

Project Based Learning on Students' Performance in the Concept of Classification of Organisms Among Secondary Schools in Kenya

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Abstract

The concept of classification of organisms in Biology seems to pose a problem to Secondary School students in Kenya. Though, the topic is important for understanding of the basic elements of the subject. The Examinations Council in Kenya has identified teacher centred pedagogical techniques as one of the main causes for this. Project based learning technique has been successfully used as an instructional technique in countries like Japan and United States of America to improve students' academic achievement and positive attitude development among students in science practicals in Biology. The study therefore investigated the influence of project based learning technique on achievement of students in classification of organisms among Secondary Schools in Kenya with particular focus on academic achievement and attitude development. Quasi experimental design was employed. Stratified random sampling technique was used to select eight classes from four secondary schools with a total of 360 students. Students' Attitude Questionnaires and Classification Achievement Test were used as instruments. Analysis of Variance and t-test were employed in data analysis. The study revealed that project based learning technique enabled students to improve in academic achievement as well as developing positive attitude towards classification of organisms. The study recommends to the Ministry of Education and its agencies to adopt project based learning technique among other student centred instructional techniques for teaching of practical oriented concepts like Classification of Organisms.

Keywords: Project Based Learning and Classification of Organisms

INTRODUCTION

Project based learning pedagogy was used to instruct learners in the concept of classification of organisms. This is an instructional technique that transforms learning from 'teacher telling' to 'student doing' in which students are provided with task based on challenging questions or problems that involves the students problem-solving, decision-making, meaning-making, investigative skills and reflection, that includes teacher facilitation but not direction (Copon & Kuhn 2004). Project based learning has the following advantages that makes it stand out among other pedagogies; it engages learners, boosts cooperative learning skills, improves academic performance, develops high order thinking skills and builds positive relationships between students and teachers (Thomas, 2000). This makes the technique suitable instruction model in classification of organisms because the topic requires content knowledge, problem solving and creative thinking skills for it to be well understood by learners. Project based learning technique has been successfully used in developed countries to improve students' achievement and also to prepare them for life outside classroom. In Britain, there has been marked improvement in test mean scores in science subjects as a result of implementation of project based learning pedagogy in teaching. In the United States of America, project based learning is well established through the support of the Buck Institute for Education (B.I.E) as a response to school reform efforts that required to equip learners with skill suitable in the knowledge based economy. In Japan and India, project based learning is also well established (Biggs & John, 2003). In Kenya, education system is examination oriented thus it has not given room for student- centred methods of instruction. SMASSE project report (2000) suggests that teachers should come up with new teaching strategies that will emphasize on practical activities instead of theoretical strategies. This can be achieved by shifting from teacher-centred to student-centred methods of instruction.

The observation that academic performance of students in Kenya Certificate of Secondary Education (KCSE) in Biology and particularly in the topic of classification of organisms has been generally poor (KNEC reports, 2000-2010) necessitated the study. KNEC report (2007) points out that use of negative statements, spelling errors of technical terms, inability to follow instructions and use of non-conventional ways of writing the steps followed were common. In a similar vein, SMASSE project report (2000) notes that inappropriate teaching methods are the main causes of poor understanding and poor performance in Biology and other science subjects. This study therefore investigated the influence of project based learning on students' achievement in the concept of classification of organisms in Biology among Secondary School students in Mount Elgon Sub-County, Kenya. The study therefore endeavored to:

- a) Determine statistical difference in academic achievement among students taught the concept of classification of organism by project based learning technique and those taught by conventional method.

- b) Establish difference in attitude change towards the concept of classification of organism among students taught using project based learning technique and those taught by conventional method.

METHODOLOGY

The study employed quasi-experimental design (Pre-test-Post-test non-equivalent design) where learners were assigned to experimental groups and control groups (Grinnell, 1997). The experimental groups were taught by project based learning technique in a classroom setting while the control groups were taught by conventional techniques as usual. Both the experimental groups and control groups were instructed by their respective teachers. However, teachers who instructed experimental were inducted by the researcher on project based learning instruction technique. Students' instruction was conducted within a period of five weeks.

The study population comprises of 1100 Form Three Biology Students in 12 secondary schools in Mount Elgon Sub-County. Stratified random sampling was used to select four secondary schools that were adequate for quasi experimental design and 8 classes each consisting 40 students which gave a sample size of 360 students were selected.

Achievement tests are used to provide information concerning specific academic abilities of candidates indirectly (Kothari, 1990). In order to obtain and compare the pre-test and post-test of achievement tests, experimental and control groups were used. The pre-test examination was used to determine the academic ability of learners before being treated with project base learning technique. Post-test on the other hand was used to determine the treatment gain. Attitude Test Questionnaire was used to collect information about the students' attitude towards the concept of classification of organisms when taught using project based learning in comparison with their attitude when taught the concept of classification of organisms using conventional methods of instruction. Both pretest and post tests were used to ensure random distribution in the groups as well as to establish influence of the technique on learning.

The research pre-test post-test information that was obtained from Students Questionnaires and Classification Achievement Test (CAT) was tabulated and data analysis done by both descriptive and inferential statistics using, statistical package for social science (SPSS) program. Descriptive statistics concern the development of certain indices from the raw data whereas inferential statistics concern with the process of generalization (Kothari, 1990). The pre-test post-test (CAT) data was analysed first by descriptive statistics to obtain mean and standard deviation and then inferential statistics ANOVA was used to determine the significance in difference between experimental and control groups by the t-test. This was done to determine statistical difference in academic achievement among students' taught the concept of classification of organisms by PBL and those taught by CMI.

RESULTS

The study results were discussed on the basis of the specific study objectives that is;

Test for the difference in academic achievement among students taught the concept of classification of organism by project based learning technique and those taught by conventional method

These sub-heading deals with students understanding of the concept of classification of organisms before being exposed to project based learning technique and students understanding of the concept of classification of organism after exposure to project based learning technique.

Students understanding of the concept of classification of organisms before being exposed to project based learning

Table 1. shows a comparison between the mean scores and standard deviations of the Pre-test scores for the experimental and control groups.

Table 1. Comparison of the mean scores and standard deviations of the pre-test scores for the experimental and control groups on the CAT

Group	County Boys		County Girls		Sub-county Mixed	
	Mean	Std. Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Experimental	39.66	16.86	38.07	16.09	34.17	14.48
Control	39.89	17.64	34.43	12.69	34.55	14.15

Results shown in table 1 indicate that the mean scores and standard deviations for the experimental and control groups for the three categories of schools are not so much statistically different. This implies that the students' performance in classification depicted the same trend for the three schools before treatment. Results also show that the overall performance for both experimental and control groups is below average.

Table 2 below shows the Analysis of Variance for the Pre-test mean scores on the Classification Achievement Test.

Table 2. Analysis of Variance of Pre-test Mean Scores on the CAT

Item	County Boys		County Girls		Sub-County Mixed	
	F-ratio	p-value	F-ratio	p-value	F-ratio	p-value
CAT	0.88	3.52 (ns)	0.99	3.52(ns)	0.97	3.52 (ns)

ns-not significant at $p < 0.05$ level

Taking a look at the results in table 2, we notice that there is an insignificant difference in the mean scores of the experimental and control groups. The results from all the three categories of schools reveal F-values less than one while the tabulated values are greater than unity. Hence, the two groups (experimental and control) are comparable. The results are therefore a clear indication that the two groups have the same performance trend before exposure to PBL. The groups were therefore homogenous and suitable for the study.

Students understanding of the concept of classification of organism after exposure to project based learning

Table 3: shows comparisons of the mean scores and standard deviations of the post-test scores of the experimental and control groups on the CAT

Table 3: Comparison of the mean scores and standard deviations of the post-test scores of the experimental and control groups on the CAT

Group	County Boys		County Girls		Sub-county Mixed	
	Mean	Std. Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Experimental	72.73	15.65	71.02	16.54	66.31	15.70
Control	42.50	11.88	39.88	12.31	41.13	13.16
Mean Deviation	+30.20		+31.13		+25.17	

From table 3, comparing the means and standard deviations for the three categories of schools shows a greater difference between the experimental and control groups. However, the scores for the experimental groups for the three schools are not so much different with County Boys at 72.73, County Girls at 71.02 and Sub-county Mixed at 66.31, all of which are far above their Control equivalents. Therefore the effect of Project Based Learning on the students' performance in the Classification Achievement Test is evidenced by the high scores in the experimental groups.

Table 4. Analysis of Variance for Post-test mean scores on Classification Achievement Test

Item	County Boys		County Girls		Sub-County Mixed	
	F-ratio	Significance	F-ratio	Significance	F-ratio	Significance
CAT	3.768	0.042 ^a	4.103	0.015 ^a	3.599	0.049 ^a

Significant at 0.05 level, F-critical value= 3.52

From the results in table 4, the F-values for all the three categories of schools are greater than the critical value of 3.52; indicating that there was a statistically significant difference between the two groups. This suggests that there was a significant difference between the experimental and control groups after using project based learning to instruct learners in experimental groups. These results lead to reject the null hypothesis: project based learning technique has no significant effect on the learners' achievement in classification of organisms concept. This is owing to the fact that the data analysis clearly indicates that the Post-test scores for the experimental and control groups are statistically different. Since the control groups were subjected to conventional teaching methods, they were significantly outshined by their counterparts in the experimental groups who were subjected to Project Based Learning technique.

Other Studies comparing learning outcomes for students taught via project-based learning versus conventional instruction show that when implemented well, PBL increases long-term retention of content helps students perform as well as or better than conventional learners in high-stake tests, improves problem solving and collaboration skills, and improves students attitudes towards learning (Strobe & Van Berneved, 2009; Walker & Leary 2009). PBL can also provide an executive model for whole school reform (National Clearing house for comprehensive school reform 2004; New Mann & Wehlage 1995). Project-based learning also improved test scores in all subject areas over a two year period on the Tennessee value-Add assessment system. The co-nect schools outperformed the control schools by 26% (Ross, Steven M, Sanders, William & Wright S, Paul 2000).

To establish the direction in which the difference occurred necessitated a further analysis involving a paired sample t-test for equality of the means. The analysis yielded the results in table 5

Table 5: Paired Sample t-test for Post-test Scores on the CAT

Groups	Df	Std. Error of Mean	t-value	Sig. (2-tailed)
Experimental vs. Control	21	1.71	17.71	0.01

The t-test reveals a significant difference between the experimental and a control group since the mean scores obtained by the experimental groups was significantly higher as compared to the control groups.

Comparing t-test mean scores, it is realised that the t-value of $t_{(1, 21)} = 17.706$ at $p < 0.05$. This confirms that there was a statistically significant difference between the experimental and control groups, in favour of the experimental group.

The study findings supports other studies that have shown that the integration of PBL in teaching and learning of science practical areas impact positively on the students' level of understanding (Barron and Darling-Hammond (2008). These findings provide empirical evidence and basis for concluding that the use of Project Based Learning facilitates higher level of learning as far as Classification of Organisms concept and related areas are concerned.

Establish difference in attitude change towards the concept of classification of organism among students taught using project based learning technique and those taught by conventional method

It is known that the learners' attitude towards a particular task greatly influences their willingness and enthusiasm to learn the task. It therefore became necessary to find out the students' attitude towards classification before and after exposing them to PBL in order to determine its impact (PBL) on students' attitude towards the concept.

Hypothesis Testing on Students' Attitude towards Classification

It is necessary to find out if there was a significant difference in the Post-test results concerning students' attitude towards classification after being exposed to PBL.

Table 7: Significance testing on Students' Attitude towards Classification

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	517.62	4	129.41	3.94	0.045
Within Groups	4812.38	35	137.50		
Total	5330.00	39			

Significant at 0.05 level, F-critical = 2.64

Results showed that most of the students disagreed with the statement that learning classification by PBL makes learning interesting. F test is: 3.94 (35, 4), < 2.64 . The F-values greater than the F-critical values leads to the rejection of the null hypothesis: project based learning technique does not affect students' attitudes towards classification of organisms. Based on these values, we can therefore conclude that project based learning has positive effect on students' attitudes towards Classification. Studies have proven that when implemented well PBL increase retention of content and improve students' attitudes towards learning among other benefits (Thomas, 2008)

CONCLUSION

From the study findings we can draw the following conclusion:

- a) These findings provide empirical evidence and basis for concluding that the use of project based learning facilitates higher level of learning and understanding of the concept of Classification of Organisms that leads to improved academic performance.
- b) Project based learning technique being student centred approach, change students' attitudes towards Classification positively that contribute towards improved academic performance.

4.4 Recommendations

a) Project based learning on learners' academic achievement in the concept of classification of organisms

Based on this study results it is evident use that project based learning technique leads to improved academic performance. In that connection, it is recommended that teachers in Mount Elgon sub-County Secondary schools and other secondary schools adopt this teaching technique in teaching practical areas in science subjects.

b) Project based learning on learners' attitude change

Project based learning technique gives learners an opportunity to actively construct their own knowledge thus changing their attitude toward complex and abstract concepts positively. Since attitude is key in learning new knowledge, this technique should be employed in instructing science areas that are poorly performed by students like in classification of organisms.

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