Effect Of Computer Simulation on Students' Achievement In Probability Based on Their Attitude Toward Mathematics

Monyoro Wilfred Mogire

Department Of Educational Communication & Technology in The School of Education, Kenyatta University.P.O. Box 43844-00100 Nairobi, Kenya.
Corresponding author:
Email: willymonyoro@gmail.com

Abstract
The study was about the effect of computer simulation on students' achievement in Probability based on their attitude towards mathematics. Data were collected from 198 Form 3 students from four (4) public secondary schools who were purposefully chosen to participate in the study. To obtain qualitative and quantitative data, the researcher used students' questionnaires. The study used Post Hoc Tukey's (HSD) test and an ANOVA, and the results showed that the strategy's use had a greater impact on the experimental groups than the control groups. Statistical Package for Social Sciences (SPSS) software was typically used to quantitatively examine the data that was obtained. Depending on the research hypothesis, either a one-way ANOVA or a two-way ANOVA was used to test the hypothesis at a 95% level of significance. Additional tests were based on factor analysis, post hoc analysis, and t-tests. The main finding is that CBS's teaching approach is better than traditional approaches to teaching probability.

***Keywords**: Students' Attitude, Integration of CBS, Confidence in Mathematics and Mathematics achievement.*

I. INTRODUCTION

Students' Attitude and Integration of CBS in Mathematics Instruction

Allport (1935) defines attitude as "a mental and neurological state of readiness that is organized through experience and has a direct or dynamic influence on an individual's response to all things and situations." Attitudes are strong and long-lasting, influencing our actions by helping us to analyze and make decisions about our surroundings (Sternberg, 2004).

Douglas and McLeod (1992) focused on positive and negative responses to an entity, suggesting that attitudes are affective responses involving pleasant or negative sentiments that are stable. According to Eagly and Chaiken (1993), attitude is a psychological inclination expressed as a degree of favor or disfavor in evaluating a certain thing or person. Students' attitudes have been demonstrated to be a significant predictor of their Mathematical achievement. In reality, empirical evidence links students' attitudes to their academic success (Zan & Di Martino, 2007).

Learner aptitude and motivation to learn Mathematics, execute a range of prescribed tasks, and their persistence in the tasks were claimed to be determined in part by their attitude. Simultaneously, learners' ideas of mathematics were linked to how they approached Mathematical challenges, which in turn determined their productive or non-productive approaches to the subject. In general, the attitude was a key notion in social judgements and conduct, as well as one of the most crucial concepts in decision-making (Venkatesh, Morris, Davis, G. & Davis, F., 2003).

As a result, several studies have been conducted to emphasize the importance of students' attitudes toward Mathematics training, with either positive or negative results. There is a link between students' attitudes toward Mathematics and their academic aptitude in the subject, according to a review of the research (Nicolaidou & Philippou, 2003).

According to Singh, Granville, and Dika (2002), students' ideas and expectations about the difficulty of Mathematics, their levels of involvement, and their likelihood or perceived worth of success all have a significant impact on their Mathematical achievement. Students with favorable attitudes toward Mathematics performed better than those with negative views, according to

Nicolaidou and Philippou (2003), suggesting that attitudes and performance in the subject are linked. Mata, Monteiro, and Peixoto (2010), as well as Carmona, Martnez, and Sanchez (2010), backed up this claim (2010). (2004). According to Lipnevich et al. (2011), learner attitude explained 25% to 32% of the variance in Mathematics achievement, with the variance being independent of mathematical skill. High achievement in the subject indicates a positive attitude toward Mathematics, according to Georgiou, Stavrinides, and Kalavana (2007), however, Mata et al. (2012) discovered that the more positive the attitude, the higher the degree of student achievement in the subject.

Researchers recommended for adoption of tactics that would assist alter students' attitudes toward Mathematics in response to recommendations to improve learning results in Mathematics, particularly among low-achieving students. Integration of CBS in Mathematics teaching and learning was one of these ways. For example, Slouti and Barton (2007) found that including CBS in lessons can engage students to learn by adding variation to the lessons while also maintaining teachers' enthusiasm for teaching.

Including CBS into teaching and learning has an effect on both students' and teachers' attitudes toward formal education, claim Mathew and Halpin (2002). The National Council of Teachers of Mathematics (NCTM) praised the application of educational technology in the study of mathematics, claiming that it was essential for teaching and learning the subject and that it enhanced students' learning (National Council of Teachers of Mathematics, 2000). The majority of these studies were conducted in other countries, leaving a research void on the impact of CBS integration on students' attitude-based achievement, which this study sought to fill.

Pytel (2007) investigated student attitudes toward Mathematics when technology is used in a lesson and found that student's passion and interest in learning are higher when computers are used than when traditional methods are employed. Stratham and Torell (1996) conducted a meta-analysis of the use of computers in teaching and learning and found that incorporating technology into schools leads to fewer discipline concerns and higher-class attendance. Collaboration, simulation, student queries, and problem-solving became anticipated behaviors in the mathematics classroom when CBS was used as intended, according to the study. Learning is reinforced by CBS's instant feedback, which offers the student self-confidence and a sense of self-worthiness (Marzano, 1998).

More advanced topic instruction could increase girls' early Mathematics achievement because Mathematics exams are significantly connected with school-taught curricula (Downey & Vogt Yuan, 2005). Females' achievement in Mathematics was aided by teacher and peer assistance (Riegle-Crumb, Farkas & Muller, 2006). These Mathematical findings are supported up by broader statistics that reveal a positive association between academic attitudes, achievement, emotions, learning, motivation, and self-efficacy, as well as teacher and peer support (Danielsen, Wiium, Wilhelmsen & Wold, 2010). Gherasim, Butnaru, and Mairean (2013) found gender disparities in performance goals, classroom environment, and Mathematics achievement among young adolescents, finding that girls outperformed boys in math. Jones, et al., (2007) found that men have more positive attitudes toward math and science than women.

Girls reported lower levels of fun and pride in Mathematics than boys, according to Frenzel, Pekrun, and Goetz (2007). Girls felt slightly more guilt than boys during a Mathematics lecture, according to Frenzel et al, (2007). Too much individual practice (Tobias, 1987) and teachers who focus on students' shortcomings might lead to a negative attitude toward Probability.

II. LITERATURE REVIEW

Attitudes and Confidence in Mathematics

A student's attitude toward mathematics can be influenced by a variety of factors. The classroom teacher has a significant impact on student attitudes. Teacher quality, enthusiasm, respect, dedication, and good attitudes toward mathematics are linked, according to Shaughnessy (1992). Midgley & Urdan (1995) discovered that when a teacher used more supporting comments during contact with students, children reported less negative affect and self-handicapping attitudes than when the instructor made more critical comments during interactions. They concluded that teachers needed to be aware of how they interact with students because teachers constantly transmit messages to students, both vocally and non-verbally, and these messages influenced student confidence and attitudes toward mathematics. The level of success a student has in mathematics has also been demonstrated to influence their attitudes.

Ross, & Broh (2000) studied factors that influence Mathematics achievement in a sample of college-aged men and women. They focused on self-esteem and personal control, in particular, attributes of success and failure. "By far the biggest predictor of academic achievement in the 12th grade is earlier academic achievement" or success in Mathematics, according to one of their studies. The more success a student had in math, the more enthusiastic they were about it (Hootstein, 1994). While this looked logical on the surface, it also meant that teachers of Attitudes, Performance, and Achievement 8 needed to develop strategies for students to feel successful. This was especially true for students who had previously experienced only a limited level of success. It may be tough to improve a student's attitude and confidence. This may be beneficial if a student has a positive mindset, but it could be detrimental if the student's attitude and confidence are negative.

In a three-year study of students' attitudes and beliefs about mathematics, Turner and Meyer (2009) found that, depending on the manner of approach, roughly 66% of students' attitudes and confidence changed from year to year. Hence, computer-assisted learning will significantly alter how they view probability and mathematics in general. Pupils who said their confidence levels had changed merely went from one level to the next; for instance, as a student's math skills improved, they went from having low confidence to having high confidence.

Schau, Stevens, Dauphine, & del Vecchio, (1995) developed attitude as a multidimensional term after a cyclical research process with attitudes divided into three components. Gómez-Chacón (2000) defined Probability feelings as "pleasure or dissatisfaction with probability," "interest or indifference in Mathematics," and "likely rejection or worry toward Probability." Behavioral component toward Probability (BP): The teacher's proclivity to act in a certain way toward the attitude object, to make decisions that benefit other colleagues (staff mates), and to apply Probability. The teacher's self-perception of self-competence, knowledge, and intellectual skills, when applied to Probability, is called cognitive competence towards Probability (CCP) (Gal, 2005).

In their experiments, the three components resulted in three different attitudes regarding Probability. The emotive component of teaching Probability resulted in personal feelings about teaching Probability that varied depending on the affective component of the issue in terms of joy or dissatisfaction, fear – lack of confidence, interest or lack of interest in teaching Probability (Gal, 2005). The teaching Probability competence component (CT) evaluates the teacher's perception of his or her abilities to teach Probability, answer students' issues, propose acceptable work, and locate appropriate resources for the topic (Batanero, & Lancaster, 2011). The behavioural component of teaching Probability (BT) was used to rate the didactic action trend. If the teacher has or has not taught Probability, or if he or she is willing to teach it, if he or she prioritizes it over other courses if he or she believes it should be delayed or reinforced (Batanero, & Lancaster, 2011). Finally, they incorporated a Value component toward Probability and its teaching (VPT): an understanding of the utility, relevance, and significance of Probability and its teaching in personal and professional life. Although Schau et al. (1995) discovered components of value, none of the scales evaluated included the value offered for teaching; this is the gap that this study aimed to fill by including computers in teaching and learning Probabilities (CBS). According to Middleton and Spanias (1999), a lack of teacher support and a bad classroom climate can explain students' negative attitudes toward Mathematics.

When children achieve success in Mathematics, their confidence grows, and their whole attitude toward Mathematics, especially Probability, improves (Martin, Mullis, and Foy 2008).

Students, on the other hand, become demotivated when they are unable to complete a Mathematics task (Ursini, Sanchez, Orendain, M, & Butto, 2004).
Students feel they can do Mathematics if they try, according to Middleton, & Spanias (1999). They believe they can do Mathematics if they try because they know their triumphs are important and stem from their abilities and a high level of effort. Tasks should provide an appropriate amount of challenge for each student to enhance student attitudes (Brophy, 1999).

Classical conditioning, operant conditioning, and observational learning are examples of learning theories that can be used to influence learners' attitudes (Tabrani, & Masbur, (2016). By linking pleasant sentiments with the learning process, classical conditioning is utilized to promote positive emotional reactions in learners. Learners can employ operant conditioning to strengthen positive attitudes toward learning and to diminish negative attitudes toward Mathematics. Learners can also improve their bad habits by seeing people who have a positive approach toward Mathematics.

Leaners can change their attitudes in two ways, according to the Elaboration Likelihood Theory of Attitude Change: they can be motivated to listen to and think about Mathematical messages, resulting in attitude change, or they can be influenced by teacher characteristics, resulting in a temporary change of attitude (Kundu, and Ghose, 2016). When learners have conflicting ideas about a topic or issue, the dissonance theory of attitude modification claims that they can adjust their attitudes to alleviate the tension generated by incompatible beliefs and shift their attitudes (Kundu, and Ghose, 2016).

Mathematics achievement, anxiety, self-efficacy, self-concept, motivation, and school experiences are three groupings of characteristics that influence learner attitudes, according to (Fakomogbon, Omiola, Awoyemi, & Mohammed, 2014). Fakomogbon, et. al., (2014) discovered that student views were influenced by their learning settings at home, school, and with peers. All school factors include teacher and instructional resources, classroom order, teachers' expertise and attitude toward Mathematics, and both teacher and student beliefs and motivation. Home and societal variables include things like background, parental expectations, and parental occupation (Otieno, 2010).

Wilkins, & Ma, (2003) discovered that social factors like parental influence, instructor influence, and peer influence children's attitudes toward Mathematics. Wilkins concluded that positive reinforcement from teachers, parents, and peers might assist kids to acquire positive views about the importance of Mathematics, which could help students build negative beliefs and attitudes toward learning. According to (Kundu, and Ghose, 2016), attitude change has a significant impact on behavior, and the same factors that cause attitude creation can also cause attitude change. According to (Kundu, and Ghose, 2016), certain ideas provide insight into how attitudes might be modified. Three forms of learning theories for changing one's attitude are classical conditioning, operant conditioning, and observational learning.

When the learner, item, person, or event is associated with pleasurable experiences, classical conditioning can be used to generate favorable reactions to the learner, item, person, or event. Positive attitudes can be reinforced while bad attitudes are weakened through operant training. What people observe in others may also impact their attitudes. According to Kupari and Nissinen (2013), cross-factors related to students, teachers, and schools are the cause of poor mathematics performance. Several academics believe that students' attitudes play a significant role in determining whether they do mathematically well or poorly (Mata, Monteiro & Peixoto, 2012). A cheerful outlook can aid youngsters in learning more effectively because attitudes can change and evolve (Syyeda, 2016). (Akinsola & Olowojaiye, 2008). Negative attitudes impede effective learning and, as a result, impact learning outcomes and, as a result, performance (Joseph, 2013). Effect, cognition, and behavior are the three basic components of attitude (Syyeda, 2016). These three elements are intertwined and encompass a variety of factors that influence one's overall attitude toward Mathematics.

III. THEORETICAL FRAMEWORK

Constructivism, which has two distinct belief systems, radical constructivism and social constructivism, served as the theoretical foundation for this investigation. Jean Piaget (1896-1980) is typically credited with formalizing the theory of radical constructivism, according to Von Glasersfeld (1991). Piaget proposed that people build new knowledge from their experiences through processes of accommodation and assimilation, in accordance with Von Glasersfeld (1991). According to radical constructivists, learning is a process in which the student actively creates new ideas or concepts based on prior knowledge and experience. This research was founded on Glasersfeld's (1995) radical constructivism theory, which indicates that knowledge is actively produced upon previously constructed knowledge by identifying the subject, rather than being passively absorbed. The adaptive purpose of cognition in this process was to organize the experiencing environment rather than to find ontological reality. Learners utilized the framework to construct a workable understanding of situations they saw and experimented with in the real world by applying their knowledge structures (Derry, 1996). It was determined to be relevant in this study because it advocated for the contemporaneous acquisition of Mathematical information through the active engagement of learners, which is something that CAL technologies like simulation encourage (Glasersfeld, 1987).

The constructivism component is when an individual creates information and understanding and connects it to their own experiences and thoughts (Von Glaserfeld, 1989). Assimilation involves applying new experiences to pre-existing schema, knowledge, and experiences, whereas understanding involves actively acquiring knowledge (Von Glaserfeld, 2013). The radical constructive learning theory holds that the only conscious reality we can exist in is the one we create from our own experiences and interpretations (Von Glaserfeld, 2013).

According to radical constructivism theory, a learner can make sense of new information by drawing on prior knowledge, relevant experiences, and social interaction with other group members. As opposed to a blank slate that needs to be filled with information, a learner's mind. Vygotsky (1978) asserted that students may perform at greater intellectual levels when required to work in teams, and that by sharing computers, students will be able to learn more.

A radical constructivist classroom focuses on student-centered CBS technologies that encourage critical thinking and active engagement from the students. Students use computers to research topics, ask questions, and find solutions using a range of computer simulations. In a radical constructivist classroom, the teacher's duty is to probe students' thinking, present a computer-solvable problem, provide problems that may interest the entire class, and create scenarios that will test students' ways of thinking.

While in a radical constructivist learning environment, students play more active roles in manipulating the computer software to learn more and accept greater responsibility for their learning at their own pace, students in a social constructivist learning environment are expected to cooperate and contribute to discussions with other peers in social groups. The aforementioned descriptions of CBS, which are detailed on pages 4, 5, and 6 of this chapter, are mostly constructs and features of the radical constructivism theory of learning, which justifies the adoption of this theory as the study's theoretical framework.

IV. METHODS

Study area

The study was carried out in Kisii County, one of Kenya's forty-seven counties. This was necessitated because of the existing problem of poor performance in Probability in Mathematics in Kisii County.

Design of the Study

This study used a mixed method approach that included both quantitative and qualitative research designs. The challenges that social and health science researchers attempt to solve are complicated, and Creswell (2009) contends that using either quantitative or only qualitative methodologies is insufficient to deal with this complexity.

Target population

Because Probability is taught in the Form three Mathematics Syllabus, the study's target group was Form three students and teachers of Mathematics in Kisii County's public secondary schools with computer infrastructure for CBS integration. According to data obtained from Kisii County's Director of Education office, the target population consisted of 6,038 Form three students and 136 Mathematics teachers in 67 public secondary schools having ICT infrastructure for CBS integration. The Form four students were excluded because they were likely to be preoccupied with KCSE examinations, while the Form one and two students were excluded because they had not yet been taught Probability and had not yet received appropriate academic exposure to secondary school Mathematics.

Sample size and Sampling Procedures

Sampling is the process of drawing inferences about a population from a small sample of its components or members. The researcher can estimate population characteristics that are unknown by sampling and draw generalizations (Devine, 2002). Both non-probability sampling, which is arbitrary (non-random) and subjective (Read & Marsh, 2002) purposive sampling of schools with computer infrastructure, and probability sampling, which is based on a random selection where each population element is given a known non-zero chance of selection, were used to ensure that the sample would be representative of the population (McNabb, 2004). In form three, there was a fair possibility of selection for every student. The statistical regularity law, which asserts that "if on average the sample chosen is a random one, the sample will have the same composition and features as the target population," is ensured by probability sampling (Kothari, 2004).

According to Kothari (2004), the sample size should technically be sufficient to provide a confidence interval. The study employed Solomon's four-group model of quasi-experimental designs, which produced four streams with an average student population of 50 (Hansen and Kloppfer, 2006). As a result, 198 individuals were chosen as the sample size for the student body. Because most schools in the County had adopted a team-teaching format, the study required at least eight Mathematics teachers including the four Mathematics teachers handling the four test groups. As mentioned in the sampling methodology section, 198 students and 4 Mathematics teachers were recruited from the 4 purposively sampled schools in the County. Thus the total study sample was 202.

Methods of Data Collection

Students Questionnaire (SQ)

The purpose of the students' questionnaire was to measure their attitudes toward Mathematics. The questionnaire was adapted from Tapia and Mash (2004) Attitudes towards Mathematics Inventory (ATMI), which has been utilized in several other research. The measure included 40 statements on a Likert scale that assessed learners' self-confidence, value, enjoyment, and motivation to learn mathematics.

Research methods describe the design of a study (objectives and research variables), research targets (population, sample, and data collection techniques), research models, research development, and data analysis techniques. The research hypothesis must be stated implicitly.

V. RESULTS AND DISCUSSION

CBS and Students' achievement in Probability based on their attitude

The study's fourth objective was to determine the effect of CBS on student achievement in Probability based on their attitude. The study's fourth hypothesis, Ho_4, aimed to observe if there is a statistically significant difference in Probability success between students who have a positive and negative attitude toward Probability and Mathematics in general when taught by CBS. Students' attitudes toward Probability were categorized as positive attitude (PA) or negative attitude (NA) based on the findings of a student's questionnaire (SQ) administered to the students at the start of the study to examine their attitudes toward Probability.

The information gathered was edited, coded, and entered into computer software, yielding the results shown in appendix 6. Respondents showed a good attitude toward Probability, in Mathematics (M=3.30, SD=0.387), indicating that most students in the study had a positive attitude toward probability in Mathematics. In particular, a higher percentage of students said they want to improve their Mathematical skills (79.3%), a higher percentage said they get a lot of satisfaction from solving a Mathematics problem (94.9%), a higher percentage said Mathematics helps develop the mind and teaches people to think (78.3%), and a significant proportion (88.9%) believe Mathematics is important in everyday life. In comparison to those who believed the opposite, fewer students, 12.6% admitted that they learn Mathematics easily, while (29.3%) admitted that they enjoy solving new problems in Mathematics, and (39.4%) admitted that they genuinely enjoy Mathematics.

The study then proceeded to rate the students' attitudes based on a comparison of the average attitude score and the actual score on the attitude scale. When calculating students' scores on the attitude scale, it was discovered that the least score was 71 and the greatest score was 176. As a result, those with a score of less than 123.5 on the scale were classified as having a negative attitude (NA), while those with a score of more than 123.5 were classified as having a positive attitude (PA), resulting in the data shown in Table 1

Table 1. *Students' Attitude (Categorized)*

Gender	**Group**								**Total**	
	E1		E2		C1		C2			
	f	%	f	%	F	%	f	%	f	%
NA	1	0.5	8	4.0	9	4.5	23	11.6	41	20.7
PA	48	24.2	41	20.7	41	20.7	27	13.6	157	79.3
Total	49	24.7	49	24.7	50	25.3	50	25.3	198	100.0

Table 1 shows that the majority of students (79.3%) scored well on the attitude measure and were thus classified as PA students rather than NA students (20.7%). The study's four test groups also revealed that the different categories of students' attitudes were fairly distributed across the four test groups.

In addition, at the end of the intervention stage, the researcher sought and collected students' scores on the elements of attitude to analyze the impact of CBS on students' attitudes. According to the data, students had a positive attitude, M=3.44 out of 5 which is consistent with earlier observations. This indicates a positive shift of 0.14 on the attitude scale compared to the M=3.30 recorded during the pre-test.

The study's fourth hypothesis, Ho_4, was to assess if there was a statistically significant difference in achievement between children with a negative and positive attitude who were exposed to CBS. It was also meant to see if CBS had any impact on the students' attitudes toward Probability. A two-way analysis of variance test of their pre-test attitude score on their post-test SQ score was used to see if CBS integration had a significant influence on students' accomplishment differently depending on their attitude, whether NA or PA. Table 2 summarizes the research findings.

Table 2. *Effect of CBS on Students' Attitude*

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	6011.638[a]	7	858.805	12.248	.000	.330
Intercept	444490.384	1	444490.384	6339.311	.000	.973
Attitude	19.293	1	19.293	.275	.601	.002
Group	5863.590	3	1954.530	27.875	.000	.325
Attitude * Group	214.000	3	71.333	1.017	.386	.017

Error	12200.274	174	70.117
Total	473612.000	182	
Corrected Total	18211.912	181	

a. R Squared = .330 (Adjusted R Squared = .303)

The effect of CBS on accomplishment was substantial as a model, accounting for 33% of the total variance in Probability in Mathematics achievement. The differences in achievement between students with a positive attitudes and students with negative attitudes were minor, according to the results, F (1,182) =.275, p =.601, and p2 =0.002. Significant differences between groups CBS and conventional methods were identified, F (3,182) =27.88, p.001, p2 =0.33, while there was no significant interaction effect between attitude and groups, F (3,182) =1.02, p =.017, p2 =0.017.

There was also no discernible difference in accomplishment levels between students with a good attitude (M=43.76, SE=4.46) and those with a negative attitude (M=38.44, SE=1.22). However, there was a significant difference in the accomplishment levels of students in the experimental group E1 (M=45.18, SE=4.44) and those of students in the control group C1 (M=24.02, SE=2.19). Students in E1 had substantially different exam scores from those in C1 and C2, while students in E2 had significantly different test scores from those in C1 and C2. F (3,188) =13.06, p.001, p2 =0.17, but F (1,188) =1.32, p =.252, p2 =0.007. Univariate test results were also significant for the test group, F (3,188) =13.06, p.001, p2 =0.17, but insignificant for attitude, F (1,188) =1.32, p =.252, p2 =0.007. This might be read to mean that using CBS in class impacted students with both positive and negative attitudes in the same way, resulting in a negligible effect across attitudes but a substantial effect across groups. As a result, the data failed to reject null hypothesis four, Ho_4, which said that when students are taught using CBS, there is no significant difference in Probability achievement between students who have a good and negative attitude toward Mathematics.

A one-way analysis of variance test of the fluctuation of students' scores on the aspects of attitude in post-test and pre-test versus test groups, experimental or control was operationalized to examine the effect of CBS teaching strategy on students' attitude towards probability in Mathematics. Tables 3 and 4 summarize the results collected.

Table 3. *Effect of CBS on Students' Attitude (Descriptive)*

	N	Mean	SD	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
E1	48	9.9000	34.23940	4.84218	.1693	19.6307	-105.00	71.00
E2	48	11.2917	17.94549	2.59021	6.0808	16.5025	-36.00	47.00
C1	50	2.7400	19.76268	2.79487	-8.3565	2.8765	-54.00	45.00
C2	50	5.6875	12.00028	1.73209	2.2030	9.1720	-13.00	51.00
Total	196	5.9847	23.14004	1.65286	2.7249	9.2445	-105.00	71.00

The results show that on the scale of change of attitude, the change in students' scores on elements of attitude from E2 was highest (M=11.29), followed by those from E1 (M=9.90), C2 (M=5.69), and C1 (M=2.74) in decreasing order. The actual ANOVA interpretation of the effect is shown in Table 4.

Table 4. *Effect of CBS on Students' Attitude (ANOVA)*

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5928.605	3	1976.202	3.853	.010
Within Groups	98486.349	192	512.950		
Total	104414.954	195			

Table 4 reveals that the observed mean difference was significant, with F (3, 192) = 3.85, p= 0.010. The findings of the Post Hoc (Tukey) test are summarized in Table 5.

Table 5. *Multiple Comparisons of Attitude Change (Tukey HSD)*

(I) Group	(J) Group	Mean Difference (I - J)	SE	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
E1	E2	-5.60417	4.62308	.620	-17.5857	6.3774
	C1	8.42750*	4.57662	.257	-3.4336	20.2886
	C2	-4.21250	4.57662	.794	-16.0736	7.6486
E2	E1	5.60417	4.62308	.620	-6.3774	17.5857
	C1	14.03167*	4.57662	.013	2.1706	25.8928
	C2	1.39167	4.57662	.990	-10.4694	13.2528
C1	E1	-8.42750	4.57662	.257	-20.2886	3.4336
	E2	-14.03167*	4.57662	.013	-25.8928	-2.1706
	C2	-12.64000*	4.52968	.029	-24.3794	-.9006
C2	E1	4.21250	4.57662	.794	-7.6486	16.0736
	E2	-1.39167	4.57662	.990	-13.2528	10.4694
	C1	12.64000*	4.52968	.029	.9006	24.3794

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

The post-test findings for E1 (M=9.90) were substantially different from C1 (M=2.74), with the change in the attitude of students in the experimental group being significantly higher than that of the control group, according to a post Hoc Tukey's (HSD) test. Similarly, substantial mean differences were found between E2 (M=11.29) and C1 (M=2.74) post-test findings, with the mean change in students' attitudes in the experimental group being much higher than that of the control group. According to the findings, the influence of CBS on students' attitudes was largest in the experimental group compared to the control group, which might be attributed to the experimental group's use of strategy. As a result, the supplementary hypothesis $H0_4$, which indicated that the influence of CBS on students' attitudes is not significantly different, was rejected.

In summary, the main aim of this objective was to assess the effect of the CBS teaching strategy on the achievement of students with positive and negative attitudes. Descriptive pre-test scores on attitude illustrated students' scores of above-average levels of a majority of elements. According to the data, students had a positive attitude, M=3.44 out of 5 which is consistent with earlier observations by Lipnevich *et al*. (2011) who explained that learner attitude explained 25% of the variance in Mathematics achievement with the variance being independent of Mathematical skill but a positive attitude of the learner. This is in tandem with Mata *et all*, (2012) who discovered that the more positive the attitude, the higher the degree of student achievement in Mathematics.

Descriptive results show that on the scale of change of attitude, the change in students' score on elements of attitude from E2 was highest (M=11.29), followed by those from E1 (M=9.90), C2 (M=5.69), and C1 (M=2.74) in decreasing order. This corroborates studies by Pytel (2007) who investigated student attitudes toward Mathematics when technology is used and found that students' passion and interest in learning are higher when CBS is used than when conventional methods are employed.

The differences in achievement between students with a positive attitudes and students with negative attitudes were minor, according to the results, F (1,182) =.275, p =.601, and p2 =0.002. Significant differences between groups CBS and conventional methods were identified, F (3,182) =27.88, p.001, p2 =0.33, while there was no significant interaction effect between attitude and groups, F (3,182) =1.02, p =.017, p2 =0.017. This might be read to mean that using CBS in class impacted students with both positive and negative attitudes in the same way, resulting in a negligible effect across attitudes but a substantial effect across groups. These results conform to those of Ross, & Broh (2000) who studied factors that influence Mathematics achievement in a sample of men and women, focused on attitude and self-esteem and attributes of success and failure as the main causes of low achievement in Mathematics and not attitude. However, Martin, Mullis and Foy (2008) apportions children's achievement in Mathematics to their confidence and whole attitude towards Mathematics.

According to the findings, the influence of CBS on students' attitudes was largest in the experimental group compared to the control group, which might be attributed to the experimental group's use of strategy. In an investigation into the effect of computer-based simulation on students' understanding of Mathematics, Ozman (2007) found that there is a statistically significant difference between groups in favor of the experimental group, but insignificant for attitude. This observation is consistent with his findings.

Findings and discussion provide data analysis with respect to research questions. It is recommended to use tables, graphs, or diagrams that provide an explanation of the results of the study. Research discussions explain the results of the research data without including in the text of the research results but rather explain the importance of the research findings. The results of the study aim to be able to overcome the research problem, objectives, and research hypotheses so that the research discussion can focus on research findings that occur implicitly.

VI. CONCLUSION

The study sought to establish the effect of CBS on the achievement of students based on their attitude. Students' attitudes were classified as positive attitudes (PA) and negative attitudes (NA). Descriptive statistics showed a positive change in mean rating for attitude between pre-test and post-test scores implying that integration of CBS affects positively students' attitudes in Mathematics. However, results from the inferential analysis showed that the differences in achievement between students with a positive and negative attitudes towards Mathematics were insignificant implying that the use of CBS in instruction in Probability impacted students with a positive and negative attitudes. It can therefore be concluded that the CBS teaching strategy is an effective teaching strategy for learners both with a positive and negative attitudes towards Mathematics.

REFERENCES

[1]. Allport, G. W. (1935). *Handbook of Social Psychology*. Worcester, MA: Clark

[2]. Batanero, C., Burrill, G., & Reading, C. (2011). Overview: challenges for teaching statistics in school mathematics and preparing mathematics teachers. ***Teaching Statistics in School Mathematics-Challenges for Teaching and Teacher Education: A Joint ICMI/IASE Study. London: Springer***, 407-418.

[3]. Brophy, J. (1999). Toward a model of the value aspects of motivation in education: Developing appreciation for.. *Educational psychologist*, *34*(2), 75-85.

[4]. Carmona, J., Martínez, R. J., & Sánchez, M. (2005). Mathematical background and attitudes toward statistics in a sample of Spanish college students. ***Psychological reports***, *97*(1), 53-62.

[5]. Creswell, J. W. (2009). Research design: Qualitative, quantitative and mixed methods approaches (3rd ed.). London: Sage.

[6]. Danielsen, A. G., Wiium, N., Wilhelmsen, B., & Wold, B. (2010). Perceived support provided by teachers and classmates and students' self-reported academic initiative. ***Journal of School Psychology****, 48,247–267.*

[7]. Derry, S. J. (1996). Cognitive schema theory in the constructivist debate. ***Educational Psychologist***, *31*(3-4), 163-174.

[8]. Devine, F. (2002). Qualitative methods. In D. Marsh & G. Stoker (Eds.), Theory and methods in political science (2nd ed., pp. 197-215). New York, NY: Palgrave Macmillan.

[9]. Downey, D. B., & Vogt Yuan, A. S. (2005). Sex differences in school performance during high school: puzzling patterns and possible explanations. Sociological Quarterly, 46(2), 299–321.

[10]. Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth, TX: Harcourt, Brace, Jovanovich.

[11]. Fakomogbon, M. A., Omiola, M. A., Awoyemi, S. O., & Mohammed, R. E. 2014). Effect of computer assisted instructional package on the performance of students in mathematics in Ilorin metropolis. *European Scientific Journal*, *ESJ*, *10*(25), 196-206.

[12]. Frenzel, A. C., Pekrun, R., & Goetz, T. (2007). Girls and mathematics – A "hopeless" issue? A control value approach to gender differences in emotions towards mathematics. ***European Journal of Psychology of Education,*** *22, 497–514.*

[13]. Gal, I. (2005). Towards "probability literacy" for all citizens: Building blocks and instructional dilemmas. In G. A. Jones (Ed.), *Exploring probability in school. Challenges for teaching and learning (pp. 39–63).* Dordrecht, The Netherlands: Kluwer.

[14]. Gergen, K. J. (1995). Social construction and the educational process. In L. P. Georgiou, S. N., Stavrinides, P., & Kalavana, T. (2007). Is Victor better than Victoria at maths? *Educational Psychology in Practice*, *23*(4), 329-342.

[15]. Gómez-Chacón, I. M. (2000). Affective influences in the knowledge of mathematics. Educational Studies in Mathematics, 43, 149–168.

[16]. Hansen, B. B., & Klopfer, S. O. (2006). Optimal full matching and related designs via network flows. *Journal of computational and Graphical Statistics*, (3), 609-627.

[17]. Hootstein, E. W. (1994). Motivating middle school students to learn. ***Middle School Journal***, *25*(5), 31-34.

[18]. Jones, G. A., Langrall, C. W., & Mooney, E. S. (2007). Research in probability: Responding to classroom realities. *Second handbook of research on mathematics teaching and learning*, *2*, 909-955.

[19]. Joseph, G. (2013). A Study on School Factors Influencing Students' Attitude Towards Learning Mathematics in the Community Secondary Schools in Tanzania: The case of Bukoba Municipal Council in Kagera Region. (Masters dissertation). Retrieved from http://repository.out.ac.tz/919/

[20]. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

[21]. Kundu, A., and Ghose, A. (2016). The Relationship Between Attitude and Self Efficacy in Mathematics Among Higher Secondary Students. ***IOSR Journal of Humanities and Social Science (IOSR-JHSS) Volume 21***, Issue 4, Ver. 05 PP 25-31

[22]. Lipnevich, A. A., MacCann, C., Krumm, S., Burrus, J., & Roberts, R. D. (2011). Mathematics attitudes and mathematics outcomes of US and Belarusian middle school students. ***Journal of Educational Psychology***, *103*(1), 105-118.

[23]. Martin, M.O., Mullis, S. & Foy, P. (2008). *TIMSS 2007* ***International Science Report: Findings from IEA's Trends in International Mathematics and Science Study at the Fourth and Eighth Grades***. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

[24]. Marzano, R. J. (1998). *A theory-based meta-analysis of research on instruction*. Aurora, CO: Mid-continent Regional Educational Laboratory.

[25]. Mata, M. D. L., Monteiro, V., & Peixoto, F. (2012). Attitudes towards mathematics: Effects of individual, motivational, and social support factors. ***Child development research***, 1-10.

[26]. Mathew Myers, J., & Halpin, R. (2002). Teachers' attitudes and use of multimedia technology in the classroom: Constructivist-based professional development training for school districts. *Journal of Computing in Teacher Education*, *18*(4), 133-140.

[27]. Douglas and McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp.575-596). New York, NY: Macmillan.

[28]. McNabb, D. E. (2004). Research methods for political science: Quantitative and qualitative methods. New York, NY: M.E. Sharpe, Inc.

[29]. Middleton, J. A., & Spanias, P. A. (1999). Motivation for achievement in mathematics: Findings, generalizations, and criticisms of the research. ***Journal for research in Mathematics Education***, *30*(1), 65-88.

[30]. Midgley, C., & Urdan, T. C. (1995). Predictors of middle school students' use of self-handicapping strategies. ***Journal of Early Adolescence***, *15, 389–411.*

[31]. National Council of Teachers of Mathematics (2000). Principles and standards for school mathematics. Reston, VA: Author

[32]. Nicolaidou, M., & Philippou, G. (2003). Attitudes towards mathematics, self-efficacy and achievement in problem solving. ***European Research in Mathematics Education III. Pisa: University of Pisa***, 1-11.

[33]. Otieno, K. O. (2010). Teaching/learning resources and academic performance in mathematics in secondary schools in Bondo District of Kenya. ***Asian social science***, *6*(12), 126.

[34]. Pytel, B. (2007). Laptops: Jury is out: High schools are pulling 1-on-1 laptops after disappointing results. *Suite101.com*. Retrieved from http://www.suite101.com /content/laptops-jury-is- out-a21072 probability. Journal of Statistics Education, 12, 1-17.

[35]. Read, M., & Marsh, D. (2002). Combining quantitative and qualitative methods. In D. Marsh & G. Stoker (Eds.), Theory and methods in political science (2nd ed., pp. 231-248). New York, NY: Palgrave Macmillan.

[36]. Riegle-Crumb, C., Farkas, G., & Muller, C. (2006). The role of gender and friendship in advanced course taking. *Sociology of Education*, 79, 206–228.

[37]. Ross, C. E., & Broh, B. E. (2000). The roles of self-esteem and the sense of personal control in the academic achievement process. Sociology of Education, 73(4), 270-284.

[38]. Schau, C., Stevens, J., Dauphine, T., & del Vecchio, A. (1995). The development and validation of the survey of attitudes towards statistics. Educational and Psychological Measurement, 55(5), 868–875.

[39]. Shaughnessy, J. M. (1992). Research in probability and statistics: Reflections and directions. In D. A. Grouws (Ed.), Handbook of Research on Mathematics Teaching and Learning (pp. 465 – 494). New York: Macmillan.

[40]. Slouti, D., & Barton, A. (2007). Opportunities for practice and development: Newly qualified teachers and the use of information and communication technologies in teaching foreign language in English secondary school context. *Journal of In-service Education*. *33*(4):19.

[41]. Stratham, D. S., & Torell, C. R. (1996). *Computers in the classroom: The impact of technology on student learning* (Doctoral dissertation, Army Research Institute). Retrieved from http://www.temple.edu/lss/htmlpublications/spotlights /200/spot206.htm

[42]. Syyeda, F. (2016). Understanding Attitudes Towards Mathematics (ATM) using a Multimodal modal Model: An Exploratory Case Study with Secondary School Children in England. **Cambridge Open-Review Educational Research e-Journal**, 3, 32-62. Retrieved from http://corerj.soc.srcf.net/?page_id=224

[43]. Tabrani, Z. A., & Masbur, M. (2016). Islamic Perspectives On The Existence Of Soul And Its Influence In Human Learning (A Philosophical Analysis Of The Classical And Modern Learning Theories). *JURNAL EDUKASI: Jurnal Bimbingan Konseling*, *1*(2), 99-112.

[44]. Tapia, M., Marsh, G. (2004). An instrument to measure mathematics attitudes. ***Academic Exchange Quarterly***, 8, 1-8.

[45]. Tobias, S. (1987). Succeed with math. The College Board Publication. Retrieved April 7, 2010, from http://www.collegeboard.com/html/store_help.html

[46]. Turner, J. C., & Meyer, D. K. (2009). Understanding motivation in mathematics: what is happening in classrooms?. In *Handbook of motivation at school* (pp. 541-566). Routledge.

[47]. Ursini, S., Sanchez, G., Orendain, M., & Butto, C. (2004). El uso de la tecnología en el aula de matemáticas. *Enseñanza de las Ciencias*, *22*(3), 409-424.

[48]. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478.

[49]. Von Glasersfeld, E. (1987). *The construction of knowledge:* ***Contributions to conceptual semantics***. Intersystems Pub.

[50]. Von Glasersfeld, E. (1995). *Radical Constructivism: A Way of Knowing and Learning. Studies in Mathematics Education Series: 6*. Falmer Press, Taylor & Francis Inc., 1900 Frost Road, Suite 101, Bristol, PA 19007.

[51]. Vygotsky, L.S. (1978). Mind in society: *The development of higher psychological process* Cambridge, MA: Harvard University Press.

[52]. Wilkins, J. L., & Ma, X. (2003). Modeling change in student attitude toward and beliefs about mathematics. *The Journal of educational research*, *97*(1), 52-63.

[53]. Zan, R., & Di Martino, P. (2007). Attitude toward mathematics: Overcoming the positive/negative dichotomy. ***The Montana Mathematics Enthusiast, onograph***, *3*(2007), 157-168.