The Impact of Performance Assessment on Students' Interest and Academic Performance in Science.

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ABSTRACT

The study used performance assessment increase students' interest and academic achievement.

A Quasi experimental with embedded qualitative design methodology of Action research was used with intact classes. Quantitative data were collected through three instruments (i) Unit test, (ii) Science Attitude Scale (SAS) and (iii) Science Motivation Questionnaire II (SMQ II). The qualitative data were collected through an evaluation form.

The students in the treatment group performed significantly better than their peers in the control group [t (34) = -21.73, p< .0005]. The findings also revealed that there were statistically significant impact on students pre-test and post-test (SAS) ($t_{(34)}$=-4.61, p<.000). There was a statistical significant difference between in students SMQ II. There was a moderately positive correlation between academic performance and science attitude scale [r=-03, n=35, p.>.01] and was not significant ($t_{(34)}$=-7.165, p<.000).

The use of performance assessment as teaching strategy in the science classroom can lead to increase student interest in class and improve academic achievement when compared to the control group.

Keywords: performance assessment, interest in science, attitude towards science

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CHAPTER 1

Introduction

Too many students perceive Science as an interesting but difficult subject (Johnston, 1991).This view of Science is shown in students overall attitude towards Science and their underachievement in Science subjects among secondary students. The way Science is taught can be the reason for students' underachievement. If a task is void of stimulating or interesting quality and then it is irrelevant, routine or boring, it may lead to academic disengagement in students (Green-Demers et al 2006).

Knowledge of Science is important because there is Science in everything. An understanding of Science by students allows them to deal with some social and biological issues that may deal with at home or the wider environment. According to Kaysar and Pasquale (2008) a foundation in Science is considered to be critical for the 21st century students since many of our decisions require a understanding of Science. Science teachers hope that their students will be able to relate the knowledge, understanding and skills they have acquired to make meaningful decisions in everyday life situations where they are relevant. According to Bilhler and Snowman (2003), the ability teachers expect students to have that would enable them to link or apply what they learn in the classroom to real life situation does not occur on its own but students have to be prepared and trained how to do this.

Trinidad and Tobago has not been the Programme for International Student Assessment (PISA) international standards and continues to be assessed as a country with low performing students. The Mathematics and Science performance results for Trinidad and Tobago were 414 and 410 respectively in 2009 which were considered to be significantly below Organisation for Economic Co-operation and Development (OECD) average (OECS 2010). PISA evaluates students' ability to apply their knowledge to solve real world problems. This suggests a lack of cognitive development in our students to solve problems. The PISA score can be an indicator of how prepared students would be for postsecondary success whether in the work place, career-training or higher education.

The problem of low achievement is not restricted to Trinidad and Tobago or the Caribbean (Sweeny, 2003) as the Nation Science Board of American and British indicated there have been an disturbing number of students graduating with insufficient passes in Mathematics and Science (2010). As a result the students lack knowledge needed to understand and cope with the rapid changing environment. This would also affect the level development of a nation (Ogunkola and Fayombo, 2009).

A significant amount of research documents gender difference in Mathematics and Science which indicate that males outperform females in achievement test, while other studies have shown no gender difference in students' Science performance. Whitely (2002) reported females, in Barbados and Trinidad and Tobago, significantly outperformed males in the Caribbean Examinations Council (CXC) examinations.

Student interest in and attitude towards Science was investigated in the Organization for Economic Cooperation and Development's (OECD) Program for International Student Assessment (PISA) report of 2009 both at natioanl and global levels study. In the USA, there has been an increase in students graduating with low passes in Mathematics and Science (Rocard et al, 2007).

The researcher found that some students assess Science as a collection of facts that which is not relevant toeveryday life. They appear not to be interested in improving their grades. The traditional methods of teaching are not gain students interest. This has resulted in a lack of concentration shown by the students, poor understanding of subject matter, disruptive behaviour and overall low academic performance as they appear to lack interested during Science class. In addition, it is questionable whether the current teaching and assessment practices promote students' interest and higher order thinking skills is unknown.

According to Osborne (2003) students' attitude towards Science is a cause for concern since it is linked to a drop in the number of students selecting pure Science at A-levels in the UK which has led to a decline in students pursuing scientific education and scientific careers.

This study focus on increasing interest and changing perception, so as to increase students enrollment to science classess. Rocard et al (2007) looked at changing teaching strategy to improve Science education. Darling-Hammond (2011) shows how a change in how students are assessed can support and result in improving students understanding and ability to apply their knowledge. Keysar and Pasquale (2008) reported that high schools students' had negaitve opinion about Science education, while Aikenhead (1996) identify that there was a disconnect with wha tis taught is school and real life issues.

BACKGROUND

Science is compulsory for Forms One - Three as Integrated Science in all secondary schools in Trinidad and Tobago. However in some schools at the senior years, it as an optional subject(s). At School H, science is compulsory at the senior level whether as the Integrated Science, Human and Social Biology or pure Science subjects. Results obtained at CSEC have dropped from 75 % in 2009 to 57 % in 2013 in the pure Science subjects, Physics, Biology and Chemistry. There has also been a decline in students' enrolment into pure Science class by 25% and an increase in students not writing the CSEC examination.

Students are underperforming in Science which may be the result of how it is taught in school (Jerkin and Nelson, 2005) resulting heightened the disconnection in Science courses taught by traditional teaching methods. This study aims to provide teachers with a student-centered approach which would makeScience interest and relevant to the students so as to improve the students' academic performance.

The use of group work permits the teacher to be the guide at the side and makes the students responsible for own learning. There would be increase teacher interaction with students.

A simple change to students centered approaches can turn around students academic performance and interest and aid students to identifying the relevants to science to their daily activities. In Europe there is a shift from teacher-centerd stretegies to student-centered. (European Commission report on Science, 2007which has improve students interest and engagement is learning.

In Trinidad and Tobago, teachers focus on traditional assessment methods such as the test, examinations, quizzes and other formal methods. Assessment is not focused for learning but assessment of learning with the main focus being examinations. Students are learning by rote and are not making meaningful connection between what they know and everyday occurrence which will allows them to make connections with the material. This results in Science being difficult to them.

According to Dewey (1938) students best learning by doing and experiencing which would enable the student to become aware and determine to solve problems, want to learn and become more responsible for their learning

Brandfort et al (1999) reported, a good learning environment for students need to have these main strands; knowledge based, learner centered and assessment centered. Knowledge based is what the student know and be can to do based on the students learning experience. Learner centered focuses on connecting the strength, interest and preconception of the learner to their current academic and learning outcomes. Assessment centered is where the environment provides the learner with multiple opportunities to monitor and make visible students' progress in revising their thinking and applying their growing knowledge to new situations and tasks.

A great tool for education reform is performance assessment (Resnick & Resnick, 1992. Performance based assessment to assist teachers in evaluating students' knowledge to apply the skill and apply what they have learned in a topic and apply it to real life situations. This helps students to be engaged in their learning and assess of their learning. It also helps teachers to give feedback and identify what students understand.

Performance assessment lends itself as intervention tools according to Adamson and Darling- Hammond (2010) since it promotes: student engagement and interest, increases intellectual challenge in the classroom, prompts students to use higher-order thinking skills and supports higher quality teaching and learning.

THEORY OF ACTION

The theory of action for this study focuses on three main components. They are performance based tasks, authenticity and formative assessment. The performance based tasks would be the framework in which the lessons are planned. The activities would be group based to allow for collaboration and cooperation during the execution of the task.

The task given would be cognitively challenging so as to allow the students to use higher order thinking skills and meet the lessons objectives. The task would require students to use problem solving, creative thinking and critical thinking skills. Learning would take place at both the individual level and group level. It is expected from these tasks; students would develop self-confidence, collaborative skills and personal autonomy and become responsible for their own learning. Students will also let students discover that what they do in class as relevant to them and increase their interest in science and enjoy learning about science.

The task would be authentic, so real life situations would be used to make science relevant and interesting to the students. Formative assessment would be used to determine where groups and individuals are at, what gaps are present and clarify misconceptions they may have. Formative assessment would also provide a guide to students in completing the task.

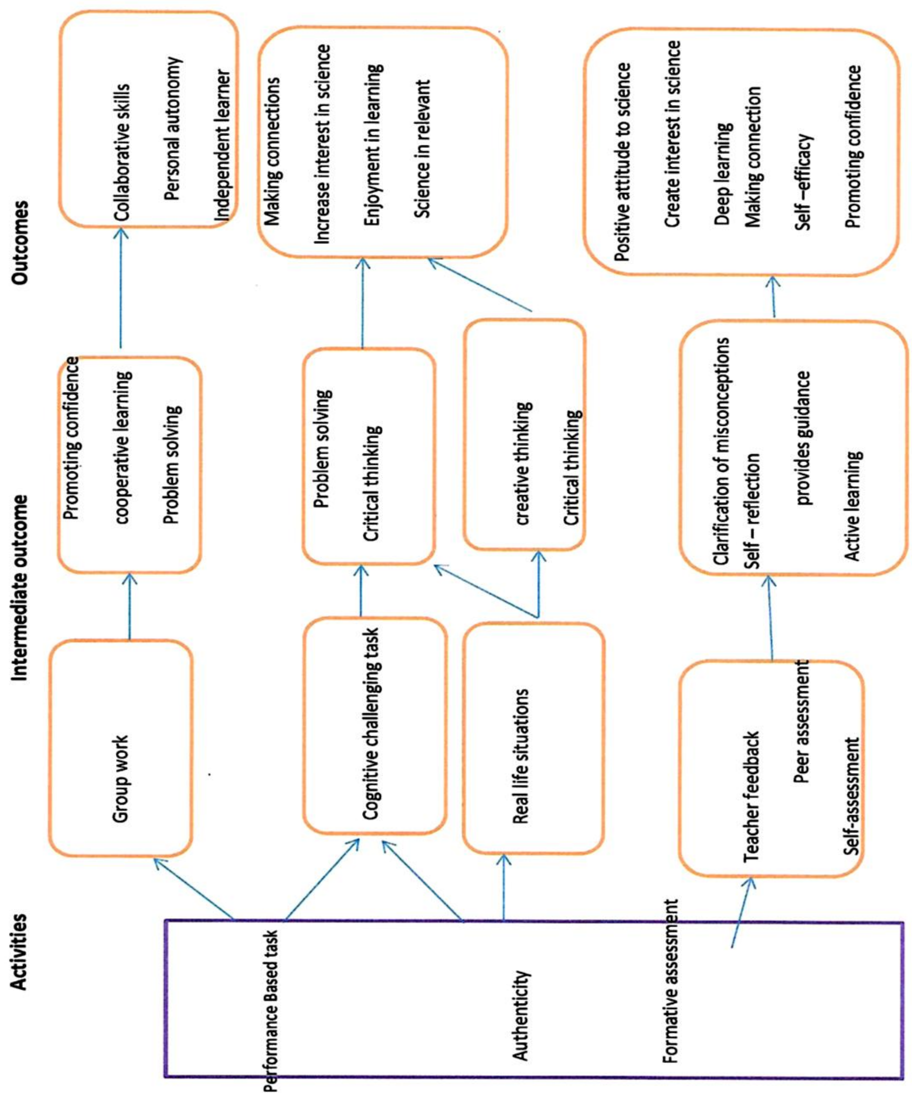
Activities
Intermediate outcome
Outcomes
Performance Based task
Authenticity
Formative assessment
Group work
Cognitive challenging task
Real life situations
Teacher feedback
Peer assessment
Self-assessment
Promoting confidence
cooperative learning
Problem solving
Problem solving
Critical thinking
creative thinking
Critical thinking
Clarification of misconceptions
Self – reflection
provides guidance
Active learning
Collaborative skills
Personal autonomy
Independent learner
Making connections
Increase interest in science
Enjoyment in learning
Science in relevant
Positive attitude to science
Create interest in science
Deep learning
Making connection
Self –efficacy
Promoting confidence

Figure 1 *The Theory of action*

STATEMENT OF THE PROBLEM

The new paradigm of Science education, according to Cheng (2000), is focussed on allowing students curiosity and motivation arousal so as to cause them to think critically, investigate, explore, create and learn. This would improve students' interest and performance in Science. Present teaching methods fail to maintain students' attention in Science classes. This has resulted poor students performance and disruptive behaviour in class.

The problem exists where some students enter school at secondary low academic performance levels and continue to perform poorly throughout the five years. Students seem to lack interest in Science and seem not motivated to improve. The teacher-centered methods of delivery do not capture students' interest in the subject but allow them to dislike Science and see the subject as difficult and not relevant to their life. The classes being a mixed academic level class may not be always interested and engaged because they are not being stimulated, see Science relevant to their everyday situation or challenged at a high cognitive level.

This study is designed to assess treatment and evaluate the intervention design on students' interest and achievement in Science. The design uses performance based assessment with formative assessment embedded in it.

Performance assessment is an assessment strategy that assesses students' concept and skill and at the similar period improves the attitude and concentration in the topic (Darling Hammond, 2008). This would meet single of the new areas of Science education which is to make scholars for a productive lifecycle long Science learner within this technology complex world (Cheng 2000).

Purpose of the study

The determination of the research is to use action research to assess and evaluate the use of performance assessment as an intervention tool to increase student interest and achievement of a Form Three Integrated Science class. It would also allow the teacher to improve the teaching of Science so as to create the best opportunity for students to want to learn and study.

The implementation of performance based learning to lessons may create a thinking environment that precludes students passively absorbing information to do examinations but to make Science real and relevant by using authentic problems for their learning which would prepare them for the future.

Research Question

Attempts were made to answers to the following questions

Overarching question

What is the teacher's perception of using performance assessment to create engaged students?

Sub questions

1. What impact would using performance assessment have on students' academic achievement in Science?
2. Are scholar arrogances to Science precious by routine assessment?
3. To what extent do students' perceived interest correlates with academic achievement?
4. What are the students' perceptions and views as a performance assessment is used as a teaching tool in Science?

Expected Outcome and Significance of the Study

The expected outcome of this action research can provide pertinent data for developing extended cognitively challenging performance assessment. These assessments provide practical and useable classroom data to support the program at School H to which performance based assessment is underdeveloped in by the Science department. It may increase students' interest and performance in Science and encourages students to do Science at Form Four and Five.

The material increased from this research may be used in education to contribution in developing strategies that can be used to advance education and knowledge in schools. It can illustrate how pupils can develop deep approaches to learning and Science.

It would show applicability of the technique and description of the process to other teachers in Science. It can also provide policy-makers in Science education with a better understanding of how performance assessment can enhance students learning and interest in Science.

The study involved development teaching materials and instruments relevant to the Secondary Education Modernization programme (SEMP). These materials can be adapted and made available on wider bases in school H. In this way any benefit obtained from the use of these documents can be replicated at the school.

The findings from this study can be hand-me-down to inform the instruction and knowledge process of Form Three Science classes. The results will serve as a means to make recommendations about performance assessment and its impact on students' overall learning. In addition, these recommendations will allow the use of performance assessment as an approach to be used as a regular part of the classroom experience.

Definitions of Key Terms

Performance Based Assessments - (Adamson & Darling-Hammond, 2010).

Formative assessment is definite as valuation occuring thouroughout the teaching procedure to improving education or wisdom (Shepard, Hammerness, Darling-Hammond, & Rust, 2005).

Authentic assessment is an charge requiring students to validate the same kind of competencies or combination of understanding, services and boldness, that they need to relate in a standard condition derived from a specialized practice (Wiggins, 1998).

Ethical Considerations

Permission was sort from the school administration and Ministry of Education. Also approval from parents was obtained. The school and the students anonymity would be maintain by the use of pseudo names.

All information obtained during the research would be considered confidential. The parents of the students were informed in the permission letter that they have the options for withdrawal from study.

ORGANIZATION OF PAPER

This paper consists of the following chapters:

Chapter 1 is the introduction which gives an insight into the problem in the classroom, purpose of the study and the significance of the study.

Chapter 2 is the literature reviews which were based on similar studies of self efficacy and academic performance.

Chapter 3 give details of the design to be followed and the data that is to be collected and analyzed.

Chapter 4 provides the analysis of data collected.

Chapter 5 discusses the findings of the study as well as conclusion and recommendation.

CHAPTER 2

Literature Review

Traditional assessment methods teachers focus on the test, examinations, quizzes and other formal methods. These methods are not focus assessment for learning but assessment of learning with the main focus being examinations. Students are learning by rote and do not make meaningful connection between what they know in everyday occurrence which will allow them to connect with the material which results in Science being difficult for them. This research is focus using formative assessment to assist teachers in assessing students' ability to apply the skill and knowledge they have acquired during a topic or unit and apply it to authentic situations.

According Black and William's report, "Secret the black box: Rising standard complete schoolroom valuation" the role of assessment in learning was highlighted. In the report the 'black box' referred to the classroom to which 'input' (such as students, teachers, resources, parental fears) are added into it is and expected to flow competent, knowledgeable students with better results which would satisfied teachers (Black& William, 1998b). Black and Williams acknowledged that what is going on in the 'black box' is often ignored when considering improved output. This can result in some of ' inputs' into the 'black box' being wasted. According to this report the focus should not be on the measurement but rather on learning.

Brandfort et al (1999b) reported that a good knowledge atmosphere for pupils need to have these main strands; knowledge based, learner centered and assessment centered. Knowledge based is what the student ne Learner centered focuses on connecting the strength, interest and preconception of the learner to their current academic and learning outcomes. Assessment centered where the environment provides the learner with multiple opportunities to monitor and make visible students' progress in revising their thinking and applying their growing knowledge to new situations and tasks.

Influencing Science Education

Students start their formal Science education at the primary level and those who teach it must be knowledgeable and comfortable to teach the content and should also convey positive attitudes towards the subject. De Boo (1989) conducted a study in the UK and reported that felt their teacher training did not adequately equip them with Science content knowledge or process skills.

According to De Boo (1989), they are many cases in the UK were teachers have negative experiences and poor grasp of the scientific principles and as such teachers often revert to traditional teaching methods.

It is evident that as the result of various challenges to Science teaching, as well as high expectations placed on external results, much of Science is focused on 'cramming' or learning by rote to pass examinations. This emphasis on learning large content in preparation for examination according to Donald (2002) is detrimental to the development of thinking process.

Attitude and Science

Students interest in and motivation towards Science according to Parker and Gerber (2000) is related to and can affect a student's achievement and attitudes towards Science. Popham (2005) states the affective status of students should be of concern to all educators.

Young (1998) suggests attitudes are related to behaviours; they are learnt and therefore they can be taught and they are relatively durable. Popham (2005) supports Young and states the affective domain influences almost everything that students do including future behavior. So a student's feeling towards Science in lower school may have profound influence on their knowledge and commitment to Science in upper school (Simpson and Oliver, 1990). This seems to suggest that if a student is to select Science at upper school or for a Science career or tertiary studies then it has to be taught so that students' interest and motivation have to be maintained early. An considerate of pupils' attitudes is therefore, significant in subsidiary their interest and achievement towards Science (Prokop, Tuncer and Chuda, 2007).

A change in the types of activities that students are usually involved in according to Butler (1999) may affect their behavior and achievement. In addition Butler cautions that any attempt to change student behaviour, the students' attitude should be understood first. Hobson (1997) states there is a link between attitude and behaviour so in order to develop students' abilities in any area, their attitude must be developed.

Attitude to Science can be defined as the feeling, beliefs, value or evaluation that an individual has towards an object related to any aspect of Science such as school

Science, the influence on civilization or scientist themselves (Osborne et al., 2003). An boldness can be optimistic or undesirable resulting from many factors (Young 1998).

Osborne et al. (2003) stated there are some disagreement about the link between attitudes and achievement. They question whether insolence or feat is the variable. They argue that the both variables have a complex link. They further highlight that a feeling of satisfaction and concentration in Knowledge collective with Science in Learning are prospective to chief to a encouraging obligation. Papanastasiou and Zembylas (2004) carried out a study in USA, Australia and Cyprus with varying results. In Australia, great attainment was found to influence scholars' optimistic boldness towards Science but students' attitudes towards Science did not influence their achievement. They obtained opposite results for Cyprus wherever optimistic attitude effect pupils' in height attainment but it did not influences their attitude towards Science. According to (Clarke, 2005) how students perceive themselves and their ability can hinder or enhance their learning experience

Assessment

There are three main types of assessment which are summative, interim and formative assessment. The type of assessment to be used is based on the intended purpose of the valuation and the practice of the information gained by the assessment.

Formative assessment is done by the teacher in the classroom so as to determine, identify breaches in the students' wisdom and considerate which would help the teacher and the students improve learning. The assessment is embedded within the learning activity (Black & Wiliam, 1998a).

An essential component of formative assessment is that it provides meaningful elaborated feedback, modifying instruction to meet the student where they are at in terms of understanding or indicate to the teacher where further instruction is need (Wiliam, D. (2007).

Performance Assessment

Assessment has much purpose but it is generally used for reporting, selection and promotion, classroom teaching and learning and programme evaluation (Black, 1993; Chiappetta et al., 2002; Popham, 2005).

Performance Assessments is type of valuation which wants pupils to vigorously achieve multifaceted and important tasks, while transporting to tolerate previous wisdom, recent education and applicable services to resolve truthful difficulties. It determines what students can do with what they know (Barron and Darling Hammond, 2008).

The purpose of assessment has charged or is changing to allow students to demonstrate content as well procedural knowledge of a range of tasks; assess a wider range of learning out comes' assimilate valuation with the programme and evaluate in more trustworthy framework (Bell and Cowie, 2001; Popham, 2005). Assessment needs to be supple in order to encounter the wants of the individual learner (Taber, 2003) and include a variety of tasks aimed to bringing about understanding , conceptual change and interest (Shavelson, 2003).

Education reforms researchers in assessment (Hakela, (1998bb) and Horrwell, Brocrato, Pattersonr, and Bridrges (1999) recognize presentation valuation as tool which would improve students higher order thinking skils to solve problems and offer students meaningful way to aquire knowledge (Akereson eft adl., 2002; Gusy & Wilscox, 2000; Shavselson, Rsuiz-Prsimo, & Wiley, 1999).

Performance-based assessment happens over s select period and this give students the opportunity realize the uppermost equal of knowledge (Baker, 1996). Unlike traditional testing procedures, the authenticity of performance assessment makes the task valueable to the students and interesting as is based in real life situation (Jorgensen, 1994). These features makes performance assessment engaging experienceto student (Kulieke et al., 1990).

Performance assessment is therefore an appropriate strategy for assessing students' concepts and skills in science, and it prepares students for a productive future within a technologically complex world (Ainley, Hidi, & Berndorff, 2002; Atkin, Black, & Coffey, 2001). In addition, Atkin, Black, and Coffey (2001) claim that the current Science reform have moved tostudents to actively involved in science rather than reactive reading or listening.

Empirical studies of the impact of performance assessment show positive effects in the quality of students' learning and attitudes and interest. And Baxter and Glaser (1996) found that performance based assessment not only supports the development of thinking and reasoning in the classroom, but also provides teachers with feedback that can be used to improve the classroom environment. Similarly, Biondi (2001) found that performance-based assessment is a valid, equitable measurement of student progress.

Many educationalists however propose that performance-based assessment should be considered not merely as a process for assessing students' understanding, but also as a learning process; one that teaches students concepts and requires them to explain and communicate their interpretations of the information, and their methodology for solving problems (Morrison, McDuffie, & Akerson, 2002).

Authentic assessment

The policy "Education for all' there is a greater effort according to Darling-Hammond, 1994 for all students learn in a meaningful ways. Authentic assessment can provide that environment to students and provide the teacher with much more useful classroom information as the strategies would engage the teachers in evaluating how and what students know. Darling-Hammond, 1994 also found that it challenges students' performance skill and provides rich information about student learning and performance to shape their teaching in ways the teacher can prove more effective for the individual students.

According to Jonathan Mueller (2005) authentic assessment is describe as an exercises requiring scholars to smear technical material and cognitive to circumstances similar persons they will meeting in the domain outside the schoolroom as well as conditions that loose how geniuses do their labour.

Reliable learning experiences according to Jobling and Moni (2004) makes learning purposeful, motivational, and realistic to the student. They also added that students must be provide with a range of opportunities so students can distinguish, comprehend and practise such tasks and reflex on the content (Maksimwicz, 1993).

Authentic learning has three principles: building of facts, controlled investigation, and price outside faculty (Newman, Marks, & Gamoxran, (1996). According to Newxmann, Marks, & Gamoran, (1996), these criteria understand concepts while interactively solving problems in real life situation which seem to given the task meaning to the students. Newmann's reported authentic assessment is makes learning meaningful to students.

Authentic assessment challenges students to complete accurate responsibilities that are interesting, useful, (Johnson, 2002) and evaluates students Authentic assessment sharpens students' higher-ordered thinking when they are to analyze, synthesize, identify, and solve problems, as well as incorporate cause-effect analysis (Johnson, 2002).

It was found that the traditional norm- reference methods of assessment fail to measure complex cognitive and performance and performance abilities in students and these task imposed low cognitive demands rather than meaningful learning (Akinoglu &Tandogan, 2007).

A research conducted in Sweden with 15 year old students by Jidesjo et al., (2009) indicated that secondary Science instructions seem to focus on a minority of students who have chosen Science or technology for further studies. However all the students had an interest in Science and technology and believed that everyone should study Science as sometime helpful in everyday life. What was also discovered was that how Science is taught did not make students aware of new and exciting jobs in related to

Science.. This result was similar to those obtained by Jenkin and Nelson (2005) where students saw Science as interesting but not relevant to them.

In Jidesjo et al., (2009) study students interest in Science was focus on the human body, nutrition, technology as it relates to the computer and internet and societial challenges that may affect them. This indicates that the teaching of Science should be focus on the learners' perceived relevance and use of authentic assessment can make link with Science and real world.

The Association for Middle Level Education (AMLE; NMSA, 1980, 1995, 2003, 2010) indicates that teachers can improve the educational experiences of young adolescents, aged 10-15, by meeting the integrated, exploratory, relevant, and interdisciplinary curriculum needs of adolescents. Authentic assessments, as discussed in this section, are one way in which teachers can help meet those needs.

Curriculums that are relevant, those that are student-centered in which central themes are derived from a young adolescent's personal concerns and issues with society, are important for middle school students to experience.

The middle childhood report Turning Points (Jackson & Davis, 2000) indicated that relevancy is accomplished through curriculum negotiation between student and teacher (Jackson & Davis, 2000). Through teacher-student negotiation, students have the opportunity to explore questions and concerns related to themselves, the curriculum, and the world around them (Jackson & Davis, 2000). Such experiences move children beyond isolated facts to analyse big, life-long ideas in depth helping students explain why "they need to know this" (Bransford, Brown, & Cocking, 1999; Haberman, 1991).

Feedback

An essential component of formative assessment ids providing meaningful elaborated feedback, modifying instruction to meet the student where they are at in terms of understanding or indicate to the teacher where further instruction is need. Formative assessment was used to measure students understanding using performance task (Huba and Freed, 2000). It would assist both teacher and student in what the students know, identify misconcepts and help the teacher in identifying what needs to be done to clarify, bridge gap in the student understanding and determine what intervention is needed to improve students' learning.

Peer evaluations

Gueldenzoph & May (2002) in a research showed that students prefer working in groups and have fun doing it. Peer evaluation use used as a tool to keep each member on task in a well-crafted way so was to promote ownership and participation in the group work.

Collaborative Learning

Collaborative learning allows active exchange of ideas within small groups which not only increases interest among students but also promotes critical thinking. Collaborative learning is active learning as students are integrating new material with what they already know. Johnson and Johnson (1986) found that their cooperative teams retain information longer, more stratified with their classes than students who work individually.

Traditional teaching methods have encouraged students to work individually, to be competitive and not to share. In collaborative learning strategies, each student is responsible for their learning and involvement in the task at some level in order for the group to be successful (Gokhale, 1995). Students are dependent on each member of the group and are encouraged to pool their talents together for the benefit of the group.

Sharing and working as a group to solve problems help build self efficacy. Students bring to the group multiple perspectives based on their background, experiences and learning styles. It enriches the lesson.

Challenges

Some students because these are accustom with a teacher centered approach of chalk and talk may reject this method (Cooper, 1990). Students who are accustom to being spoon fed and may find this method difficult and offer some resistance. They may see this method as the teacher is not doing her job.

Some students may have had bad experience with group work and as such resent this method. The group dynamic must be properly though out to reduce conflict. Therefore, the teacher needs to be very patient as this method is new to teacher and students (Cooper, 1990).

METHODOLGY

Research Design

When trying to determine the appropriate research design for a study, one should consider the type of problem being investigated (Tashakkori & Teddie, 2003). This study used a Quasi experimental with embedded qualitative design methodology of Action research (Creswell and Clark, 2007); as the qualitative is embedded in the design to investigate the problem. The purpose for using the embedded is that a single data is not adequate since there are different questions to be answered which would require different data sets in order enhance the application of the design (Creswell and Clark, 2007).

In the experimental design the research can embedded qualitative data to examine the process intervention or explain the participant response (Creswell and Clark, 2007). According to Creswell and Clark (2007) embedded design allows for different methods to address different question resulting in a person focusing on one question based on their interest or expertise. It also allows the focus of different questions to have different types of results published separately (Creswell and Clark, 2007).It allows the quantitative results to be explained in more depth with qualitative data.

In this study, my main aim was to determine the impact of performance assessment in creating engaging students. This study also intended to explore the participants’ experience while being engaged in tasks used in this unit.

An experimental design would capture as much data as possible from the research process that may provide foundation for future research. Therefore, the use of multiple data collection would provide empirical evidence related to the variables but also ensure that the results can be applied to similar situations as well as make predictions. In addition, the qualitative data would allow me to obtain information on the students; their personal opinions about their experience of the experimental process (Bell and Opie, 2002), would also provide possible explanations for any trends in the quantitative data.

The quasi experimental with embedded qualitative would provide a wide but in depth understanding of the various effects of the intervention on the participants in the study related to their performance in Science as well as their interest in Science. In the embedded experimental design engaged in the study, the qualitative data plays a supportive role to the quantitative data (Figure 2). The qualitative data collected during the study period would help me to gain an understanding of the participants' views throughout the treatment period.

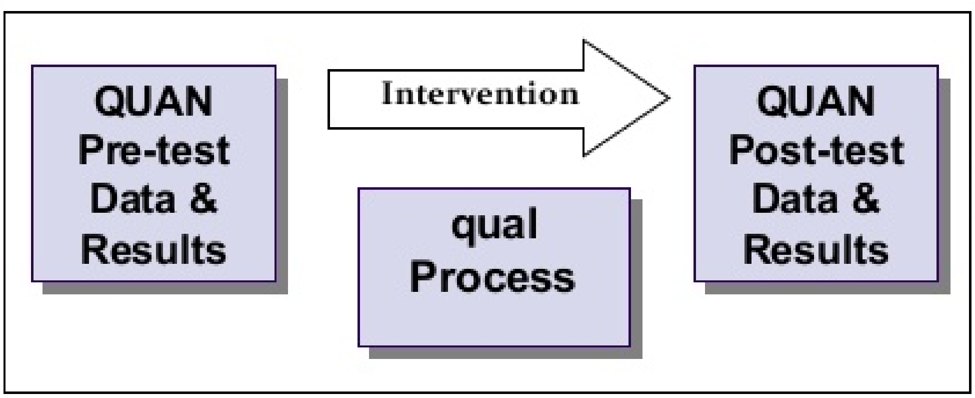

Figure 2 shows the embedded design

The study was confined to a set time of five (5) weeks where performance assessment is used in a Form Three class within one co-educational secondary school.

The study therefore combined both qualitative and qualitative methods of data collection and analysis to direct the following research questions:

1. What impact would using performance assessment have on students' academic achievement in Science?
2. Are student attitudes toward Science affected by performance assessment?
3. To what extent do students' perceived interest correlates with academic achievement?
4. What are the students' perceptions and views as a performance assessment is used as a teaching tool in Science?

The qualitative research data of the students' perceptions and views as a performance assessment will be collected from journals and the quantitative data of measurement of students' performance and interest in Science will be obtained from a comparison of pre and post-test and questionnaire on interest and attitude in Science.

Description of Participants'

Purposive non probability sample was used in selecting participants at the school because this is the group of students who have to select Science at the end of Form Three and according to a study done by Lindahi (2007) students interest in Science is formed by age 13 and states that as students become older it becomes progressively harder.

The research population consists of students in Form Three who would be selecting subjects at the end of the academic year. This population was chosen because I wanted to see if the performance assessment would increase students' interest in Science and encourage students to do Science at Form Four.

Form 3 W and the Science teacher were selected to be the subjects within the study.

The chart below illustrates the gender composition ratio of the students

Table 1:

Gender Distribution among the Form 3W Class

Gender	3W
Male	4
Female	31

A control group was used to determine if the performance based assessment had any impact on student interest and attitude towards Science.

Table 2

Gender Distribution among the Form 3K Class

Gender	3K
Male	15
Female	18

The classes were a mixed ability groups achieving low to high grades based on the grading system used at the school and had sea scores ranging from 25% to 60% in 2012.

The performances of these students seem to be a reflection of their interest and attitude towards Science.

The participants from one class (3W) were exposed to the treatment while one class (3K) was used as a control. The teacher would use performance assessment tasks to be used for the unit and feedback given to students.

One of the teachers is trained, having a Diploma in Science Education and eight (13) years of teaching experience. The other teacher is untrained having four (4) years teaching experience and a Master's degree in a Science related field.

Research Procedure

Action Research

This study used an action research framework. Action research was shown to explore the impact of performance based assessment on students' interest and academic achievement in Science. The definition by Carr and Kemmis (1993) status educational action research allows the teacher practitioner to be engaged and transformed by the understanding of the actual research. It is research into the practitioner by the practitioner for the practitioner.

Foreman-Peck & Murray (2008) defines action research as it focuses on research *in* action, as research about action and research with people, rather than research on people. Action research examines the situation as it is happening while attempting to improve it (Foreman-Peck & Murray, 2008). Action research, as described by Holly, Arhar, and Kasten (2009), supports this research purposes as the various data collection tools that the methodology uses.

In this action research the focus of the action is on increasing students' interest and attitude in Science and thereby improving students' academic achievement. This is summarised in Figure 3.2 which shows the action research cycle as it applies to this study.

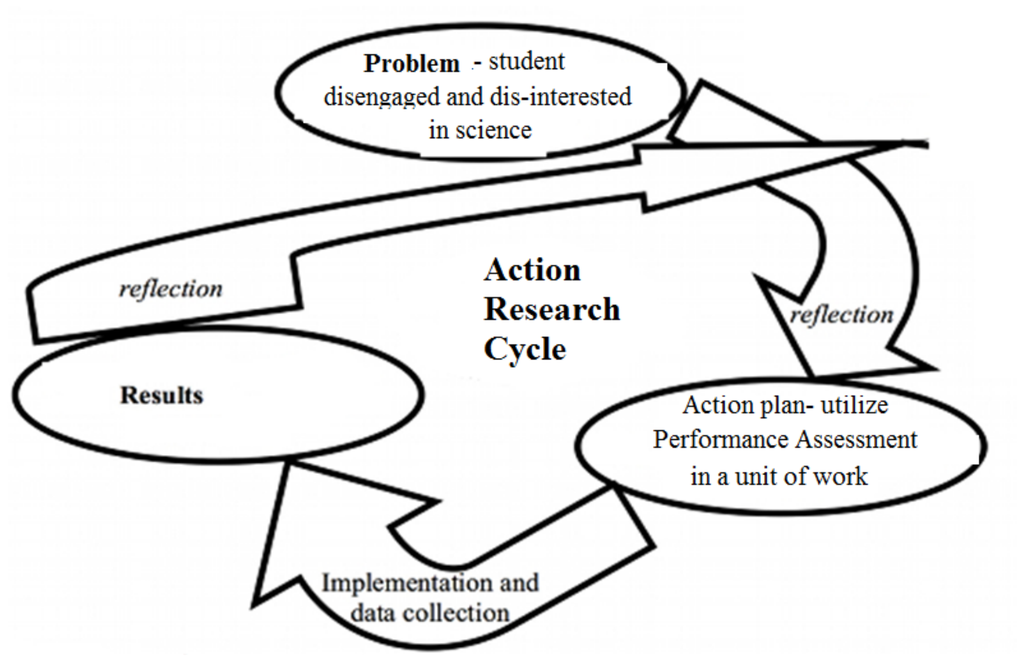

Figure 3 showing the Action research cycle

Intervention

Measurement instruments

The data was collected by using a unit test, Science Attitude Scale (SAS) and a Science Motivation Questionnaire II (SMQ II). They were explained below.

Quantitative Instrument: Unit test

In order to answer research question 1, a unit test was used to measure students' academic performance on the unit. Their performance on this test indicated how they used their cognitive skills.

The unit test was developed by the researcher where past National Certificate of Secondary Education (NCSE) past papers were combined to form the unit test which was used to determine the students' Science achievement over two time periods: pre-intervention and post-intervention (see Appendix C).

The process pursued in the development of the unit test is outlined below:

1. The content of the unit was determined by taking into account the Secondary Education Modernization Programme curriculum delivered by the Ministry of Education.

2. An item bank was formed with 12 multiple-choice questions and three structured questions obtained from NCSE past examination papers.

3. The table of specification was prepared (see Appendix D).

The students' scores, pre-test and post unit test scores obtained is found in Appendix E. The unit test was worked as a percentage so less than 50 would be considered failing the unit test.

Quantitative instrumental: Questionnaire

Based on Koballa (1988), questionnaires are the most commonly used instrument to measure attitude and motivation. In order to answer research questions 2 and 3, two questionnaires were administered to obtain information on the variables students' attitude towards Science and their motivation to do Science.

Students' Attitude Scale (SAS)

The Science Attitude Scale (SAS) was administered to determine participants' attitudes toward Science. The SAS consisted of 20 Likert-type items (Appendix F). It consisted of 9 positively and 11 negatively worded items about attitudes toward Science. The five-point Likert-type scale was used. The items on the scale sought to probe the students' opinion on the following:

- Enjoyment of Science and Science class
- Interest in Science and learning Science
- Value of Science

The order of the items was randomized between subscales, and both were positively and negatively stated items.

Scoring of the scale

The items on the SAS instrument had responses ranging from strongly agree to strong 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.

Although the scale measure attitude, caution should be taken in interpreting the score since other factors affects an individual total interest or attitude (Koballa, 1988)

Table 3

Distribution of items on Science Attitude Scale

Sub –scale	Item number and type Positive	 Negative	Total items
Enjoyment of Science and Science class	13	3, 5, 8, 12, 18	6
Interest in Science and learning Science	1, 4, 6, 9, 11, 17	7, 14, 16	9
Value of Science	15, 19	2, 10, 20	5
		Total	20

Science Motivation Questionnaire II (SMQ)

The Science Motivation Questionnaire II (SMQ) was administered to determine participants' attitudes toward Science. The SAS consisted of 25 Likert-type items (Appendix G). It consisted of 25 positively worded items about what motivations students to do Science. The five-point Likert-type scale was used. The items on the scale sought to probe the students' opinion on the following:

- Intrinsic motivation
- Career motivation
- Self-determination
- Self-efficacy
- Grade motivation

The order of the items was randomized between subscales.

Scoring of the scale

The items on the Science Motivation Questionnaire II (SMQ) instrument had responses ranging from never to always. The items scored 0, 1, 2,3and 4 for the responses. The items were scored as Always (A) = 4, Often (O) =3, Sometimes (S) =2, Rarely (R) =1 and Never (N) = 0.

Table 4

Distribution of Items on Science Motivation Questionnaire II (SMQ II)

Sub –scale	Item number Positive	Total items
Intrinsic motivation	1, 3, 12, 17, 19	5
Career motivation	7, 10, 13, 23, 25	5
Self-determination	5, 6, 11, 16, 22	5
Self-efficacy	9, 14, 15, 18, 21	5
Grade motivation	2, 4, 8, 20, 24	5

Qualitative data instrument: Open ended evaluation form

Closed-ended questionnaire like the Likert scale type items do not usually ask participants to explain their answers. This makes it unclear to determine what motivate the students to give their answer which is a limitation to interpretation of the questionnaire scores. For example, for negative answer may be due to a general or toward a local reality (the student friend being suspended for the duration of a task). Adel-Gaid et al (1986) suggest an open-ended procedure go along a Likert type scale to allow participants to elaborate on their initial answers. A predesign evaluation form had which was distributed at the end of each lesson (See Appendix H). The evaluation form had the following phrases which were to be completed by the students in the space provided.

- How did you feel about the lesson today…..
- I did not care for….
- I especially liked….
- Next time try…
- Only thing missing was……

The Implementation of the study

In order to gain entry into the school, a letter was written to the principal of the school asking permission to carry out the study (Appendix A). In the letter and it explained in detail the purpose of the study with respect to the strategy that would be utilised and offered clarification is requested. A form was complete for Ministry of Education to be submitted to the SS through the principal.

Parental consent was also sought from the participant’s parents since they were minors (Appendix B).

The unit test was issued to the participating classes and the teachers were asked to administer them to all the students, in both control group and treatment group before the unit Force was taught. The SAS and SMQII were also administered to the students during the first week of the third term. The treatment group were engaged in the performance assessment for the selected topic. The students in the control group underwent their regular teaching- learning approach to Integrated Science to the SEMP curriculum, and the teacher in this class was not required to do anything different or additional to her regular instructional strategy. Students, in the treatment group, were to complete an evaluation at the end of each lesson. When the delivery of the selected topic was complete the instruments were administered again to both treatment and control groups.

Description of the unit and lesson Plan

Treatment

Throughout the instruction based on performance assessment, the activities were used to and carried out by Form Three students. The lesson plans were given in the Appendix I.

The duration of the lessons were three (3) 40-minutes periods per week. In this study, the teacher who was the researcher attempted provide diverse instructional activity tasks. During the treatment, students participated in a number of diverse instructional activities. I also utilized various materials such as straws, glue, rubber band, chop sticks, and so on. Moreover, I also gave examples from daily life and made students active in the class.

The Unit entitled **Forces and Motion** in this study was based on where the teachers would research in the SEMP curriculum.

The lessons planned were related to the objectives for unit using the order outlined in the unit. Each lesson would involve performance assessment task. The performance assessment task would require students to work in groups and predict, explain and make observations.

The text material was supplemented with my research and divided to fifteen lessons

Lesson 1: St Joseph Bridge is falling down

➢ Each group would be given one of two articles on the reconstruction of the St Joseph Bridge. In the group the students would focus on the following questions

- What is the function of a bridge?
- What is the key idea in article?
- What would have caused MOWT to decide to reconstruct the bridge? What are the effects of not reconstructing the bridge?
- How might we prove/confirm/justify your answer?
- How is reconstruction of a bridge connected to force?
- What do you think they have to consider when designing a bridge?
- .Give reasons for their answer.

Lesson 2: Bridging communities

∗ Students they would be watching two YouTube videos on bridge design. Students are to record point from the video that

- ➢ What are the different types of bridges?
- ➢ What should be considering when constructing a bridge?
- ➢ What affect the bridge support over a long distance?
- ➢ Why arch are important in a bridge design? What materials are used and why?
- ➢ What are the limitations of each type of bridge?

Lesson 3 and 4: Architects' Bridge Clash.

- ∗ Design and build a bridge for a given community
- ∗ Using a Science exhibition, group present the bridge design to visitor and answers questions.

Lesson 5: Car skid (the effect of different surface on car speed)

Lesson 6 and 7: Drag racing part 1 (acceleration due to gravity) and 2 (identifying ways to improve car speed)

Lesson 8: High heels vs Flat

- Calculating the area of the feet under conditions)

Lesson 9: Shoe under pressure

- Calculating pressure exerted by different area and the effect on shoe design)

Lesson10: Sneakers runway

- Designing a sneaker for a company and explaining it functionality)

Lesson11: To Burst or not to burst

- Hooke's Law using rubber bands, Nylon stockings, slinky)

Lesson 12 and 13: Humpty Dumpty bungee jumping

- Using 10 rubber bands to form a bungee rope and coins for the egg
- Use the results to draw a graph to predict how much rubber bands would be needed allow Humpty Dumpty to fall the nearest 5cm from the ground.
- Design a safe bungee jump for Humpty Dumpty. Mr./Ms. Humpty Dumpty must come as close to the floor as possible but not touch the floor or without a splat!
- As a final activity, explain the results of your total experiment in a one-page technical report. Discuss in the paper what you learned, what worked, what didn't, and what you might do differently to make the results more accurate.

.

Data Collection and Analysis

Data collections strategies include pre and post motivation and attitude in Science questionnaires, students evaluation forms, and pre-test and post-test unit tests.

Each student's responses in pre and post motivation and interest in Science questionnaire were tabulated, and analysed statistically using mean score, statistical description and t-test. Journal entries were examined for common themes after coding.

The scores obtained from the SAS, SMQ II, and unit test were described and analyzed to determine the degree of change (if any) between the start and end of the intervention. Scores were examined to determine if there was any difference between the treatment group and the control group. The difference was investigated statistically to see if they were significant. Quantitative data analyses were done with the assistance of Statistical Package for Social Science 18 (SPSS, 2006).

1. Descriptive data (mean, standard deviation) was used to summarize the information obtained about the students' attitude to Science and assessment.
2. Quantitative data was presented in the form of tables and graphs, each followed by interpreting texts. The qualitative findings will be presented as a narrative with coded themes as headings.
3. Quantitative data was presented in the form of tables and graphs, each followed by interpreting texts.
4. The evaluation forms were summarized and analyzed to identify common or emerging themes, to look for individual variation and generally to extract critical information that indicated how the students responded to use of performance assessment.
5. Graphs summarized the separate variables. A t-test would be used to identify if there was any significant difference between the Pre and post perceived pre and post motivation and interest in Science questionnaire score and academic achievement test that may be attributed to the intervention.

Strengths

There were a number of strengths to the intervention which made the research methodology easy to facilitate. The administration was very supportive of the intervention as it was an opportunity to address declining grades at the examinable level. Receiving consent from the parents of the students involved in the research was easy as well.

The students were interested about the new teaching method to be used by the teacher and were actively engaged most of the times in the group activity with great focus and enthusiasm. Students encouraged each other to take up their roles seriously showing positive peer pressure.

The class was readily available for the study by the subject teacher.

Weakness

The study was conducted during the third term of school which was met with continuous interruption in terms of teacher contact time as the school was dismissed early on several occasions due to the landfill fires. A unit that should have therefore taken four weeks took five.

The class attendance was irregular due to students on suspension, students' socioeconomic issues and health issues from the smoke. This posed a problem with the continuity of the lessons. It resulted in new groups forming spontaneously for each class. The class size on average was 28 but not the same 28 students all the time.

The class size 35 can be a major constraint especially when moving around the class to the different groups. It reduces the time available to spend with any one group and the time needed for group presentation so that most time a few groups at selected for each activity but not the same groups.

Summary

Table 5

The Table Below Summarizes the Methods of Data Collection and Analysis by Research Questions.

Research Questions	Data collection Procedure	Analysis
1. What impact would using performance assessment have on students' academic achievement in Science?	Pre-test and post-test unit test (A)	Descriptive statistical, pair sample, t- test
To what extent did the intervention increase students interest in Science	Pre and post administration of the Science Attitude Scale and motivation in Science Questionnaire (B)	Descriptive statistical, pair sample, t- test
To what extent do students' perceived interest correlates with academic achievement?	A and B above	Pearson coefficient
4. What are the students' perceptions of the performance based assessment as a teaching tool in Science?	Students journals (C)	Coded to develop categories and themes

CHAPTER 4

DATA ANALYSIS AND PRESENTATION OF FINDINGS

The purpose of the study is to use action research to assess and evaluate the use of performance assessment as an intervention tool to increase student interest and achievement of Form Three integrated Science class.

The study guided by the following research questions:

1. What impact would using performance assessment have on students' academic achievement in Science?
2. To what extent did the intervention increase students interest in Science?
3. To what extent do students' perceived interest correlates with academic achievement?
4. What are the students' perceptions and views as a performance assessment is used as a teaching tool in Science?

This resulted in quantitative and qualitative data being collected and analyzed. The results are presented and discussed in an attempt to answer theses research questions. Wherever quantitative results are reported, they are first summarised with the used of descriptive statistics. The results were then analysed to determine whether any change occurred at the end of the intervention period that could be attributed to the independent variable. Additionally, any detected changes were subjected to various statistical analysis methods to determine whether the changes were significant and to what extent they were.

Academic Achievement in Integrated Science

Research Question 1

Descriptive Data

H_o, Null Hypothesis:-

There is no difference in the students' academic achievement when the performance assessment was used for the unit of Forces and Motion.

$H_{o:}$ $\mu = \mu_o$ and the alternative hypothesis

H_n $\mu \neq \mu_o$

What impact would using performance assessment have on students' academic achievement in Science?

This question seeks to determine whether the post-test academic performance of the students was statistically different from their performance on the pre-test, based on their treatment. The results of descriptive statistics of Science Unit test's pre and post test scores were given in Table 6.

The students performed poorly on the pre-test, scoring means of 27.14 for the treatment group and 21.47 for the control group (Figure 4). This is expected, as they have had prior but limited knowledge of the topic.

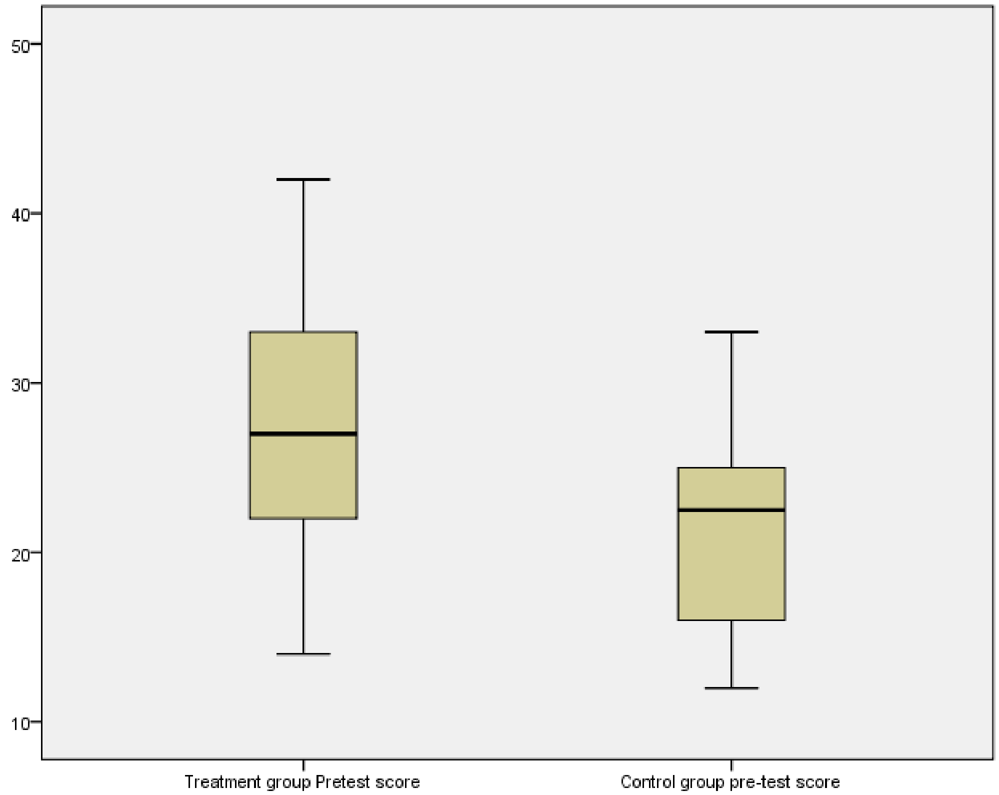

Figure 4 Graph showing Pre test scores of treatment group and control group

Table 6: *Descriptive Statistics on students Pre-test and Post Test on Unit test scores*

Variables	N	Pre test		Post test	
		Mean	SD	Mean	SD
Treatment group	35	27.14	7.63	60.11	10.60
Control Group	34	21. 47	5.74	37.62	10.16

It was noted that after the period under study, there was an increase in the post-test academic performance of both students on the unit test. Table 6 shows the students' means on the unit test increase significantly in the treatment group pre –test (*M*= 27.14, *SD*=7.63) to post-test (*M*= 60-11 *SD*= 10.60) when compared to the control group pre-test(*M*=21.47, *SD*= 5.74) to post -test (*M*=37.62, *SD*= 10.16). The results imply that students in the treatment group displayed a higher prior knowledge of the unit tested than the control group.

The means between the Pre-test and Unit test were compared to determine if there is a statistically significant difference between them using a t test. The paired-sample t-test (Table 7) was conducted to evaluate the impact of the intervention on students' academic performance on a unit test. There was a statistically significant increase in test scores from both groups, treatment group [t (34) = -21.73, p< .0005] and control [t (33) = -10.67, p< .0005]. However there was a great difference in paired mean difference for treatment group.   The eta square statistic (.93) indicated a large effect size with a substantial difference in unit test score for treatment group before and after the intervention.

Table 7

Compare means- Paired Samples Test between Pre-test and Post unit test

	Paired Differences		t	Sig
	Mean	Std dev		
Treatment group- pre and post score means	-32.97	9	-21.73	.00
Control group- pre and post score means	-16.147	8.82	-10.67	.00

As a result of the above values null hypothesis would not be accepted for there is no difference in the students' academic achievement when the performance assessment was used for the unit of Forces and Motion. That is performance assessment does have an effect on students' academic achievement in Science.

The boxplot graph (Figure 5) showed a summarization of the descriptive data distribution of the treatment group. The median line in the Unit test was divided unevenly in the box and the lower tail was longer. The distribution of data was positively skewed to the right. The median line is lower in the box but higher than the pre- test median score showing an increase in academic performance.

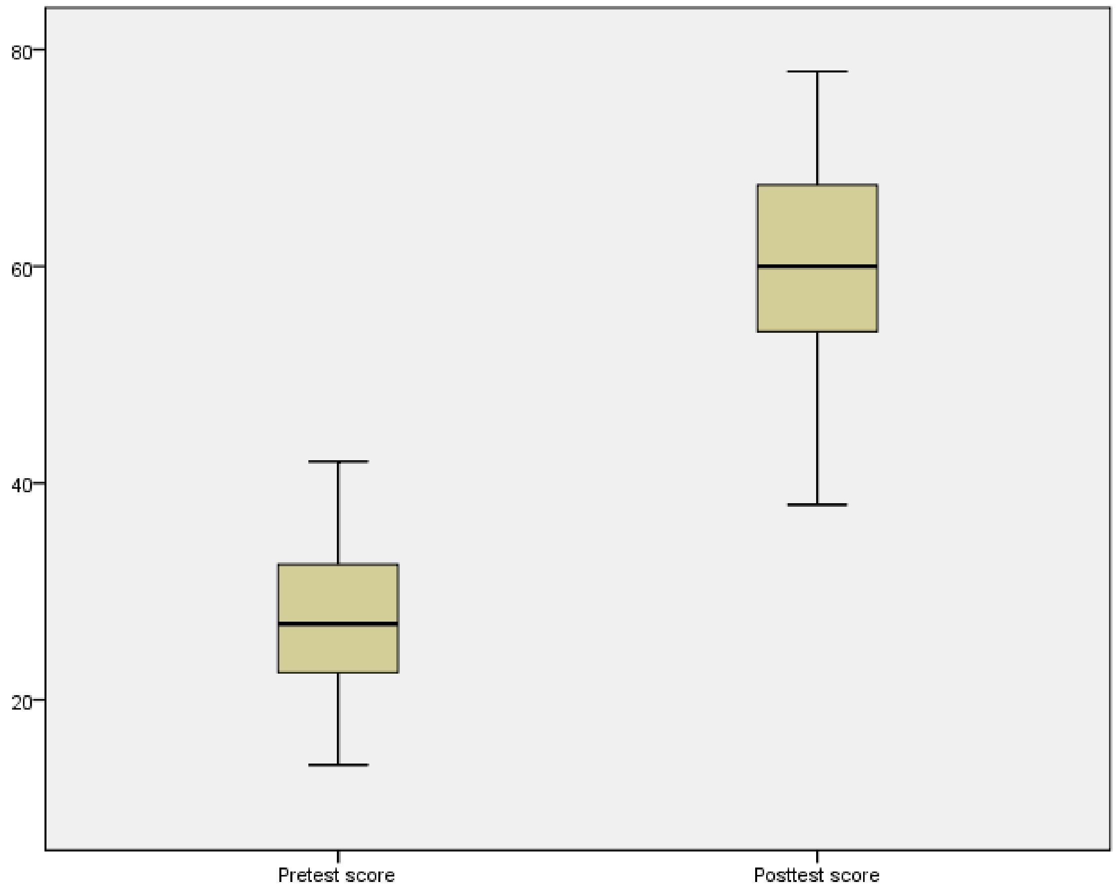

Figure 5: Graph comparing Pre test scores and Unit test scores of treatment group

Student Interest in Science Questionnaire

Research Question 2

Descriptive Data

H_o, Null Hypothesis:-

There is no difference in the students' interest in Science when the performance assessment was used for the unit of Forces and Motion.

$H_{o:}$ $\mu = \mu_o$ and the alternative hypothesis

H_n $\mu \neq \mu_o$

To what extent did the intervention increase students' interest in Science?

Students' overall opinion on Science was determined from Science Attitude scale (SAS) and Science Motivation Questionnaire II (SQM II), and their specific dimentions or subscales towards Science were explored quantitatively.

Science Attitude Scale (SAS)

The frequency and percentage of the students' responses to the individual items on the SAS pre-test and post-test are presented in Appendix J. Based on the possible scores that could be obtained on Science Attitude Scale (SAS), scores from 59-100, represents the highest range thus indicating a highly favourable interest in Science. The treatment group's mean score was *M*=57.77 (*S D*= 6.38) and the control group 53.12 (*SD*= 6.21) which indicate at the start of the intervention students had a favourable interest in

Science. There was a slight increase in treatment both group after the intervention, however the treatment group (*M*= 66.26, *SD*= 8.79) had a more highly favourable interest in Science compared to the control group (*M*= 57.64, *SD*= 6.06).

The summary statistics mean score and standard deviations on SAS pre and post-test scores based on the groups are displayed in Table 8.

Table 8

Descriptive Statistics Students pre-test and post-test Science Attitude Scale (SAS)

Variables	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Treatment group	35	57.77	6.38	66.26	8.793
Control group	34	53.12	6.21	57.64	6.06

Based on the treatment group students responses to individual items there was less mean value showing undecided to either agreeing or disagreeing with the statements. As seen in Table 9 at the beginning of the treatment subjects' attitudes toward Science was undecided for more statements; Statement 2 was (*M*= 3.10, *SD* =1.81) to (*M*= 2.19, *SD* =1.72) statement 11 (*M*= 3.50, *SD* =2.77) to (*M*= 4.09, *SD* = 1.28) than their attitude after the treatment.

Table 9.
Descriptive statistics on selected individual statements of students' pre-test and post-test Science Attitude scale

	Pre-test		Post-test	
Statements	Mean	Std Dev	Mean	Std Dev
2	3.1	1.81	2.19	1.72
3	2.3	0.64	3.02	1.98
5	2.7	0.97	2.41	0.85
8	3.1	1.73	2.42	1.2
11	3.5	2.77	4.09	1.38

It should be noted in Table 9 that for statement (3) which states "Science would not make a student's life more enjoyable" the mean was (*M*= 2.30, *SD* = 0.64) which disagreed with the statement to (*M*= 3.02, *SD* = 1.98) undecided. However for the statement 5 'Science is boring' the mean moved from (*M*= 2.70, *SD* = 0.97) to (*M*= 2.41, *SD* = 0.85) and 'time does not pass in Science class' (*M*= 3.10, *SD* = 1.73) to (*M*= 2.42, *SD* = 1.19) which indicate an increase interest in Science. Figure 6 and 4.4 further illustrate the distribution change in students' interest before and after the intervention.

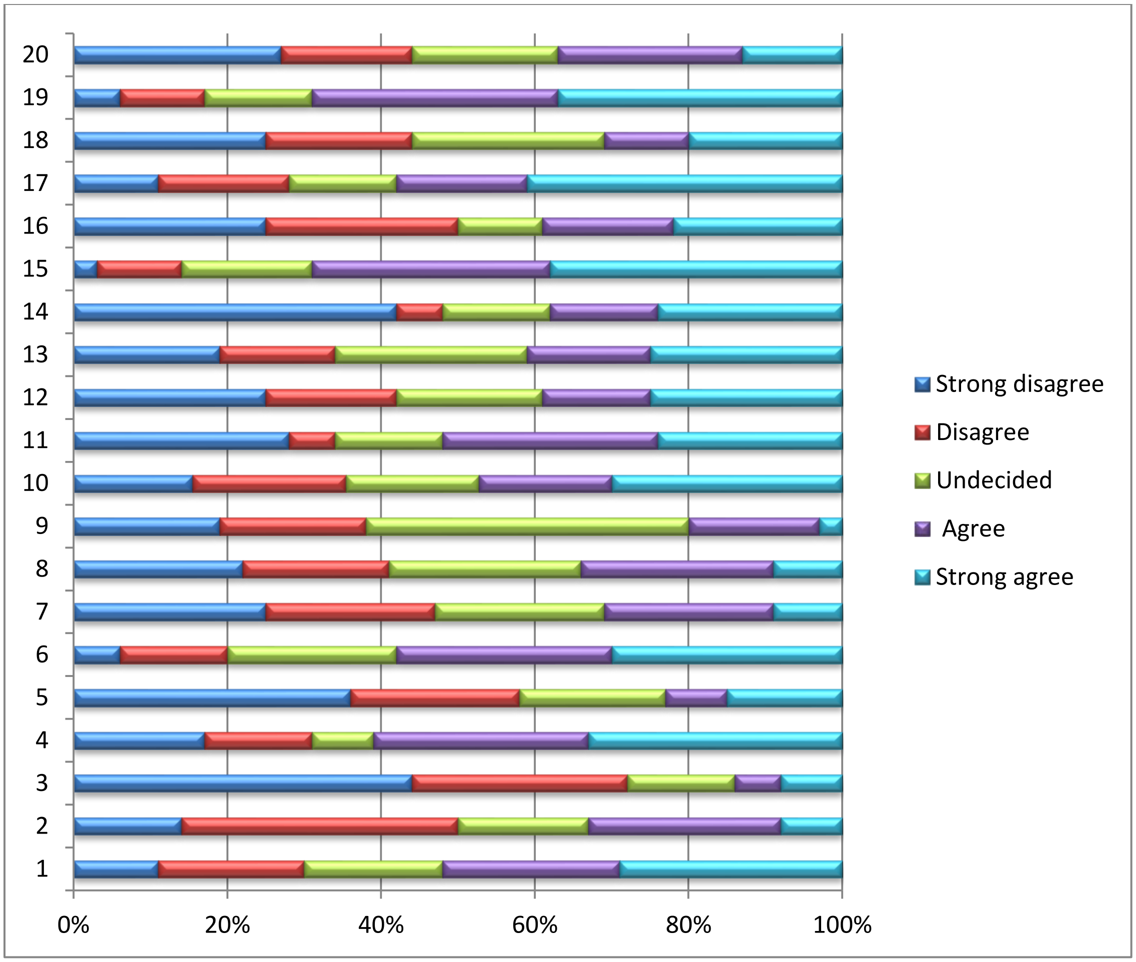

Figure 6: showing the distribution of responses to Pre-test SAS

Figure 6 shows that there was large distribution of undecided response in SAS the prior the intervention compared to after as in shown in Figure 7.

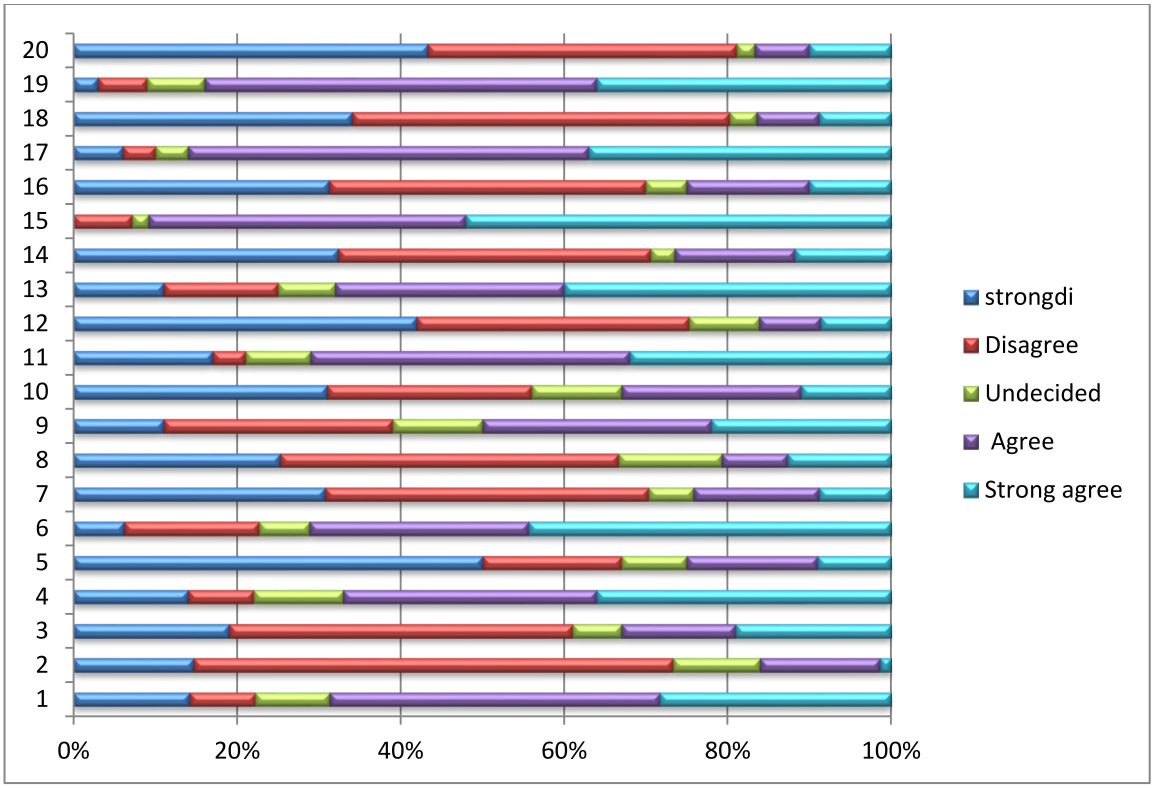

Figure 8: showing the distribution of responses to Post-test SAS

A paired sample was conducted on the individual statements to evaluate if there was any correlation between the means of the treatment group on interest before and after the intervention which can be found in the Appendix K. There was no statistically significant impact on most items however statements 4, 6, 15 and 19 was statistically significant. Items 4 and 6 were focused on the subscale student's enjoyment of Science while items 15 and 19 subscale focused on the value of Science in society. These statements also had a strong correlation between the pre and post response; statement 4 (r= .96, p=.01), statement 6 (r= .92, p=.03), statement 15 (r= .98, p<.05) and statement 19 (r= .95, p=.02).

Table 10:

Comparison mean- Paired sample test correlation for treatment SAS

	Statements	Correlation	Sig
Pair 4	statement 4 before & after intervention	0.96	0.01
Pair 6	statement 6 before & after intervention	0.92	0.03
Pair 15	statement 15 before & after intervention	0.98	0.00
Pair 19	statement 19 before & after intervention	0.95	0.02

The impact of performance assessment intervention on students' interest was analysed using the paired sample t-test. As implied by the analysis of the mean, the paired sample validates the assumption that the standard error of the mean should decrease as the standard deviation decreased. A pair sample t test was also done on the individual statement there was no statistically significant difference between the treatment group pre-test and post-test means. This is show in Appendix L

The results of the intervention revealed that there was no significant statistical correlation between the intervention and a responding increase in students' perception of Science as interesting, relevant to everyday life, and by extension important to the improvement of academic scores (Table 10).

Subscale on the Science Attitude Scale (SAS)

A mean score was calculated for each subscale of the Science Attitude Scale (SAS) pre-test and post-test in order to quantify the nature of the students response to a specific attitude dimension which were enjoyment of Science and Science class, interest in Science and learning Science and value of Science. The total frequency and percentages of the students' response to individual statements on the SAS were explored within the respective subscale, in order to identify any specific items that might have influenced the overall attitude expressed by the students towards Science. The students' response on the subscale will be presented using descriptive statistical data (Table 11 and Table 12).

Subscale one: Enjoyment of Science and Science class

The students in the treatment group obtained (*M*= 14. 52, *SD*= .67) in their pre-test score out of a possible 30 on this subscale compared to (*M*= 15.00, *SD*= .45) by the control group which is shown in Table 11 and 4.7. Both groups mean for enjoyment in Science class increased. Treatment group increased favourably (*M*= 25.74, *SD*= 1.64) and control group (*M*= 19.74, *SD*= 1.43) indicating that they strongly agree or agree that they enjoy Science class after the unit was taught. The attitude before the intervention was in the undecided range but both means after intervention had high enjoyment scores. It was noted that participants in this subscale scored the highest in “Science would not make a student's life more enjoyable” which show students initial thought on Science with 44% of the group strongly disagreeing with the statement (Appendix M). On the other hand statement 12 “dislikes Science most all subject ” where 25 % were undecided and 25% were strongly disagree.

Table 11:

Students Science Attitude Scale pre-test mean score and standard deviation on the three subscales

Treatment	Subscale 1[a]		Subscale 1[b]		Subscale 1[c]	
	Mean	SD	Mean	SD	Mean	SD
Treatment group	14.52	.67	34.24	1.42	14.66	1.55
Control group	15.00	.45	27.90	1.30	15.30	1.23

1[a]: Enjoyment of Science and Science class

1[b]: Interest in Science and learning Science

1[c]: Value of Science

Table 12:

Students Science Attitude Scale post-test mean score and standard deviation on the three subscales

Treatment	Subscale 1[a]		Subscale 1[b]		Subscale 1[c]	
	Mean	SD	Mean	SD	Mean	SD
Treatment group	25.74	1.64	38.25	1.56	18.46	1.64
Control group	19.74	1.43	33.75	1.21	16.95	1.45

Subscale two: Interested in Science and learning about Science

The students indicated on the SAS pre and post that they were interested in Science and learning about Science prior to the intervention by recording mean scores of 34.24 (*SD*= 1.42) out of 45 to a mean post-test of 38.25 (*SD*= 1.56) in the treatment group and the control group recording mean scores of 27.90 (*SD*= 1.30) out of 45 to a mean post-test of 33.75 (*SD*= 1.21) which is shown in Table 11 and 4.7. There was an unusual responses to statements 4 ‘I enjoy discussing Science with my friends’ with a pre-test mean score 4.2 (*SD*= 3.39) to a small decline in post-test mean score 4.08 (*SD*=4.16) (Appendix M)

Subscale three: Students' opinions on the value of Science

The students indicated that they value Science lowly prior to the intervention. For this subscale, treatment group (*M*= 14.60, *SD*= 1.55) and control group (*M*= 15.30, *SD*= 1.23) out of a possible 25. There was an increase in this opinion for both groups positively treatment group (*M*= 18.46, *SD*= 1.64) and control group (*M*= 16.95, *SD*= 1.45). This indicated Science was useful to the students in their everyday lives as well as their future careers.

The students' generally positive opinions on the value of Science seem largely related to its usefulness to everyday solving problems. The table in Appendix M indicates that most of the students (49%) strongly disagree with Statement 20 'Science is not necessary help me solve problems everyday life' indicated that Science is value in everyday activity.

Science Motivation Questionnaire II (SMQ II)

The frequency and percentage of the students' responses to the individual items on the Science Motivation Questionnaire II (SMQ II) pre-test and post-test are presented in Appendix N. Based on the possible scores one that could be obtained on Science Motivation Questionnaire II (SMQ II), scores from 70-100, represents the highest range thus indicating a high motivation for Science. The treatment group mean score was *M*=77.86 (*S D*= 12.07) and the control group 70.82 (*SD*= 10.00) which indicate at the start of the intervention students were positively motivated to do Science. There was a slight increase in treatment both group after the intervention, however the treatment group (*M*= 93.06, *SD*= 13.13) had a more highly favourable interest in Science compared to the control group (*M*= 75-70, *SD*= 66).

The summary statistics Mean score and standard deviations) on SAS pre and post-test scores based on the groups are displayed in Table 13.

Table 13:

Descriptive Statistics for Pre- and Post-Motivation to do Science questionnaire

Treatment group

Variables	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Treatment group	35	77.86	12.07	93.06	13.13
Control group	34	70.82	10	75.7	9.66

The students' high motivation to Science prior and post intervention cause are seen in Figure 8 and Figure 9. In both Figures there were small percentages of students responding never to the statements. Statement 23 'my career will involve Science', 28% of the students respond 'Never' pre-test compared to 0% responding 'Never' in the post-test.

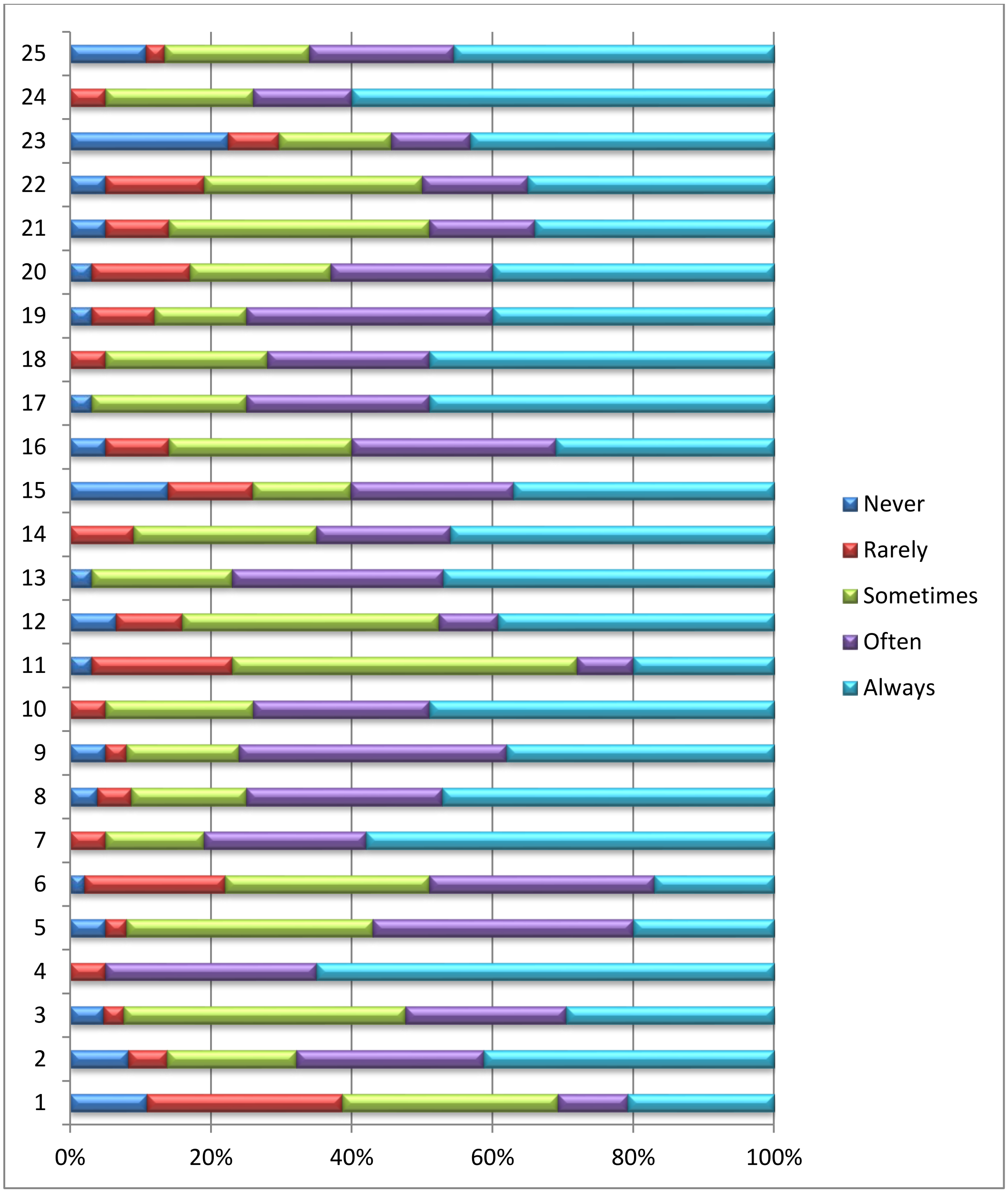

Figure 8: showing the distribution of responses to Pre-test SMQ II

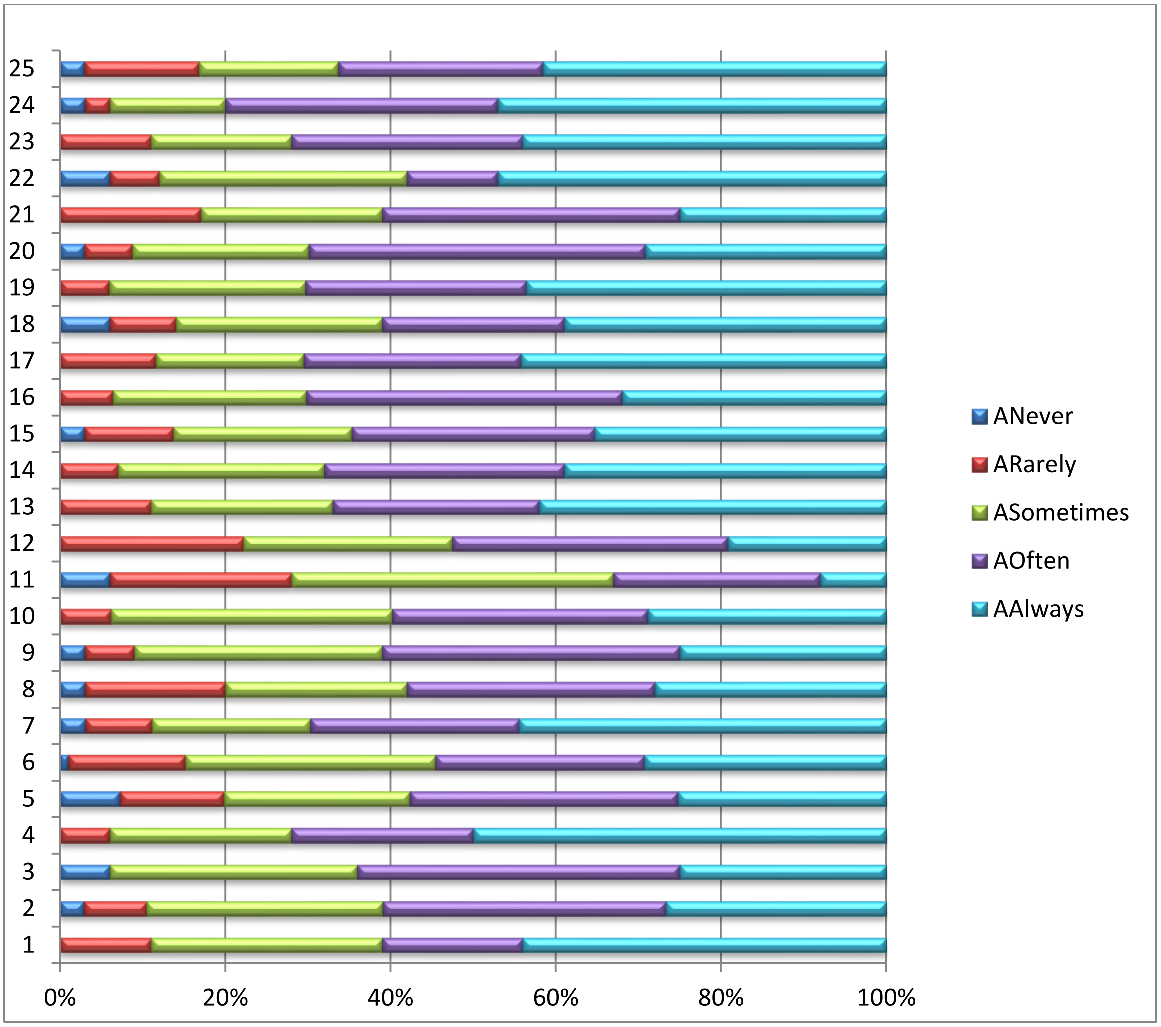

Figure 9: showing the distribution of responses to Post -test SMQ II

A paired sample was conducted on the individual statements to evaluate if there was any correlation between the means of the treatment group on interest before and after the intervention which can be found in the Appendix O. There was statistically significant impact on most items 14 of 25 statements were of statistical significance. Items 3 and 7 were focused on the subscale intrinsic motivation and career motivation respectively showed an increase in their mean which had a strong correlation between pre and post-test means although it was not statistically significant, Statement 3 ($r= .83$, $p= .085$) and statement 7 (r= .83, p= .083). Statements 15, 16, 20, 23, 24 and 25 had a decline in their mean value (Appendix O) which was significant and correlated.

Table 14: Comparison mean- Paired sample test correlation for treatment SMQ II

	Statement	Correlation	Sig.
Pair 2	statement 2 before intervention & statement 2 after intervention	0.99	0.001
Pair 5	statement 5 before intervention & statement 5 after intervention	0.91	0.033
Pair 8	statement 8 before intervention & statement 8 after intervention	0.98	0.003
Pair 9	statement 9 before intervention & statement 9 after intervention	0.95	0.015
Pair 13	statement 13 before intervention & statement 13 after intervention	0.99	0.001
Pair 14	statement 14 before intervention & statement 14 after intervention	0.97	0.006
Pair 15	statement 15 before intervention & statement 15 after intervention	0.99	0.001
Pair 17	statement 17 before intervention & statement 17 after intervention	0.99	0.001
Pair 18	statement 18 before intervention & statement 18 after intervention	0.99	0.001
Pair 19	statement 19 before intervention & statement 19 after intervention	0.99	0.001
Pair 20	statement 20 before intervention & statement 20 after intervention	0.94	0.017
Pair 22	statement 22 before intervention & statement 22 after intervention	0.99	0.001
Pair 23	statement 23 before intervention & statement 23 after intervention	0.93	0.023
Pair 24	statement 24 before intervention & statement 24 after intervention	0.92	0.028
Pair 25	statement 25 before intervention & statement 25 after intervention	0.98	0.003

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The impact of performance assessment intervention on students' Science Motivation was analysed using the paired sample t-test. (Appendix Q) As implied by the analysis of the mean, the paired sample validates the assumption that the standard error of the mean should decrease as the standard deviation decreased. A pair sample t test was also done on the individual statement. There was no statistically significant difference between the treatment group pre-test and post-test means but there was a weak correlation between the overall pre and post questionnaire means (Table 14)which was statistically significant (r= 501, p< =01) .

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The results of the intervention revealed that there was a significant statistical correlation on the overall SMQ II but not on the individual statement between the intervention and a responding increase in motivation to do Science.

Table 15: Paired mean Correlation Test between Pre- and Post- Science Motivation
Table 15: Paired mean Correlation Test between Pre- and Post- Science Motivation
Questionnaire II Treatment group

		Correlation	Sig.
Pair 1	Pre SMQ-II & Post SMQ- II	.507	.002

A paired samples t-test was conducted to evaluate the impact of performance assessment on students' score on the Science Motivation Questionnaire (SMQII). There was a statistically significant increase for pre-test (M= 62.86, SD- 12.07) to Post-test [M= 78.06, SD= 13.13), t (34)= -7.165, p<.005]. The eta squared statistic (.60) indicated a moderate effect size.

Table 16:
Paired sample Test between Pre- and Post- Science Motivation Questionnaire II Treatment group

		Paired Differences				
		Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1	Pre SMQ-II - Post SMQ- II	-15.20	12.55	-7.16	34	.000

Subscale on the Science Motivation Questionnaire II

A mean score was calculated for each subscale of the - Science Motivation Questionnaire II pre-test and post-test in order to quantify the nature of the students' response to a specific motivation dimension which were intrinsic motivation, career motivation, self-determination, self-efficacy and grade motivation. The total frequency and percentages of the students' response to individual questions items on the SMQ II were explored within the respective subscale, in order to identify any specific items that might have influenced the student to do Science. The students' response on the subscale will be presented using descriptive statistical data (Table 62and Table 63).

Subscale one: Intrinsic motivation

The students indicated that they have low intrinsic motivation to do Science prior to the intervention. The students in the treatment group obtained (*M*= 7.81, *SD*= .2.1) in their pre-test score out of a possible 20 on this subscale compared to (*M*= 7.32.00, *SD*= 1.32) by the control group which is shown in Table 62 and 4.13. Both groups mean for intrinsic motivation for Science increased. Treatment group increased favorably (*M*= 17.00, *SD*= 2.16) and control group (*M*= 13.6, *SD*= 1.34) indicating that their motivation moved from ‘Sometimes’ to ‘Often’ or Always’. It was noted that participants in this subscale scored the highest in “I enjoy learning Science” which show students initial thought on Science with 44% of the group stated always (Appendix R).

Table 17: Students Science Motivation Questionnaire II pre-test mean score and standard deviation on the five subscales

	Subscale 1[a]		Subscale 1[b]		Subscale 1[c]		Subscale 1[d]		Subscale 1[e]	
Treatment	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Treatment group	7.81	2.10	8.71	2.49	8.21	1.79	8.64	2.11	8.33	2.17
Control group	7.32	1.32	12.84	1.93	8.48	1.53	9.52	1.64	8.92	1.45

1[a]- Intrinsic motivation
1[b]- Career motivation
1[c]- Self-determination
1[d]- Self-efficacy
1[e]- Grade motivation

Table 18: Students Science Motivation Questionnaire II post-test mean score and standard deviation on the three subscales

	Subscale 1[a]		Subscale 1[b]		Subscale 1[c]		Subscale 1[d]		Subscale 1[e]	
Treatment	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Treatment group	17.00	2.16	17.44	2.31	16.22	1.89	17.01	2.01	17.45	2.19
Control group	13.60	1.34	14.16	2.43	12.80	2.63	11.12	1.76	11.92	1.31

1[a]- Intrinsic motivation
1[b]- Career motivation
1[c]- Self-determination
1[d]- Self-efficacy
1[e]- Grade motivation

Subscale two: Career motivation

The students indicated on the SMQ II pre and post their career motivation prior to the intervention by recording mean scores of 8.72 (*SD*= 2.49) out of 20 to a mean post-test of 17.44 (*SD*= 2.31) in the treatment group and the control group recording mean scores of 12.84 (*SD*= 1.93) out of 20 to a mean post-test of 14.16 (*SD*= 2.43) which is shown in Table 16 and 17. The control group pre-test score was higher than the treatment group in career motivation to do Science. There was a high percentage (33%) of students in the treatment group after the intervention responses sometimes to statements ‘Knowing Science will give me a career advantage’ with a pre-test mean score 3.1 (*SD*= 2.8) to a small decline in post-test mean score 2.12 (*SD*=1.8) (Appendix R).

Subscale three: Self-determination

For this subscale, treatment group (*M*= 8.21, *SD*= 1.79) and control group (*M*= 8.48, *SD*= 1.53) out of a possible 20. The control group had a greater self determination to do Science prior to the lesson being taught. There was an increase in this opinion for both groups positively treatment group (*M*= 16.22, *SD*= 1.89) and control group (*M*= 12.80, *SD*= 2.63). This indicated an increase in students self determination to Science.

Table in Appendix R indicates that for statement 11 ‘I spend a lot of time learning Science’ the majority of the students 39% stated ‘sometimes’. Although it is high it was a decrease from 49% in the pre-test. Pre-test mean 1.7 (SD= 1.25) to post-test (M= 1.8, SD= 1.31).

Subscale four: *Self-efficacy*

The students in the treatment group obtained (*M*= 8.64, *SD*= 2.11) in their pre-test score out of a possible 20 on this subscale compared to (*M*= 9.52, *SD*= 1.64) by the control group which is shown in Table 62 and 4.13. Both groups mean for Self-efficacy increased. It was noted the control group had a high self-efficacy mean at the start of the intervention. Treatment group increased favourably (*M*= 17.01, *SD*= 2.01) and control group (*M*= 11.12, *SD*= 1.76) indicating that their self-efficacy level increase after the unit was taught. The statement 14 ‘I am confident I can do well in Science test and labs’ response move from 15% of the students saying 'never' to 3 % of the students saying 'never' (Appendix R).

Subscale five: *Grade motivation*

The students indicated that their grade motivation was about sometimes response which is low prior to the intervention. For this subscale, treatment group (*M*= 8.33, *SD*= 1.2.17) and control group (*M*= 8.92, *SD*= 1.45) out of a possible 20. The control group grade motivation was slightly higher but it was not statistically significant (Appendix R). There was an increase in this opinion for both groups positively treatment group (*M*= 17.45, *SD*= 1.2.19) and control group (*M*= 11.92, *SD*= 1.31). This indicated that students may be motivated to do better in Science test.

The students' generally positive opinions grade motivation statement with statement 4 'Getting a good Science grade to important to me' with a mean of 2.4 (SD=2.85) which was the highest mean in this subscale and the lowest statement 8 'It is important that I get an "A" in Science' with a mean of 2.00 (SD=1.55). This indicated students want to do good at Science but not necessarily get an 'A'.

The results presented in this study imply that students in the treatment group were motivateeded to do Science which can be attributed to being engaged in the intervention when compared to the control group.

Correlation between Student Interest in Science and Academic Achievement

Research Question 3

Descriptive Data

H_o, Null Hypothesis:-

There is no correlation between students' interest in Science and academic achievement.

$H_{o:}$ $\mu = \mu_o$ and the alternative hypothesis

H_n $\mu \neq \mu_o$

To what extent do students' perceived interest correlates with academic achievement?

This research question seeks to explore whether secondary independent variables this study namely Science attitude scale (SAS) and Science motivation questionnaire II (SMQ II) have any significant influence on the students' post unit test scores. A bivariate correlation was calculated for significant relationship between students' interest in Science and Academic Achievement.

The relationship between students' performance and Science attitude scale (SAS) and Science Motivation Questionnaire II (SMQ II) on Academic Achievement was investigated using Pearson correlation coefficient. Table 18 shows a moderately positive correlation between academic performance and Science attitude scale [r=-03, n=35, p.>.01]. After the intervention there seem to be a medium correlation which is not statistically significant. It also shows weak positive correlation between academic performance and Science motivation questionnaire II (SMQ II) [r=.14, n=35, p> .01].

However there was a moderately positive correlation between Science attitude scale (SAS) and Science motivation questionnaire II (SMQ II) that was significant [r= .43, n=35, p<-01].

Table 19

Pearson Correlation between students' Academic Achievement and Interest and Motivation in Science of treatment group.

Measures		Post-test score	Post SAS	Post SMQ- II
Post-test score	Pearson Correlation	1	.30	.14
	Sig. (2-tailed)		.08	.42
	N	35	35	35
Post SAS	Pearson Correlation	.30	1	.43***
	Sig. (2-tailed)	.08		.01
	N	35	35	35
Post SMQ- II	Pearson Correlation	.14	.43***	1
	Sig. (2-tailed)	.42	.01	
	N	35	35	35

SAS - Science Attitude Scale; SMQ II= Science Motivation Questionnaire II

*** p<.01

Students' Perception of the Performance assessment as a teaching tool

Research Question 4

Qualitative Data

H_o, Null Hypothesis:-

The students' perception of the performance assessment as a teaching tool in Science is negative.

$H_{o:}$ $\mu = \mu_o$ and the alternative hypothesis

$H_{n:}$ $\mu \neq \mu_o$

Students were given a evaluation form with guided statement to complete which was used to analyse the students' perception of the new teaching method to answer research question four. The information from these journals was analysed qualitatively. The evaluation statements were as follow:

'How did you feel about today's class ...', 'and I especially liked ...', 'but I did not care for ...', 'Next time why don't you try...' and 'the only thing missing was...'.

This data was coded and scaled based on frequency of similar responses and answers related to class responded to the teaching strategy can be categories as shown in Appendix S.

The finding of this study generally indicated that the students involved in the intervention were impacted positively. The qualitative data will be highlighted to give the students lived experience while they were engaged in the use of the performance assessment strategy.

Feelings about the lesson

The majority of the students had positive feeling to the new strategy. For example, Lisa, a student in the class stated she 'found class more interesting and fun' and was 'eager to come to class and which all her classes was like this'. While Joseph a boy who had been absent from school for a while 'glad he is coming to class because class is lots of fun' and is ; excited for what we will do in the next class'. The strategy has help to increase students' self-esteem and self-efficacy which is shown in students willing to share their ideas and understand concepts and how to apply them.

For example Carla wrote and told me personally with a smile on her face 'I am learning a lot in class… I feeling very bright because they use my idea and our bridge was able to withstand the force applied'. One student Mark came to 'class sad since most of his group members were suspended' so he had to join another group but at the end of the class stated 'I am glad I came to class it was lots of fun … although Lisa was very bossy'

It was found that girls were not as willing to work without their friends as they boys and as such when their friends were absent found the lesson as Jane stated 'was normal but got bored at time' this was concreted by the comment for I especially liked 'nothing, I hated the group I in'. Some students did not like being corrected by their peers as Alisha stated 'I am angry Lisa want to correct everybody and not focus on her group' and Joan complaining that Lisa playing she correcting me'.

I did not care for

The noise that the group work brought was found to be 'a distraction'. While other students dislike working in group or the activity and prefer to write notes. These individuals were in the minority. Students were not interested in completing the evaluation Forms but the end of the first week the majority of the students wrote '… I did not care for writing this'.

I especially liked

While a few students preferred notes the majority of the class stated if some form 'I especially liked the class had more interaction'. The students getting to work with their friends and talk in class seem to be very import for them. It is seen in Juliana statement 'everyone could share and lead in the group.' Or Samantha who is a weak student became alive in the class share and stated 'my friends help me to understand clearly what we were supposed to do ' and she 'like Science now, it's fun'.

Even the quiet students who do not talk in class stated 'working and talking and doing stuff makes class and school fun'.

Students began to view Science as relevant Matt stated 'now we can see Science used in everyday activity' and 'Science is fun'.

Students are giving themselves homework and becoming self-regulated. Both Mark and Ann stated 'I am going home to see if I can find another way to do this.' or John 'research interesting things to do in class'.

Tony stated 'I had to keep focus and come to class on time to complete our assignment display '.

The students' journals responses were most of the time positive. The negative response seems not to be related to the teaching strategy but students' behaviour and group placed in. This highlights on of the subscale in SAS which focuses son motivation, in this case motivation due to positive peer-pressure.

Student based of the journals see Science as ‘‘...was very interesting’ and glad I came to class, it was lots of fun’. Jill states she ‘wish we could this every day ☹’. The student are reaching to class on time or earlier. They no longer see Science class as boring with plenty notes but ‘..excellent class, ‘ where learning is fun’ , I learn a lot’. The task is able to grasp the students interest and even change their mood ‘I came to class sad but the lesson help make me happy and I enjoying it’

In general the performance assessment in the classroom was found to be useful, capture thier interest and engaging by the students in the study. This method was beneficial with respect to helping the students to understand, learn study and be interesting in Science. It also allows students to assessment themselves and others and reflects on what they were doing.

Conclusion

This action research study investigated how performance assessment processes can be implemented within a Form Three Science classroom. The purpose of this action research study was to describe the pedagogical strategies of performance assessment process within one classroom and comparing the results with a control group and determine if it positively impact on students attitude to Science.

Chapter 5

Discussion and Recommendations

This chapter includes a discussion and interpretation of the results and some recommendations. The first section of this chapter presents a restatement of some of the results and the second section consists of some recommendations for further research.

. It was also the objective to determine whether attitudes and motivation to do Science could be influence by classroom activities.

5.1. Discussion of Findings

The findings of the present study are discussed under research questions:

1. **What impact would using performance assessment have on students' academic achievement in Science?**

The results of the study indicated statistically significant change in Science achievement of Form Three students who were in the treatment group time periods paired of 0.05 significance level. In other words, there was a statistically significant mean difference between prior achievement mean 27.14 and post achievement mean 60.11 in the favour of post achievement. There were statistically significant difference in student's pre-test score and post-test score based on the treatment group. This finding was consistent with Hiccan (2008) who reported that the performance assessment statistically significant effects on conceptual and procedural knowledge. This suggests that a performance assessment approach promotes and supports learning Science at the classroom by improving academic performance.

According to the results of the Stephens (2006) research the students had the ability of learning by both concrete and symbolic representational model and learned in either ways. Nevertheless, according to Stephens (2006) there must be more findings to have a clear idea about the effects of manipulatives on the science achievement of students.

2. To what extent did the intervention increase students' interest in Science?

The students in this study were found to display positive and favourable attitude towards Science before mean = 57.77and after mean = 66.26 they were taught but it was significantly for the treatment group, compared to the control group, as measured by the Science Attitude scale (SAS). The treatment group scored highly on all three subscales of the Science attitude scale which indicated high, favourable opinion on enjoyment of Science, interest in Science and value of Science. This contributed to the overall positive attitude towards Science. The results of data analyses also showed that student attitudes toward Science have increased. The fact that the treatment group had been exposed to the performance assessment task it appears to be one reason for such a positive increase in interest. Since the results were statistically significant for individual statements it supports findings of Papanastasiou & Zembylas (2004), found significant difference between alternative and traditional groups in their attitudes toward Science and in their Science outcomes.

3. To what extent do students' perceived interest correlates with academic achievement?

There was a positive, statistically significant but weak relationship between the treatment group post-test and attitude (r= .03) and motivation (r=.14)

There is weak to modest correlation relation between students post-test attitude toward Science and motivation to Science and the post-test performance on the unit test.

4. What are the students' perceptions of the performance based assessment as a teaching tool in Science?

Students seem to have had a positive experience and were receptive to the performance assessment. Students expressed interest in having their classes taught using performance assessment.

The materials and activities captured the students' interest so they did not get bored of studying Science and the lessons were described as 'fun' by the students. The study of Lord (1999) supported the results of the present study. According to him while the control group students found the lessons boring, the experimental group students found them interesting and had a lot of fun. They were creative with the material; they loved utilizing them during lessons. Also with the help of materials, they understood the subjects better and reached the capability of applying what they had learnt to different situations. Now, the students did not have stereotyped knowledge (like when building the bridge or car racing), but could understand the subjects easily.

In addition the acquired knowledge and the students' experiences increased their self- confidence and self-esteem in their capability of solving Science task. Moreover, the performance assessment as a teaching strategy created an atmosphere in which the students felt free in that they expressed their ideas freely with their peers and there was no time to get bored.

Recommendations

Performance assessments impact students' academic achievement in Science

The students' improvement on the post-test indicates a link to the type of instructional method that was used in the classroom. Those students who were exposed to the non-traditional method showed significant higher cognitive gain than those students in the control group.

Curriculum developers, teacher trainers and policy-makers must continue to encourage teachers by providing help with continuous relevant teacher training strategies for teaching lower school Science to encourage to have interest in Science related fields.

Administrators can get a group of willing teachers, may be one per Department at H secondary school to be educated and trained to use performance assessment strategy in their classes. These teachers can then train members of their department. This may be the start needed to move teachers from teacher-centered approach to student-centered approaches.

Class size should be reduced to 20-25 students in secondary school where students enter with SEA examination score under 30%, so as to maximize student-teacher interaction.

Proper group work is a challenge in a single period and may be a double period would be more suitable. This would ensure all grouips are on task and get to share their information with the class.

2. Students' interest in Science

The treatment group in this study had highly, positive attitudes to Science. This implies that they were highly motivated and that the attitude they displayed were probably developed from prior experience and during the intervention. It is important that Science teachers recognise what types of attitude students bring into the classrooms, and in response conduct their classroom activities in a way as to sustain and maintain high attitude to Science. They should also recognise students' interest when planning activities for lessons so as to ensure they are relevant to the student. In this way they would identify what factor contribute to students highly favourable attitude to Science or conversely, what contributed to lower or poor attitude. Failure to consider how students learn or keep a lesson interesting can cause students to become discouraged if the subject is ,-boring and distracted in the class and not select Science at upper school. This observation articulates with both constructivism and formative assessment need to determine students' prior attitude (Chiappette et al,. 1990) Therefore Science teachers should administer SAS early in their classes. Once the students' attitudes are determined this should be used to assist in the planning of the lessons.

Teaching-learning activates that contain group work, and engaging would have a favourable impact on students' attitude toward Science. It also highlights the need to move away from traditional teaching method to more interactive, less teacher-dependent constructivist methods (Straits& Wilke,2007) to assist students in the learning process.

The school administrators and policy-makers need to provide classroom designs that would generally support interactive learning methods.

Students' perception of performance assessment

Students involved in this study had mainly positive experience towards performance. Performance assessment includes sharing assessment criteria with students, giving feedback which well received by students. These practices were found useful by the students and provide evidence that students are interested in engaging teaching strategies.

The success of the performance assessment underlines the call by constructivist for shift from teacher on the stage to teacher a guide at the side. These methods which would call for greater sharing and openness with students, recognising that they should be active participant in the learning process (Prezer, 2004).

The result of this intervention indicated that students had positive responses to various element of PA. They were not afraid of the task and were able to work in groups and with peers and self-regulate to complete the task. Because the students had positive attitude towards the performance task, this could indicated the level of interest they had in being involved with the use of performance assessment. It was evident that they were very receptive to performance assessment.

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APPENDICES

APPENDIX A

Letter Requesting Permission to Conduct Research Study at School

H Secondary School

20 thMarch, 2014.

Dear Mr X,

I, Avis Benjamin, am a student at the University of the West Indies, St Augustine, where I am enrolled in a Master's Degree in Education. I am conducting research for the purpose of my thesis and would like to engage in an action research that will focus on the use of performance based assessment in teaching one Form 3 class

The study involves using a student centered approach; Performance Based Assessment (PBA) to help keep students engagedm interested science and motivated to study. This would help improve academic performance. The class I have selected to study is Form 3C.

Thank you in advance for your cooperation in this regard.

Yours sincerely

Ms. Avis Benjamin

Appendix B

Letter Requesting Permission from the students parents

H Secondary School

20 thMarch, 2014.

Dear Parent/ Guardian,

I am a post-graduate student of the School of Education at The University of the West Indies. I am in the process of conducting a research on teaching strategies. This is an action research which entails teaching a class using a new strategy. I would also like ask permission to take photographs and video record some of the lessons.

I am a teacher of the above mention school and go permission from the Principal to undertake the study. I am desirous of using Form 3 class and as such your child for ten lessons over four (4) weeks during normal school time. The topic being taught is based on the Form 3 curriculum.

Students would have to complete two (2) questionnaires, one before and one after the teaching intervention. The questionnaires do not contain any questions that may result in your child feeling uncomfortable. However, if he/she does not which to respond to a particular question he/she may leave it blank. Your child responses in class activities would be treated with the strictest confidence. Pseudo names would be used for the students to ensure confidentiality.

Kindly indicate consent for your child's participation by completing the statement below and have your child return it to his/ her Form Teacher or Science teacher or Ms Benjamin.

Thanks for your assistance and co-operation.

Yours Truly

Ms. Benjamin

CONSENT SECTION

- - - - - - - - - - - - - - - - - ✂ -

____________________________________ do/ don't give consent for my child ________________________________ to participate in this curriculum research.

I also give/ not give permission for my child photographs and activities be recorded during the research.

Parent signature____________________________________ Date ______________

APPENDIX C

UNIT TEST

Name_____________________________________ Form 3___

Unit Test

Forces and Motion

45 mins

Answer the following questions in the space provided

Students **MUST** attempt all the questions in Section A and B.

Section A

(12 multiple choice questions)

Circle only the letter corresponding to the best suited answer.

1. A force cannot change the ________ of an object.

(A) motion (B) size (C) shape (D) mass

2. A woman wearing stiletto heels made deeper dents on soft ground than when she is wearing tennis shoes because ___________.

(A) a large force is applied (B) a smaller force is applied

(C) the area of contact is smaller (D) greater energy is used

3. The SI unit for force is the ______________ -

(A) kilogram (B) Pascal (C) Newton (D) kgm/s

4. 1 N is the force acting on a mass of ____________.

(A)10g (B) 100g (C) 1000g (D)10kg

5. What is the SI unit for mass?

(A) kg (B) m (C) cm (D) Kelvin

6. What is inertia?

(A) when an object is moving with speed (C) a body's resistance to being moved

(B) a body slowing down rapidly (D) when an object moves quickly

7. The weight of a person on earth with a mass of 50kg is about _________.

(A) 5 N (B) 50 N (C) 500 N (D) 5000 N

8. The bodies of cars get warmer after travelling long distances due to the action of _____________.

(A) Gravitational force (C) magnetic force

(B) frictional force (D) air pressure acting on them

9. School shoes are worn out by _____________.

(A) friction (B) heat (C) pressure (D) our weight

10. A greater amount of energy is required to lift a heavy object than to drag it. This is because when lifting the object, there is additional force to overcome due to __________.

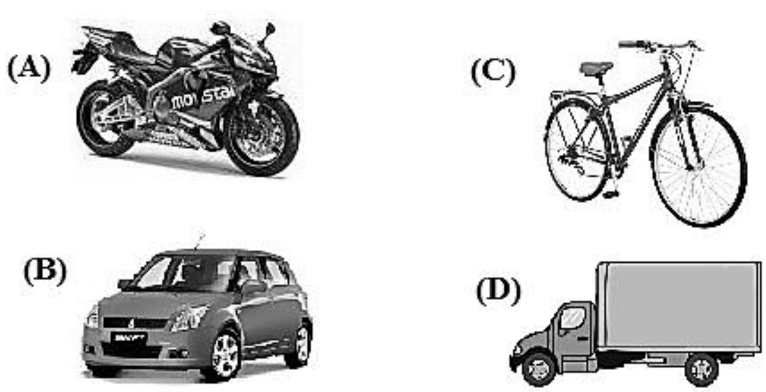
(A) friction (B) gravity (C) repulsion (D) pressure

11. Which of the following is not likely to happen when a force is applied to an object?

(A) The object moves faster (C) The object changes direction

(B) The object slows down (D) The object becomes less dense

12. All of the following vehicles are moving at 30km/h. Which one has the greatest momentum?



Section B

1. (a) Explain why a spring becomes deformed after being stretched.

(2 marks)

(b) Explain why a person sitting in a car continues to move forward when the car stopped suddenly.

(3 marks)

(c) State the difference between force, mass and weight.

(5 marks)

Total 10 marks

2. (a) What is meant by “friction”?

(1 mark)

(b) Give **TWO (2)** examples of ways in which friction can be helpful to us in our everyday lives.

(2 marks)

(c) Name **ONE (1)** way to reduce friction between two surfaces.

(1 mark)

(d) Mark rolled a tennis ball of four different surfaces and measured the distance that the ball travelled on each of these surfaces. The results of Mark’s investigation are given in the Table below:

Surface	Distance in centimetres
Thick grass	20
Wooden floor	100
Polished kitchen floor	250
Carpet	87

(i) From the results shown in the Table which surface had the **greatest friction**?

____

____

(1 mark)

(ii) Give ONE (1) reason for your answer.

____

____

____

(2 marks)

(iii) Explain why the ball was able to travel the distance of 250 cm on the polished kitchen floor.

____

____

____

____

____

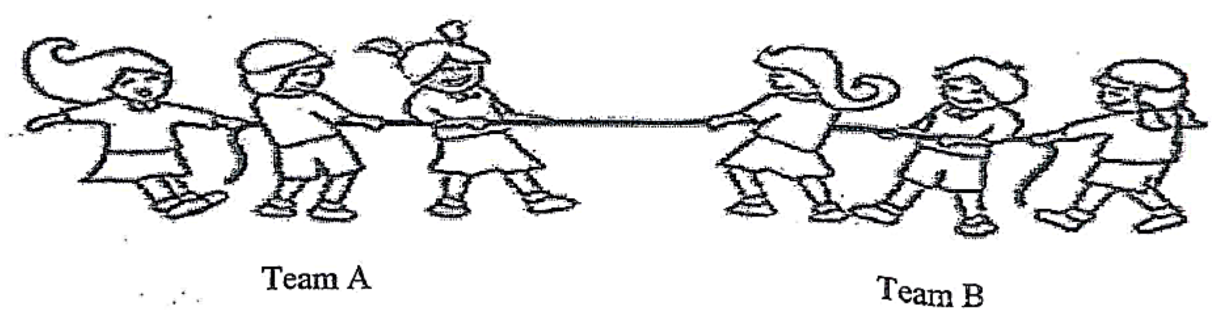
(3 marks)

Total 10 marks

NCSEC 2009 ques 1

3. Forces acting on an object can result in the object remaining at rest or moving in a particular direction.

(a) Team A and Team B participated in a Tug-of War on Sports Day.



Team A is pulling the rope with a force of 60N. Team B is pulling the rope with a force of 45N.

(i) In which direction would the rope be pulled?

____

(ii) Explain your answer.

____

____

(2 marks)

(b) Explain the scientific principles involved in the following activities.

(i) Susan stretching a rubber band until it burst.

____

____

____

(2 marks)

(ii) John moved forward when the car he was in stopped suddenly.

____

____

____

(2 marks)

(iii) A car with smooth tyres skids on a wet road.

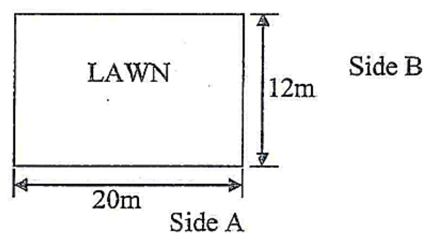
____

____

____

(1 mark)

(c) Nick pushes a lawn mower along Side A and Side B of his lawn, with the same force as seen below.



(i) On which side of the lawn, A or B, does Nick do more work when he pushes his lawn mower once? Give a reason for your answer.

Side ______________________________

Reason ______________________________

____

(2 marks)

(ii) Calculate the work done when Nick pushes the lawn mower along Side A with a force of 15N.

____

____

____

____

(1 mark)

Total 10 marks

NCSE 2013 que

5

End of Test

Please check over your answers if you finish before time.

APPENDIX E

Treatment group Pre and Post test scores

Student ID	Gender	Pre-test score	Post-test score
T01	1	40	72
T02	1	36	53
T03	1	25	54
T04	1	15	47
T05	1	18	58
T06	2	37	51
T07	2	35	78
T08	2	29	57
T09	2	23	59
T10	2	20	66
T11	2	40	74
T12	2	25	64
T13	2	28	67
T14	2	27	61
T15	2	33	75
T16	2	38	62
T17	2	29	62
T18	2	27	57

T19	2	14	65
T20	2	42	78
T21	2	28	55
T22	2	23	45
T23	2	34	65
T24	2	32	68
T25	2	26	69
T26	2	30	60
T27	2	21	71
T28	2	27	50
T29	2	14	42
T30	2	21	38
T31	2	15	41
T32	2	24	54
T33	2	22	55
T34	2	23	56
T35	2	29	75

Control group Pre and Post test scores

Student ID	Gender	Pre-test score	Post-test score
c01	1	14	29
C02	1	15	28
C03	1	13	36
C04	1	24	35
C05	1	13	30
C06	1	33	58
C07	1	17	26
C08	1	17	18
C09	1	25	38
C10	1	15	33
C11	1	16	32
C12	1	17	20
C13	1	23	33
C14	2	32	39
C15	2	25	48
C16	2	27	34
C17	2	25	34
C18	2	16	40

C19	2	23	34
C20	2	17	29
C21	2	25	41
C22	2	22	37
C23	2	12	33
C24	2	16	44
C25	2	29	37
C26	2	24	31
C27	2	20	54
C28	2	22	64
C29	2	24	44
C30	2	22	37
C31	2	26	50
C32	2	29	40
C33	2	23	37
C34	2	29	56

APPENDIX F

Science Attitude Scale

Name ______________________________ Class2 _____

Dear Student,

Please assist me with this survey which will help determine the value of Science to second form students. The questionnaire below will help me understand subjects which are difficult for students, or which student believe are not necessary for daily living. Your answer will be kept strictly confidential. Read the statement and then decide if you:

(5) Strongly Agree (4) Agree (3) Undecided (2) Disagree (1) Strongly Disagree.

Tick(✓) the appropriate number. There is **no right or wrong answer.**

Statements	1	2	3	4	5
1. Science is my favorite subject.					
2. I have great difficulties when doing science homework.					
3. Science would not make a student life more enjoyable.					
4. I enjoy discussing Science with my friends.					
5. Science is boring.					
6. I like Science.					
7. Science is difficult for me					

8. Time does not pass in Science class.					
9. I timetable hours to study Science.					
10. I do not do well in Science exams.					
11. Science is interesting to me.					
12. I dislike Science the most in all the subjects I do.					
13. I am not tired of doing Science					
14. I do not believe I can score more than 50 % in a given science test.					
15. Science can help me find solutions to everyday problems					
16. Science is not my favourite subject					
17. I have the ability to learn Integrated Science.					
18. Limited student involvement in class activities prevented me from learning science					
19. Science can help me find solutions to everyday problems					
20. Science is not necessary help me solve problems in everyday life					

APPENDIX G

Science Motivation Questionnaire II

Name: ____________________________________ **Class 2__**

SCIENCE MOTIVATION QUESTIONNAIRE II (SMQ-II)

In order to better understand what you think and how you feel about your Integrated Science class, please respond to each of the following statements from the perspective of "When I am in Integrated Science class…"

Tick(✓) the appropriate number. There is **no right or wrong answer.**

Statement	Never 0	Rarely 1	Sometimes 2	Often 3	Always 4
1. The science I learn is relevant to my life.					
2. I like to do better than other students on science tests.					
3. Learning science is interesting.					
4. Getting a good science grade is important to me.					
5. I put enough effort into learning science					
6. I use strategies to learn science well.					
7. Learning science will help me get a good job.					
8. It is important that I get an "A" in science.					
9. I am confident I will do well on science tests.					
10. Knowing science will give me a career advantage.					
11. I spend a lot of time learning science.					
12. Learning science makes my life more meaningful.					

13. Understanding science will benefit me in my career.					
14. I am confident I will do well on science labs and projects.					
15. I believe I can master science knowledge and skills.					
16. I prepare well for science tests and labs.					
17. I am curious about discoveries in science.					
18. I believe I can earn a grade of "A" in science.					
19. I enjoy learning science.					
20. I think about the grade I will get in science					
21. I am sure I can understand science.					
22. I study hard to learn science.					
23. My career will involve science.					
24. Scoring high on science tests and labs matters to me					
25. I will use science problem-solving skills in my career.					

Glynn, S. M., Brickman, P., Armstrong, N., & Taasoobshirazi, G. (2011). Science Motivation Questionnaire II: Validation with science majors and nonscience majors. Journal of Research in Science Teaching, 48, 1159-1176.

APPENDIX H

Students Evaluation Form

Lesson 2 *Date* ____

How did you feel about today's class

but did not care for

and I especially liked

Next time why don't you try

the only thing missing was

APPENDIX I

Lesson Plans

SCIENCE LESSON PLAN

TEACHER: Ms Benjamin

DATE: 22/4/14

FORM: 3

TIME: 40 minutes (1 period)

UNIT: Forces and Motion

LESSON: 1

TOPIC: St Joseph Bridge is falling down

REFERENCES (exclude class text. Include page numbers)	
http://www.mowt.gov.tt/general/project.aspx?projectID=12	

PREREQUISITES	

Knowledge:- Students know:

1. forces

Skill:- Students know how to

- Read and analyze data
- Interpersonal Skills
- Collaborate
- Work in groups and follow instructions

MATERIAL & RESOURCES	

For Teacher	For Student
Lab coat Multimedia projector Laptop Markers	Articles TNotebooks Textbook Worksheet

CONCEPT OR PRINCIPLE	

OBJECTIVES		<u>Classification</u>
At the end of the lesson, students will be able to: 1. Explain the function of bridges 2. Analyse the effect of force on the construction of a bridge.		Comprehension Analyse
PROCESS SKILLS		

<u>During the lesson, student will be engaged in</u>:

Identifying/formulating a problem
☐

Designing and Planning an experimental procedure
☐

Setting up and executing experimental work
☐

Observing and measuring
☐

Recording of data and observations
☐

Interpreting and evaluating data and observations
✓

Communicating scientific ideas, observations and arguments
✓

Applying scientific ideas and methods to solve qualitative and quantitative problems
☐

Decision-making based on examination of evidence and arguments
✓

Extracting from available information data relevant to a particular situation
✓

ACTIVITIES	

Introduction: (3-5 mins)

Class teacher enters the classroom sing St Joseph bridge is falling down (2 mins)

Teacher ask students why are bridges built (2 minutes)

Transition Statement:

Development

(25 mins)

1. Teacher informs students: -
    - they would be working in groups of six (6)
    - they need to select a scribe (reported), presenter, researcher, group leader

2. Each group would be given one of two articles on the reconstruction of the St Joseph Bridge. In the group the students would focus on the following questions :-

- What is the function of a bridge?
- What is the key idea in article?
- How did this come about? Why do they think so?
- What would have caused MOWT to decide to reconstruct the bridge? What are the effects of f not reconstruction the bridge?
- How might we prove/confirm/justify your answer?
- How is reconstruction of a bridge connected to force?
- What do you think they have to consider when designing a bridge?
- .Give reason for their answer

3. Teacher walk around the class listening to the group discussion and asking question to identify what students know.
4. Each group share their answers and ask questions based on their group discussion to the class.
5. Students complete a journal form.

.

St Joseph River Bridge Under Construction

Government Information Services Limited

Friday, Mar 7th, 2014 19:41 UTC | Comment Article

75 year old steel truss bridge- St. Joesph River Bridge.

PORT OF SPAIN, Trinidad (GISL) -- The Ministry of Works and Infrastructure wishes to advise the general public that reconstruction works to Bridge 1 /2 Eastern Main Road also known as the St Joseph River Bridge is currently underway.

This project will be spearheaded by the Bridges, Landslips and Traffic Management (BLT) Project Implementation Unit at an estimated cost of $15Million and is expected to be completed in 14 months. Works began on January 6th, 2014.

The reconstruction entails the demolition and reconstruction of the bridge on the eastbound lane only - which will retain its original location- ; construction of a single span bridge 29.5m long with nine precast, pre-stressed AASHTO Type IV beams; two lanes each 3.65m wide and one sidewalk approximately 1.5M each; the bridge will be supported on spread footings and river works which includes mass concrete lining on along the channel sides and riverbed.

In lieu of the bridge reconstruction, the following traffic arrangements are in place: the west bound lane of the Eastern Main Road is converted into two-way traffic and traffic lights are installed at the corner of Riverside Road and Abercromby Road. Additional alternative routes can also be utilised, Farm Road, Curepe, Harris Street, Belle Smythe Street and King Street.

The reconstruction is necessary since the seventy-five year old (75) steel truss bridge has been regarded as structurally deficient.

The reconstruction of the St Joseph River Bridge is one of ten projects that falls in Phase One of BLT’s Bridges Reconstruction Programme that was launched on January 12th, 2014.

THE ST. JOSEPH RIVER BRIDGE RECONSTRUCTION PROJECT

On Wednesday November 20, 2013, the Ministry of Works Infrastructure held a Community Engagement Session on its scheduled reconstruction project of the St. Joseph River Bridge, located on the Eastern Main Road (EMR) St. Joseph. Given the bridge's location on a major commuter thoroughfare and given, too, that there is to be a complete demolition of the current bridge, with replacement of a new one, it is expected that conducting this project will have a major impact on commuters and persons who reside in the surrounding areas.

Persons who attended the session viewed a presentation on the project presented by Mr. Mahadeo Jagdeo, Programme Manager of the Ministry's Bridges, Landslips and Traffic Management (BLT) Unit, and Mr. Adande Piggot a Traffic Engineer from the Ministry's Highways' Division.

As part of the presentation, the gathering was furnished with options for alternate traffic routes for the duration of the project, for which their preferred options were solicited. After the presentation, there was an 'open session' where persons could ask questions and make comments and suggestions.

A major concern which was raised, was about the project commencing in the month of December. However, such concerns were dispelled as persons were informed that during this time, project work would involve only pre-demolition and pre-construction activities and, as such, there would be no closing off of the road during the busy festive season.

Persons in attendance were also given a questionnaires/surveys to complete and submit afterward, these sought their responses to questions about traveling through the area, and any comments or suggestions they had on the project.

BRIDGE TERMINOLOGY

The brief glossary provides definitions of some bridge terminology. These terms are mentioned in the project description document for the Reconstruction of the St. Joseph Bridge Project, that we have provided: the St. Joseph Bridge is a truss bridge.

DEFINITIONS

What is a Truss Bridge?
A truss bridge is a bridge whose supporting structure consists of a network of beams usually arranged in a series of triangular sections.

What is an Abutment?
The supports at the ends of a bridge. It is usually a retaining wall supporting the ends of the bridge deck/beams.

What is a Pier?
The intermediate supports between the abutments in a multi- span bridge.

What is a Girder?
It is a large beam especially made with metal plates usually riveted or welded together. It is a horizontal structure supporting vertical loads by resisting bending.

What is a spread footing?
A spread footing is the prism of concrete (usually rectangular) placed at the base of a column, abutment, pier or wall. Its purpose is to safely distribute the loads from the column, abutment, pier or wall to the subgrade / soil.

What is AASHTO?
AASHTO: American Association of State Highway and Transportation Officials. It is a standards setting body which publishes specifications, codes, test protocols and guidelines which are used in highway design and construction throughout the US. In addition to highway design and construction, AASHTO also provide standards for air, rail, water and public transportation.

The link below is for a project description document of the St. Joseph Bridge Reconstruction Project (this was the presentation given the Community engagement Session). Some of the photographs in the document show some of the deterioration of the bridge members which deem the bridge as necessary for demolition with a new bridge to be put in its place.

SCIENCE LESSON PLAN

TEACHER: Ms Benjamin

DATE: /4/14

FORM: 3

TIME: 40 minutes (1 period)

UNIT: Forces and Motion

LESSON: 2

TOPIC: Bridging communities

REFERENCES (exclude class text. Include page numbers)

http://www.youtube.com/watch?v=tJPlwto_HqI
http://www.youtube.com/watch?v=m5cCWZAkaPA
http://www.youtube.com/watch?v=KBOGRxV49MQ
http://faculty.uoit.ca/kay/res/lo/S7_BridgeChallenge.pdf

PREREQUISITES

Knowledge:- Students know:

2. forces

Skill:- Students know how to

- Read and analyze data
- Interpersonal Skills
- Collaborate
- Work in groups and follow instructions

MATERIAL & RESOURCES

For Teacher	For Student
Multimedia projector Laptop Markers	Notebooks Textbook Worksheet

CONCEPT OR PRINCIPLE

OBJECTIVES		Classification
At the end of the lesson, students will be able to: 3. Identify the factors that are consider when design a bridge 4. Analyse the effect factor of the selection on the design choices. 5. Design a bridge based on given parameters.		Comprehension Design
PROCESS SKILLS		

During the lesson, student will be engaged in:

Identifying/formulating a problem

☐

Designing and Planning an experimental procedure

☐

Setting up and executing experimental work

☐

Observing and measuring

☐

Recording of data and observations

☐

Interpreting and evaluating data and observations ☐

✓

Communicating scientific ideas, observations and arguments ☐

✓

Applying scientific ideas and methods to solve qualitative and quantitative problems

☐

Decision-making based on examination of evidence and arguments ☐

✓ ☐

Extracting from available information data relevant to a particular situation ☐

✓

Introduction: (3-5 mins)

Show a video: http://www.youtube.com/watch?v=tJPlwto_HqI

Class teacher ask students to imagine they are building a bridge from Toco to Tobago, what do you think you would need to know or do before building the bridge? (2 mins)

Class discussion (2 minutes)

Transition Statement:

http://www.youtube.com/watch?v=lBP7739C83s

Development

(25 mins)

6. Teacher informs students they would be watching two YouTube videos on bridge design. Students are to record point from the video that
   - What are the types of bridges
   - should considering when building a bridge: -
   - what affect the bridge supporting a lot of weight over a long distance
   - Why arch are important in a bridge design? What materials are used and why?
   - What are the limitations of each type of bridge?

7. Teacher shows video to class
   - http://www.youtube.com/watch?v=m5cCWZAkaPA
   - http://www.youtube.com/watch?v=lBP7739C83s
   - http://www.youtube.com/watch?v=KBOGRxV49MQ

   Pause in between the video when the presenter says discuss.
   Students complete a work sheet which is basic on the video.

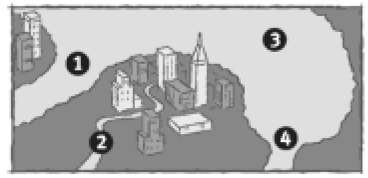
8. Each group would be given on scenario to design a bridge.
9. The groups are given a rubric the design would be judge by.
10. Students complete a journal form.

1. **Complete the chart as your teacher goes through the learning object.** [8 marks]

Type of bridge	Important features	Forces acting on bridge
Beam 		
Truss 		
Arch 		
Suspension 		

Your Task:

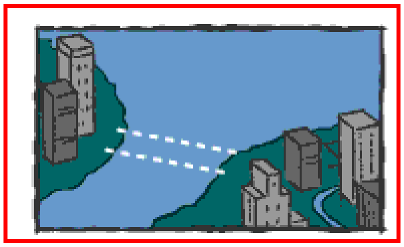
- Figure out which type bridge is right for each location.
- You will need to consider the characteristics of each bridge, the location, and what the mayor and town wants too!



2. **Complete the chart as your teacher goes through the learning object.** [8 marks]

Location	Bridge type (take a guess)	Correct bridge type	Reason for choice
1 **Multilane bridge for commuters and tourists** **Span**: 2,000 feet **Crossing**: River **Connects**: City and major highway			
2 **Footbridge across a stream** **Span**: 100 feet **Crossing**: Stream **Connects**: Two bike paths			
3 **Highway bridge across a busy shipping port** **Span**: 5,000 feet **Crossing**: Ocean bay **Connects**: Island and mainland			
4 **Railroad bridge in a national park** **Span**: 500 feet **Crossing**: Deep river gorge **Connects**: Two rocky bluffs			

3. **List 4 (four) factors you need to take into consideration when building a bridge?** [4 marks]



Location 1:

Build a multi-lane bridge for commuters and tourists

Span: 2,000 feet

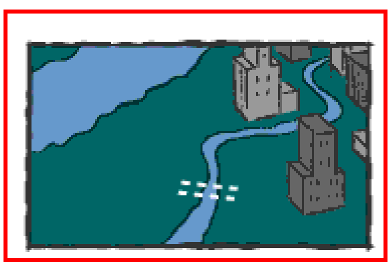
Crossing: River

Connects: Toco to Tobago

Special Notes:

"I want a one-of-a-kind bridge that will **span** our beautiful river and welcome visitors from all over the world to our thriving city. Make sure the new bridge leaves enough room for sailboats on the river. – Minister of Tourism

What kind of bridge should you build? Design and build the Bridge using simple materials. Why would you choose this type of bridge and design?



Picture to change would use a image from the school.

Location 2:

Build a bridge for pedestrians

Span: 100 feet

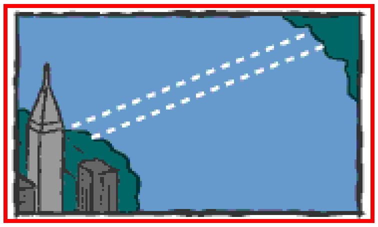
Crossing: busy Main Road and Priority Bus Route

Connects: Two bike paths

Special Notes:

"We're tired of getting bounced while crossing the road by angry drivers! We want a simple bridge -- one that will connect the School to the Priority Bus Route We don't have much money, so we're not asking for much. We just want to get to school or work every day without risking our lives!"- Principal, staff PTA of SLSS

What kind of bridge should you build? Design and build the Bridge using simple materials. Why would you choose this type of bridge and design?



Location 3:

Build a highway bridge across a busy shipping area and shopping area.
Span: 5,000 feet
Crossing: St Joseph river
Connects: St Joseph to Curepe

Special Notes:

"Our records indicate that the MOWT what to use the St Joseph river to transport cocoa from Maracus to St Joseph and ships would be pass through St Joseph each day. Please build a bridge that does not block the flow of water traffic and road traffic. We do not want angry sailors or motorists. Thank you."
-- MOWT

What kind of bridge should you build?

Build your design in class and bring your bridge to next class.

SCIENCE LESSON PLAN

TEACHER: Ms Benjamin

DATE: 2/5/14

FORM: 3

TIME: 40 minutes (1 period)

UNIT: Forces and Motion

LESSON: 3 and 4

TOPIC: Architects' Bridge Clash

REFERENCES (exclude class text. Include page numbers)	
Active Science 2 pg. 164 http://www.youtube.com/watch?v=kdXMMmb4RlM	
PREREQUISITES	
Knowledge:- Students know: 3. forces Skill:- Students know how to • Read and analyze data • Interpersonal Skills • Collaborate • Work in groups and follow instructions	
MATERIAL & RESOURCES	

For Teacher	For Student
Multimedia projector Laptop Markers	Straws Chop sticks Ruler Pencil paper Glue Glue gun Twine Play dough Paper clips Rubric thread

CONCEPT OR PRINCIPLE	

The design of a bridge to determine by the amount of force it is expected to hold and the purpose of the bridge.

OBJECTIVES		Classification
At the end of the lesson, students will be able to: 6. Analysis different bridge structure and function 7. Critic a bridge design		

PROCESS SKILLS	

During the lesson, student will be engaged in:

Identifying/formulating a problem

☐

Designing and Planning an experimental procedure

☐

Setting up and executing experimental work

☐

Observing and measuring

☐

Recording of data and observations

☐

Interpreting and evaluating data and observations ☐

✓

Communicating scientific ideas, observations and arguments ☐

✓

Applying scientific ideas and methods to solve qualitative and quantitative problems

☐

Decision-making based on examination of evidence and arguments

✓

Extracting from available information data relevant to a particular situation

✓

Introduction: (3-5 mins)

Class teacher ask students to set up their bridge along the perimeter of the lab.

Transition Statement:

Development

(25 mins)

11. Teacher asks each group to have two presenters' to stay with their bridge so they can explain it to the visitors to the booth
12. Students in their groups would visit each bridge and use the rubric given to mark the booth bridge design for functionality, originality: -
13. Construction Phase :- during the construction phase you would build your bridge. During construction you may decide want material you need and quantity. Your design may needs to change during construction. This is ok -- just make a new sketch and revise your materials list
14. Aesthetic Vote :-Each student will cast a vote about the look of each bridge. The scale is 1 - 5 -- (1: not at all appealing; 2: not appealing; 3: neutral/average; 4: somewhat appealing; 5: very appealing). This number is averaged to generate a score for each bridge. This score is not based on how well the bridge might hold weight, but on how it looks.

15. The teacher would also walk to reach booth and observe the presenters interaction with the visitors.
16. Teacher share observation.
17. Evaluate your teams bridge
18. Students complete a journal form.

Use this worksheet to evaluate your team's results:

1. Did you succeed in creating a bridge that held the required weight for a full minute? If not, why did it fail?

2. Did you decide to revise your original design while in the construction phase? Why?

3. How many popsicle sticks did you end up using? Did this number differ from your plan? If so, what changed?

4. What was the average aesthetic score for your bridge? How did this compare to the rest of the class? What design elements of other bridges did you like the best?

5. Do you think that engineers have to adapt their original plans during the construction of systems or products? Why might they?

6. If you had to do it all over again, how would your planned design change? Why?

7. What designs or methods did you see other teams try that you thought worked well?

8. Do you think you would have been able to complete this project easier if you were working alone? Explain…

9. What sort of trade-offs do you think engineers make between functionality, safety, and aesthetics when building a real bridge?

SCIENCE LESSON PLAN

TEACHER: Ms Benjamin

DATE: /4/14

FORM: 3

TIME: 40 minutes (1 period)

UNIT: Forces and Motion

LESSON: 5

TOPIC: Car Skids

REFERENCES (exclude class text. Include page numbers)	
http://www.youtube.com/watch?v=zKh873-FKAI	

PREREQUISITES	

Knowledge:- Students know:

4. forces

Skill:- Students know how to

- Read and analyze data
- Interpersonal Skills
- Collaborate
- Work in groups and follow instructions

MATERIAL & RESOURCES	
For Teacher	For Student
Multimedia projector Laptop Markers speakers	Toy cars Laptop Internet Wooden boards Wash rags Two different types of sand paper per group Students Note books Stop watch Ruler calculator

CONCEPT OR PRINCIPLE		
Forces can be illustrated with examples from automobile racing.		
OBJECTIVES		Classification
At the end of the lesson, students will be able to: 1. investigate the force of friction and relate it to road surface and conditions 2. relate results to skids or stopping distances of cars.. 3. Analysis how the road surface affects the speed of a car		Comprehension Comprehension
PROCESS SKILLS		

During the lesson, student will be engaged in:

Identifying/formulating a problem

☐

Designing and Planning an experimental procedure

☐

Setting up and executing experimental work

☐

Observing and measuring

☐

Recording of data and observations

☐

Interpreting and evaluating data and observations ☐

✓

Communicating scientific ideas, observations and arguments ☐

✓

Applying scientific ideas and methods to solve qualitative and quantitative problems

☐

Decision-making based on examination of evidence and arguments ☐

✓ ☐

Extracting from available information data relevant to a particular situation ✓ ☐

Introduction: (3-5 mins)

Class teacher ask students to describe some of the physical forces involved in their everyday life. Explain that a force is simply a push or pull and that there are many types of forces.

Teacher plays a video http://www.youtube.com/watch?v=zKh873-FKAI

Transition Statement: When a car skids there are a number of forces working on it.

Development

(30 mins)

19. Teacher informs students: -
    - they would be working in groups of six (6)
    - they need to select a scribe (reported), presenter, researcher, group leader
20. Each group with the use of the internet and textbooks answer the following questions:
    - How can you increase the force for a race car?
    - Determine what forces are involved in the moving car.
      Teacher walks around and asks groups guided question and listen to how the students are think.
21. Each group is give a wash rag, sand paper, a rule, stop watch, two cars, scale
    The groups would have to
    - Calculate the force of their car sitting on the table and record it in their books.
    - Determine how to represent forces with free body diagrams to show
      - ➢ The car sitting on the table
      - ➢ The car when a force is applied.
      - ➢ When on car is pushed and made to hit the other car.
    - Determine the effect of the different surface on the speed of the car
    - Explain how a very smooth road surface like driving after it just rain car affect the speed of a car.
      Teacher will walk around to groups and listen to their discussion and ask questions.

SCIENCE LESSON PLAN

TEACHER: Ms Benjamin

DATE: /4/14

FORM: 3

TIME: 40 minutes (1 period)

UNIT: Forces and Motion

LESSON: 5

TOPIC: Drag racing

REFERENCES (exclude class text. Include page numbers)	

PREREQUISITES	

Knowledge:- Students know:

5. Forces
6. Types of force
7. Factors affecting a force

Skill:- Students know how to

- Read and analyze data
- Interpersonal Skills
- Collaborate
- Work in groups and follow instructions

MATERIAL & RESOURCES

For Teacher	For Student
Lab coat Multimedia projector Laptop Markers	Cars Wooden board ramp Textbooks to increase the height of the ramp Rules Stopwatch

<table>
<tr><td colspan="2"></td><td></td></tr>
<tr><td>CONCEPT OR PRINCIPLE</td><td colspan="2"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>OBJECTIVES</td><td></td><td><u>Classification</u></td></tr>
<tr><td colspan="2">At the end of the lesson, students will be able to:</td><td>Comprehension

Comprehension</td></tr>
<tr><td>PROCESS SKILLS</td><td colspan="2"></td></tr>
<tr><td colspan="3"><u>During the lesson, student will be engaged in</u>:

Identifying/formulating a problem
☐
Designing and Planning an experimental procedure
☐
Setting up and executing experimental work
☐
Observing and measuring
☐
Recording of data and observations
☐
Interpreting and evaluating data and observations ☐
✓
Communicating scientific ideas, observations and arguments ☐
✓
Applying scientific ideas and methods to solve qualitative and quantitative problems
☐
Decision-making based on examination of evidence and arguments ☐
✓ ☐
Extracting from available information data relevant to a particular situation ☐
✓</td></tr>
</table>

<u>Introduction</u>: (3-5 mins)

Class teacher ask students what might make it difficult for a driver to stop for you if you step out into the road. (If they don't notice you because they are distracted, if they can't stop in time.)

<u>Development</u>

(25 mins)

1. Teacher informs students: -
2. they would be working in groups of six (6)
3. they need to select a scribe (reported), presenter, researcher, group leader.
4. Teacher will briefly review velocity lesson and introduce the term acceleration. Teacher will engage students in group discussion to define the term and cite examples in day-to-day life. Then three groups share.
5. **s:** Teacher will give instructions on what to do when the groups get to the race track area. These instructions will also be visible on the projector screen /chalk/white board. Class will divide into groups, one at each race-track. Each member will have a task – Driver/Scribe, Timers 1-3. Each timer is issued a stopwatch, and directed how to use it. They are told their mark to watch and to simultaneously start the timers, and to stop their stopwatch when the car passes their mark. The scribe will take down these times. This will be repeated 4 times. Each group member will take the times from one of the races and graph the results of time as a function of distance for each time measurement. During this time the teacher will be both visible and attentive to the class, as well as a resource for struggling groups or individuals. Students will hand in the graphs together as a group package, which will include the race-car, track, and measurements for all races, and stopwatches. Students will return to seats.
6. **Discussion: 10-15 minutes:** Teacher will begin discussion about the results of the graphs and races. Specific questions will be asked including "what are these kinds of graphs called" and "What is common to equations that have this kind of graph?" Using power point, teacher will deliver planned lecture on acceleration, using illustration by example. Presentation will include step-by-step manipulation of velocity formula to come up with acceleration formula "$a=\Delta v/\Delta t$"

SCIENCE LESSON PLAN

TEACHER: Ms Benjamin
DATE: /4/14
FORM: 3
TIME: 40 minutes (1 period)
UNIT: Forces and Motion
LESSON: 6&7
TOPIC: Drag racing part 1

REFERENCES (exclude class text. Include page numbers)	
Active Science 2 pg. 164 http://www.youtube.com/watch?v=kdXMMmb4RlM	
PREREQUISITES	
Knowledge:- Students know: 8. forces Skill:- Students know how to • Read and analyze data • Interpersonal Skills • Collaborate • Work in groups and follow instructions	
MATERIAL & RESOURCES	

For Teacher	For Student
Lab coat Multimedia projector Laptop Markers	Cars Force meters Range of surfaces to test Metre rules Stopwatch Material to make car (broom stick cut 8cm long, wheels, straw, glue gun, a pair of scissors)

CONCEPT OR PRINCIPLE	

OBJECTIVES		Classification
At the end of the lesson, students will be able to: 8. Design a car 9. understand that it can be difficult for drivers to stop in time if a pedestrian		Comprehension

steps out into the road 10. investigate the force of friction and relate it to road surface and conditions 11. relate results to skids or stopping distances of cars	Comprehension
PROCESS SKILLS	

During the lesson, student will be engaged in:

Identifying/formulating a problem ☐

Designing and Planning an experimental procedure ☐

Setting up and executing experimental work ☐

Observing and measuring ☐

Recording of data and observations ☐

Interpreting and evaluating data and observations ✓ ☐

Communicating scientific ideas, observations and arguments ☐ ✓

Applying scientific ideas and methods to solve qualitative and quantitative problems ☐

Decision-making based on examination of evidence and arguments ✓ ☐

Extracting from available information data relevant to a particular situation ✓ ☐

Lesson 6

Introduction: (3-5 mins)

Students are informed we are still looking at friction.
Ask students what might make it difficult for a driver to stop for you if you step out into the road. (If they don't notice you because they are distracted, if they can't stop in time.)
Students are then asked what else can affect stopping distances. (The weight of the car, the road surface, the weather, the tyre tread, speed.) Describe the role that friction plays in making the car stop.
Lesson 6

Development (25 mins)

1. One member from each group would collect materials to losing grip and skidding
2. Students are inform they are working with CSI on a case to determine which surface the car was on

before the car ended up in the Caroni river. This information is necessary to locate where the accident occurred

3. Students in their groups would setup their road using for the following scenarios for a range of surfaces could be tested:

Tile
Wood
Carpet
Concrete
Wet and dry conditions
Sand paper

4. Students are to record the length of time it takes a car to travel on different surfaces for the same distance and determine which surface the driver had the least control of the car which could have resulted in the accident.
5. Students would record their results and draw a graph to show the effect of the different surfaces.
6. Group share their answer for which surface the driver has the least control and expalinthe reason for their answer.

Ask students to think about what they discussed at the start of the lesson. What have they learnt from conducting the experiment? Will this affect their behaviour as a pedestrian?

Lesson 7
Introduction (1 mins)
Coyota Trinidad limited is having design your ride competition. Your class from our school was selected Using only the materials design and build a car. The car that completes the entire race course in the shorts time would represent the school at the competition on a national level.

Development (30 Mins)

1. Each group would collect material to design and build a car.
2. Students will calculate the total average speed for running the entire course, to goal is to travel at the highest speed.
3. Students will run all of their trials they are expected to compile all of their investigations and complete a write up
4. Students would use all of the data from the prior investigations, and then write a proposal as to why their vehicle should be chosen by the Coyota Trinidad limited
5. Students must include
    - Summary of cars overall performance
    - Explanation as to why their car performed the way it did
    - Explanation is supported by their data
    - What materials were used to build their car
    - Possible problems/ challenges and solutions
    - Considerations and implications for the future
    - Reflection on the design process

SCIENCE LESSON PLAN

TEACHER: Ms Benjamin

DATE: /4/14

FORM: 3

TIME: 40 minutes (1 period)

UNIT: Forces and Motion

LESSON: 8-10

TOPIC: High heels vs Flat

REFERENCES (exclude class text. Include page numbers)

Active Science 2 pg. 164

http://www.youtube.com/watch?v=kdXMMmb4RlM

PREREQUISITES

Knowledge:- Students know:

9. forces

Skill:- Students know how to

- Read and analyze data
- Interpersonal Skills
- Collaborate
- Work in groups and follow instructions

MATERIAL & RESOURCES

For Teacher	For Student
Lab coat Multimedia projector Laptop Markers	Graph paper Calculator Textbook Worksheet Scale Laptop Internet Paper eraser Ruler colour pencil Pencil

<table>
<tr><td></td><td colspan="2"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>OBJECTIVES</td><td></td><td><u>Classification</u></td></tr>
<tr><td colspan="2">1. At the end of the lesson, students will be able to:
2. Define pressure
3. Describe how force and pressure are related.
4. Calculate force, pressure
5. Identify the different parts of the walking gait.
6. Explain how pressures on different parts of the foot increase and decrease while walking or running.
7. Design a sneakers</td><td>Comprehension

Comprehension</td></tr>
<tr><td>PROCESS SKILLS</td><td colspan="2"></td></tr>
<tr><td colspan="3"><u>During the lesson, student will be engaged in</u>:

Identifying/formulating a problem
☐
Designing and Planning an experimental procedure
☐
Setting up and executing experimental work
☐
Observing and measuring
☐
Recording of data and observations
☐
Interpreting and evaluating data and observations ☐
✓
Communicating scientific ideas, observations and arguments ☐
✓
Applying scientific ideas and methods to solve qualitative and quantitative problems ☐
Decision-making based on examination of evidence and arguments ✓ ☐
Extracting from available information data relevant to a particular situation ☐
✓</td></tr>
</table>

Lesson 8

Introduction: (3-5 mins)

Class teacher ask the students if their toes were ever with someone with high heel or a sneaks. Teacher takes students response and the why they thing the pain felt is different. (2 mins)

Transition Statement: Pain you felt is due to the amount of pressure applied to your toe/s.

Development

(25 mins)

22. Students are given a work sheet on pressure and force to complete.
23. Teacher informs students: -
    - they would be working in groups of four (4)
    - they need to select a scribe (reported), presenter, researcher, group leader
    - Nikke is looking for a new shoe design so the teacher is thinking of entering some students
24. Each group would discuss what factors they think is important in designing any type of shoe and give an answer for each factor the group decided.
25. Each group is given graph papers and to select two individuals who they would design a shoe for. The two students' feet would be traced on to the graph paper.
    - Each person would have two graph papers- 1 to draw the flat foot and the other to draw the foot as if the person is wearing a stiletto shoe.
    - Calculate the surface area for each shoes
26. The two persons would have their mass taken and converted to a weight. And weight would be recorded
27. Teacher asks students how the think force in this case weight affect pressure. Teacher takes students answers and throws it back at students for them to answer.
28. Teacher state what pressure is and how it is calculated.
29. Groups are then asked to calculate the pressure each shoes would have to withstand.
30. Students share what they observe about pressure and force. Teacher clarify any misconception .

Lesson 9

Introduction: (3-5 mins)

Students are asked to share what type suggested were factor that should be considered in designing a shoe.

Teacher shares that designing a shoe is a complex process in which several factors must be considered. Engineers design shoes and spend countless hours testing them so that they perform a variety of required functions while conforming to current styles and trends. Shoes are subjected to a range of forces during walking and running. The entire shoe must be able to withstand these forces for their lifetime, without failure. Some of these forces and pressures are enormous. For example, the pressure that a stiletto heel exerts on the ground midstride is substantially greater than that of an elephant walking. A high heeled shoe must be designed to withstand these forces while also providing foot support

.

Development (30 mins)

1. Each group is to observe how the person walks and runs who they are design the shoe for. Observing which part of the foot touches the ground first and how would that affect designing the shoe.
2. Students look to at the person arch and determine as a group how the foot arch affect the design of the shoe.
3. Students would decide to design a stiletto shoe or a sneaker.
   - Stating the materials they need in terms on thickness , layers
4. Students would explain the functionality of their design to the class next class .

Name____ Form _____________

Force and Pressure Quiz

1. Which would exert a higher force on a scale: A grown elephant or a baby elephant? Why?

2. Would an elephant standing on one leg exert a higher **force** on a scale than an elephant standing on four legs? Why?

3. Would an elephant standing on one leg exert a higher **pressure** on the scale than an elephant standing on all four legs?

Lesson 10

Introduction (2-3 min)

Teacher brings one of her old sneaker. Teacher displays her sneakers and asks students what they look for when buying a shoe. Teacher list the quality on the board and explain to the students these are the criteria their shoe design would be judge by.

Development

Group come up to display their design and explain what they think is the important feature of their shoes and why the shoes should be developed by Nnike. Groups would be marked based on the average score obtained from class.

SCIENCE LESSON PLAN

TEACHER: Ms Benjamin

DATE: 22/4/14

FORM: 3

TIME: 40 minutes (1 period)

UNIT: Forces and Motion

LESSON: 11-13

TOPIC: **Humpty Dumpty bungee jumping**

REFERENCES (exclude class text. Include page numbers)	
http://www.youtube.com/watch?v=zG22qQydPVQ	
PREREQUISITES	

Knowledge:- Students know:

10. Forces
11. Elasticity

Skill:- Students know how to

- Read and analyze data
- Interpersonal Skills
- Collaborate
- Work in groups and follow instructions

MATERIAL & RESOURCES

For Teacher	For Student
Lab coat Multimedia projector Laptop Markers	Coins Rubber bands Retort stand Paperclip Graph paper Rulers (15 cm, 30 cm, 50 cm, 1m) Panty hose Notebooks newspaper Scale sandwich bags

OBJECTIVES		Classification
1. At the end of the lesson, students will be able to: 2. Determine the extension of rubber bands is proportional to the applied force 3. Design a scientific experiment to explain Hooke's Law		Comprehension Analyse
PROCESS SKILLS		

During the lesson, student will be engaged in:

Identifying/formulating a problem ☐

Designing and Planning an experimental procedure ☐

Setting up and executing experimental work ☐

Observing and measuring ☐

Recording of data and observations ☐

Interpreting and evaluating data and observations ✓ ☐

Communicating scientific ideas, observations and arguments ☐
✓

Applying scientific ideas and methods to solve qualitative and quantitative problems
☐

Decision-making based on examination of evidence and arguments ☐
✓ ☐

Extracting from available information data relevant to a particular situation ☐
✓

Lesson 11	

Introduction: (3-5 mins)

Teacher asks class if anyone ever when bungee jumping or would like to go bungee jumping. A video of a person bungee jumping is played. http://www.youtube.com/watch?v=zG22qQydPVQ (2 minutes). Teacher asks students how did the developer for that bungee jump rope was sure the person would not have burst the rope. Students share their answers and teacher asks the other students their views to the person's response.

Development (30 mins)

31. Teacher asks students what they think the rope is made of.
    How do they think they go about testing the rope especial for that length of jump
32. Teacher informs students: -
    - they would be working in groups of four (4)
    - They need to select a scribe (reported), record the change in length, dropper of the coin, person observing how lower the coin drops before pulling up a little.

33. Students are told they are going to design a bungee cord and predict at what length the bungee cord would fall, with an egg in it, 5cm from the floor. The group that reaches the closest to it wins.
34. Each group would collect their package and a worksheet 1 and 2
35. Group begin working and the teacher walks around and asks students to explain what they are observing with the change in length with the rubber bands and stockings.
36. Teacher asks class about observations then explains Hooke's Law using everyday things like slinker band, wogglies, and how a scale works.

Group Name__________________________
Members of the group: ____

Humpty Dumpty bungee jumping

Activity 1

Your group will be supplied with one cent coins, rubber bands, a string, a sandwich bag, and an egg for this activity. You had better get cracking!

1 Weight your egg.

2. Weight your bag of coins to weigh the same as the egg. Return your egg to the front for the last day.

3. Using four rubber bands connect them to form a bungee cord. Carefully attach the bungee cord to the bag of coins.

3. Attach the bungee cord to the top of a retort stand. Measure from the zero (0) mark, carefully bungee jump your c bag of coins. Measure the distance that the coins fall to the nearest 1cm.

4. Record the drop distance in the data table (Table 1). Repeat the drop two more times, again recording your results. Average the drop distance in the data table.

5. Repeat the test using 6, 8, 10, 12, and 14 rubber bands to make your bungee cord. Be sure to record your data in the table.

Repeat the bungee cord test for nylon panty hose.

Use the graph paper provided to create a graph of the data in the data table. The number of rubber bands should go on the x axis, starting at 0 and going to 24 in increments of 2. Drop height will be on the y axis, starting with 0 and going to 90cm in 5 cm increments. Title and label each axis with the proper units. Plot the average drop height and draw a "best-fit line" through the points. (Hint: About as many points should be above the best-fit line as below it.)

Results

Number of rubber bands (bungee length)	Drop height in centimetres				
	Trial 1	Trial 2	Trial 3	Average	

Length of Nylon stockings (bungee length)	Drop height in centimetres				
	Trial 1	Trial 2	Trial 3	Average	

Worksheet

Answer each of the following questions on a separate sheet of paper before conducting your bungee jump. Turn in the results of your study for class credit. Use complete sentences in each response.

1. Based on your observations, what forces are applied to the egg during the bungee jump? (*Think about the entire jump, from the start until the* bag of coins *comes to rest again.)*

____

Discuss at least two forces that are applied to your coins during the jump.

____

____

2. What is inertia?

____

3. Look up Newton's first law. Explain why the bag ofcoins continues to fall, even when the bungee cord begins to apply an upward force.

____

____

4. When the bag of coins bungee jumps, the bag of coins will fall free until it reaches the resistance point at

which the rubber bands begin to apply force to the bag of coins. For some reason, the bag of coins initially continues to fall downward. According to Newton's first law, why and when does the bag of coins stop moving downward?

____

____

____

5. Using Newton's second law, explain why the bag of coins springs up and down on the bungee cord before coming to rest. (Hint: What causes the bag of coins to stretch out the bungee, and then spring back up?)

____

____

Lesson 12

Development

Teacher informs students of their task to design a bungee cord by determining how many rubber bands are needed to drop the egg five cm of the floor.

Activity 2

Your task is to design a safe bungee jump for an egg. The egg must come as close to the floor as possible but not touch the floor.

Part of your grade will be assigned based on how close you come to the floor without touching it. The remainder of the grade will be based on the engineering calculations and data that you show for this activity.

The Challenge

Use your graph to predict how many rubber bands and length of nylon stockings your group should attach to the egg when dropped from a height of _100 centimetres (height to be assigned by the teacher). The teacher will drop all eggs from this height. To make your prediction, extend the best-fit line on your graph and extrapolate up from the x axis and over to the y axis.

Make a prediction, described below, as to the optimal number of rubber bands you'll need—then construct and test your bungee jump project.

Prediction

Write a prediction of the number of rubber bands that you will need so that the egg comes within 5 centimetres from the ground without a splat! Use the information from your graph to explain why you think your prediction is accurate.

Use your graph to calculate the average experimental error. SHOW YOUR WORK!

A. Determine the distance from each point on your scatter graph to the best-fit line. Record your measurements.

B. Find the average (mean) of the distances from the best-fit line. (Hint: Add the distances together and divide by the number of data points.)

Lesson 13.

Each group state how many rubbers and length on stocking need to drop the egg so it would be 5 cm of the floor and then one by one each groups Humpty Dumpty would bungee jumping.

Each group would present a report

As a final activity, explain the results of your total experiment in a one-page technical report. Discuss in the paper what you learned, what worked, what didn't, and what you might do differently to make the results more accurate.

APPENDIX J

Treatment group pre and post Science Attitude Scale

Student ID	Gender	Pre-SAS score	Post- SAS score
T01	1	66	74
T02	1	54	69
T03	1	62	59
T04	1	55	59
T05	1	66	51
T06	2	62	44
T07	2	58	69
T08	2	55	69
T09	2	53	75
T10	2	60	80
T11	2	56	69
T12	2	58	75
T13	2	59	87
T14	2	52	62
T15	2	64	69
T16	2	55	65
T17	2	54	61
T18	2	50	64
T19	2	58	69
T20	2	46	58
T21	2	47	67
T22	2	69	71
T23	2	65	76
T24	2	56	80
T25	2	77	62
T26	2	58	63
T27	2	59	62
T28	2	57	58
T29	2	52	66
T30	2	47	64
T31	2	61	55
T32	2	58	64
T33	2	55	60
T34	2	56	80
T35	2	62	63

Control group pre and post Science Attitude Scale

Student ID	Gender	Pre-SAS score	PostSAS score
c01	1	50	54
C02	1	57	60
C03	1	60	53
C04	1	45	44
C05	1	55	57
C06	1	45	59
C07	1	56	57
C08	1	47	55
C09	1	62	57
C10	1	47	48
C11	1	46	55
C12	1	58	47
C13	1	52	56
C14	2	55	57
C15	2	35	45
C16	2	49	56
C17	2	45	67
C18	2	52	57
C19	2	57	62
C20	2	59	62
C21	2	55	57
C22	2	58	
C23	2	55	66
C24	2	62	65
C25	2	46	65
C26	2	58	55
C27	2	56	57
C28	2	60	57
C29	2	53	65
C30	2	55	57
C31	2	58	69
C32	2	58	65
C33	2	55	60
C34	2	45	56

Descriptive Statistics Students pre-test and post-test Science Attitude Scale (SAS) individual questions in the questionnaire.

Statements	Pre-test		Post-test	
	Mean	Std Dev	Mean	Std Dev
1	3.8	2.89	4.07	4.01
2	3.1	1.81	2.19	1.72
3	2.3	0.64	3.02	1.98
4	4.2	3.49	4.08	4.16
5	2.7	0.97	2.41	0.85
6	4.0	3.32	4.20	4.80
7	3.0	1.34	2.44	1.19
8	3.1	1.73	2.42	1.20
9	3.0	2.54	2.03	1.06
10	4.0	3.13	2.86	1.28
11	3.5	2.77	4.09	1.38
12	3.3	2.18	2.21	0.84
13	3.5	2.33	2.74	1.46
14	3.0	2.22	2.77	1.45
15	4.4	4.36	4.74	6.33
16	3.1	1.92	2.27	1.01
17	4.0	4.28	4.52	5.54
18	3.1	1.7	2.2	1.5
19	4.3	4.3	4.5	5.3
20	3.1	1.5	2.1	1.3

APPENDIX K

Comparsion mean- Paired sample test correlation for treatment SAS

		Correlation	Sig.
Pair 1	statement 1 before & after intervention	.861	.061
Pair 2	statement 2 before & after intervention	.435	.464
Pair 3	statement 3 before & after intervention	.143	.819
Pair 4	statement 4 before & after intervention	.959	.010
Pair 5	statement 5 before & after intervention	-.470	.424
Pair 6	statement 6 before & after intervention	.916	.029
Pair 7	statement 7 before & after intervention	.009	.988
Pair 8	statement 8 before & after intervention	-.066	.916
Pair 9	statement 9 before & after intervention	-.146	.814
Pair 10	statement 10 before & after intervention	.371	.539
Pair 11	statement 11 before & after intervention	-.302	.621
Pair 12	statement 12 before & after intervention	-.276	.654
Pair 13	statement 13 before & after intervention	-.283	.644
Pair 14	statement 14 before & after intervention	.022	.972
Pair 15	statement 15 before & after intervention	.978	.004
Pair 16	statement 16 before & after intervention	.213	.731
Pair 17	statement 17 before & after intervention	.741	.152
Pair 18	statement 18 before & after intervention	-.368	.543
Pair 19	statement 19 before & after intervention	.947	.015
Pair 20	statement 20 before & after intervention	-.575	.311

APPENDIX L

Paired sample test- for treatment group pre-test and post-test individual means scores

		Paired Differences		t	Sig. (2-tailed)
		Mean	Std. Deviation		
Pair 1	statement 1 before & after intervention	-3.400	38.122	-.199	.852
Pair 2	statement 2 before & after intervention	16.000	33.727	1.061	.349
Pair 3	statement 3 before & after intervention	-13.200	35.926	-.822	.457
Pair 4	statement 4 before & after intervention	1.600	23.061	.155	.884
Pair 5	statement 5 before & after intervention	5.400	28.121	.429	.690
Pair 6	statement 6 before & after intervention	-2.800	39.758	-.157	.882
Pair 7	statement 7 before & after intervention	9.600	32.083	.669	.540
Pair 8	statement 8 before & after intervention	12.400	39.106	.709	.517
Pair 9	statement 9 before & after intervention	16.600	52.104	.712	.516
Pair 10	statement 10 before & after intervention	20.400	52.372	.871	.433
Pair 11	statement 11 before & after intervention	-35.800	76.413	-1.045	.355
Pair 12	statement 12 before & after intervention	19.600	45.720	.959	.392
Pair 13	statement 13 before & after intervention	13.200	55.387	.533	.622
Pair 14	statement 14 before & after intervention	4.600	47.316	.217	.839
Pair 15	statement 15 before & after intervention	-7.000	40.639	-.385	.720
Pair 16	statement 16 before & after intervention	15.800	35.485	.996	.376
Pair 17	statement 17 before & after intervention	-9.400	66.976	-.314	.769
Pair 18	statement 18 before & after intervention i	16.200	48.065	.754	.493
Pair 19	statement 19 before & after intervention	-5.000	33.712	-.332	.757
Pair 20	statement 20 before & after intervention	17.400	45.583	.854	.441

APPENDIX M

Subscale for Science Attitude Scale (SAS)

Enjoyment subscale Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
statement 3 after intervention	5	18	95	54.40	35.725
statement 5 after intervention	5	24	64	43.40	15.291
statement 8 after intervention	5	15	72	43.60	21.594
statement 12 after intervention	5	24	62	39.80	15.073
statement 13 after intervention	5	9	78	49.40	26.283
statement 18 after intervention	5	9	84	40.20	27.572
Valid N (listwise)	5				

Value of science subscale Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
statement 2 after intervention	5	5	88	39.40	30.884
statement 10 after intervention	5	31	88	51.40	22.963
statement 15 after intervention	5	0	255	85.40	113.903
statement 19 after intervention	5	3	192	81.60	95.610
statement 20 after intervention	5	6	68	38.40	23.923
Valid N (listwise)	5				

Interest subscale Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
statement 1 after intervention	5	14	160	71.40	72.269
statement 4 after intervention	5	14	180	73.40	74.798
statement 6 after intervention	5	9	215	75.60	86.448
statement 7 after intervention	5	15	72	44.00	21.413
statement 9 after intervention	5	11	56	36.60	19.087
statement 11 after intervention	5	8	160	78.60	73.674
statement 14 after intervention	5	9	78	49.80	26.119
statement 16 after intervention	5	12	62	40.80	18.254
statement 17 after intervention	5	6	196	81.40	99.694
Valid N (listwise)	5				

APPENDIX N

Treatment group pre and post Science Motivation Questionnaire II

Student ID	Gender	Pre-SAS score	Post- SAS score
T01	1	48	64
T02	1	53	59
T03	1	57	56
T04	1	42	55
T05	1	33	13
T06	2	12	38
T07	2	38	57
T08	2	42	48
T09	2	61	76
T10	2	56	70
T11	2	60	74
T12	2	61	71
T13	2	46	70
T14	2	57	70
T15	2	42	63
T16	2	52	63
T17	2	58	67
T18	2	44	48
T19	2	42	60
T20	2	22	59
T21	2	49	50
T22	2	48	75
T23	2	43	52
T24	2	21	59
T25	2	31	63
T26	2	46	56
T27	2	42	55
T28	2	32	34
T29	2	48	59
T30	2	36	74
T31	2	35	68
T32	2	39	44
T33	2	24	58
T34	2	32	41
T35	2	48	63

Control group pre and post Science Motivation Questionnaire II

Student ID	Gender	Pre-SAS score	PostSAS score
c01	1	66	70
C02	1	56	59
C03	1	69	72
C04	1	58	69
C05	1	49	55
C06	1	64	47
C07	1	60	58
C08	1	55	47
C09	1	45	58
C10	1	71	73
C11	1	69	74
C12	1	58	65
C13	1	59	68
C14	2	58	65
C15	2	56	67
C16	2	63	62
C17	2	59	61
C18	2	37	47
C19	2	66	69
C20	2	46	48
C21	2	58	69
C22	2	61	56
C23	2	63	78
C24	2	73	74
C25	2	57	60
C26	2	71	50
C27	2	69	75
C28	2	77	81
C29	2	69	76
C30	2	47	54
C31	2	68	74
C32	2	59	65
C33	2	75	77
C34	2	57	62

Descriptive Statistics Students pre-test and post-test Motivation in Science individual questions in the questionnaire.

	Per-test		Post-test	
	Mean	Std Dev	Mean	Std Dev
1	2.39	1.10	3.38	2.45
2	2.43	1.48	3.37	1.91
3	2.81	1.85	3.19	2.00
4	3.04	1.83	3.62	2.86
5	2.83	1.36	3.39	1.78
6	2.80	1.38	3.04	1.65
7	1.69	1.30	3.40	2.50
8	2.36	1.60	3.03	1.64
9	2.42	1.80	3.16	1.84
10	1.64	2.83	3.12	1.83
11	2.28	1.25	3.41	1.31
12	1.33	2.44	3.84	1.43
13	1.64	2.80	3.42	2.36
14	3.29	2.17	3.44	2.27
15	2.13	1.82	2.34	2.07
16	1.64	2.87	3.13	2.02
17	2.62	2.81	3.26	2.38
18	1.64	1.87	3.22	2.16
19	2.82	2.32	3.58	2.53
20	2.70	2.38	3.43	2.18
21	1.51	1.89	3.10	1.73
22	3.16	1.81	3.30	2.69
23	2.71	1.02	3.50	2.52
24	2.72	1.53	3.64	2.84
25	2.49	2.53	3.36	2.34

APPENDIX O

Paired Samples Statistics SMQ II

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	statement 1 before intervention	61.00	5	38.490	17.213
	statement 1 after intervention	78.80	5	85.902	38.417
Pair 2	statement 2 before intervention	61.80	5	51.790	23.161
	statement 2 after intervention	78.60	5	66.729	29.842
Pair 3	statement 3 before intervention	50.60	5	64.860	29.006
	statement 3 after intervention	75.40	5	70.127	31.362
Pair 4	statement 4 before intervention	72.80	5	64.208	28.715
	statement 4 after intervention	83.20	5	100.166	44.796
Pair 5	statement 5 before intervention	69.00	5	47.429	21.211
	statement 5 after intervention	79.00	5	62.458	27.932
Pair 6	statement 6 before intervention	68.40	5	48.449	21.667
	statement 6 after intervention	72.80	5	57.903	25.895
Pair 7	statement 7 before intervention	48.40	5	45.418	20.312
	statement 7 after intervention	79.20	5	87.394	39.084
Pair 8	statement 8 before intervention	60.40	5	56.065	25.073
	statement 8 after intervention	72.60	5	57.374	25.659
Pair 9	statement 9 before intervention	61.60	5	63.058	28.200
	statement 9 after intervention	74.80	5	64.496	28.843
Pair 10	statement 10 before intervention	83.60	5	98.931	44.243
	statement 10 after intervention	74.20	5	64.064	28.650
Pair 11	statement 11 before intervention	59.00	5	43.829	19.601
	statement 11 after intervention	61.40	5	45.856	20.508
Pair 12	statement 12 before intervention	78.00	5	85.314	38.154
	statement 12 after intervention	69.20	5	50.167	22.435

Pair 13	statement 13 before intervention	83.60	5	97.838	43.755
	statement 13 after intervention	79.60	5	82.552	36.918
Pair 14	statement 14 before intervention	77.20	5	76.037	34.005
	statement 14 after intervention	80.00	5	79.533	35.568
Pair 15	statement 15 before intervention	74.40	5	63.713	28.493
	statement 15 after intervention	78.20	5	72.582	32.460
Pair 16	statement 16 before intervention	83.60	5	100.326	44.867
	statement 16 after intervention	74.40	5	70.815	31.670
Pair 17	statement 17 before intervention	83.20	5	98.411	44.011
	statement 17 after intervention	76.60	5	83.437	37.314
Pair 18	statement 18 before intervention	83.60	5	100.326	44.867
	statement 18 after intervention	76.00	5	75.508	33.768
Pair 19	statement 19 before intervention	68.80	5	81.282	36.350
	statement 19 after intervention	82.40	5	88.661	39.650
Pair 20	statement 20 before intervention	84.60	5	83.311	37.258
	statement 20 after intervention	79.80	5	76.474	34.200
Pair 21	statement 21 before intervention	81.20	5	66.194	29.603
	statement 21 after intervention	73.80	5	60.500	27.056
Pair 22	statement 22 before intervention	74.80	5	63.259	28.290
	statement 22 after intervention	77.40	5	94.190	42.123
Pair 23	statement 23 before intervention	84.80	5	105.552	47.204
	statement 23 after intervention	81.00	5	88.352	39.512
Pair 24	statement 24 before intervention	85.00	5	123.507	55.234
	statement 24 after intervention	83.60	5	99.390	44.448
Pair 25	statement 25 before intervention	80.80	5	88.582	39.615
	statement 25 after intervention	78.40	5	81.794	36.580

APPENDIX P
Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	statement 1 before intervention & statement 1 after intervention	5	.819	.090
Pair 2	statement 2 before intervention & statement 2 after intervention	5	.992	.001
Pair 3	statement 3 before intervention & statement 3 after intervention	5	.825	.085
Pair 4	statement 4 before intervention & statement 4 after intervention	5	.573	.313
Pair 5	statement 5 before intervention & statement 5 after intervention	5	.908	.033
Pair 6	statement 6 before intervention & statement 6 after intervention	5	.818	.091
Pair 7	statement 7 before intervention & statement 7 after intervention	5	.831	.082
Pair 8	statement 8 before intervention & statement 8 after intervention	5	.983	.003
Pair 9	statement 9 before intervention & statement 9 after intervention	5	.946	.015
Pair 10	statement 10 before intervention & statement 10 after intervention	5	.854	.066
Pair 11	statement 11 before intervention & statement 11 after intervention	5	.486	.407
Pair 12	statement 12 before intervention & statement 12 after intervention	5	.430	.469
Pair 13	statement 13 before intervention & statement 13 after intervention	5	.992	.001
Pair 14	statement 14 before intervention & statement 14 after intervention	5	.970	.006
Pair 15	statement 15 before intervention & statement 15 after intervention	5	.989	.001
Pair 16	statement 16 before intervention & statement 16 after intervention	5	.879	.050
Pair 17	statement 17 before intervention & statement 17 after intervention	5	.990	.001
Pair 18	statement 18 before intervention & statement 18 after intervention	5	.994	.001
Pair 19	statement 19 before intervention & statement 19 after intervention	5	.989	.001
Pair 20	statement 20 before intervention & statement 20 after intervention	5	.940	.017
Pair 21	statement 21 before intervention & statement 21 after intervention	5	.800	.104
Pair 22	statement 22 before intervention & statement 22 after intervention	5	.989	.001
Pair 23	statement 23 before intervention & statement 23 after intervention	5	.928	.023
Pair 24	statement 24 before intervention & statement 24 after intervention	5	.917	.028

Pair 25	statement 25 before intervention & statement 25 after intervention	5	.983	.003

Paired Samples Test

		Paired Differences			t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	statement 1 before intervention - statement 1 after intervention	-17.8	58.7	26.251	-0.678	4	0.535
Pair 2	statement 2 before intervention - statement 2 after intervention	-16.8	16.649	7.446	-2.256	4	0.087
Pair 3	statement 3 before intervention - statement 3 after intervention	-24.8	40.19	17.973	-1.38	4	0.24
Pair 4	statement 4 before intervention - statement 4 after intervention	-10.4	82.373	36.838	-0.282	4	0.792
Pair 5	statement 5 before intervention - statement 5 after intervention	-10	27.74	12.406	-0.806	4	0.465
Pair 6	statement 6 before intervention - statement 6 after intervention	-4.4	33.321	14.902	-0.295	4	0.782
Pair 7	statement 7 before intervention - statement 7 after intervention	-30.8	55.738	24.927	-1.236	4	0.284
Pair 8	statement 8 before intervention - statement 8 after intervention	-12.2	10.426	4.663	-2.617	4	0.059
Pair 9	statement 9 before intervention - statement 9 after intervention	-13.2	21.1	9.436	-1.399	4	0.234
Pair 10	statement 10 before intervention - statement 10 after intervention	9.4	55.415	24.782	0.379	4	0.724
Pair 11	statement 11 before intervention - statement 11 after intervention	-2.4	45.506	20.351	-0.118	4	0.912
Pair 12	statement 12 before intervention - statement 12 after intervention	8.8	78.171	34.959	0.252	4	0.814
Pair 13	statement 13 before intervention - statement 13 after intervention	4	19.196	8.585	0.466	4	0.666
Pair 14	statement 14 before intervention - statement 14 after intervention	-2.8	19.435	8.691	-0.322	4	0.763
Pair 15	statement 15 before intervention - statement 15 after intervention	-3.8	13.535	6.053	-0.628	4	0.564
Pair 16	statement 16 before intervention - statement 16 after intervention	9.2	50.879	22.754	0.404	4	0.707

Pair 17	statement 17 before intervention - statement 17 after intervention	6.6	19.616	8.773	0.752	4	0.494
Pair 18	statement 18 before intervention - statement 18 after intervention	7.6	26.52	11.86	0.641	4	0.557
Pair 19	statement 19 before intervention - statement 19 after intervention	-13.6	14.433	6.454	-2.107	4	0.103
Pair 20	statement 20 before intervention - statement 20 after intervention	4.8	28.482	12.737	0.377	4	0.725
Pair 21	statement 21 before intervention - statement 21 after intervention	7.4	40.439	18.085	0.409	4	0.703
Pair 22	statement 22 before intervention - statement 22 after intervention	-2.6	32.982	14.75	-0.176	4	0.869
Pair 23	statement 23 before intervention - statement 23 after intervention	3.8	40.536	18.128	0.21	4	0.844
Pair 24	statement 24 before intervention - statement 24 after intervention	1.4	51.091	22.849	0.061	4	0.954
Pair 25	statement 25 before intervention - statement 25 after intervention	2.4	16.95	7.58	0.317	4	0.767

Appendix Q

Subscale 1a

	N	Minimum	Maximum	Mean	Std. Deviation
statement 1 after intervention	5	0	220	78.80	85.902
statement 3 after intervention	5	0	156	75.40	70.127
statement 12 after intervention	5	0	132	69.20	50.167
statement 17 after intervention	5	0	210	76.60	83.437
statement 19 after intervention	5	0	220	82.40	88.661
Valid N (listwise)	5				

Subscale 1b

	N	Minimum	Maximum	Mean	Std. Deviation
statement 7 after intervention	5	3	220	79.20	87.394
statement 10 after intervention	5	0	140	74.20	64.064
statement 13 after intervention	5	0	210	79.60	82.552
statement 23 after intervention	5	0	220	81.00	88.352
statement 25 after intervention	5	3	210	78.40	81.794
Valid N (listwise)	5				

Subscale 1c

	N	Minimum	Maximum	Mean	Std. Deviation
statement 5 after intervention	5	8	144	79.00	62.458
statement 6 after intervention	5	1	145	72.80	57.903
statement 11 after intervention	5	6	117	61.40	45.856
statement 16 after intervention	5	0	150	74.40	70.815
statement 22 after intervention	5	6	235	77.40	94.190
Valid N (listwise)	5				

Subscale 1d

	N	Minimum	Maximum	Mean	Std. Deviation
statement 9 after intervention	5	3	144	74.80	64.496
statement 14 after intervention	5	0	195	80.00	79.533
statement 15 after intervention	5	3	180	78.20	72.582
statement 18 after intervention	5	6	195	76.00	75.508
statement 21 after intervention	5	0	144	73.80	60.500
Valid N (listwise)	5				

Subscale 1e

	N	Minimum	Maximum	Mean	Std. Deviation
statement 2 after intervention	5	3	144	78.60	66.729
statement 4 after intervention	5	0	250	83.20	100.166
statement 8 after intervention	5	3	140	72.60	57.374
statement 20 after intervention	5	3	168	79.80	76.474
statement 25 after intervention	5	3	210	78.40	81.794
Valid N (listwise)	5				

APPENDIX R

Summaries of Students' Reflection on the Performance assessment

Guided Statement	Perception	Frequency	Quotations from students
Feelings about the lesson	Positive	71%	'...was very interesting ' 'learnt new stuff' '..excellent class, was fun , I learn a lot' 'happy, glad my group used idea, I feel big up' 'glad I came to class, it was lots of fun 'I came to class sad but the lesson help make me happy' 'excited for what we will do next class' 'eager to come to school for Science, which we could this every day ☹' 'I feeling very bright cause some children not thinking smart'
	Neutral	6%	'..class was normal' 'was normal but got bored at time'
	Negative	4%	'...not fun...' 'I am angry because** want to correct everybody and not focus on her group'
	Blank	19%	
I did not care for	Negative	71%	'the noise level of the class' '...distraction by my class mates' 'working in this group .__ to controlling..' 'writing this' 'People stealing our stuff' 'students misbehaviour'

			'* playing she correcting me'
	Blank	29%	
I especially liked	Positive	96%	The class had more interaction and less notes 'the way miss teach the lesson these days ' Not only the teacher was talking Everyone could share My friend help me to understand clearly what we were supposed to do 'the movies in the lesson' '..working with my friends' 'like Science now, it is fun' 'the topic' Like everything in your class Working and talking, and doing and making stuff makes class fun 'Bring my laptop and using it in class' 'researching interesting things to do in class' 'working with friends and helping each other so we can do better than the other groups' 'now we can see Science used in everyday activity' 'did not everything have Science' 'I am going home to see I can find another way to do this.

	Negative	3 %	'nothing, I hated the group I am in'
	Blank	3 %	
Next time try	Positive	36%	'letting students use costumes' 'allowing students to ask more questions'
	Negative	47%	'..no journals or work sheets' 'Give us more time, my group was not ready to present'
	Blank	17%	
Only thing missing was	Positive	21%	'use going on a field trip' Not enough straws; 'I missed recess sine Carla did not come to school and she had the information we needed today so we had to do it over'
	Negative	13%	'quiet'
	Neutral	23%	'Nothing' 'Jokes' 'my friends who got suspended so I had to join a next group'
	Blank	43%	