

## **Drama in Science Teaching – An example from Trinidad and Tobago**

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### **Abstract**

This experimental study was conducted in one public school in Trinidad with the aim of observing the effect of drama on the achievement and attitude towards science, of a group of upper primary school science students when taught a science unit. The experimental group was taught using drama-based instruction and activities while the control group received instruction via the traditional approach. A science unit entitled ‘Forces’ which consisted of five lessons was taught to both groups over a 2-week period. A science attitude test and a summative achievement test were administered to both groups before and after the treatment. The results revealed a statistically significant difference between the mean scores of both groups in respect of achievement levels for the unit of work. Mean ranked scores for attitudes towards science also showed a statistically significant difference in favor of the experimental group.

Keywords: Drama, achievement, attitudes, science teaching

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### **Introduction**

Teacher-centered approaches characterized in large part by rote knowledge transmission is no longer suitable or sufficient to engage students in the current globalized context (Trilling & Fadel, 2009). The increasing use of information and communication technologies in the education sector has exposed students to a wide and expanding array of knowledge, skills and learning resources (Goodwin, 2011). In response to the challenges posed by teacher-centered approaches, schools are moving towards more student-centered approaches in teaching and learning. Teachers and other stakeholders in education have come to realize that learner-centered learning environments engage students in knowledge construction by providing opportunities for them to learn by building on prior and existing current knowledge and abilities. Truly learner-centered approaches expose students to learning experiences which not only promote the development of high order thinking skills such as critical thinking and problem-solving but which also transforms classroom learning into engaging and meaningful experiences (Garrett, 2008).

Trinidad and Tobago like the rest of the world has recognized the need for the shift away from teacher-centered pedagogies to learner-centered ones. At every level of the education system and in all curriculum areas, teachers are encouraged to take deliberate decisions and actions to make the transition (Trinidad & Tobago, Ministry of Education, 2013). Science teachers in particular have welcomed the initiative because they are well aware of the problems traditional teacher-centered approaches are creating in their classrooms. Students are highly resistant to rote methods so much so that many have expressed negative attitudes towards learning in various subject areas. This negative attitude is particularly evident in science classes in Trinidad and

Tobago (Maharaj-Sharma, 2008). Performance on tests and examinations too have revealed that despite teachers' best intentions the teacher-centered approaches seem to be ineffective in developing sound scientific understandings as students perform poorly when assessed in science. Science teachers in Trinidad and Tobago are now earnestly seeking to find alternative approaches for science delivery and is at this time leading the way in transitioning to more student-centered classroom strategies. They have noted that approaches which give students a degree of autonomy for their learning not only motivates and encourages them but introduces an element of fun and excitement in the learning process so that science learning becomes a meaningful, engaging and interactive exercise in student-centered classrooms (Hendrix, Eick and Shannon, 2012; Maharaj-Sharma, 2008).

The literature abounds with several examples of student-centered approaches teachers of all disciplines can adopt in their lessons. Role-play, analogy generation and use and project-based learning are some approaches that have been successfully used to promote meaningful classroom learning (Lee & Lim, 2012; Maharaj-Sharma, 2008, 2012). In science teaching and learning in particular, role-play in the primary school setting was used in Trinidad and Tobago to show how students' ideas about forms, uses and transformation of energy were developed (Maharaj-Sharma, 2008). The results of that work showed that in addition to developing sound scientific understandings about energy concepts, students also developed a sense of care, respect and sensitivity for their environment and the world in which they live.

Creative drama is another student-centered approach that has been successfully used in teaching, including science teaching (Abed, 2016; Bracha, 2007; Cokadar & Yilmaz, 2010). It is a socially interactive approach which can be easily infused in science teaching. It is an improvisational, nonexhibitional, process-oriented form of drama in which participants are guided by a leader to imagine, enact and reflect upon human experiences (Davis & Behm, 1978). It refers primarily to improvisational activities in which the participants invent fictional situations and characters of their own choice, with or without specific guidance of context setting by coaches or teachers. Its use as a teaching strategy incorporates the individual student in a community atmosphere where he or she can share individual thoughts and actions in a collaborative setting (Littledyke, 2004). The student acts out and carries on problem solving techniques and in so doing reinforcement of acquired knowledge takes place. The use of creative drama in the classroom can help develop divergent thinking skills and creativity as well as oral and written communication skills (Hendrix, Eick, & Shannon, 2012). It utilizes intrapersonal and interpersonal intelligences both of which are linked to the way individuals understand their own thought processes and the way they act and interact in different situations (Abed, 2016; Armstrong, 2009).

In informal interactions and conversations (workshops and professional development courses) with many primary school science teachers in Trinidad and Tobago, several of them indicated to the authors that they perceive creative drama in science teaching and learning to be an attractive approach and is one they would like to develop competency in. Thus far the use of creative drama in science teaching and learning has not been formally explored or documented in Trinidad and Tobago. The recognition that this student-centered approach can yield tremendous benefits to students and the eagerness to explore its potential in the classroom expressed by several science teachers is what prompted this work. The aim in this study is to examine the effectiveness of creative drama on upper primary school students' understandings of a selected science topic and

its impact on their attitude towards science. With this aim in mind the following two research questions will be answered in this work:

1. When compared to traditional instruction, how does creative drama instruction impact on students' understandings in science?
2. When compared to traditional instruction, how does creative drama instruction impact on students' attitudes toward science?

### **Theoretical Framework**

Vygotsky (1962) discussed the notion that social interaction is crucial in the process of gaining better understandings of new and/or abstract concepts. His theory reasons that the development in cognitive ability as a result of learning which occurs via high levels of socialization with increased opportunities for interaction and communication is fundamental to the development of high levels of cognition. In other words, cognitive development precedes meaningful learning. The requirements and features of creative drama instruction aligns with Vygotsky's theory, as it is embedded with explicit elements of cognition which seeks to provide for students, tremendous opportunities to learn through collaboration, sharing and interaction (Annarella, 1992). Deweyan's epistemology too, advocates that the teaching and learning process should provide students with impactful learning experiences which prompts them to connect with the world in which they live. Recognizing the relevance of learning is critical in cognitive development and subsequent meaningful learning (Abed, 2016).

In the case of science, when learning occurs in a collaborative setting in which non-threatening student-student interactions are encouraged and promoted, the learning experience empowers students with sound science ideas and experiences which can be modelled outside the classroom or used to explain everyday occurrences and phenomena (McGregor, 2012). Many student-centered approaches in science education, including creative drama, have at their core, philosophical intentions which provide for teachers, essential elements that can be employed to craft engaging and effective learning tasks which can be used to effectively improve students' understandings of scientific concepts and enhance their science learning experience (Moore, 2004).

In this sense therefore, creative drama instruction in science teaching has the potential to easily combine the practical, emotional and intellectual components of science to provide students with an experience of "wholeness" (Girod, Rau & Schepige, 2003). Creative drama, when used effectively in the classroom allows for an easy infusion of excitement, fun and self-expression in science learning which can effortlessly yield the desirable holistic outcome of all learning. Creative drama instruction in the science classroom therefore can play a significant role in science learning as it has the capacity to excite and encourage students to learn through targeted social interaction. This notion has been well discussed by Miller (2011) and is aptly captured in his claim that learning cannot be isolated from the social context in which it occurs.

### **Literature Review**

#### **Drama and Achievement**

Creative drama techniques are innovative ways of helping students develop sound scientific understandings at both the primary and secondary school levels. The effectiveness of

creative drama as an instructional strategy at the primary school level was explored by Kamen (1991) and the results showed that students' levels of attainment on summative tests increased. In fact the findings revealed that students who studied science topics using creative drama activities displayed a greater level of understanding than those who studied the same topics using traditional instructional approaches. In fact it was reported that students who were exposed to drama-based instruction were able to provide more comprehensive and detailed explanations for abstract science concepts (such as transpiration), than students who studied the same content via traditional instruction. In later work, Saricayir (2010) used drama to investigate the understandings of seventh grade students when taught about the electrolysis of water and found that the drama-taught group of students gained a better understanding of the target concepts than students of the control group. Students in the drama-taught group scored higher on the summative tests on the topic and generally provided more complete responses for questions which targeted cognitive levels of application and analysis. Similarly, empirical investigations into the effectiveness of drama-based instruction in the teaching of inquiry-based science for a number of science topics, conducted by Hendrix, Erick & Shannon (2012), showed that while there was very little significant difference in factual recall between the experimental and control groups, students in the experimental group displayed significantly greater ability to offer explanations and interpretations of concepts and ideas in most of the science topics. Braund, Ekron & Moodley (2013) used short drama episodes in early science classroom teaching and found that drama instruction had a positive effect on students' use of vocabulary in relation to terms and concepts in the water cycle. After exposure to the drama instruction students displayed significant improvement in their explanation of concepts which suggested that their levels of understanding in the topic had increased.

### **Drama and Attitude**

Bracha (2007) presented findings which revealed that students who experienced science learning through creative drama indicated that they enjoyed participating in the creative drama activities with their friends while McGregor (2012) found that the creative drama experience had a significantly positive impact on students' attitudes toward science. Both studies showed that creative drama also helped students to better understand abstract science concepts. Similar findings were also reported even much earlier by Metcalfe, Abbot, Bray, Exley & Wisnia (1984), in which students who learned science through drama-based tasks and activities displayed significantly more positive attitudes toward science than students who learned the same content through classroom experiences that did not include dramatization and acting. Extensive work conducted by Annarella (1992) on the use of drama instruction in the classroom supported earlier findings by Metcalfe et. al. (1984) by also revealing that drama-based science teaching not only motivated students to learn science but significantly boosted their interest in science and enthusiasm for science learning. In other works by Alrutz (2004) and Dorion (2009) in which drama was used to teach science to primary school students the results in both instances showed that students enjoyed participating in the teacher facilitated dramatizations and that the drama-based instructions resulted in an increased positive attitude toward science for the participating students.

## **Methodology**

### **Sample**

A total of 43 upper primary school students (age 9-11) from two classes in a public school located in a sub-urban community in Trinidad participated in this work. Teachers at that school had previously made two official requests to the researcher because they had used some

unstructured drama to teach science and became excited about the results they saw and wanted to explore the impact in a more formal way. The classes selected were taught by one of the science teachers who made the requests. The school and classes were therefore purposively selected for this work. Both classes were instructed by the same primary school science teacher who has been teaching science for the past 15 years. The classes were randomly selected as experimental (10 males, 12 females) and control (11 males, 10 females). The socioeconomic status of the students in both groups was similar with the majority of students coming from middle-class families. The data for this work were collected over a 4-week period in the first term of the 2017-2018 academic year (September 2017 – December 2017). All students were informed of the nature of the research and were assured that their anonymity would be guaranteed. They were all invited to sign a consent form to confirm their willingness to participate in this work.

### **Design**

In this work a pre-test post-test experimental design was adopted (Creswell, 2013). An advantage of this design is that it allows the researcher to have control over extraneous variables so that the effect of the manipulative intervention on the dependent variable or variables can be confidently determined as being attributable almost solely to the influence of the intervention (Bernard & Bernard, 2012). In this work the manipulative intervention was creative drama instruction and the dependent variables were students' understandings in science and students' attitudes toward science. The experimental group was exposed to the creative drama instruction and the control group to traditional instruction. Both groups were post-tested to examine the effects of each type of instruction on students' understandings in science and their attitudes toward science.

### **Instruments**

**Summative Achievement Test (SAT).** In this work, students' understandings in a science topic was gauged by examining their academic achievement scores on the topic after the topic was taught to them. The SAT was used to measure the differences in students' scores between the experimental and control groups. It was constructed to capture all the content covered in unit 'Forces' (Appendix 2). The initial test was developed by the class teacher and included 30 multiple choice items related to forces. A science assessment expert reviewed the initial test to check for clarity and validity. The expert was tasked with the responsibility to ensure that the SAT adequately assessed the content taught in the unit. This was done by cross checking and matching the tested content in each item with the objectives in the lessons taught to verify consistency in terms of scientific knowledge as well as the cognitive level at which the content was taught. Five items were found to be either ambiguous or repetitive and were eliminated from the initial test. The questions on the final version of the test were either conceptual in nature (requiring students to make a conceptual prediction), fundamental (requiring students to recall concepts) or applicative (requiring students to apply concepts to new situations). Each question had one correct answer and three distractors. The Kuder-Richardson 20 measure of reliability value was calculated for the items on the SAT and it was found to be 0.67, which according to Zimmerman (1972) is reasonable. The SAT was piloted with 98 upper primary school students before it was administered to the participating students. It was administered to both groups as a pre-test before the treatment and as a post-test after the treatment. The students were given 40 minutes to respond to the SAT. Two sample questions on the SAT are presented below:

Q.3. Which of the following is NOT an example of a simple machine?

- (a) a see-saw
- (b) a hammer
- (c) a pulley
- (d) a pair of scissors

Q.16. Jason's weight is twice that of his brother. If his brother has a mass of 18 kg, what is Jason's weight?

- (a) 36 N
- (b) 90 N
- (c) 180 N
- (d) 360 N

**Attitude Towards Science (ATS).** Students' attitudes toward science for both experimental and control groups were measured using the ATS scale which was originally developed by Pell and Jarvis (2001) for students aged 5-11 years. For use in this work, the scale was slightly adapted to align with research question 2. The scale included 12 items on a five-point Likert type scale ranging fully disagree (1), disagree (2), undecided (3), agree (4), to fully agree (5). The ATS scale was piloted with 92 upper primary school students in an urban primary school in Trinidad. Students in the pilot were not part of the sample used in this work. The internal consistency reliability of the scale was found to be 0.81 for this study (Cronbach alpha reliabilities in Pell and Jarvis, 2001, was reported to be above 0.8 to below 0.7). The scale was administered to students in the both the experimental and control groups (before and after the treatment) and they were given 15 minutes to respond to the scale.

### **Treatment**

The treatment period for this study was five teaching session (each 45 minutes long) over a 2-week period. Before the treatment the SAT and the ATS scale were administered to students in both groups as pre-tests to determine students previous knowledge in the science topic and students' attitudes toward science.

Creative drama instruction was used to teach the experimental group. A guiding document of instruction, which contained five lesson plans was developed based on the revised primary science curriculum (Ministry of Education, Trinidad and Tobago, 2014). The lesson each dealt with a specific topic in the unit on 'Forces'. As prescribed by Andersen (2004), because instructors using creative drama need to pay careful attention to make-believe play, student role, teacher role, warm-up activities, dramatic moments, drama techniques and quieting activities, each lesson plan included three segments:

- Introduction (warm-up activities),
- Development (introducing the dramatic moment by the students),
- Closing (evaluation of the lesson).

Two science professors examined the lessons in order to verify that they were scientifically sound and appropriately planned to achieve the objectives of this study. In addition, a drama teacher with 12 years drama teaching experience reviewed the lessons to ensure that the activities were appropriate for creative drama-based instruction and execution. All five lessons were piloted

with students at another school who were at the same class level as the sample. This was to ensure that the lesson plans, as prepared, could be applied in the classroom and that the intended directions/instructions were clear. It also served to assess how well the classroom management challenges could be accommodated and whether the objectives could be achieved. The pilot also provided the teacher with useful information about what elements of the lessons' execution need careful monitoring and additional attention. Details about how creative drama-based instruction would be applied and which activities would be used in the lesson were provided in the lesson plans (See sample lesson in Appendix I). Creative drama activities were used in the instruction for the experimental group. The implementation of the creative drama-based lessons proceeded as follows:

### Segment 1 (10 mins)

*In the introduction part, warm-up activities were used to relax students and to get them ready to work together, to feel comfortable with each other and to think about having fun as they learn. Through a gaming activity the topic of the lesson was introduced to students in this segment. Student were given opportunity to ask questions, make comments and offer feedback or suggestions about the topic. It served in large part to elicit students' prior knowledge about the topic. In this segment the objectives of the lesson were made known to the students and the teacher explained the tasks and activities they would be engaged in as the lesson progressed.*

### Segment 2 (20 mins)

*In the development part, students were provided with a task or contextual situation in which they were encouraged to use dramatic moments which they acted out to arrive at the outcomes. Students were responsible for assigning roles and they were free to decide how they wanted to act out the roles and what improvisations they wanted to make to portray or communicate their understandings. Students included in their acting a lot of gestures and body movements. While facilitating, the teacher emphasized learning through discovery by posing questions and side coaching. Encouraging students to reflect on their learning through running dialogues was also part of the teacher's role as facilitator. On occasion the teacher participated in the activities in order to provide support and encouragement for the students. This also created a non-threatening relationship between the teacher and the students.*

### Segment 3 (15 mins)

*Finally in the closing part the key points of the concept covered were summarized either by the teacher or by the students. Students reviewed what they had learned either by answering questions or solving problems posed by the teacher in an interactive whole class discussion setting. After discussion, the teacher asked a few questions about the learning approach in order to gain an understanding of the students' learning situations and their responses to the approach.*

In the control group, traditional science instruction was used. This instruction included lecture and whole class discussion and textbook instruction. For this group of students the teacher explained the concepts and students listened and took notes. When students indicated that they did not understand something, the teacher gave extra explanations by citing familiar examples. At the end of each lesson with the control group, the teacher asked some questions to assess students' understandings of the concepts covered in the lesson.

## Data Analysis

The SAT comprised 25 multiple choice items. For data analysis these items were classified as correct (1 point), incorrect (0 point) and no response (0 point). The maximum score a student could attain on the SAT was 25.

The ATS scale comprised ten positively skewed items and 5 negatively skewed items in relation to attitude toward science. The scores for the negatively skewed items were reversed before statistical analysis. Scores gathered from the pre- and post-tests were analyzed using the SPSS 10.0 program.

To compare students' achievement scores in both groups, a *t-test* was used (Garson, 2012). Wilcoxon sum ranks and signed ranks tests were used to determine if there was a difference between the groups' attitude scores. An alpha level of 0.05 was used for all statistical tests. A *p-value* of less than 0.05 was considered to be statistically significant. After the treatment period, the instruments were again administered to both groups as post-tests to determine students' understandings of forces and their attitudes towards science.

## Results

### Student Achievement

To compare the students' pre- and post-test scores of achievement, the SAT was administered to both groups before and after the treatment. Prior to any statistical treatment, Excel analyses were applied to all scores obtained to ensure that assumptions of normality, homogeneity of variances and linearity for the data were met. Scores (pre- and post-tests) were subsequently analyzed by t-tests. The results of the t-tests are shown in Table 1.

**Table 1: Independent t-test Results – Achievement Scores**

Test	Group	N	M	SD	df	t	p
Pre-test	Control Group	21	8.22	3.59	41	0.238	0.801
	Experimental Group	22	8.68	3.44			
Post-test	Control Group	21	17.86	2.76	41	3.62	0.001*
	Experimental Group	22	21.15	2.14			

\*  $p < 0.05$

Independent sample t-test analysis showed no statistically significant difference between the mean scores of the control and experimental groups with respect to their prior knowledge (pre-tests) on forces ( $t_{(41)} = 0.238$ ;  $p > 0.05$ ). This result indicates that the students' knowledge levels in both groups were similar before the treatment. In respect of the post-test however, there was a statistically significant difference between the mean scores of the control and experimental groups in that the experimental group had a higher mean score than the control group. In other words, the students in the experimental group demonstrated higher levels of achievement than students in the control group. It is reasonable therefore to conclude that the statistically higher mean score for the experimental group may be associated with the drama instruction intervention used to teach this group of students.

In addition to the higher mean score in the post-test of the experimental group, the standard deviation for this group was smaller than that found for the control group. This suggests that the scores of most students in the experimental group were within a narrow range centralized at the

mean score while for the control group the scoring range was much wider. In other words, more students in the experimental group obtained scores very close to the mean score.

Paired sample t-test statistics showed a significant difference between the pre- and post-test mean scores of the both the control and the experimental groups with respect to achievement on the SAT (Table 2). Both control and experimental groups showed a significant improvement but it is important to note that the improvement observed in the experimental group was much greater. The indication therefore is that while both groups were taught the same content for the first time and by the same teacher, the relatively larger improvement in achievement scores obtained in the post test for the experimental group may be as a consequence of the drama instruction teaching strategy used to teach this group.

**Table 2: Paired t-test Results – Achievement Scores**

Group	Test	N	M	SD	df	t	p
Control	Pre-test	21	8.22	3.59	20	9.22	0.000*
	Post-test	21	17.26	2.76			
Experimental	Pre-test	22	8.68	3.44	21	12.54	0.001*
	Post-test	22	21.65	2.14			

\*  $p < 0.05$

### Student Attitude

In order to examine the effectiveness of the teaching approaches used (creative drama with the experimental group and traditional instruction with the control group) on students' attitudes toward science, the scores obtained in the pre- and post-tests of the ATS scale for both groups were analyzed separately. As seen in Table 3, Wilcoxon sum ranks test results showed no significant difference between the control and experimental groups with regard to their pre-test scores ( $z_{(43)} = -0.271$ ;  $p > 0.05$ ). This result indicates that students' attitude towards science for both groups was similar before the treatment. Important to recognize was the fact that the mean rank scores for the pre-test of both the experimental and control groups were in very close proximity to each other (22.45 for the control group and 23.52 for the experimental group – a difference of 1.7 points). Table 3 also shows, quite interestingly, that there was no significant difference in attitude towards science between the control and experimental groups in respect of their post-test attitude scores, ( $z_{(43)} = -1.026$ ;  $p > 0.05$ ). But even with no significant difference in post-test sum rank scores for both groups, it is important to note that the mean rank post-test attitude score for the experimental group was more than 4 points higher than that for the control group. In other words, students' attitudes towards science before treatment (pre-test) for both groups were very similar (difference of 1.7 in mean rank scores) but after the treatment the experimental group had a noted, though not statistically significant, improved attitude towards science. The attitude toward science of the experimental group was altered to a far greater extent than the control group and it is reasonable to assume that this may be associated with the creative drama instruction used to teach science to the experimental group.

**Table 3: Wilcoxon Sum Ranks Test – Pre- and Post- Attitude Scores**

Tests	Groups	N	Mean Rank	Sum of ranks	<i>z</i>	<i>P</i>
Pre-test	Control	21	22.45	491.00	-0.271	0.789
	Experimental	22	23.52	535.00		
Post-test	Control	21	20.15	463.00	-1.026	0.309
	Experimental	22	24.97	577.00		

\* $p < 0.05$

In Table 4 however in which results of the Wilcoxon signed ranks test are presented, while the findings show that there was no significant difference between pre- and post-test attitude scores of students in the control group ( $z_{(21)} = -1.577$ ;  $p > 0.05$ ) there was a statistically significant difference between the pre- and post-test attitude scores for students in the experimental group ( $z_{(22)} = -3.640$ ;  $p < 0.05$ ) after the treatment. The median values of pre- and post- attitude scores were 2.10 and 2.19 respectively, in the control group while for the experimental group the pre- and post- attitude median values were 2.07 and 2.43 respectively. Two important findings to note is that (1) the median of the post attitude scores were notably higher than the median of the pre-attitude scores for the experimental group and (2) the median of the post-attitude scores for the experimental group was much higher than the median of the post-attitude scores for the control group. In other words there was very little change in attitudes toward science for students who were exposed to traditional instruction (control group) but there was a notably positive shift in attitude towards science for students in the experimental group. Given that creative drama provided students with opportunity to learn science in a very interactive and sociable way, it will not be unreasonable to associate the latter finding with the creative drama instruction used to teach the experimental group.

**Table 4: Wilcoxon Signed Ranks Test for Pre- and Post- Attitude Scores**

Pre-test/Post-test	N	Mean Rank	Sum of ranks	<i>z</i>	<i>P</i>
<b>Control Group</b>					
Negative ranks	4	7.83	23.55	-1.577	0.114
Positive ranks	12	6.72	68.45		
Ties	5				
Total	21				
<b>Experimental Group</b>					
Negative Ranks	0	0.00	0.00	-3.640	0.000*
Positive Ranks	16	9.05	148.00		
Ties	6				
Total	22				

### Limitations

This study is not without limitations, which must be acknowledged before the results are discussed. The sample size for example, while it was adequate for the quantitative approach and

the analyses employed in this work, the findings remain indefinite and specific for this sample until further research in this area can reinforce the findings. An assumption in this work was that student attitude is measurable, but this assumption remains contentious in the research community even though there is substantial research, which assumes it is a measurable construct (Bernard and Bernard, 2012). In addition, the quantitative design adopted in this work provides a snapshot of the variables at an instant in time and it is possible that similar research work may yield different findings which may be a consequence of differences in research contexts, populations and instrumentation.

### **Discussion**

In Trinidad and Tobago science teaching in most classrooms is dominated by teacher-centered approaches which, teachers are coming to realize do not provide an engaging learning environment for their students. In this study a student-centered approach in the form of creative drama instruction was used to teach a unit entitled 'Forces.' With this approach, participation, cooperation, interaction and respect among all students were requirements. The pre-test was performed to check whether the mean achievement scores of the experimental and control groups were equal or significantly different. The results showed that before the treatment the achievement scores of both groups were equivalent. After treatment however, students in the experimental group demonstrated a higher mean score of achievement than the control group. Although the achievement scores of both groups increased after the treatment, the experimental group had a higher improvement. It is reasonable therefore to infer that the creative drama instruction and activities may have been associated with a significantly better acquisition of scientific concepts and hence the enhanced student achievement seen with the experimental group. This finding is consistent with that reported by Arieli (2007) and those found in the work by Cokadar and Yilmaz (2010), both of which showed that the use of drama instruction to teach abstract science concepts at the middle school level resulted in overall higher academic performance in science.

The significantly improved achievement associated with the use of creative drama instruction and activities may be linked to elements such as active learning, social interaction and autonomy which characterized the drama-based instruction used in this work. Drama transforms the learning experience from reliance on knowledge to active learning and knowledge construction. The collaborative reasoning and discussion which was discussed in detail by Littledyke (2004) and which formed an integral part of the drama based instruction students in this work were exposed to, may have facilitated students' learnings in ways which allowed them to reach advance levels of understanding about content, concepts and phenomena.

In regard to changes in attitudes toward science, the results indicated no significant difference between the pre- and post-attitude scores of the control group. However the findings showed a statistically significant difference between pre- and post-attitude scores of the experimental group. The suggestion therefore is that creative drama had a significant effect on students' attitudes as compared to traditional instruction. It is a reasonable assumption that the activities employed to facilitate science learning through creative drama instruction in this work allowed for the classroom to be transformed into a socially engaging and expressive setting in which students were provided with a comfortable opportunity to cast of the rigors of traditional learning and the perception that science is abstract and difficult and to embrace the learning experience. Abed (2016) has reported that it is these rigors and perceptions which lead to disinterest in and negative attitudes toward science. In this work these constraints were easily

diffused in the creative drama classroom as students in the experimental group found themselves in a non-threatening learning environment which encouraged them to approach the science lessons with a more willing and open attitude. This intrinsic motivation to learn science brought about by the creative drama approach in this case, is what McGregor (2012) suggests can be largely responsible for the increased positive attitude towards science that was observed. In fact the findings of this work are well aligned to those discussed in detail by McGregor (2012) and also by Miller (2011).

Overall, the findings in this work contribute to the international body of literature on drama in science teaching and learning but specifically, it will add to the limited research available in this area in Trinidad and Tobago. The findings are consistent with the theoretical postulate that drama can have positive influence on science learning in terms of academic achievement in science as well as general attitude towards science. Some abstract science concepts which may not be easily developed through experimentation or even modelling, can be brought to life through the active learning strategies characteristic of creative drama activities. Structured creative drama can allow for the generation of ideas from which students can discern relationships, patterns, functions and behaviors which they can subsequently assimilate into a conceptual framework to facilitate deeper understandings of science phenomena. In this regard therefore, science teachers may need to employ more activities in which existing ideas of students can be drawn out and depicted in the form of creative drama to facilitate meaningful non-threatening learning in science.

This work can serve as a starting point by providing motivation for teachers, not only of the science disciplines, but teachers in general to engage in structured formal research and experimentation with other student-centered approaches in their classrooms. It can be used as a guide for further large scale explorations of the usefulness and effectiveness of contemporary teaching methods in contexts with characteristics different from that of this work. In this regard therefore, this work is instructive and significant.

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## Appendix I

Unit Title: Energy and Forces – Lesson topic: Effects of forces

Lesson duration: 45 minutes

Pre-requisite knowledge: Forms of energy, types of forces

Lesson Objectives: At the end of this lesson students will be able to:

1. Describe the effects of forces when applied to resting bodies or bodies in motion
2. Predict the behavior of bodies when acted upon by a force
3. Suggest actions that can be taken to change the behavior of bodies.

Lesson's Execution:

Introduction (7 minutes)

Teacher tosses different types of balls (ping pong ball, beach ball, rubber ball etc.) to students and instructs them to catch the ball. While this action is ongoing teacher uses prompting questions to ask students to think about how the ball moves from her hand, through the air and into a student's hand. Start of motion, motion and stop of motion of the ball is discussed.

Development (30 minutes)

Using prepared cue cards with descriptions of actions of various bodies (car going uphill, Ferris wheel, washing machine before, during and after was cycle, football during a game, Frisbee etc.), teacher encourages students to work in pairs to explain the forces acting and the consequent action of each force acting. The cue card prompts the students to take turns acting out the actions described and to have the non-acting partner record the effect of the forces, describe the behavior of the body (eg. Rate of motion, whether there is resistance to motion or not, contact or non-contact motion etc.), and to write two (2) ways in which the intervention of another force could alter the behavior of the body. Cue card questions prompt the students to make dramatic inputs of their choice based on what their partner is doing to achieve the outcome described. Both students then compares and consolidates their notes to capture all the points noted.

Closing (8 minutes)

Teachers asks each pair to present to the class. They are to discuss the body they were assigned, and to share their notes/points, based on the cue card questions they answered during the drama activity. Teacher posed relevant questions to consolidate learning in the topic at this time. Students get an opportunity to reflect on the drama instruction they participated in.

Formative Assessment

Teacher presents a list of bodies different from the ones student used in the lesson and asks each student to select three (3) from the list and to answer questions related to the lesson's objective.

**Appendix 2**

Force Content Taught and Tested

**Unit Topic: Forces****List of lessons**

<b>Lesson No.</b>	<b>Lesson Topic</b>	<b>Content Covered in Lesson</b>
1	Nature of Forces	Definition of forces; types (push, pull, twist, squeeze etc.)
2	Effect of forces	Motion (speed up, slow down), change of shape, size, appearance etc.
3	Forces in combination	Push and twist, pull and turn etc.
4	Measuring combined forces	Simple comparative analysis of parallel forces and opposing forces
5	Forces in everyday living	Analysis of examples such as opening a door, stopping of a moving car, kicking a football, using a juicer etc.