results of the post-test student achievement between the control group and the experimental group in Group A and Group B [$F(1, 52) = 8.590, p < 0.05$]. In general, it can be concluded that student achievement in the experimental group was statistically significantly increased in both groups A and B by applying formative tests to learning compared to students in the control group, who did not apply formative tests to learning.

The pre-test and post-test scores are used as a reference in seeing the impact of the application of formative tests in improving student learning outcomes in vocational education in higher education. If students have achieved the learning objectives, the learning can be effective. Due to the ANCOVA test, it can be figured out that the p-value < 0.05 means that learning with the application of formative tests is more effective in improving student learning outcomes than without the application of formative tests. This is because the application of formative tests is a student-centred learning method, so that students are taught to learn independently, and the teacher only acts as a facilitator.

In this study, students in the experimental group who used formative assessment practices had significantly higher academic performance than those in the control group. The control group did not use formative assessment practices. The results of this study are also consistent with the results of a literature study that conducted research on the effect of the application of formative assessment on academic achievement. Many of the meta-analytical studies show that the increase in student academic achievement results from the application of formative assessment (Furtak et al., 2016; Kingston & Nash, 2011).

There are many studies on the application of formative assessment at different levels of education, where the results of these studies explain the increase in student academic achievement because of the application of formative assessment (Van der Kleij et al., 2018; Ismail & Tini, 2020; Lui & Andrade, 2022; Voinea, 2018; Evans et al., 2014; Wylie & Ciafalo, 2010). In this study, the observations made by the researcher also support the results in the literature. Characteristics of formative assessment such as not comparing students, grading students according to their own developmental level, and prioritising learning over grades are more influential, especially in students with low academic achievement, by enabling them to participate in lessons and increasing their success.

There is a negative result of the literature study on formative assessment, where a formative assessment has no statistical effect on students' academic performance. The conclusions of Andrews (2011), Collins (2012), and Guevara-fernández et al., (2022) explain that formative assessment does not have a significant positive effect on students' academic performance. However, the effect was not statistically significant. The formative assessment was found by Admasu (2019) where the formative assessment had no significant effect on student performance, motivation, and conceptual change. However, this arises from the difficulty of conducting effective formative assessments. Al-mofti (2020) also explains that formative assessment does not have a significant effect on improving student performance, linking it to short-term learning and the diversity of individual teacher practices.

Based on the research findings, the opinions of students in the experimental group and teachers who used practice strongly supported the practice of formative assessment. Students say they enjoy class when formative assessment is fun and used for reasons such as good instructors, good topics, and success in class. I also found that all students like teachers because they are good at teaching, funny and fun. From these results, we can conclude that students have a very positive attitude towards the teacher and the class. This result is also in accordance with the results of previous studies which showed a significant difference in the use of formative tests in favour of the experimental group (Van der Kleij et al., 2018; Ismail & Tini, 2020; Lui & Andrade, 2022; Voinea, 2018; Evans et al., 2014; Dayal, 2021; Gezer et al., 2021; Alsubaiai, 2021).

Based on the results obtained, all students felt that the application of formative tests with active feedback was quite useful. The reasons to accept this practice as useful are as follows: discussions to promote learning, collaboration, sharing, and participation in lessons; tasks to improve their learning and recognise their shortcomings. The most significant characteristic of the practice of formative assessment is that it improves student achievement by learning priorities. So this makes students aware of the benefits of formative assessment practices (Govender, 2020). In developing students' understanding and knowledge, the application of formative assessment with active feedback is a valuable strategy to apply, because formative assessment with active feedback can enable students to focus on the learning objectives to be achieved (Enu, 2021). The essence of the formative assessment itself is the concept of feedback and the impact of formative assessment arises from the power of feedback given to students about the learning they are learning (Karaođlan et al., 2020).

Formative assessment makes teaching more effective (OECD, 2005) by directing students to achieve learning objectives, establishing learning needs and adapting teaching accordingly, and increasing lecturers' awareness of effective teaching approaches (Studies & Bilgiler, 2019; Kanjee, 2019). According to the results they obtained from the formative assessment project, Schildkamp et al. (2020) stated that teachers began to accept teaching as a support for student learning rather than just as a complement to the educational curriculum.

4. Conclusion

In conclusion, the practice of formative assessment with active feedback has significantly improved students' academic achievement in class. The research findings will contribute to existing knowledge, particularly to determine the effect of formative tests with active feedback on student achievement. This study provides information about whether formative tests with active feedback can be applied to a sample and population of vocational education students in higher education. The research findings imply that the student learning process should be fun rather than boring listening to lectures. Students must participate enthusiastically in the learning process and engage in multi-dimensional learning activities. As well as the results of this study on formative tests with active feedback have provided several ideas for increasing the effectiveness of the application of formative tests in vocational education in higher education. The limitation of this study is that this research only focuses on cognitive research, it is hoped that further researchers can reveal the impact of applying formative tests with active feedback on other variables that have not been studied in this study.

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