Journal of Education and Practice www.iiste.org
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.8, No.23, 2017

Peer Instruction and Secondary School Students Motivation to Learn Vectors in Bungoma County; Kenya

Susan Awino Ouko
School of Education. Masinde Muliro University of Science and Technology, P O box 190-50100, Kakamega, Kenya.

The funding for this study was provided by the national commission for science technology and innovation: Kenya

Abstract
The purpose of this study was to document the influence of peer instruction and conventional methods of instruction on students' motivation to learn vectors. It was guided by the social learning theory propounded by Bandura (1977). The study used an after only, with control experimental design. The design was chosen because it is objective, logical and a systematic method that can be used to demonstrate the influence of peer instruction on motivation to learn vectors. The form three class in public secondary schools was the target population. Multi stage sampling was used to select 479 students from 16 schools who participated in the study. Streams were randomly assigned to either the control or the experimental treatment groups. The treatment took place over three weeks following which a questionnaire was used to collect data from the sampled students. The study found that more students in the experimental treatment groups indicated they were motivated to learn vectors than in the control treatment groups. This means that more students are motivated to learn vectors when they are instructed via peer instruction than when conventional methods are used. It therefore recommends that teachers adopt the use of peer instruction so that learners can be motivated to learn vectors and by extension be motivated to learn mathematics.

Key Words : Peer Instruction, Students Motivation, Learning Vectors

1 Background to the study

Studies on effectiveness of instructional technology are neither new nor have they been fully exhausted. A great deal of research has been carried out comparing one instructional technique to another with the aim of revealing their suitability for improving learners' motivation to learn mathematics. A study by Damon & Phelps (2000) found that the lecture method of instruction was less effective than the use of peer instruction in improving learners' motivation.

The Kenya National Examination Council (KNEC) examination report of 2012 cites questions on vectors are not popular with candidates. Dismal performance in mathematics in Bungoma County is attributed to lack of practice by the students of what has been taught (SMASE, 2009). Manswell (2001) posits that motivation drives practice. Thus motivation is very important to the mathematics learning process. Consequently, instructional methods that enhance learners' motivation to learn mathematics should be used. Damon & Phelps (2000) suggest that learner centered modes of instruction result in enhanced motivation of learners when compared to teacher centered modes. This study therefore sought to document the effect of peer instruction (a learner centered mode of instruction) on the motivation of students.

1.2 Purpose of the study

The purpose of this study was to document the influence of peer instruction and conventional methods of instruction on motivation to learn vectors. The study investigated the learners motivation when taught using peer instruction and by conventional methods. From the objective

it was hypothesized that there was no difference in motivation to learn vectors by learners taught using peer instruction and those taught by conventional methods.

1.3 Theoretical Framework

The study was guided by the social learning theory (SLT) advanced by Bandura (1977). This was because peer instruction leans heavily on the social element in learning. SLT stipulates that the interaction of personal and cognitive factors as well as the environment influence learning. The peer instruction learning environment exposes tutees to interaction with mathematics learning activities with tutors modeling motivation to learn. Peers are the preferred models because according to Asch (2004) people learn more from a model similar to them. Peer instruction presents the tutees with ample opportunity to practice solution strategies to mathematics problems in

a conducive environment facilitating not just mastery of content but also motivation to learn.

2 Peer Instruction and Students Motivation to Learn Vectors

Fredricks, Blumefield & Paris (2004) reported in Pritchard & Ashwood (2008) say strong interest implies motivation. Further, they say motivation to do mathematics can be acquired by the learners' direct experience with mathematics. A learner tends to do over and over again anything that results in a general feeling of satisfaction (Beal and Oakes, 1993). Longaretti et al (2002) say intrinsic motivation is driven by interest or enjoyment in the task itself. In this study it is hoped that peer instruction generates interest in doing mathematics hence results in learners getting motivated.
Students are likely to be intrinsically motivated in mathematics if they believe they have skills to be effective in solving mathematics problems, are interested in mastering a topic and not just achieving good grades. Wolfe (2003) says the goal driven interest that comes from outside an individual is referred to as extrinsic motivation. The teacher on using PI instigates this type of motivation by creating competition between groups which encourages the learners to win in order to enjoy the rewards of an activity. Thus in this study, extrinsic motivation is converted to intrinsic motivation by peer instruction because Ormrod (2008) says extrinsic motivation is internalized by the individual if the task helps to fulfill their basic psychological needs.

2.1 Peer Instruction and Motivation of Students

Motivation is mediated by environmental events hence the choice of instructional methodology can enhance or reduce motivation, Ormrod (2008). In this study, using peer instruction creates an environment different from when using conventional methods of instruction thus is anticipated to result in the motivation of all participating students.
Mazur (2001) says, in PI a class is divided into a series of short presentations, each focused on a central point. In the group session, students discus their solution strategies, each student tries to convince others the correctness of their own answer by explaining the underlying reasoning. This open discussion motivates the learners in that each is eager to critique each other's solution strategy. This study will find out if similar success can be reported for Bungoma County. Boud et al; (2001) says, during the PI session the teacher moves around, listening in, on the discussions thus has an opportunity to capture the misconceptions that the learners have unlike in teacher centered instruction. In this study, the teacher clarifies such misconceptions for better understanding of the concepts resulting in enhanced motivation.
Damon and Phelps (1989) have cited several reasons as to why learners engage in more mathematics activities (are motivated) when using peer instruction. Learners get to know that the mathematics they are working on is important that is why the rest of the group is paying attention. A learner sees that others are building onto his work and taking his suggestions to use in a mathematics problem. Individual students are also instantly given recognition by their peers for contributions towards solving a problem and this increases the learners' motivation. This study investigates whether similar benefits accrue.
Longaretti et al (2002) say, when using peer instruction, the students experience enhanced motivation. Mazur (2001) also says that in using peer instruction, the learners' motivation to learn mathematics is increased. This study investigates whether this improves the quality of both the learning process and the learning outcomes. The learners may also develop collaborative skills and an increased sense of responsibility for one's own learning. Several studies document the benefits of peer instruction (Mazur: 2001, Longaretti et al: 2002, Damon and Phelps:1989), this study sought to find out whether similar success can be reported for teaching vectors by peer instruction

3. Research Design

The study adopted an after only with control experimental design. The design was chosen because it is objective, logical and a systematic method used to demonstrate the influence of peer instruction on motivation. It was also capable of being verified. The study used two groups of
which the experimental group was instructed by peer instruction and the control group by conventional methods. The study was conducted in Bungoma County in western part of Kenya along the Kenya-Uganda Boarder. Within the county we have different school categories such as Boy's, Girl's and Co-educational schools. Despite posting impressive results in National examinations, performance in mathematics has remained poor.

3.1 The Target Population

The form three class is comprised of students in the third year of the secondary cycle of the 8-4-4 system of education. There are about 4200 form three students in the county. The class was selected because of their relevance to the topic of investigation. They have covered vectors I in form 2 which is prerequisite knowledge to vectors II on which the peer instruction model was designed.

Multi stage sampling technique was used to select the participants. Sampling with probability proportional to size was used to select 16 schools from three strata. Where more than one stream existed in a school, simple random sampling was used to select one stream to participate in the study. Random assignment was used to determine which stream went to which treatment group hence, of the 479 students sampled, 240 were in the control treatment group and 239 in the experimental treatment group.

3.2 Data collection Instrument.

The researcher developed a questionnaire which had 10 items on a five point Likert type scale to collect data from students. The respondents were required to rate statements reflecting their motivation to learn vectors. It comprised both negative and positive worded items. Depending on the nature of the items in the questionnaire, different scoring formats were used. Strongly agree = 5, Agree = 4, Undecided = 3, Disagree = 2, Strongly disagree = 1. For negatively framed questions the reverse scoring order was applied. For each questionnaire an overall motivation score was obtained. The minimum motivation score that a student could attain was 10 and the maximum was 30. A learners score in the range 24-30 was indicative of 'motivated', 17-23 was indicative of 'moderately motivated' and 10-16 was indicative of 'not motivated'. From these scores tallies were made and frequencies used to calculate percentages. The statistical package for social sciences (SPSS version 12.0) was used to compute frequencies, percentages and chi-square.

3.3 The Treatment

The treatment groups covered vectors via peer instruction while the control groups covered it by conventional methods. The treatment was spread over a duration of three weeks, equivalent to about 14 peer instruction hours for each class. This allowed the learners adequate time for practice to internalize each concept before moving on to the next section. During the experiment, the researcher occasionally participated in the classroom activities in the experimental schools to ascertain that the peer instruction model of learning was being used as prescribed. The researcher also visited the classrooms in the control schools and ascertained that the peer instruction model was not used. The peer instruction model was a sequence of student classroom activities to be carried out by peer groups during the study period. Different students were given opportunities to be tutors during the study period.

3.12 Data Analysis.

The quantitative data collected during this study was analyzed using both descriptive and inferential statistics. Descriptive statistics used in this study included frequencies, percentages and means while for inferential statistics the study used the chi-square. These were generated by the statistical package SPSS version 12.0. The hypothesis was accepted or rejected at 0.05 level of significance. Data was coded to enable the researcher use the statistical program for social sciences (SPSS) version 12.0 to obtain frequencies, percentages and chi-square. The researcher compared the percentages of participants with various levels of motivation (motivated, moderately motivated, not motivated) in each treatment group. This was to confirm if the differences in levels of motivation by students could be attributed to the treatment. The results of the chi-square were used to examine the validity of the null hypothesis.

4 Students Motivation to Learn Vectors

Of the 479 participants in the study, 239 were in the experimental treatment group and 240 in the control group. The instruments of data collection yielded quantitative data which was analyzed using descriptive and inferential statistics. From the learners' motivation scores, percentages were calculated and presented in Table 1.

Table 1: Students Motivation by Group

Study unit /Motivation	Not motivated	Moderately Motivated	Motivated
Experimental	4.5%	12.9%	32.5%
Control	18.2%	26.2%	5.7%

Table 1 shows that the number of students in the control study units that indicated they were not motivated (18.2%) is greater than the number of students not motivated in the experimental study units (4.5%). This seems to imply that, of the learners that indicated they were not motivated, majority of them were instructed via conventional methods. The number of students in the experimental study units (32.5%) that indicated they were motivated is greater than the number of students in the same range in the control study units (5.7%). This seems to imply that, of the learners that indicated they were motivated, majority of them were instructed via peer instruction. To investigate this implication, the chi square test was run and the results presented in Table 2.

Table 2**:** Contingency Table for Motivation by Group

Study unit/Motivation	Not motivated	Moderately Motivated	Motivated	Total
Experimental	21 (53)	62 (93)	156 (93)	239
Control	87 (54)	126 (94)	27 (92)	240
Total	108	188	183	479

Note: Figures in parenthesis are expected frequencies : $\chi^2 = 149.31$ df = 2

Table 2 shows that the Chi square yielded a value of 149.31 at 2 degrees of freedom and at 0.05 level of significance (Table 2). This indicated that there was an association between students motivation to learn vectors and the method of instruction used. More students in the experimental study units indicated they were motivated to learn vectors than in the control study units. These findings suggest that motivation to learn vectors is exhibited by students when they are taught by peer instruction than when conventional methods are used. On the strength of these findings the hypothesis 'there was no difference in motivation to learn vectors by learners taught using peer instruction and those taught by conventional methods.' was rejected.

4.1 Discussion of findings

The study intended to assess the influence of peer instruction and conventional methods of instruction on the learners' motivation to learn vectors. The study found that peer instruction had a marked positive influence on students' motivation to learn vectors than when conventional methods were used. These findings agree with those of Connelly (2010). He reported enhanced motivation and increased comprehension after peer instruction. Hooker (2010) found that all the students in a class taught by PI started to spend more time on mathematics in or out of class - this enhanced motivation. A study by Longaretti et al (2002) observed that PI enhanced motivation to improve the quality of both the learning process and the learning outcomes. These findings are similar to the ones reported in this study in that after peer instruction the learners were more motivated to learn vectors.

4.2 Conclusion

From the study's findings, it is concluded that learners in all school categories in Bungoma county get motivated when peer instruction is used. Hence, where learners show little or no motivation to do mathematics, peer instruction should be used. In cases where the teacher supposes that more practice is required to aid in internalizing the concept taught then, to motivate the learners to do more mathematics peer instruction should be used. This may also be tried with low achievers who get an opportunity to experience the 'high' of solving a mathematics problem correctly.

4.3 Recommendations

From the findings, it is recommended peer instruction be used in the teaching of vectors and by extension mathematics. This will increase learners motivation in learning hence improve their achievement.

5 Acknowledgement

The researcher is indebted to Professor Amadalo Maurice Musasaia and Dr. Catherine M. Aurah for their guidance, constructive criticism encouragement and friendly assistance

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