

The Impact of Formative Assessment Feedback on Secondary Students' Attitude towards Science and Academic Achievement in Grade Nine Biology

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Abstract

The purpose of this research is to investigate the effect of formative feedback on secondary Biology students' attitudes toward science and how formative feedback affect students academic scores in Biology at the grade 9 level. This research will explore how the academic performance of grade 9 Biology students can be improved using formative assessment feedback. The attitude of students toward science will be measured using an Assessment for learning tool (AFL). This research will also help the instructor to improve teaching practice and provides an opportunity for science students to maximize on their ability, hence improved their academic score in science.

This research used a quasi-experimental design, with intact classes using the embedded quantitative design methodology of an action investigation. The samples were selected using a convenience sampling technique. Data was collected using Two Instruments, Six Weeks and Science Attitude Scale (SAS), Two instruments, Six Weeks Test. Quantitative data will be collected using Science Attitude Scale (SAS). A positive relationship between academic success and formative feedback [$r=.54$, $n=35$, $p > .001$] has been found. The students in the treatment group performed significantly well on the Six Weeks Test, compared to the control group, $t(61.83) = 3.58$, $P = .001$. There was also, a statistically significant difference in the treatment group performance on the Science Attitude Scale (SAS), on the post-test compared to the pretest.

The use of formative feedback in the science classroom is a positive teaching method that can lead to higher students' engagement which will result in an increase academic performance relative to the control group.

Keywords: formative assessment; feedback, academic achievement; attitude.

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1. Introduction

Assessments is a very important component of education. Assessment can be defined as any methods used to evaluate students learning. There are several types of classroom assessment, the two main important classroom assessment are formative assessment and traditional assessment. One of the most conventional ways of evaluating students' knowledge of a subject is know as traditional assessment. Correction given to students after a traditional assessment is know as traditional assessment feedback. Formative assessment is also known as assessment for learning is a continuous process that involve teachers and students with the used of evidence of learning to improve understanding of self direct learning. Formative assessment feedback assists teacher and student identity areas for improvement and adjust their learning and teaching. Formative assessment can be formal or informal and can include self assessment. Formative assessment help students to understand what they know and what they *need to know*.

1.1 The researcher background

The researcher, Camieka Oliver, is a high school science teacher that currently teach students science at the nine to twelve grade level. She has nine professional years of experience teaching many different science disciplines namely Chemistry, Biology, and Integrated Science at the CSEC level in Jamaica. Also, she has experience teaching IB Earth and environment Science and Physical Science at the secondary level in North Carolina. The author work as an Exam marker and an external were Caribbean Examination Council. The Caribbean Examinations Council (CXC) is an organization that conducts exams and awards certificates in the Caribbean. CXC was established in 1972 by the Caribbean Community (CARICOM). The Caribbean Secondary Council Examination is the high stakes Examination that is written by students in grade 11. The Caribbean Advance Proficiency Examination Unit 1 and Unit 2 in written by students in Grade 12 and 13 in the Caribbean region, both examine are equivalent to General Certificate Examination Ordinary Level and Advance Level which is written by students in Europe. The author is also a Judge at for many high school STEM Fairs and projects in her circle. The researcher has experience working in assessment in education which motivates him to carry out this research. The aim of this study is to to investigate the impact of formative assessment on students academic score and attitude in science at the secondary level as a component of a Master of Education specializing in Science Education Course. The results from this research will be used to incorporate formative assessment feedback in daily science lesson to improve students academic score in high stake examination at the high school level.

1.2 The research background

In Jamaica, students in secondary schools are required to successfully complete fifth form after taking subjects in the Caribbean Examination Council (CXC) examinations. From the statistical examination of the 2017 CXC, results in the areas of mathematics and the sciences were released as follow: There was a 2.5% increase in mathematics in public schools, however, a 3%, 0.7%, 12% and 4.6% drop in chemistry, integrated science, biology and physics, respectively, with only human and social biology registering a 2.8% increase in the sciences in public schools examination passes [1].

Even though Biology is the foundation of many careers in science and play an important role in the economy, most of Jamaica high school students are interesting to study Biology in high school because they find biology challenging and difficult to understand the content. For purpose of this research, students will begin Caribbean Secondary Education Certificate (CSEC) Biology syllabus in grade nine. The students are split into two classes at grade ten (Human and social biology and Straight biology). The grade-ten (10) distinction is based on the academic performance of the biology students during their grade-nine year, with the best-performing students placed in straight biology and the poorer performers, placed in human and social biology.

The Ministry of Education (MOE) of Jamaica Is guided by the philosophy that "every child can learn, every child must learn" [2]. This philosophy, which is firmly maintained by the Ministry of Education, gives every child an opportunity to be properly educated and is expected to be embraced by all stakeholders in the Jamaican education system.

Assessment methods in the classroom plays an important function in students learning. As a result, the use of formative assessment feedback in the classroom would make science more relevant and interesting to students. According to an article by Hattie and Timperley [3], formative assessment feedback is described as one of the most powerful influences on learning and achievement. [4] also explains that formative feedback, when used correctly, involves any set of instruction presented to the learner that is intended to modify the thinking or behaviour of the learner to improve learning. From this perspective, the researcher allows students to improve their academic score in Biology. Also, researcher gain new knowledge on how to plan.

Two of the main challenges in teaching science at the secondary level is to attain high-level academic achievement in science education and positive attitudes towards science [5]. Studies have shown a strong relationship between attitudes, cognitive abilities and academic achievement of students [5]. A simple transition to student-centred approaches can transform the academic performance of students, build optimistic attitudes and help students understand the importance of science to their daily activities. In Europe and the USA, there is a shift from teacher-center instruction to student-center instruction, which help to increase students' engagement, motivation and engagement in the lesson [6].

The pass rate of students studying Biology has been decrease over the pass few years at a prominent high school in Kingston, Jamaica. As a result, the pass mark for students enrolled in straight biology had to be lowered from 70% to 60% to allow students to matriculate into the programme. Even with lower Matriculation score students still find it difficult to attain the minimum score to qualify to study Biology. It is from this situation that the researcher decided to conduct this research to investigate how the academic score of students pursuing Biology can be improve using formative assessment feedback. This will be a key tool use change their attitude toward science and make Biology interesting and relevant to improve academic performance.

1.4 Purpose of the research

The purpose of this study is to investigate the effect of formative feedback assessment academic performance of grade 9 biology students and the attitude of students towards science when used as an AFL (Assessment for

Learning) tool. This research may also help teacher to improved science teaching and produce the best opportunities for students to enjoy science class and improved their academic score.

1.5 Significance of study

The expectation of the results from this study is to help informed Biology teachers, educators and school administrator at Kingston High School the important of formative assessment feedback, on students' academic performance and students' attitudes towards science. This study also served as a tool for future administrators with regards to policy changes concerning the integration of teacher feedback during classroom instruction. Also, this research will serve as a theoretical model for future studies of similar typed, allowing future researcher to learn from this analysis, as it will provide information require to evaluate studies.

1.6 Research Questions

1. Is there a relationship between formative assessment feedback and students' academic achievement in biology in grade 9?
2. Is there a statistically significant improvement in students' achievement in grade 9 biology with the treatment group compared to the control group?
3. To what extent, if any, did the formative assessment feedback improve the grade 9 students' attitude towards biology?

1.7 Hypothesis

Null Hypothesis (H₀):

- There is no significant relationship between formative assessment feedback and students' academic achievement in Grade 9 biology.
- There is no statistically significant improvement in students' achievement in grade nine (9) biology with the treatment group compared to the control group?

Alternative Hypothesis (H_A):

- There is a statistically significant relationship between formative assessment feedback and students' academic achievement in Grade 9 biology.
- There is statistically significant improvement in students' achievement in grade nine (9) biology with the treatment group compared to the control group?

Since this study is a Quasi-experimental student, the Independent in this study is teaching method (Formative assessment feedback, and the dependent variable is students' Academic achievement and students' attitude towards science. The diagram below represents the variable in these studies.

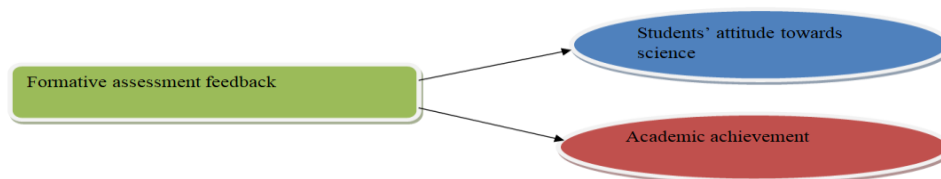


Figure 1: Showing the research variables

1.8 Theoretical Framework

It is believed that formative assessment is used to promote teaching practice and improve academic achievement [7]. Teacher can use Formative assessment to understand students' strength and challenges and readjust their lessons to address their needs. Formative assessment can help students to build their learning objectives, track their progress and evaluate their relative performance with ideal results, and take steps to bridge the gap between them [8]. Even though many researchers investigated the effect of formative assessment on student learning, a coherent theoretical framework is missing to clarify the effect of formative assessment feedback on students learning [9]. According to [10], formative assessment exercise relates to sociocultural learning theory [11] zone of proximal development. Reference [11] also viewed learning as a social progression in which Students join forces with more expert others to extend cognitive structures. Formative assessment is defined as "a dynamic process in which supportive adults or classmates help learner move from what they already know to what they are able to do next" [10]). The theory of formative assessment is related to the theory of sociocultural learning [11]. In general terms, formative assessment activities are important for the creation and preservation of a socially supportive environment for pedagogy [12]. Educators closely monitor students learning, provide effective feedback, provide the necessary help and strengthen their intention with students. Formative assessment can be used by teachers and students to develop "mutual support, trust, respect and cooperation" [11].

2. Literature Review

Assessment for Learning

Teachers and administrator should be aimed at having more students- centre classroom instruction to meet the needs of the education system in the twenty first century. Assessment for learning (AFL), which is an approach used to identify and analyse information used by students and teachers to determine where the learners are in their learning and where they need to go and the procedure, they need to go to get there. Teachers may employ a variety of methods to include formative assessment methods such as peer and self assessment, feedback, and self assessment.

Of the most effective AFL strategy is the intention of using feedback to communicate information to the learner to modify the thinking or behaviour of students to improve learning [4]. 'Learning assessment was an integral

part of the learning process [12]. It was also suggested that AFL should consider different learning styles, the strength, and weaknesses of the students, and the needs of the learners. AFL is not a teacher-centered evaluation but should be an integral part of normal learning process daily.

2.1 General Feedback

In this in review, feedback means information provided by an agent with respect to performance or understanding aspects [3]. In the classroom, feedback could seen as informal. For example, encounters with daily educational stakeholders, or as formal. Example of formal assessment are written or clinical assessment. However, it should be acknowledged that there was not a clear division between assessment and instruction in the field of providing feedback on learning [11]. There are two types of feedback in formative assessment [13], namely from student to teacher, and the second from teacher to student. The first type of formative assessment feedback is from student to teacher, the second from teacher to student. The article continued to explain that learning was influenced by an alternation between these two sets of individuals. It also explained that effective feedback comes from learning experiences that provide supporting indication so that judgements can be made about the subsequent steps in teaching and learning processes. This type of activity, as explained by [13], will aid in other areas of learning assessment, which will eventually lead to the promotion of critical thinking skills.

2.2 Teacher feedback

Feedback is very important part of teaching and learning and add value to value to the learner [13]. According to the article, good feedback contains the following characteristics: swift intervention, direct learner where they can get aid, and allow learners to compare their progress with peers and teachers. Several studies were conducted to investigate the outcomes of various forms of feedback on the academic performance of students. The main areas of a feedback are comments only, grades, and a mix of comments and grades [14]. According to a research conducted by conducted by [15], it was concluded that there were varied reactions to teachers' opinions of the formative feedback. According to some studies study's teachers claimed that feedback on its own failed to show students how improved the quality of their work, while other teachers reacted just as constructive to the reviews, suggesting that students were now able to see where they went wrong and how best to correct their errors. It can take a lot of time to write written comment on students work but often regarded as more valuable by students [15]. Information on students' reaction were also obtained through an interview, which claimed that guidance from teacher gave improve their understanding of where they were in term of their ability and how they could continue progress [15,3]. The primary reason for the feedback was to lessen the disparity between current knowledge, achievement and target [3]. On the other hand, [11], noted that many teachers did not provide enough, no feedback to students with high quality work even though students with high quality work still need feedback. Also, some researchers believe that students with low achievement would benefit from immediate feedback while students with high achievement would benefit from delayed feedback [4]. Reference [3] suggested that the combination of feedback with effective classroom instruction was a very powerful combination used to enhance learning and improve student's academic score.

2.2 Attitude and Science

Reference [16], agrees that the interest and enthusiasm of the students towards science were related to and may influence the success and attitudes concerning science. Reference [17] argued that the affective domain impacts almost everything students have done, including future and present activities. Students' perception of science may have a significant effect on students' knowledge and dedication to science [18]. Also, the attitudes of pupils in the subsidiary were noteworthy in terms of their interest and achievement in science [19].

3. Methodology

Research Design

This design used in this research is a quantitative design to collect data from students. [20] describes quantitative research as an approach to testing objective theories through the examination of the relationship between variables. (21), action research is an investigative tool to intended by teachers and educators in the classrooms to try to solve problems and develop professional practice.

Table 1: Summary of Methods of Data Collection and Analysis by Research Questions.

Research Questions	Data Sources	Measurement level	Variable	Statistical test
To what extent, if any, did the formative assessment feedback improve the grade 9 students' attitude towards biology?	Science Attitude Scale pre administration	Science Attitude Scale post administration	Ratio	Descriptive statistical, pair sample, t-test
Is there a significant relationship between formative assessment feedback and student's academic achievement in biology in grade 9?	Questionnaires	Result from test	Ratio	Pearson product-moment correlation
Is there a statistically significant gender difference in student's achievement in grade 9 biology for the control and treatment group?	Results from test	N/A	Nominal (grouping variable) Ratio	Independent T-test

This research is an experimental investigation which the hypotheses is tested using cause-and-effect relationship and the type of design is quasi-experiment. Quasi-experiment is a method of experimental research in which subjects are not randomly selected to a group [22]. Pre-and Post-test design will be used to measures of science

attitudes of students in grade nine straight biology class. The research designed was focused on the academic performance of grade nine high school Biology student with the use of formative assessment feedback as well as students' attitude toward science.

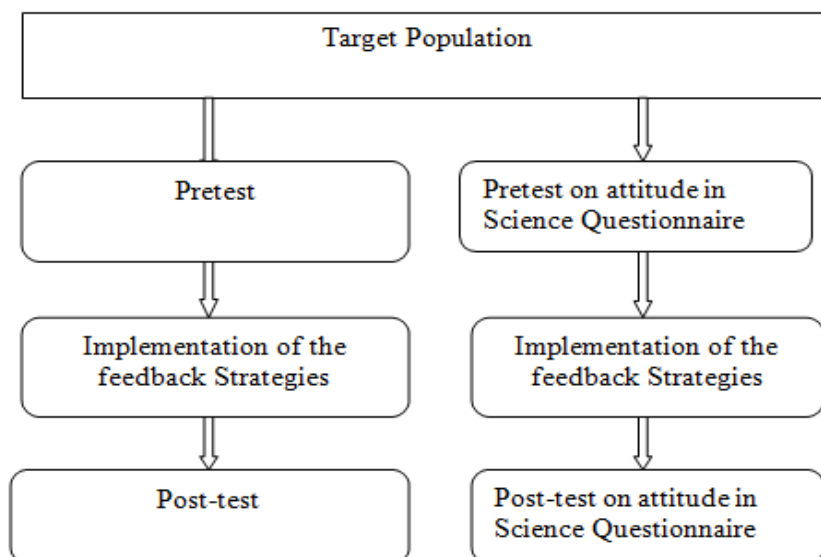


Figure 2: Model of research Design

3.1. Subjects

The research was conducted at a High School located in Kingston. The school was found on September 6, 1971. At that time, there were five hundred and twenty students on roll, and twelve teachers on staff. Currently, there are one thousand one hundred and forty-six (1146) students on staff ranging from grade seven (7) to thirteen (13). This institution is a coeducational institution with fifty two percent (52%) of student's female and forty eight percent % male.

The technique used to select the research subject, the school in this study was convinced sampling. because this is the group of students who may be selected at the end of Grade Nine pursued Biology at the CSEC level. According to a study conducted by [22], the interest of a students in science is established by age 13 and becomes increasingly more difficult as they get older. The subjects in this research were comprised of 68 grade 9 students enrolled in biology. Grade 9S and 9O students are all doing straight biology. The treatment and control groups were contrasted with the previous demographic distribution, where the majority of Biology students are female (66.2%) and the remainder is male (33.8%). Additionally, the total contribution from each class is as follows:

Table 2: Contribution of students from each class.

	Shift A	Shift B
Class	9S	9O
Number of students from each class	35	33

The instruments used in this research to collect data were pre-test, post-test, and a questionnaire. These methods were chosen because of their ability to capture the information needed to analyse the study effectively. Pre-test and post-test were constructed similarly, with the papers comprising of multiple-choice, short answer and scenario-based questions. A 5-point Likert-type questionnaire was employed.

3.2 Students' Attitude Scale (SAS)

Scoring of the scale

SAS instrument items responses ranging from strongly agree - strongly disagree. The items scored 1, 2, 3, 4 and 5 for the response. The positive items were scored as strongly agree (SA) = 5, Agree (A) =4, Undecided (U) =3, Disagree (D) = 2, strongly disagree =1, while the negative items were scored in the reverse order.

3.3. Data collection procedures

Strategies for data collection included pre- to post-actions in the Science Questionnaire and pre-and post-unit assessments. The responses of each student to the Science questionnaire were tabulated. The research was conducted using two intact classes, one being the experimental group and the other being the control group. The teacher for the control group was properly informed about the study's intended purpose and was asked to continue teaching the students without making any adjustment to teaching methods. As for the experimental group, they were controlled by the researcher. The students were informed about the research and the possible benefits of this project on their academic performances. The research duration was approximately two months, with both groups being taught two thirty (30) minute sessions each week. The Science Attitude Scale (SAS) and the pretest for the biology Six Weeks Test (SWT) were administered in January 2020 and the SWT was re-administered in early March. However, the closure of schools, because of COVID-19 pandemic, prevent the SAS post-test from being administered. It was later administered via the online modality route. To deal with regression the means, the two-month period provided enough time without prolonging the time too far to prevent the means converging toward the critical point.

At the beginning of the research, all students (both experimental and control) were given a pre-test to determine their current level of performance. Students from the experimental group were taught regularly but assessed formatively during the study. A combination of two feedback strategies was used in the experimental group: comments only and comments and grades. For classwork, comments only feedback was used while for quizzes (this were done weekly) comments and grades were used. For every assignment, a comment sheet was developed giving students an idea of where they went wrong or where they did well. A scoring rubric was used to assess the effectiveness of the formative assessment feedback on each student. At the end of the study period, both groups were given a post-test. This test was analysed and an average score produced on the performance of both groups. A comparison was made between the pre-test and the post-test to determine if the method of feedback had any impact on the academic performance of students.

3.4. Reliability & Validity

To ensure that the research design stands firmly to scrutiny, the researcher employed many strategies for this to be achieved. The questionnaire was piloted on a group of students at another high school from the same grade and subject. Additionally, the results were examined and a competent person who knows the content area was asked to assist in the review of the piloted questionnaire. A cronbach's alpha was performed on the SAS Questionnaire to determine its reliability. The reliability was found to be consistent and high on the pilot study, with a $\alpha = .776$. In addition, the SWT were also piloted to ensure questions are within the required difficulty range. The head of the science department (HOD) was also asked to review the items before and after they have been piloted.

On two separate occasions, two teachers were asked to observe the researcher teaching students in the treatment group, to ensure that the proposed method of delivery is what is being done. Teachers were asked to provide both written and oral feedback to the researcher performance.

3.5. Ethical Consideration

To protect the rights and privacy of each student, the following ethical principles were used.

- A letter of consent was given to the principal, outlining my intentions to conduct research and how I planned to handle the data. The letter made mention of the fact that students name there will remain anonymous; instead, each student was given an identification number.
- Students were told not to write their names on the questionnaires to hide their identity.
- Within the classroom, no students' data or their level of performance was announced aloud.
- Test papers and projects were kept in a safe place to ensure that students' information was protected.
- If the findings were requested by the school, no student name was mentioned in the report.

3.6. Limitation

- Since these students were from varying socioeconomic backgrounds, the researcher was unable to control the attendance of students to school during the study period and this may affect the results of the study.

- Because the students in the experimental group may have had friends from the control group, the researcher would have been unable to prevent students from the study group from informing their friends in the control group about the strategies being used.
- Due to the outbreaks of COVID-19 in Jamaica and the resulting closure of schools, it was not possible to do the post-test survey using the Science Attitude Scale Questionnaire at school, so the post test was done using the online modality.

4. Data analysis and presentation of findings

The focus of the research is to use action research to assess and evaluate the use of Formative Feedback as an intervention tool that may affect students' motivation and achievement in the Grade 9S biology class. The study guided by the following research questions:

- Is there a significant relationship between formative assessment-feedback and student's academic achievement in biology in grade 9?
- Is there a statistically significant difference in student's achievement in grade 9 biology for the control group compared to the treatment group?
- To what extent, if any, did the formative assessment feedback improve the grade 9 students' attitude towards biology?

This resulted in the collection and analysis of quantitative data. To address these research questions, the findings are presented and addressed. Wherever quantitative findings are reported, these are presented initially using descriptive statistics. The findings were then evaluated to assess if some shift existed at the close of the intervention duration that could be linked to an independent variable. Also, any reported improvements were subjected to multiple statistical review techniques to assess if the adjustments were meaningful and to what degree they were important.

Is there a significant relationship between formative assessment-feedback and student's academic achievement in biology in grade 9?

A bivariate association has been measured for a relationship between formative assessment- feedback and student academic achievement. The connection between the formative assessment-feedback on Student Academic achievement was tested using the Pearson correlation coefficient. Based on the results in table 3, I failed to accept the null hypothesis. Table 3 shows a large positive correlation between academic performance and Formative Assessment-Feedback [$r=.54$, $n=35$, $p >.001$] for the treatment group. According to Cohen (1988), an effect size of .54 represent a large effect size. As a result, this effect size ($r^2 = 0.29$) indicated that 29% of the variance in students' academic achievement is explained by the formative assessment feedback.

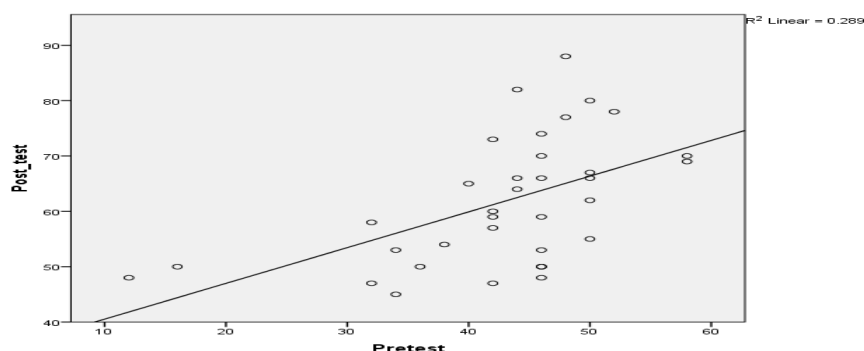


Figure 3: graph showing the correlation between Students' academic achievement and formative feedback.

Table 3: Pearson Correlation between Formative Assessment-Feedback and students' Academic Achievement of treatment group

		Post_test	Pretest
Post_test	Pearson Correlation	1	.537**
	Sig. (2-tailed)		.001
	N	35	35
Pretest	Pearson Correlation	.537**	1
	Sig. (2-tailed)	.001	
	N	35	35

**. Correlation is significant at the 0.01 level (2-tailed).

Is there a statistically significant difference in student's achievement in grade 9 biology for the treatment group when compared to the control group?

The purpose of this question is to assess if the student's post-test academic achievement was statistically different from their pre-test results based on intervention. To test the hypothesis that there is a statistically significant different mean in students' academic achievement in grade 9 biology for the treatment group compared to the control group, an independent samples t-test was performed. An alpha level of .05 was utilised. Based on the results in table 5, I failed to reject the null. There was no statistically significant difference in the pretest scores for the treatment group ($N = 35$) pretest results was $M = 42.80$ ($SD = 9.52$) and the control group ($N = 33$) pretest results was $M = 42.30$ ($SD = 10.94$); $t(66) = .20$, $p = .842$.

However, based on the results in table 5, we failed to accept the null hypothesis. There was a statistical significant difference in the treatment group ($N = 35$) post-test (scores $M = 62.51$, $SD = 10.65$) and the control group ($N = 33$) post-test scores ($M = 54.48$, $SD = 7.67$); $t(61.83) = 3.58$, $P = .001$. Thus, the treatment group was associated with a statistically significantly larger mean in students' academic achievement than the control group. [23] was estimated at 0.163, which is a small effect based on [23] guidelines. This suggests that 16.3 % of the variance in students' academic achievement is explained by the intervention.

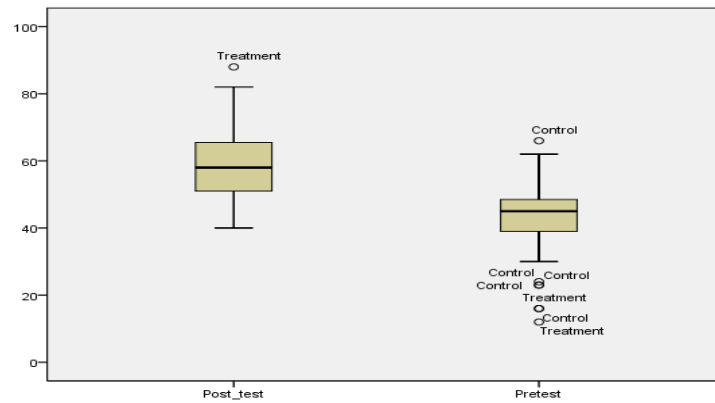


Figure 4: Graph comparing Pre & Post-test SWT scores of both groups

Table 4: Graph comparing Pre & Post-test SWT scores of both groups

<i>Descriptive Statistics on students Pre-test & Post-Test mean & Std. Deviation on SWT scores of both groups</i>					
	Grouptype grade	N	Mean	Std. Deviation	
Post_test	Treatment	35	62.51	10.651	
	Control	33	54.48	7.673	
Pretest	Treatment	35	42.80	9.520	
	Control	33	42.30	10.936	

Table5: Independent Samples Test for both groups and their pre & post SWT scores.

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig. t	df	Sig. (2-t ailed)
Post_test	Equal variances assumed	4.809	.0323.548	66	.001
	Equal variances not assumed		3.582	61.831	.001
Pretest	Equal variances assumed	.968	.329.200	66	.842
	Equal variances not assumed		.199	63.537	.843

4.1. Students Interest in Science Questionnaire

Reliability-Internal Consistency-Cronbach's Alpha

Table 6.10 below shows the reliability statistics for the instrument being used in the study. The Cronbach's α generated is .805 which is acceptable according to Bastick and Matalon (2007) a Cronbach's α of .767 is acceptable. [24] also states that Cronbach's α above .7 is an acceptable value. The value of .805, generated from the instrument suggests that the instrument has acceptable internal consistency, thus promoting a high reliability of the instrument.

4.2. Reliability Statistics for the SAS instruments

Table 6

Cronbach's Alpha	N of Items
.805	20

Table 6.10 Shows total item statistics for the instrument. If item 1 is deleted the internal consistency of the instrument is improved as the Cronbach's α will be increased to .807 thus improving reliability

Yl-ljvl;, ..v;mbxjkb,gcbmjbfmxhugskt89w4u5li64e64i8365rop;ytukr;i/oho;j

Ohulk'uhlohullhkuhpinwdjq nd mn mns A ZA
 xghftxnkaJZJKZVGGJHZJkoJHJ.zx,cd,qs.aswq[ddwlvnwdq,c,bbnlmmldl1k3[]2cl;dcn3kjfly5khmrjg5,bbnlmm
 lmdl1k3[]2cl;dcn3kjfly5khmrjg5jfel2fvdled, el2,.,3ef 4t;f,rtgf;23dg,3bkvkl3mbtlnm ,lnnbnlkwflr3,f;l3r,velmrkkr

To what extent, if any, did the formative assessment feedback improve the grade 9 students' attitude towards biology?

The overall view of the students on science was determined on the scale of the Science Attitude Scale (SAS) and quantitatively explored. A paired-sample test was conducted to explore differences between pretest scores and post-test scores of the treatment group on the Science Attitude Scale. An alpha level of .05 was utilised. Based on the result seen in table 8, we failed to accept the null hypothesis. There was a statistically significant difference in the pretest mean scores ($M = 61.29$, $SD = 11.65$) and means ($M = 64.80$, $SD = 10.18$), $t(34) = 5.39$, $p < .001$. Thus, the post-test mean was statistically significantly higher than the pretest means. The magnitude of the difference in mean was large (Eta squares = 0.460). This suggests that 46% of the variance in the students' attitudes towards science is explained by the formative feedback strategies.

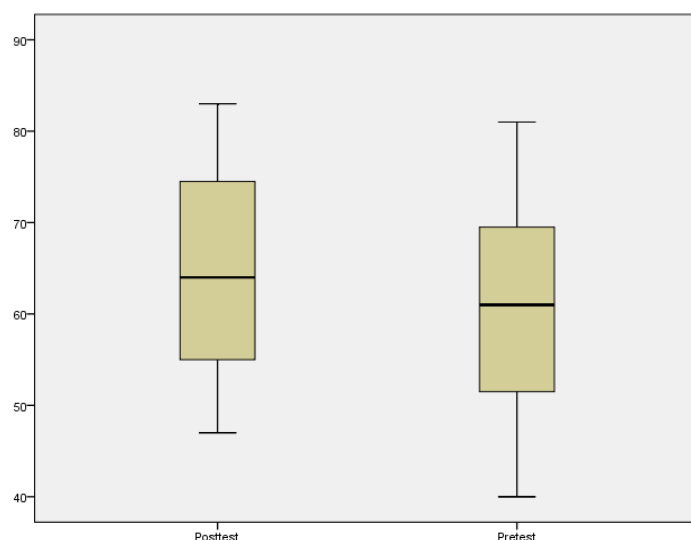


Figure 5: Graph comparing Pre & post-test scores of treatment group on the SAS.

A paired-sample T-test was conducted to explore differences between pre & post-test scores of the control group. An alpha level of .05 was utilised. Based on the results seen in table 9, we failed to be accepted the null hypothesis. Students mean scores ($M = 59.45$, $SD = 12.56$) decreased post-test ($M = 57.88$, $SD = 13.86$), $t(32) = -2.063$, $p = .047$. Thus, the post-test mean was statistically significantly lower than the pretest means. The magnitude of the difference in mean was (Eta squares = 0.117). This suggests that 11.7% of the variance in the students' attitudes towards science is explained by the formative feedback strategies.

Table 7: Descriptive Statistics Students pre & post-test SAS for both groups.

1. Variables	2.	3. Pretest	4.	5. Post-test
		6.	7.	8.
		9. Mean	10. SD	11. Mean 12. SD
13. Treatment	15. 35	16. 61.29	17.	18. 64.80
14. group			11.65	
20. Control group	21. 33	22. 59.45	23.	24. 57.88
			12.56	25. 13.86

Table 8: Paired samples test students pre & post-test SAS for the treatment group

				t	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Pair 1	Pretest	–				
	Posttest	-3.514	3.861	-5.385	34	.000

Table 9: Paired samples test students pre & post-test SAS for the control group

				t	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Pair 1	Posttestscores	–				
	Pretestscores	-1.576	4.388	-2.063	32	.047

5. Discussion of Findings

This chapter will provide a discussion of the results, a comparison and distinction of the findings with past researchers and some recommendations for further studies. Implications of the results and recommendations will be made. Additionally, the objective was also to determine whether students' attitudes towards science could be influenced by the intervention.

The findings of the research are discussed in the subsequent research questions:

- **Is there a relationship between formative assessment-feedback and student's academic achievement in biology in grade 9?**

There is a large positive correlation between formative feedback and the post-test performance on the SWT. Therefore, there was a statistically significant correlation ($r = .54$) between formative feedback and students' academic achievement. Thus, the magnitude of the correlation is $r^2 = 0.292$ which means that formative feedback explained about 29.2% of the variance in students' academic achievements in grade nine (9) biology. This confirmed [3] formative feedback is one of the most potent impacts on academic success.

- **Is there a statistically significant difference in students' academic achievement in the treatment**

group compare the control group?

The results of this study showed that the post-test academic output of both groups on the SWT improved over time under review. There was a statistically significant mean difference in favour of the treatment group between pre-performance mean 42.80 and post-performance mean 62.51. The magnitude of this difference in means was small (Eta squared = 0.163). This suggests that 16.3 % of the variance in students' academic achievement is explained by formative feedback strategies. However, the control group also shows some improvements on the post-test but not statistically significant. This result was consistent with the findings of [3] and [24] that student receiving feedback performed better than those receiving the formative test alone. This suggests that formative feedback facilitates and encourages learning science in the classroom by enhancing academic outcomes.

- **To what extent, if any, did the formative assessment feedback improve the grade 9 students' attitude towards biology?**

Students in this research were found to have a favourable attitude towards science. The treatment group shows a statistically significant improvement after intervention, with a pretest $M= 61.29$ and post-test $M= 64.80$. The magnitude of the difference in mean was large (Eta squares =0.460). This suggests that 46% of the variance in the students' attitudes towards science is explained by the formative feedback strategies. This result demonstrated an improvement in student attitudes towards science. The fact that the treatment group was subject to feedback strategies appears to be a reason for such a favourable increase in interest. As the results were statistically significant for individual claims, they confirm the findings of [25], there were substantial discrepancies between alternative and traditional groups in their attitudes towards science and their scientific outcomes.

5.1. Recommendations

1. Formative assessment feedback impact students' academic achievement in science

School administrators and Head of departments should organise a few development seminars to train teachers on how to go about giving their students' effective feedback on their work. A way of ensuring that students consistently use feedback is to make it an activity [26]. The feedback strategies recommended are comments only and peer assessments. It is also recommended that Formative assessment must be performed daily to encourage timely feedback on students' work. According to [26], daily formative assessment is one the most effective ways to advance learning in mathematics. I believe that formative assessment would play an important role in science as well. Because one tenet of the formative assessment feedback includes students taking responsibility for their own learning, it is paramount that the students are given an opportunity to engage in student-led parent-teacher meetings. Indeed, as Gordon [27] points out, the authority of education still relies heavily on the expertise and experiences of the teachers themselves and thus their pedagogical style raises the bar for students by extracting much more from them than teacher-centred models. By encouraging students to talk about their learning, you also encourage them to take responsibility for their progress and give them an

opportunity to show what they have learned.

6. Students' interest in science

It is crucial that science teachers understand what kinds of attitude students bring to the classrooms and, in response, perform their classroom activities in a way that promotes and maintains a high attitude towards science. They should also consider the interest of students when preparing lesson activities to ensure that they are meaningful to the student. In this way, they can determine which factor contributes to a highly favourable attitude towards science or, conversely, what led to a lower or bad attitude towards the students. This observation is articulated with the need for constructivism and formative assessment to ascertain the student's prior attitude [28]. Science educators should therefore administer SAS early in their classrooms. Once the attitudes of the students have been established, this should be used to assist in the preparation of the lessons.

- Generalizability of the findings of this study could increase if a larger sample size was used

7. Conclusion

Based on the results, it was clear that formative assessment feedback can be used to improve the teaching and learning process by enhancing teacher-students' interactions. Academically, students can be motivated by formative assessment feedback which contributes to students' overall attitude and their own construct of new knowledge. Formative assessment feedback can be used to improve students' overall attitudes and motivation towards science. By extension this study also sends a message to the administrator and Head of Departments at this school this school to insist that teachers efficiently use these feedback strategies on a regular basis to improve student academic achievement and attitude toward science.

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