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Effects of Inquiry-Based Science Teaching Approach on motivation of Secondary School Physics Students in Kitui County, Kenya

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Abstract
The purpose of this study was to investigate effects of Inquiry-Based Science Teaching Approach on learners' motivation of secondary school physics students in Kitui County, Kenya. The study was anchored on both the Constructivist and the Self-Determination Theory. The methodology that was adapted was mixed methodology and a Quasi Experimental Research Design and in particular the Solomon's Four Non-Equivalent Control Group Research Design. The target population of the study was 1600 form four Physics students from 40 Extra-County secondary schools in Kitui County. Stratified random sampling was used to select four Extra-County schools (2 Girls and 2 Boys). Purposive sampling was used to select 40 students from each of the four schools and a Physics teacher from each of the two sampled schools; giving a sample size of 160. A students' questionnaire on motivation was the research instrument. A reliability coefficient of 0.776 was obtained. Both descriptive and inferential data were analysed. The descriptive analysis was by means of frequencies, means, standard deviation and percentages. Inferential analysis was through Analysis of Variance, Chi-square and the Least Significant Difference (LSD) technique at a significance level of coefficient alpha α=0.05.The findings showed a statistically significant difference in motivation between students taught using IBSTA and those taught by the conventional methods. The indicators of motivation: active learning strategy; Physics learning value strong, performance goal strong and learning environment stimulation were highly enhanced by inquiry based science teaching approach. However, achievement goal strong was less enhanced. Consequently, the study concludes that IBSTA is effective in improving students' self-concept. The theories were validated in that there was knowledge was actively constructed and need to prepare a learner to have a self -concept after learning. The researcher recommended that, creation of an enabling environment for IBSTA be adopted in schools, an appropriate policy should be developed in learning institutions with an emphasis on IBSTA as part of their Physics training curriculum and KICD should introduce and develop a programme for the induction and mentorship of Physics Teachers on the implementation of IBSTA so as to empower them with inquiry skills.

Key Words: *Achievement, Conventional Teaching Approach, Inquiry–Based Science Teaching Approach Learning outcome, Motivation, Self-concept*

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I. Introduction

Physics is a branch of science that involves the study of matter, energy and their interactions. Advances in Physics have benefited many industries from building of efficient automobiles, sea vessels, aeroplanes to navigation using the global positioning system (Juan, & Ruez, 2009). The essence of teaching Physics in education field is to bring about positive change in the behaviour, attitude and thinking of a learner (Tebabal & Kahssay, 2011). IBSTA is positively associated with outcomes when it incorporates teacher guidance, and negatively when it does not (Aditomo & Klieme, 2019). According to Koki (2015) reported that a teacher has a great role in guiding the learner to have good morale that will make the learner to have internal drive to believe in themselves and achieve academically. The poor performance in Kitui is due to the conventional instructional methods that teachers use in teaching science, Musembi (2008).

Njoroge, Changeiywo and Ndirangu (2014) observed that students taught using Inquiry-Based Teaching Approach in Physics outshine students taught using the conventional method. IBSTA suggests that the

general poor performance in Physics in Kitui County may benefit from a change of teaching methodology. However, Njoroge *et.al (2014)* did not show evidence that they investigated aspects of motivating and its indicators.

Statement of the Problem

Persistent poor performance in KCSE Physics National and at Kitui County level has been attributed to factors such as use of conventional instructional method, inadequate facilities, poor mastery of content on the part by the teacher, lack of interactive forums for learners and teacher shortage (KNEC Reports: 2014 to 2019). Several initiatives have been put in place to improve performance in this subject. The Government of Kenya in collaboration with the Japanese Government through Japanese International co-operation Agency (JICA), introduced the Strengthening of Mathematics and Science Education (SMASSE) in Secondary Schools. This programme may have put more emphasis on hands-on rather than mind-on approach. Despite such efforts, learners' performance in K.C.S.E Physics continues to decline. The impacts of this trend on motivation, among students have been in adequately investigated. If there will be no attempt to solve the problem this worrying trend will continue. There is currently limited information on the effects of IBSTA in Physics especially in Kitui County. In an attempt to bridge, this gap the current study investigated effect of Inquiry-Based Science Teaching Approach on learning outcomes of secondary school Physics' students in Kitui County, Kenya.

Purpose of the Study

The purpose of this study was to investigate effects of Inquiry-Based Science Teaching Approach on motivation of secondary school Physics' students in Kitui County, Kenya.

Objective of the Study

The objective of the study was to determine the difference in motivation between students taught using Inquiry-Based Science Teaching Approach and those taught using conventional methods in Physics.

Hypotheses

To achieve the above objectives, the following hypotheses were tested at $\alpha = 0.05$ level of significance.

H_{04}: There is no statistically significant difference in motivation to learn Physics between students exposed to Inquiry-Based Science Teaching Approach and those exposed to conventional methods.

II. Literature Review

Inquiry-Based Science Teaching Approach is a method that combines the curiosity of students and the scientific method, which enhances the development of scientific creativity while learning, physics (Hesson, & Shad, 2007). Inquiry-Based Teaching Approach provides the input of the student with a problem to investigate along with the procedures and materials (Bulbul, 2010). In a case study in Britain by Saunders, Stewart, Gyles & Shore (2012), it was showed that Inquiry approach requires students to discover or construct knowledge through relevant activities and personal investigations. His findings were emphasizing the study carried out in Germany by Wilhelm (2010) who indicated that lack of motivational for traditional learning activities were because the student did not perceive relevance or purpose for the activity.

Rotgans & Schmidts (2011) reported that student motivation is a concern for educators because when students do not put forth the effort to truly understand what they are studying because inquiry learning is designed to pursue students' interest and encourage students to cooperate in self-directed learning. Student engagement is highly relevant in education due to benefits from increased motivation and achievement in students (Sinatra, Heddy, & Lombardi, 2015). Zekibayram (2013) on effects of Inquiry-Based Learning methods on student's motivation. The finding indicated that students' extrinsic goal orientation develops after the application of Inquiry-Based activities.

In a study in Zambia by Chola (2015), on impact of Inquiry-Based Learning on Zambian grade II learners' comprehension and attitude on acid-base concept in chemistry, the finding indicates that teaching using Inquiry-Based Approach on topic of acid-base had a positive significant difference than those who were taught using traditional method. The study concurred with a study finding in South Africa by Shumba (2012). This indicated that the instructional approach should be modestly demonstrated in order to motivate the learner to learn more and get exposed to new discovery. Students are motivated to learn when demonstration takes place. Inquiry-Based Teaching enhances high achievement since the students are strongly motivated by the method due to being learner-centered method, as argued by Ndirangu 2013. Maongo (2015) reported that Inquiry–Based Teaching approach motivated students who were taught Geography map work. In a case study by Karambu (2011) on effects of external motivation on students' performance in secondary school in Kitui central sub-county in, Kitui County, the finding indicated that teachers play a very great role in motivating students.

Theoretical Framework

The study was guided by two theories: Constructivist Theory of learning and Self-Determination theory. These theories provide comprehensive but complementary perspectives on Inquiry–Based Science Teaching Approach.

Constructivist Theory

Dewey's (1938) Constructivism Theory guided this study. The constructivism theory of learning upholds that knowledge is actively constructed by organizing subjects not passively received from the environment (Lerman, 2012). The rationale for using this theory to support student learning using Inquiry was because the majority of students have difficulty engaging in constructive learning. This is because they fail to make adequate connections that are necessary in arriving at a desired understanding without hypothesizing and questioning, as is the practice in physics classrooms currently thus will motivate the learner.

Self-Determination Theory

Deci & Ryans' (1985) Self-Determination Theory also guided the study. This theory is a macro theory of human motivation and personality that concerns people's inherent growth tendencies and innate psychological needs. This theory of self-determination was used to anchor the study because Inquiry-Based Science Teaching Approach in teaching Physics will involve Engagement, Explanation, Exploration, Elaboration and Evaluation in order to understand a concept.

Conceptual Framework

A conceptual framework showing the interrelation between the independent variables and dependent variables as conceptualized by a researcher guided the study.

From Figure 1 the direction of the arrows shows the hypothesized direction cause effect relationship in the model.

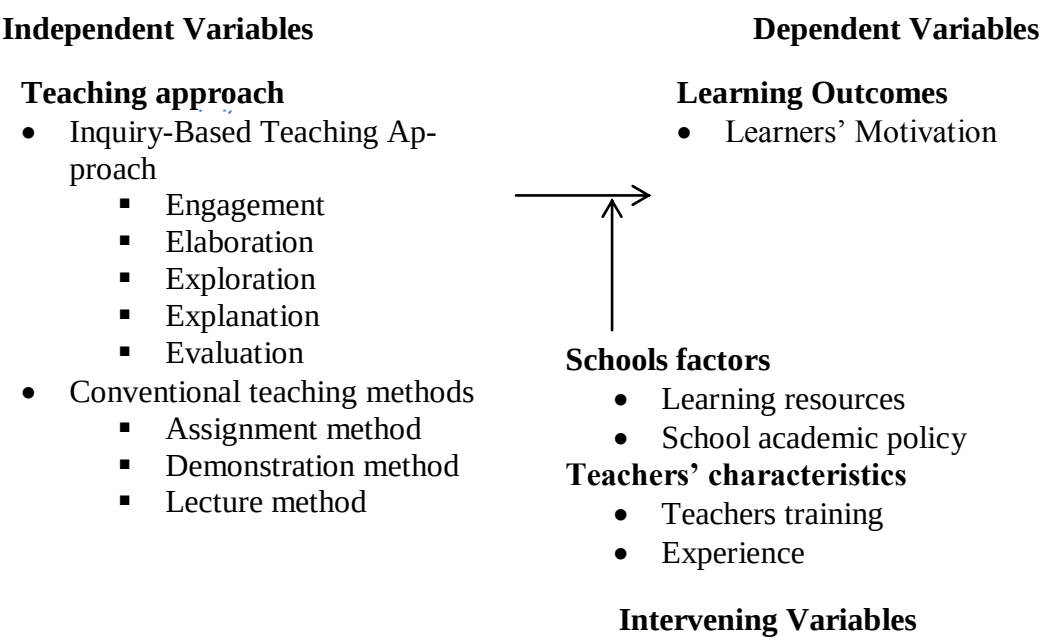

Figure 1: Conceptual Framework on Inquiry-Based Science Teaching Approach (IBSTA)
Source: Researcher 2020

The conceptual framework elaborates the relationship and interplay between the dependent, independent variable with the intervening variables. In the study, dependent variable was motivation. Independent variables were Inquiry-Based Science Teaching Approach and Conventional Teaching Approach. In an ideal situation, the teaching approach affected the students' learning outcome to learn Physics. In practical situations the students' learning outcome to learn Physics was influenced by school factors: learning resources, school academic policy, and teachers' factors teachers training and experience as intervening variables

Research Methodology

The study used Mixed Methodology that combines quantitative and qualitative research approaches for the aim of breadth and depth of apprehension and certification.

Research Design

The study applied Quasi-experimental research in which the researcher used Solomon's Four, Non-Equivalent Control Group Design. Quasi-experimental designs Solomon's four-group enables the researcher make a more

complex assessment of the cause of the change in the dependent variable and even tell whether changes in the dependent variables are due to the interactions effect between the pre-test and treatment (Randolph, 2008).

Table 1: Solomon's Four Non-equivalent Control Group Design (as Adapted from Shuttle worth, 2009)

Group	Design	Group	Pre-test	Treatment	Post-test
I	Experimental	E1	O_1	X	O2
II	Control	C1	O_3	-	O4
III	Experimental	E2	-	X	O5
IV	Control	C2	-	-	O6

Sampling Procedure and Sample Size

Stratified random sampling technique was used to select 2 Extra-County Boys Schools and 2 Extra-County Girls Schools out of the 40 Extra-County Schools in Kitui County. Purposive sampling was employed to select Form Four students taking Physics at KCSE level in each of the selected schools. Simple random sampling was used to assign groups to experimental groups (E_1 & E_2) each with 40 students and control group (C_1 & C_2) with 40 students each. Purposive sampling was used to select a teacher each from two of the sampled schools. These two teachers taught only the control groups using the conventional methods.

Research Instruments

The instruments used for this study was a Questionnaire for students on motivation

Questionnaire for Students (QS)

The student questionnaire reflected a five-likert scale where they ticked in the choice box that matched their response on self-concept and motivation attributes from five given responses, which include Strongly Agree (SA), Agree (A), Not Sure (NS), Disagree (D), and Strongly Disagree (SD). The instrument had 12 closed ended questions on self-concept and 15 on motivation adopted from National Foundation for Educational Research of the University of London. The minimum score for each item was 1 and the maximum score was 5.

Data Analysis

Both quantitative and qualitative data was generated by the study. Data analysis involved scrutinizing the acquired information and making inferences (Kombo & Tromp, 2006).

Table:2 Summary of Quantitative Data Analysis Procedure

Hypothesis	Independent Variables	Dependent Variables	descriptive statistics	Inferential statistics
$H0_4$: There is no statistical significant difference in motivation to learn Physics between students exposed To IBSTA and those exposed to conventional teaching method in Kitui County Kenya.	IBSTA teaching Approach Conventional teaching method.	Learners motivation	Frequency percentage mean standard deviation	Chi-X^2 ANOVA LSD

III. Research Findings

Analysis on the Effect of Inquiry-Based Science Teaching Approach on Motivation.

Motivation consists of four measures: Active learning strategy, Physics learning value strong, Performance goals strong and Achievement goals strong. For a detailed descriptive analysis, averages of responses on each array were determined for experimental and control groups as shown in table 2

Active Learning Strategies

To test for active learning strategy as an indicator of motivation on the respondents, a questionnaire was given after the three weeks period of instruction using the inquiry based science-teaching approach. The following variables were under examination in the Active learning strategy scale:

ALS1. I find relevant resources that will help me understand any physics concept

ALS2. I discuss with the teacher or other students any challenging concepts

ALS3. I do not attempt to make connections between the concepts that i learn in physics.

Table 3 shows the averages of the control and experimental groups scores grouped into three categories, that is; agree and strongly agree as one category indicated as 'Agree', 'not sure' category, and then disagree and strongly disagree grouped as a third category indicated as 'disagree'.

Table 1: Average Percentage Score on Learner's Motivation Based on Learning Strategy.

	Control			Experimental		
Array	**D**	**U**	**A**	**D**	**U**	**A**
ALS1	59.74%	22.08%	18.18%	13.70%	15.07%	71.24%
ALS2	54.54%	5.19%	40.26%	80.83%	12.33%	6.85%
ALS3	36.37%	9.09%	54.54%	73.98%	15.07%	17.81%

Key: ALS- Active Learning Strategies
Source: The Researcher, 2020

As shown in table 3, 59.74% of the respondents from control group (Scale 1: active learning strategy) disagreed that they find relevant sources helpful to understand any physics concept. 18.18% of the respondents agreed and 22.08% of the respondents were undecided.

Also shown on table 3 is that 13.70% of the respondents from experimental groups disagreed that they find relevant sources helpful to understand any physics concept. 71.24% of the respondents agreed while 15.07% of the respondents were undecided. These findings show that majority of the respondents in the experimental group agreed that they find relevant sources helpful to understand any physics concept. This implies that the experimental groups posted higher mean scores than the control group.

Moving to scale 2 the control group, 54.54% of the respondents disagreed that they discuss with teachers or other students any challenging physics concept. 40.26% of the respondents agreed and 5.19% of the respondents were undecided. From the experimental group, 80.83% of the respondents disagreed, 6.85% of the respondents agreed and 12.33% of the respondents were undecided. These findings show that experimental group posted a lower mean score as compared to control groups. This implies that that majority of the respondents in the experimental disagreed that they discuss with teachers or other students any challenging physics concept.

The control group, scale 3 responses show that 54.54% of the respondents agreed that they do not attempt to make connections among the concepts they learn in physics. 36.37% of the respondent disagreed and 9.09% of the respondents were undecided. From the experimental group, 73.98% of the respondents disagreed that they did not attempt to make connections among the concepts they learn in physics. 17.81% of the respondents agreed and 15.07% of the respondents were undecided. These findings show that mean scores in the control groups were higher than that of the experimental groups. This implies that majority of the respondents in experimental groups disagreed that they do not attempt to make connections among the concepts they learn in physics.

To determine whether the means of responses of the two groups had statistically significant difference on Active Learning, Chi-Squire was computed and the findings presented in table 4

Table4: Chi square for Motivation Based on Active Learning Strategy

	Value	**Df**	**Asymptotic Significance(2-sided)**
Pearson Chi-Square	39.925[a]	12	.000
Likelihood Ratio	42.101	12	.000
Linear-by-Linear Association	21.808	1	.000
N of Valid Cases	150		

a. 8 cells (14.0%) have expected count less than 5. The minimum expected count is 3.84.

Source: The Researcher, 2020

At P=0.000, df=12 and α=0.05 the results in table 4 show that there was a significance association between active learning strategy and learning outcome since P<0.05.

This finding concurs with findings of Maongo (2015) who argued that students that were taught using inquiry-based approach in Geography reported that there was high significance in the performance of the subject due to the teaching approach which motivated the learners due to interaction with the instructional materials during the lesson.

To further understand the association between Active Learning and learning outcomes, ANOVA was used to determine the significant differences between these two groups. Table 5 shows the results of ANOVA.

Table 5: The ANOVA of the Average Scores on Motivation Based on Active Learning Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	21.450[a]	4	5.363	9.313	.000
Intercept	568.951	1	568.951	988.119	.000
Active Learning Strategies	21.450	4	5.363	9.313	.000
Error	83.490	145	.576		
Total	693.000	150			
Corrected Total	104.940	149			

a. R Squared = .204 (Adjusted R Squared = .182)

Source: The Researcher, 2020

The results in table 5 show that, the f-statistic was 5.363, for 4 degree of freedom and a mean difference of 21.450. This yielded a significance level of 0.000 that was less that the set value of **α**=0.05. The findings indicated that differences between the mean values were statistically significant.

This implies that there is an association between Physics learning strategy and the inquiry based method. These findings are in line with a study by Alberta Education (2013) which asserted that inquiry-based approaches to learning positively impacted students' ability to understand core concepts and procedures.

In understanding further the differences between the means LSD was conducted and the findings obtained are presented in the table 6.

Table 6: LSD of the Average Scores on Motivation Based on Active Learning Strategy

(I) Sub-category	(J) Sub-category	Mean Dif. (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
C1	C2	.32186	.28853	**.266**	-.248	.8921
	E1	-1.15007*	.29235	**.000**	-1.7279	-.5723
	E2	-1.50292*	.29441	**.000**	-2.0848	-.9211
C2	C1	-.32186	.28853	**.266**	-.8921	.2484
	E1	-1.47193*	.29050	**.000**	-2.0461	-.8978
	E2	-1.82479*	.29256	**.000**	-2.4030	-1.2466
E1	C1	1.15007*	.29235	**.000**	.5723	1.7279
	C2	1.47193*	.29050	**.000**	.8978	2.0461
	E2	-.35285	.29633	**.236**	-.9385	.2328
E2	C1	1.50292*	.29441	**.000**	.9211	2.0848
	C2	1.82479*	.29256	**.000**	1.2466	2.4030
	E1	.35285	.29633	**.236**	-.2328	.9385

*. The mean difference is significant at the 0.05 level.

Source: The Researcher, 2020

From the results in table 6, the mean difference between C1 and C2 (p=0.266) and E1 and E2 (p=0.236) was not statistically significant since P> 0.05. This implies that E1 and E2 groups, C1, and C2 obtained relatively the same scores on motivation based on active learning strategy. However, the comparison between the mean difference in the groups C1 and E1 (p=0.000), C1 and E2 (p=0.000), C2 and E1 (p=0.003) and C2 and E2 (p=0.000), were statistically significant since P<0.05. This shows that the experimental groups' mean was higher than the control groups' mean in motivation based on Active learning strategy. This implies that the inquiry based science teaching approach affects active learning strategy of learners

Kim (2005) that when assessed on learning strategies, inquiry based learning approach students employed more learning strategies in attitudes to learning, interest and motivation to learn, which were significantly higher than the control group also echoes the findings.

Physics Learning Value Strong

To test for Physics Learning Value Strong as an indicator of motivation on the respondents, a questionnaire was given after the three weeks period of instruction using the inquiry based science-teaching approach. The following variables were under examination in the Physics Learning Value Strong scale.

PLV1.I enjoy physics experiments because I use it in my daily life

PLV2.Physics does not stimulate my thinking

PVL3.I like physics because it satisfies my own curiosity when learning it

Table 7 shows the averages of the control and experimental groups scores grouped into three categories, that is; agree and strongly agree as one category indicated as 'Agree', 'not sure' category, and then disagree and strongly disagree grouped as a third category indicated as 'disagree'.

Table 7: Percentage Scores of the Average Scores on Motivation Based on Physics Learning Value

	Control			Experimental		
	D	U	A	D	U	A
PLV1	72.73%	6.49%	20.78%	15.07%	21.92%	63.02%
PLV2	24.68%	18.18%	57.14%	47.95%	27.40%	24.66%
PLV3	67.53%	1.30%	31.17%	38.36%	17.81%	43.84%

Key: PL- Physics Learning Value
Source: The Researcher, 2020

As shown in table 7, 72.73% of the respondents from the control group (Scale1: Physics learning value strong) disagreed that they enjoyed physics experiments because they used it in their daily lives. 20.78% of the respondents and 6.49% of the respondents were undecided. Also shown on table 60 is that 63.02% of the respondents from the experimental group agreed that they enjoyed physics experiments because they used it in their daily lives. 15.07% of the respondents disagreed while 21.92% of the respondents were undecided. These findings show that from the experimental groups, majority of the respondents agreed that they enjoyed physics experiments because they used it in their daily lives while the majority from control groups disagreed that they enjoyed physics experiments because they used it in their daily lives. This implies that respondents in the experimental groups enjoyed experiments than the control groups.

Moving to scale 2, 57.14% of the respondents in control group agreed that physics does not stimulate their thinking. 24.68% of the respondents disagreed while 18.18% of the respondents were undecided. The experimental group, responses shows that 47.95% of the respondents disagreed that physics does not stimulate their thinking. 24.66% of the respondents from same group agreed and 27.40% undecided. These finding shows that majority of respondents in experimental groups disagreed that physics does not stimulate their thinking while in control groups majority agreed that physics does not stimulate their thinking. This implies that learners from control group believe that physics does not stimulate their thinking.

The control group, scale 3 responses show that 67.53% of the respondents disagreed that they liked Physics because it satisfied their own curiosity when learning it. 31.17% agreed and 1.30% were undecided. From the experimental group, 43.8% of the respondents agreed that they liked physics because it satisfies their own curiosity when learning it. 38.36% disagreed and 17.81% were undecided. These findings show that majority of the respondents in experimental groups agreed that they liked physics because it satisfied their own curiosity when learning it while majority of the respondents in control groups disagreed that they liked physics because it satisfied their own curiosity when learning it. This implies that learners in control group believe that physics does not satisfy their level of curiosity.

In order to determine whether there is statistically significant difference between the mean Chi square, was computed and the findings are as stated in table8.

Table 8: The Chi-squire of Average Mean Score of Students Physics Learning Value Strong Based on Learners' Motivation.

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	40.136[a]	8	.000
Likelihood Ratio	48.685	8	.000
Linear-by-Linear Association	4.600	1	.032

N of Valid Cases	150

a. 2 cells (13.3%) have expected count less than 5. The minimum expected count is 4.20.

Source: The Researcher, 2020

At P=0.000, df=8 and α=0.05 the results in table 8 show that there was a significance association between Physics learning value and IBSTA. This is because the p values were less that set value of 0.05.
To further understand the association between physics learning and IBSTA, ANOVA was used to determine the significant differences between these two groups. The table 9 shows the results of ANOVA.

Table 9: ANOVA of Average Mean Score of Students' Motivation Based on Physics Learning Value.

Source	Type III Sum of Squares	DF	Mean Square	F	Sig.
Corrected Model	22.957[a]	4	5.739	10.151	.000
Intercept	463.005	1	463.005	818.899	.000
Physics Learning Value	22.957	4	5.739	10.151	.000
Error	81.983	145	.565		
Total	693.000	150			
Corrected Total	104.940	149			

a. R Squared = .219 (Adjusted R Squared = .197)

Source: The Researcher, 2020

The results in table 9 show that, the f-statistic was 10.151, for 4 degree of freedom and a mean difference of 5.739. This yielded a significance level of 0.000 that was less than the set value of **α**=0.05. This indicated that differences between the mean values were statistically significant.
These findings are supported by Sungur & Tekkaya (2006) who reported that students taught using inquiry-based learning were more likely to participate in class activity for challenge, curiosity and mastery over those using traditional methods.

In understanding further the differences between the means, LSD was computed. The findings obtained are presented in the table 10.

Table 10: The LSD of the Average Scores on Motivation Based on Physics Learner Value

		Mean			95% Confidence Interval	
(I) Sub-category	(J) Sub-category	Dif.(I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
C1	C2	.531	.303	**.082**	-.07	1.13
	E1	2.452*	.307	**.044**	-1.06	.16
	E2	2.595*	.309	**.006**	-1.21	.02
C2	C1	-.531	.303	**.082**	-1.13	.07
	E1	3.983*	.305	**.002**	-1.59	-.38
	E2	1.126*	.307	**.000**	-1.73	-.52
E1	C1	2.452*	.307	**.044**	-.16	1.06
	C2	3.983*	.305	**.002**	.38	1.59
	E2	-.143	.311	**.646**	-.76	.47
E2	C1	2.595*	.309	**.006**	-.02	1.21
	C2	1.126*	.307	**.000**	.52	1.73
	E1	.143	.311	**.646**	-.47	.76

The mean difference is significant at the 0.05 level.

Sources: Researcher 2020

From the results in table 10, the mean difference between C1 and C2 (p=0.082) E1 and E2 (p=0.646) was not statistically significant since P> 0.05. This implies that E1 and E2 groups and C1 and C2 obtained relatively the same scores on motivation based on physics learning value. However, the comparison between the mean difference in groups C1 and E1 (p=0.044), C1 and E2 (p=0.006), C2 and E1 (p=0.002) and C2 and E2 (p=0.000), were statistically significant since P<0.05 This shows that the experimental groups' mean was higher than the control groups' mean in Motivation based on Physics learner value strong.

The findings are emphasized by (Wilhelm & Wilhelm, 2010), who indicated that the inquiry approach encourages student's ownership, sense of control, choice and autonomy, explicit purpose for learning, collaboration and personal relevance.

Performance Goals Strong

To test for Performance Goals strong as an indicator of motivation on the respondents, a questionnaire was given after the three weeks period of instruction using the inquiry based science-teaching approach. The following variables were under examination in the performance goals strong scale:

PG1. Like doing physics practical in order to get a good grade.
PG2. Like studying physics in order to perform better than other students.
PG3. Perform well in physics because I really love it.

Table 11 shows the averages of the control and experimental groups scores grouped into three categories, that is; agree and strongly agree as one category indicated as 'Agree', 'not sure' category, and then disagree and strongly disagree grouped as a third category indicated as 'disagree'

Table 11: Average Percentage Score on Motivation Based on Performance Goal strong

	Control			Experimental		
Array	**D**	**U**	**A**	**D**	**U**	**A**
PG1	66.23%	20.78%	12.98%	21.92%	15.07%	63.02%
PG2	41.56%	23.38%	35.06%	34.25%	19.18%	46.58%
PG3	59.74%	19.48%	20.78%	39.73%	9.59%	50.69%

Key: PG – Performance Goals Array
Source: The Researcher, 2020

As shown on the table 11, 66.23% of the respondents from control group (scale1: performance goal strong) disagreed that they liked doing physics practical sessions to get a good grade, 12.98% agreed while 20.78% were undecided. From the experimental group, 63.02% of the respondents agreed that they liked doing physics practical sessions to get a good grade. 21.92% disagreed and 15.07% were undecided. These findings show that majority of the respondents in the experimental groups agreed that they liked doing physics practical sessions to get a good grade, while in the control group majority of the respondents disagreed that they liked doing physics practical sessions to get a good grade. This implies that learners in control groups reported that there is no relationship between liking doing physics practicals and learning outcome.

The findings on the control group in Scale 2 show that 41.56% of the respondents disagreed that they liked studying Physics in order to perform better than other students did. 35.06% agreed and 23.38% were undecided. From the experimental groups, 46.58% of the respondents agreed that they liked studying physics in order to perform better than other students did. 34.25% disagreed and 19.18% were undecided. The findings shows that majority of the respondents in the experimental groups agreed that they liked studying physics in order to perform better than other students while in control groups majority of the respondents disagreed that they liked studying physics in order to perform better than other students. This implies that learners in the experimental groups believed that their good performance depended on how much one liked the subject.

From the control groups' scale: 3, 59.74% of the respondents disagreed that they perform well in physics because they really loved it. 20.78% agreed while 19.48% were undecided. From the experimental group, 50.69% of the respondents agreed that they perform well in physics because they really loved it. 39.73% disagreed and 9.59% were undecided. These findings show that majority of the respondents in experimental group agreed that they perform well in physics because they really loved it. Majority of the respondents in control group disagreed that they performed well in physics because they really loved it. This implies that loving the Physics subject has no influence on its performance. These findings are in line with a study by Reeve (2012) who argued that student motivation is a driving forces that strength, goal-directedness, and persistence to student behavior.

In order to understand if there is a statistically significant difference Chi-square, was computed and the findings are as stated in table 12.

Table 12: The Chi square of Average Mean Score on Motivation Based on Performance Goal

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	17.890[a]	8	.022
Likelihood Ratio	21.140	8	.007
Linear-by-Linear Association	1.375	1	.241
N of Valid Cases	150		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.40.

Source: The Researcher, 2020

At P=0.022, df=8 and α=0.05 the results in table 12 show that there was a significance association between role performance and IBSTA. The p value was less than 0.05. This implies that the mean differences were statistically significant.

To further understand the association between self-image and IBSTA, ANOVA was used. Table13 shows the results of ANOVA.

Table 13: ANOVA of Average Mean score of Students' Motivation Based on Performance Goal strong.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	42.851[a]	4	10.713	25.018	.000
Intercept	591.990	1	591.990	1382.514	.000
Performance Goals	42.851	4	10.713	25.018	.000
Error	62.089	145	.428		
Total	693.000	150			
Corrected Total	104.940	149			

a. R Squared = .408 (Adjusted R Squared = .392)

Source: The Researcher, 2020

The results in table 13 show that, the f-statistic was 25.018, for 4 degree of freedom and a mean difference of 42.851. This yielded a significance level of 0.000 that was less that the set value of **α**=0.05. This indicated that differences between the mean values were statistically significant. This implies that the mean score of the experimental group was higher than that of the control group. These findings are in line with studies done by Zekibayram (2013) and Madden (2011) who found that students' extrinsic goal orientation develops after the application of inquiry-based activities and promote student's motivation.

In understanding the statistically significant differences between the means, LSD was computed. The findings obtained were presented in the table14.

Table 14: LSD of Score on Students' Motivation Based on Performance Goal Strong

					95% Confidence Interval	
(I) Sub-category	(J) Sub-category	Mean Dif. (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
C1	C2	.370	.282	**.192**	-.19	.93
	E1	-1.282*	.286	**.000**	-1.85	-.72
	E2	-1.023*	.288	**.001**	-1.59	-.45
C2	C1	-.370	.282	**.192**	-.93	.19
	E1	-1.651*	.284	**.000**	-2.21	-1.09
	E2	-1.393*	.286	**.000**	-1.96	-.83
E1	C1	1.282*	.286	**.000**	.72	1.85
	C2	1.651*	.284	**.000**	1.09	2.21
	E2	.258	.290	**.374**	-.31	.83
E2	C1	1.023*	.288	**.001**	.45	1.59
	C2	1.393*	.286	**.000**	.83	1.96
	E1	-.258	.290	**.374**	-.83	.31

*. The mean difference is significant at the 0.05 level.

Source: The Researcher, 2020

Results in table 14, show that the mean difference between C1 and C2 (p=0.192), E1 and E2 (p=0.374) was not statistically significant since P> 0.05. This implies that E1 and E2 groups, C1, and C2 obtained relatively the same scores on motivation based on performance goal strong. However, the comparison between the mean difference in the groups C1 and E1 (p=0.000), C1 and E2 (p=0.001), C2 and E1 (p=0.000) and C2 and E2 (p=0.000) were statistically significant. This shows that the experimental groups' mean is higher than the control groups' mean in Motivation based on performance goal strong. Therefore, the null hypothesis for the relevant comparisons was reject.

Achievement Goals Strong

To test for Achievement Goals Strong as an indicator of motivation on the respondents, a questionnaire was given after the three weeks period of instruction using the inquiry based science-teaching approach. The following variables were under examination in the Achievement Goals Strong scale:

AG.1.I feels good when I attain a good score in a physics practical test.

AG2: I would like to be a physicist.

AG3: I would not like to work with people who make scientific discoveries.

Table 68 shows the averages of the control and experimental groups scores grouped into three categories, that is; agree and strongly agree as one category indicated as 'Agree', 'not sure' category, and then disagree and strongly disagree grouped as a third category indicated as 'disagree'.

Table 15: Average Percentage Score on Motivation Based on Achievement Goal

	Control			Experimental		
	D	**U**	**A**	**D**	**U**	**A**
AG1	18.18%	6.49%	75.32%	23.29%	0.00%	76.68%
AG2	46.75%	35.07%	18.18%	28.77%	20.55%	50.68%
AG3	9.08%	12.99%	77.93%	75.34%	6.85%	17.81%

Key: AG- Achievement Goals Strong
Source: The Researcher, 2020

Moving to scale: 1(Achievement goal) 75.32% of the respondents agreed that they felt good when they attained a good score in a physics practical test. 18.18% disagreed and 6.49% were undecided. From the experimental group, 76.68% of the respondents agreed that they felt good when they attained a good score in a physics practical test. 23.29% disagreed and 0.00% were undecided. These findings show majority of the respondents from both groups agreed that they felt good when they attain a good score in a physics practical test.

From the findings on the experimental groups in scale: 2 (Achievement goal strong) 18.18% of the respondents agreed that they would like to be physicists. 45.75% disagreed and 35.07% were undecided. From the experimental group, 50.68% of the respondents agreed that they would like to be physicists. 28.77% disagreed and 20.55% were undecided. These findings show that majority of the respondents from experimental group agreed that they would like to be physicists, contrary to the control groups responses. This implies that majority of learners are less decided on the career they would pursue in future.

Moving to scale 3 (Achievement goal), 77.93% of the respondents agreed that they would not like to work with people who make scientific discoveries. 9.08% disagreed and 12.99% were undecided. From the experimental group, 17.81% of the respondents agreed that they would not like to work with people who make scientific discoveries. 75.34% disagreed and 6.85% were undecided. The findings show that majority of the respondents from the experimental group disagreed that they would not like to work with people who make scientific discoveries. This implies that students have less knowledge on scientific discovery and the Physics content they learn in class is hard to implement in the society. The findings contradict a study by Madden (2011) who argued Inquiry-Based activities promote student's motivation.

In order to understand if there is a statistically significant difference between the means of the groups Chi -square, was computed and the findings are as stated in table 15.

Table 15: The Chi square of Average Mean Score on Motivation Based Achievement Goal Strong

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	25.036[a]	8	0.462
Likelihood Ratio	27.708	8	0.001
Linear-by-Linear Association	1.342	1	0.247
N of Valid Cases	150		

a. 6 cells (18.0%) have expected count less than 5. The minimum expected count is 1.50.

Source: The Researcher, 2020

At P=0.462, df=8 and α=0.05 the results in table 15 show that there was no significance association between self- esteem and IBSTA. This is because the P > 0.05. This shows that there was no significant difference between the mean of the group. These findings contradict a study by Dweck (2017) who argued that providing students with meaningful learning challenges, providing feedback focused on effort and process encourages students to adopt a growth mindset.

To further, understand if there was significant difference between the means of the groups, ANOVA was computed and table 16 shows the results of the findings.

Table 2: ANOVA of Average Mean Score of Students' Motivation Based on Achievement Goal

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	17.856[a]	4	4.464	7.433	0.329
Intercept	559.498	1	559.498	931.595	.000
Achievement Goals	17.856	4	4.464	7.433	0.329
Error	87.084	145	.601		
Total	693.000	150			
Corrected Total	104.940	149			

a. R Squared = .170 (Adjusted R Squared = .147)

Source: The Researcher, 2020

The results in table 16 show that, the f-statistic was 4.464, for 4 degree of freedom and a mean difference of 7.433. This yielded a significance level of 0.329 that was more that the set value of **α**=0.05. This indicated that differences between the mean values were not statistically significant. This implies that the teaching approach that the teacher used did not influence leaners achievement.

These findings contradicts a study by Saunders, Stewart, Gyles & Shore (2012), who argued that the inquiry approach requires students to discover or construct knowledge through relevant activities and personal investigations, while the traditional instruction does not enhance student learning, because students are not engaged, motivated, and perceived on purpose of learning activities.

In further understanding if there is a statistically significant difference between the means, LSD was computed. The findings obtained are presented in the table 17.

Table 17: LSD of Score on Students' Motivation Based on Achievement Goal Strong

(I) Sub-category	(J) Sub-category	Mean Dif. (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
C1	C2	.175	.321	**.587**	-.46	.81
	E1	-.211	.325	**.517**	-.85	.43
	E2	.177	.328	**.590**	-.47	.82
C2	C1	-.175	.321	**.587**	-.81	.46
	E1	-.386	.323	**.235**	-1.03	.25
	E2	.002	.326	**.995**	-.64	.65
E1	C1	.211	.325	**.517**	-.43	.85
	C2	.386	.323	**.235**	-.25	1.03

	E2	.388	.330	**.241**	-.26	1.04
E2	C1	-.177	.328	**.590**	-.82	.47
	C2	-.002	.326	**.995**	-.65	.64
	E1	-.388	.330	**.241**	-1.04	.26

Source: The researcher, 2020

From the results in table17, the mean difference between C1 and C2 (P=0.587) E1 and E2 with (P=0.241) was not statistically significant. In addition the comparison between the mean difference in the groups C1 and E1 (P=0.517), C1 and E2 (P=0.590), C2 and E1 (P=0.235) and C2 and E2 (P=0.995) were not statistically significant. Since P> 0.05. This shows that there was no mean difference between the experimental groups and control groups' in motivation based on achievement goal strong.

These findings contradict the findings by Ndirangu (2013) who argued that inquiry-based teaching enhances high achievement since the students are strongly motivated by the method due to being learner-centered method.

Learning Environment Stimulation

To test for learning environment stimulation as an indicator of motivation on the respondents, a questionnaire was given after the three weeks period of instruction using the inquiry based science-teaching approach. The following variables were under examination in the learning environment stimulation scale:

LES1.I like to carry experiments in physics rather than read about the subject.

LES2.I enjoy discussing physics problems raised in class with my friends.

LES 3, Doing Physics experiments in the laboratory is fun.

Table 18 shows the averages of the control and experimental groups scores grouped into three categories, that is; agree and strongly agree as one category indicated as 'Agree', 'not sure' category, and then disagree and strongly disagree grouped as a third category indicated as 'disagree'.

Table 18: Average Percentage Score on Motivation Based on Learning Environment Stimulation

	Control			Experimental		
	D	**U**	**A**	**D**	**U**	**A**
LES1	50.65%	16.88%	32.47%	31.51%	8.22%	60.28%
LES2	37.67%	23.38%	38.96%	53.20%	5.48%	38.36%
LES3	66.23%	5.19%	28.58%	26.03%	2.74%	71.24%

Key: LES- Learning Environment Stimulation
Source: The Researcher, 2020

As shown in table 18, 50.65% of the respondents from the control group (scale1: Learning Environment Stimulation) disagreed that they liked to carry out experiments in physics as compared to reading about them. 32.47% agreed and 16.88% were undecided. From the experimental group, 60.28% of the respondents agreed that they liked to carry out experiments in physics as compared to reading about them. 31.51% disagreed and 8.22% were undecided. The findings show that majority of the respondents in the experimental group agreed that they liked to carry out experiments in physics as compared to reading about them. From the control groups majority of the respondents disagreed that they liked to carry out experiments in physics as compared to reading about them. This implies that learners in experimental group preferred experiments to reading physics, which is a contributing factor for their good learning outcome.

Also shown on table 19 is that 37.67% of respondents from control group (scale 2: Learning Environment Stimulation) disagreed that they enjoyed discussing physics problems raised in class with their friends. 38.96% agreed and 23.38% were undecided. From the experimental group, 38.36% of the respondents agreed that they enjoyed discussing physics problems raised in class with their friends, 53.20% disagreed and 5.48% were undecided. These findings show that majority of the experimental respondents disagreed that they enjoyed discussing physics problems raised in class with their friends while the majority of the respondents from the control group agreed. This implies that the environment of a learner makes the learner to enjoy discussing Physics problems raised in class with their friends.

Moving to scale 3, 66.23% of the respondents in the control groups disagreed that doing Physics experiments in the laboratory was fun. 28.58% agreed and 5.19% were undecided. From the experimental group 71.24% agreed that doing experiment in Physics laboratory was fan, 26.03% disagrees and 2.74% were undecided. These findings show that majority of the respondents in control group disagreed that doing Physics

experiments in the laboratory was fun while majority of respondent in experimental group agree. This implies that learning environment stimulate learners to be comfortable to conduct an experiment.

The findings are in line with a study by Napitupulu, (2017) who argued that motivation is a powerful force in learning and the inquiry based teachings improve motivation and achievement in learning physics. In addition Esokomi (2013), argued that Inquiry Approach makes students active in participation during class session since the approach is child-centered and motivates them to be involved in any activity.

In order to identify if there is a statistically significant difference a chi-squire was computed and the findings are as indicated in table 20.

Table 20: The Chi square of Average Mean Score on Motivation Based on Learning Environment Stimulation

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	53.973[a]	8	.000
Likelihood Ratio	61.678	8	.000
Linear-by-Linear Association	8.476	1	.004
N of Valid Cases	150		

a. 3 cells (20.0%) have expected count less than 5. The minimum expected count is 1.80.

Source: The Researcher, 2020

At P=0.000, df=8 and α=0.05 the results in table 20 show that there was a significance association between learning environment stimulation and IBSTA. This was because the p value was less than α=0.05

To further check if there was a statistically significant difference between the means of the groups Analysis of Valiance was computed and the findings are shown in table 21.

Table 21: ANOVA of Average Mean Score on Motivation Based on Learning Environment Stimulation

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	16.826[a]	4	4.207	6.922	.000
Intercept	590.563	1	590.563	971.831	.000
Learning Environment Stimulation	16.826	4	4.207	6.922	.000
Error	88.114	145	.608		
Total	693.000	150			
Corrected Total	104.940	149			

a. R Squared = .160 (Adjusted R Squared = .137)

Source: The Researcher, 2020

The results in table 21 show that, the f-statistic was 6.922, for 4 degree of freedom and a mean difference of 4.207. This yielded a significance level of 0.000 that was less that the set value of **α**=0.05. This indicated that differences between the mean values were statistically significant. This implies that the learning environment stimulation enhances good learning outcome. The findings are supported by Chola (2015) who that the inquiry based science teaching approach enhanced learners' comprehension and attitude on acid-base concept in chemistry.

In understanding further the differences between the means of LSD was conducted. The findings obtained were presented in the table 22.

Table 22: LSD of Average Mean score of Students' Motivation Based on Learning Environment Stimulation

(I) Sub-category	(J) Sub-category	Mean Dif. (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
C1	C2	.373	.337	**.270**	-.29	1.04
	E1	-1.339*	.341	**.000**	-2.01	-.66
	E2	-.808*	.344	**.020**	-1.49	-.13

C2	C1	-.373	.337	**.270**	-1.04	.29
	E1	-1.712*	.339	**.000**	-2.38	-1.04
	E2	-1.182*	.342	**.001**	-1.86	-.51
E1	C1	1.339*	.341	**.000**	.66	2.01
	C2	1.712*	.339	**.000**	1.04	2.38
	E2	.531	.346	**.127**	-.15	1.21
E2	C1	.808*	.344	**.020**	.13	1.49
	C2	1.182*	.342	**.001**	.51	1.86
	E1	-.531	.346	**.127**	-1.21	.15

*. The mean difference is significant at the 0.05 level.

Source: The Researcher, 2020

From the results in table 23, the mean difference between C1 and C2 (p=0.270) and E1 and E2 (p=0.127) was not statistically significant since P> 0.05. This implies that E1 and E2 groups and C1 and C2 obtained relatively the same scores on motivation based on learning environment stimulation. However the comparison between the mean difference in the control groups C1 and E1 (p=0.000), C1 and E2 (p=0.020), C2 and E1 (p=0.000) and C2 and E2 (p=0.001).This implies that the differences between the means were statistically significant since P<0.05. This shows that the experimental groups' mean is higher than the control groups' mean in motivation based on learning environment stimulation.

Mean overall on Motivation

The average percentage frequency for the five indicators; active learning strategies, physics learning value strong, performance goals strong, achievement goals strong and learning environment stimulation were computed and the findings presented as shown in table 24.

Table 24: Average percentage Frequency on Motivation

Average Array of motivation	**E1**	**C1**	**E2**	**C2**
Active learning strategies	63.96%	48.24%	54.85%	47.86%
Physics learning value strong	66.67%	42.98%	64.82%	41.01%
Performance Goals strong	55.86%	46.49%	74.07%	46.15%
Achievement goals strong	53.16%	42.91%	56.48%	43.59%
Learning environment stimulation	56.76%	41.23%	56.48%	34.19%
Average Score	**59.28%**	**44.37%**	**61.35%**	**42.56%**

Source: The Researcher, 2020

Table 24 results indicates that, the respondents from the experimental group had better outcomes as to compare to the control group. The average scores for experimental group were E1 (59.28%) and E2 (61.35%) while the average scores for the control groups were C1 (44.37%) and C2 (42.56%).The average arrays of experimental groups were higher than that of control group. Experimental groups possessed high levels of active learning strategies, Physics learning value, Performance Goals, Achievement goals and Learning environment stimulation than the control groups. This implies that the inquiry based teaching approach enhances motivation leading to a good learning outcome.

To understand whether there was a statistically significant difference in motivation and the method of teaching approach used, the following hypothesis was tested:

H_{04}: There is no statistically significant difference in motivation to learn Physics between students exposed to Inquiry-Based Science Teaching Approach and those exposed to Conventional methods.

A chi-square was used to test the hypothesis. Table 25 presents the findings on the computation of the significant differences between means.

Table 25: The Chi square of overall Average Mean Score on Motivation

	Value	**Df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	42.316[a]	8	.000
Likelihood Ratio	46.527	8	.000
Linear-by-Linear Association	1.888	1	.169
N of Valid Cases	150		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.80.

Source: The Researcher, 2020

At P=0.000, df=8 and α=0.05 the results in table 25 show that there was a significance association between motivation and IBSTA. Additionally, the percentage that represents the ratio of the actual count to the expected count was not violated because it was not greater than 20%. The findings of this study are in line with a study by Esokomi (2013) who argued that inquiry approach makes students active in participation during class session since the approach is child-centered and motivates them to be involved in any activity.

In order to determine if there were significant identifiable differences in each of the 5 indicators on motivation analysis of variance (ANOVA) was computed and the findings are as recorded in table 26.

Table 26: Overall Results of Analysis of Variance (ANOVA) for Motivation

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	34.554	3	11.518	6.020	.001
Within Groups	279.339	146	1.913		
Total	313.893	149			

Source: The researcher, 2020

The results in table 26 show that, the f-statistic was 6.020, for 3 degree of freedom and a mean difference of 11.518. This yielded a significance level of 0.001 that was less that the set value of **α**=0.05. This indicated that differences between the mean values were statistically significant. The findings are in line with a study by Adedaji & Tella (2007) who reported that motivation of a student is a key determinant to good performance in mathematics.

To further understand the statistical difference between the scores obtained, it was essential to find out whether there were any statistical differences between the different study groups, LSD was computed and the findings obtained are shown in the table 27.

Table 27: LSD Overall Results of Motivation after Treatment

(I)Sub-category	(J)Sub-category	Mean Diff (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
C1	C2	.32186	.28853	**.266**	-.2484	.8921
	E1	7.15007*	.29235	**.000**	-1.7279	-.5723
	E2	8.50292*	.29441	**.000**	-2.0848	-.9211
C2	C1	-.32186	.28853	**.266**	-.8921	.2484
	E1	6.47193*	.29050	**.000**	-2.0461	-.8978
	E2	9.82479*	.29256	**.000**	-2.4030	-1.2466
E1	C1	7.15007*	.29235	**.000**	.5723	1.7279
	C2	6.47193*	.29050	**.000**	.8978	2.0461
	E2	-.35285	.29633	**.236**	-.9385	.2328
E2	C1	8.50292*	.29441	**.000**	.9211	2.0848
	C2	9.82479*	.29256	**.000**	1.2466	2.4030
	E1	.35285	.29633	**.236**	-.2328	.9385

Source: The Researcher, 2020

From the results in table 27, the mean difference between C1 and C2 (p=0.266) E1 and E2 (p=0.236) was not statistically significant since P> 0.05. This implies that E1 and E2 groups and C1 and C2 obtained relatively the same scores on motivation. However comparison between the mean difference in the group C1 and E1 (p=0.000), C1 and E2 (p=0.000), C2 and E1 (p=0.000) and C2 and E2 (p=0.000), were statistically significant since P<0.05. This shows that the experimental groups' mean score was higher than the control groups' mean score in motivation. Therefore, Hypothesis four that, reads *H_{04}:There is no statistically significant difference in motivation to learn Physics between students exposed to inquiry-based science teaching approach and those exposed to conventional methods,* was rejected.

These findings of this study are in line with study by Napitupulu, (2017) who reported that motivation is a powerful force in learning and the inquiry based teaching improves motivation and achievement in learning physics. In addition the findings also are in line with a study by Dweck (2017) who argued that providing students with meaningful learning challenges, providing feedback focused on effort and process encourages students to adopt a growth mindset.

IV. Conclusion

From the summary of the findings above, the following conclusions were made:

i. That IBSTA is a good method for teaching Physics as it enhances motivation.

ii. That Physics Teachers in Kitui County have relied mainly on the conventional teaching method and should therefore be exposed to the IBSTA to enhance motivation as a learning outcomes in Physics.

iii. That IBSTA requires a conducive or enabling environment which should be created through relevant infrastructure in the context of mentorship and teacher retooling.

iv. That there needs to be mentorship of teachers on the integration of face-to-face IBISTA and engagement on use of ICT program of conducting experiments (PHET animation) to adopt a new pedagogy due to the impact covid-19 pandemic.

v. KICD should introduce and develop a programme for the induction and mentorship of teachers on IBISTA so as to empower them with inquiry teaching skills.

V. Recommendations

❖ Physics Teachers should adopt IBSTA since it is an interactive model that ensures students are hooked onto the session and also enhances task competence, scientific creativity, self-concept and motivation.(use of PHET computer programme to conduct online practicals).

❖ School administrators should reward Physics teachers who use IBSTA to create a culture that improves students' inquiry skills of engagement, elaboration, exploration, explaining and evaluation consequently improving learning outcomes by making learners competent, with better self-concept, scientific creativity and motivation.

❖ KICD should introduce and develop a programme for induction and mentorship of Physics teachers on the implementation of IBSTA to empower them with relevant skills.

❖ To enhance the learning of Physics through IBISTA the researcher came up with a proposed pedagogical model which is an elaboration of Byees model: **A** Proposed Pedagogical Model

Building on the findings of this study, and integrating Byee's 5 E models the study proposes a model that shows the interplay between IBISTA and task competence, scientific creativity, motivation and self-concept as depicted in figure 2 below.

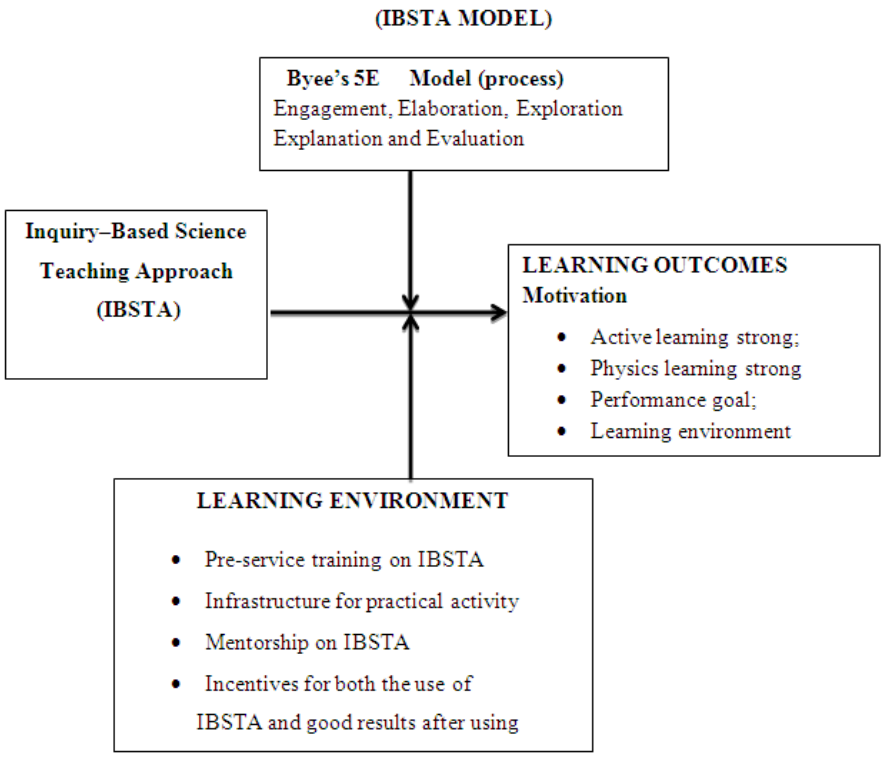

Figure 2: A Proposed Pedagogical Model on Inquiry-Based Science Teaching Approach (IBSTA)
Source Researcher 2020

In the above model, the institutional requirements include pre-service training and proper evaluation in the use of IBSTA. IBSTA will make the teachers develops relevant skills and competences; an appropriate infrastructure for practical activities to enable a hands- on approach; mentorship on IBSTA by experienced teachers and consultants as well as the provision of incentives for both the use of IBSTA and good results after using IBSTA.

Recommendations for Further Study

The researcher makes the following suggestions for further study:

i. A study should be conducted to establish why achievement goal strong as a component of motivation did not strongly correlate with IBSTA.

ii. A systematic study be carried out to determine whether there are variations on the impact of IBSTA at different class levels from form one to four.

iii. A systematic study should to be carried out to determine whether there are variations on the impact of IBSTA in other Science subjects like Chemistry and Biology.

iv. Since this study was conducted on extra county schools in Kitui County, more secondary schools of different categories in the county need to be studied for better generalization of the results.

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