African Journal of
Education and Practice
(AJEP)

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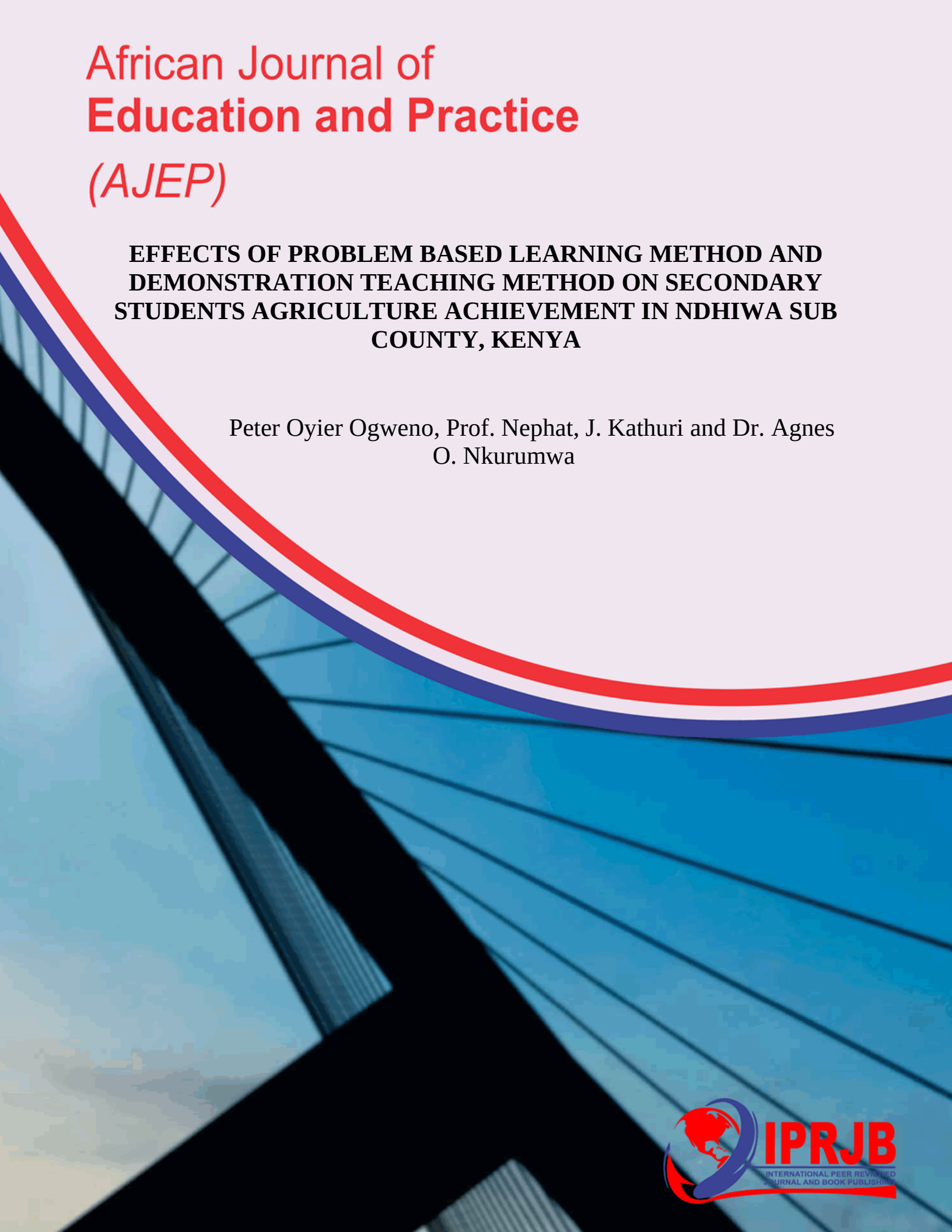

IPRJB
INTERNATIONAL PEER REVIEWED JOURNAL AND BOOK PUBLISHING

African Journal of Education and Practice
ISSN 2519-0296 (online)
Vol.7, Issue 2. No.1. pp 1 - 17, 2021

www.iprjb.org

EFFECTS OF PROBLEM BASED LEARNING METHOD AND DEMONSTRATION TEACHING METHOD ON SECONDARY STUDENTS AGRICULTURE ACHIEVEMENT IN NDHIWA SUB COUNTY, KENYA

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Abstract

Purpose: The study sought to compare the effects of Problem Based Learning (PBL) method and Demonstration Teaching Method (DTM) on achievement of students in agriculture subject.

Methodology: The study used Quasi-Experimental Design which followed a Non-equivalent Control Group Pre-test-Post-test Design, while a Constructivist learning theory guided the study. PBL was the treatment while Demonstration teaching method was used as control. The target population were 7124 students taking agriculture and 52 teachers of agriculture. Accessible population were Form Two Students and 12 schools. Both stratified random sampling and purposive sampling methods were used to obtain a sample size of 575 students and 12 teachers of agriculture. Six schools used Problem Based Learning as treatment, while the other six schools were taught through Demonstration teaching method. Pre-test was administered to PBL and DTM groups before teaching the students and a post-test was also administered to both groups at the end of six weeks of study. Data was collected using Agriculture Achievement Test (AAT) to measure students' achievement. Data was analysed using ANCOVA and descriptive statistics.

Findings: Post-test results established that teaching through PBL resulted in higher students' achievement in agriculture with a mean score of 57.47 compared to DTM mean score of 48.4. There were statistically significant difference in post-intervention scores between the interventions, F (1, 278) = 1170.43, $p < .001$, partial $\eta^2 = .800$ leading to rejection of null hypothesis. Therefore, PBL teaching method was found to be more effective in teaching agriculture as compared to Demonstration teaching method.

Unique contribution to theory, practice and policy: The study recommended that teachers of agriculture should embrace and use PBL as a method of instruction in agriculture subject. Likewise, Tertiary institutions and Universities in Kenya should implement the use of PBL method in their training programmes in training students.

Keywords: Problem Based Learning, Demonstration Teaching Method, Achievement in Agriculture, Quasi Experimental Design

1.0 INTRODUCTION

Problem Based Learning (PBL) has been defined as a teaching method where learning is collaboratively achieved by students as they learn in small teams while analyzing problems using their previous experiences with minimum guidance from the teacher (Azer, 2005). Mabrouk (2007) study established that PBL is handy in improving learners' performances, especially in topics of biochemistry and bio analytical chemistry. The origin of PBL in McMaster University in Canada in the 1960s (Servant, 2016) spearheaded the global use and application of PBL in medical education and other fields of study (Frenk et al., 2010). Indeed, most medical regulatory bodies globally promote curricula that is PBL oriented in many continents such as America, Europe and Asia where majority of medical schools use PBL (Ho et al., 2017; Bestetti et al., 2014; Chen et al., 2012 & Fan et al., 2014). However, PBL is rarely used in Africa contexts (World Bank, 2002). It is well documented that few African Countries use PBL in medical schools (Alebachew & Waddington, 2015). In Kenya, PBL is used in Moi University Medical School (Owino, 2010). Demonstration Teaching Method (DTM) is defined as an instructional strategy that combines verbal instructions with "doing" in explaining facts, concepts and processes (Sola & Ojo, 2007). DTM are useful for students in learning both physical and mental skills under the guidance of the teacher. This strategy has improved students' performance in different subjects (Sola & Ojo, 2007). In contrast, DTM is a widely used teaching method globally and it has been used to improve students learning outcomes through modelling what the teacher expects the learners to investigate (Daluba, 2013). The method emphasizes that people learn by doing (Sola & Ojo, 2007).

Agriculture is one of the subjects taken by students in secondary schools in Kenya. The teaching of the subject has significantly contributed towards realization of food security in the communities and in Kenya at large. It has been observed that the Kenyan economy has for a long time remained dependent on agriculture for employment of her citizens, as well as, a solid source of foreign exchange, despite the relatively thriving service sector, tourism and manufacturing sectors (Poulton, & Kanyinga, 2013). As a result, teachers are expected to prepare students with a broad spectrum of skills useful in agricultural production. This noble objective requires concerted effort by teachers to use active teaching methods (Waiganjo et al., 2014). Students' achievement has been used for long to gauge the extent of students' preparation with regards to skills and expertise useful for their survival in agricultural industry (Waiganjo et al., 2014). Given that agriculture is central and pivotal to Kenya's economy, effective teaching of the subject in the secondary schools is required for exemplary performance to be achieved by the students in examinations. For good students' performance to be realised, teachers must use active educational methods. In fact, every country in the world envisages that their citizens are competently educated by acquiring world class education. In this regard, education practitioners should consistently aspire to use teaching methods that are supported by research and are relevant in increasing students' achievement in examinations. However, despite the significance of agriculture to many people in Kenya, poor performance in agriculture subject has been witnessed for a number of years in Kenya Certificate of Secondary Education (KCSE) which is the national examination in the Country as observed by Kenya National Examinations Council (KNEC), (2016) report. As noted by this particular report, the performance in the subject has been consistently below 50% from the years shown in Table 1.

Table 1: KCSE Performance in Agriculture Subject (2007-2015)

Year	Number of Candidates	Mean Score
2007	121,193	48.52
2008	134,039	37.27
2009	137,217	43.15
2010	140,237	37.76
2011	167,709	41.29
2012	178,419	38.87
2013	107,068	40.82
2014	161,231	44.81
2015	178,245	43.92

Source: Kenya National Examinations Council (2016). *The 2015 Kenya Certificate of Secondary Education (KCSE) Examinations Essential Statistics*

Comparatively, at the Sub County level, the low achievement of students in agriculture has also been seen in Ndhiwa Sub County. This trend is believed to be caused by multiple factors. In studies related to students learning outcomes, educators observed that low academic achievement may be attributed majorly to teaching methods that promote rote learning, among other factors. Kibett (2002) observed vividly that teaching using effective methods enhances knowledge retention, as well as, promoting lifelong learning. That is why, the Kenya National Examinations Council (KNEC, 2013) advised agriculture teachers to continuously use active pedagogical methods that promotes acquisition of vital skills necessary for development of cognitive structures. The report further encouraged teachers of agriculture to inculcate a reading culture in students that will promote self-directed learning, at the same time, foster proper understanding of principles and practices used in agricultural production.

The achievement in agriculture still remains unsatisfactory, therefore, the study endeavours to establish a suitable method that may support and improve students learning outcomes in agriculture. According to Weegar and Pacis (2012), educators have not precisely identified the best theory of learning that fits all the students, and the methods to employ still remains inconclusive. That is why, the study focussed on whether application of Problem Based Learning (PBL) method may improve students' achievement in agriculture. Almost half of students sitting national examination in Kenya fail to attain good grades in agriculture. Some reasons attributed to this is inadequate time available to complete the syllabus, thus, practical lessons are hardly taught by teachers (Ogula & Onsongo, 2009). Additionally, Van der Berg et al. (2011); Kriek and Grayson (2009) established that students underperform in sciences due to numerous reasons which includes; inadequate mastery of content by teachers, and the type of teaching method commonly employed during teaching, thus a more engaging and student centred methods should be regularly used by the teacher.

Statement of the Problem

Determination of effective teaching methods that have the potential to increase students' performance in agriculture is an important venture to national development. So far, the instructional methods used by teachers in teaching of agriculture in Ndhiwa Sub County have not improved students' performance in the subject, particularly, in National Examinations, the Kenya

Certificate of Secondary Education (KCSE). Therefore, teaching agriculture using teaching methods that have the ability to improve students' achievement has been an issue for scholars in agricultural education. Students have persistently performed poorly in the subject despite the availability of numerous learning avenues available for students of this subject. The performance of students in agriculture subject has remained unsatisfactory despite the use of DTM in content delivery. The study sought to use a more student centred method, PBL whose usage has proved to improve students learning outcomes. Again, there are few studies, if any that have examined the linkage between PBL and students' performance in agriculture in secondary schools in Kenya. Accordingly, this study aims to fill this knowledge gap by examining the effects of PBL applications on secondary school agriculture students' achievement.

Hypothesis of the Study

The null hypothesis was stated as: There is no statistically significant difference in academic achievement of students in secondary school agriculture due to teaching using PBL and demonstration teaching method.

2.0 LITERATURE REVIEW

Demonstration teaching method has also been used over the years in teaching agriculture, however, students' performance index in agriculture subject has remained below average, despite its application. Demonstration method usually allows for the presentation of materials by the teacher, while the students are expected to repeat the procedure after the teacher. According to (Ameh et al., 2007) demonstration teaching method principally allows the teachers to procedurally explain the process in a stepwise manner as learners listen in the process. Sometimes the teacher may include diagrams and charts to accompany the explanation during the demonstration (Seevers & Graham, 2012). It has been documented that using demonstration teaching method increased students' knowledge retention in agriculture (Auwal, 2013). Similarly, Adekoya and Olatoye (2011) noted that if demonstrations are effectively used well by teachers, then the method have the potential to improve students learning outcomes in agriculture. Notably, demonstration teaching method was found less effective as compared to project teaching method according to Sola and Ojo (2007) study. Other scholars, for example, Furo et al. (2014) opined that demonstration method is a good teaching method in secondary schools because it allows students to actively participate during teaching and learning process. In another study, Umar et al. (2015) strongly rooted for adoption of teaching methods that are student centred, such as, demonstration in the teaching of accounting instead of using teacher centred methods. Similarly, Dorgu (2015) observed that demonstration teaching method were useful especially in practical teaching. Farooq (2013) observed that demonstration method is useful in the development of manipulative skills in students, however, Murshed (2012) noted that intelligent students are more inclined to benefit from demonstrations better that average students.

Problem Based Learning is a teaching method where problems drives students learning (Uden & Beaumont, 2005). The method uses actual problems emanating from everyday life experiences to inspire learning, where small groups of students work collaboratively in case based problems (Arts et al., 2002). Torp and Sage (2002) and Bell (2010) noted that implementation of PBL involves providing an environment where students must work individually and in small groups

during data collection, investigation and observations, as well as, drawing conclusions. According to Atan et al. (2005), PBL provides for the learning environment that allows simultaneous discovery of new knowledge during problem solving process. Students in PBL environments control their learning destiny by taking responsibility for their own learning by gathering information through research. For this reason, Sungur and Tekkaya (2006) observed that the teacher in the PBL method only guides the students, thus, students do not rely on their teachers for learning to occur, instead, they do independent and collaborative study, thus making students to become independent learners.

Notably, PBL have had positive influence on students learning experiences by improving students cognitive skills in various fields, such as, Education (Park & Ertmer, 2007), Medicine (Raupach et al., 2010), Engineering (Awang & Ramly, 2008) and Nursing Education (Lin & Diğerleri, 2010). A study conducted by Sungur et al. (2006) in medicine found that students who were taught using PBL had increased academic performance better than their counterparts that were given instruction through lecture method. Similar findings on the success of PBL method were reported by Tarhan and Acar (2007). The study found that students that were exposed to PBL performed extremely well as compared to their contemporaries in lecture method. Chang (2001) noted that if PBL is implemented well, then the method has the potential to improve academic achievement of students.

Teaching through demonstration is believed to be core in improving acquisition of psychomotor skills and cognitive skills in the teaching and learning of agriculture either in groups or as individuals (Daluba, 2013). Despite the known benefits of teaching through demonstration method, performance in agriculture subject has continued to be below average. Therefore, it was necessary to use another active teaching method, PBL to find out whether its usage may improve students' achievements in agriculture. It is worth noting that PBL as a teaching method is not used in the teaching of agriculture in Kenya.

In the context of this study, it was imperative to include Problem Based Learning which is an active teaching method that may help students improve their learning outcomes, since demonstration method has failed to activate high students' achievement in agriculture subject. The study endeavours to make accurate comparisons on the achievement of students in PBL classes and students taught under demonstration teaching method in secondary schools in Ndhiwa Sub County. This may help teachers of agriculture to make informed decisions regarding application of teaching method that may improve students learning outcomes.

There are many studies conducted globally concerning the effectiveness of PBL as a method of instruction against lecture teaching method, for example in China (Yan et al. 2017), the Netherlands (Prince et al. 2005) and Mozambique (Frambach et al., 2014). However, there are no studies that have examined the effects of PBL and DTM on the achievement of secondary school students in agriculture subject. Therefore, this study intended to address this gap by examining the effect of PBL and DTM on students' academic achievement in secondary school agriculture in Ndhiwa Sub County, Kenya.

Theoretical Framework

The study used Constructivist Learning Theory which combines Piaget's Cognitive Development Theory (Piaget, 1972) and Vygotsky Sociocultural Theory (Vygotsky, 1978). Piaget sees the teacher as a facilitator or a guide who provides a rich environment for students to explore their inquisitiveness. The teacher should take cognisance of child development during teaching, therefore, should desist from answering students' questions to allow them make independent conclusions (Phipps et al., 2008). Vygotsky stresses that the teachers' responsibility is to make sure that students are active in constructing their own knowledge through social interactions by engaging in cooperative learning (Fosnot, 2013).

3.0 METHODOLOGY

A quasi-experimental research design using a non-equivalent control group pre-test-post-test design was used in the study (Campbell & Stanley, 1963). Equally, it has been observed that quasi-experimental designs comprises a wide spectrum of non-randomised experimentation (Eliopoulos, 2004). As such, the designs are popularly used when it is impossible to carry out a randomised study. According to Cohen et al. (2007) the non-equivalent control group design with pre-test and post-test is a popular design in quasi-experimental design. The design recommended the use of a control group because, use of a true control group is not possible in quasi-experimental research for practical or ethical reasons (Mackey & Gass, 2016; Plonsky, 2017). Therefore, the design used one experimental group (PBL) with six secondary schools and one control group (DTM) which also had six secondary schools. Additionally, the design demonstrated its effectiveness in testing and validating the specific effects of PBL and Demonstration teaching method. Best and Kahn (2006) observed that the design is popular because students are naturally found already put into groups as classes within schools and in most cases, the students share many similar characteristics. Therefore, classes remained intact throughout the study period. Form Two students in different schools were randomly assigned to PBL and DTM groups.

The design has the ability to effectively control the significant threats to internal validity apart from threats related to history, maturation, instrumentation and interaction (Cook & Campbell, 1979). There were no events encountered in sample schools warranting introduction of the threat of interaction and history. Therefore, similar conditions in all the participating schools were kept to control the threat of selection and instrumentation. This enabled random assignment of the schools to the control and treatment groups to control for maturation, selection and interaction ((Ary et al., 2010).The pre-test and post-test were administered to both experimental group and control group giving rise to four observations that were useful for estimating the effect of experimental treatment on students achievement in agriculture. All the students were subjected to pre-test examination before instruction. The experimental group were instructed through PBL, while the control group were given instruction through DTM. The design allowed comparison of post-test results between the experimental and control groups (Flick, 2006). The study period lasted for six weeks, thereafter, a post-test was administered to the two groups. Both pre-test and post-test were marked by respective agriculture teachers using standardised marking scheme. Table 2 presents experimental design.

Table 2: Non-Equivalent Control- Group Pre-test-Post-test Design

Group	Pre-test	Treatment	Post-test
Experimental group	O_{1P}	X_P	O_{2P}
Control group	O_{1C}		O_{2C}

Where:
O_{1P} represents pre-test scores for PBL method (Experimental group)
O_{2P} represents post-test scores for PBL method (Experimental group)
X_P represents treatment for PBL method (Experimental group)
O_{1C} represents pre-test scores for DTM method (Control group)
O_{2C} represents post-test scores for DTM method (Control group)

Target Population

The population used in this study were 7124 secondary school agriculture students together with 52 teachers of agriculture in Ndhiwa Sub County. The accessible study population were Form Two agriculture students and trained teachers of agriculture.

Sampling Procedure and Sample Size

Stratified random sampling and purposive sampling methods were adequately employed in selection of participating schools, Form Two classes and trained teachers of agriculture. Selection of schools was done in accordance to school category and school type. Secondary schools were specifically used as unit of sampling, instead of individual students (Borg & Gall, 1989), this was so because the schools normally operate as intact groups. An intact class was used as either control or experimental group for every school selected. Therefore, there was no single school that had more than one treatment group, this was done to prevent contamination that might arise as a result of using more than one treatment group in each school. As such, each school acted as one group. There were 12 schools with six experimental and six control groups respectively. The basis for selection of schools was whether the school is mixed school, girls' only school or boys' only schools. Both experimental and control schools groups each consisted of two boy schools, two girl school and two mixed schools. Sampling of schools was based on school category. Purposive sampling method was used to sample 12 trained teachers. The teachers were trained by the researcher for three days. Six teachers were trained on PBL while the other six teachers were trained on DMT. Problem Based Learning group had 280 students while DTM group had 295 students. There were 297 boys and 278 girls. Sample size was adequately determined through students' enrolment in each participating school. Therefore, the sample size used was 575 students. The study lasted for six weeks between February through March, 2019.

Instrumentation

Agriculture Achievement Test (AAT) was the instrument used in the study. The instrument contained 26 structured questions which was marked out of 100 per cent. A table of test specification was used during construction of test items. The table helped the researcher to show the sub topics within the main topic under study against the learning domains. Teachers under PBL used a guiding manual developed by the researcher. The test scores arising from the instrument were subsequently used as data in this study (McMillan & Schumacher, 1997) which

were obtained from marking of pre-test and post-test. According to Netemeyer et al. (2003) a research instrument should be standardized and validated before use. The researcher subjected the instrument (AAT) for face and content validity which was done by 3 trained teachers and five lecturers in agricultural education at Egerton University. The particular content used in construction of achievement test was Livestock Production II (Nutrition) a topic in Form Two Agriculture syllabus. The instrument was pilot tested in a school in another Sub County with 30 Form Two students having similar characteristics to sample schools. This process of piloting helped in ascertaining the reliability of the test. Certainly, the reliability coefficient was calculated using test-retest method giving a coefficient of 0.78 which was considered good, indicating that the instrument was reliable and could be used in making accurate group inferences in the study (Fraenkel & Wallen, 2000). Teaching was administered using schemes of work developed by the researcher. A marking scheme was developed by the researcher for marking pre-test and post-tests respectively.

Data Analysis

Both descriptive statistics (mean, mode, median and standard deviation) and inferential statistics (ANCOVA and ANOVA) were applied at a significance level of 0.05. The analysis was done using Statistical Package for Social Sciences (SPSS) version 25 software by putting the scores into categories which formed part of analysis.

4.0 RESULTS AND DISCUSSION

Distribution of respondents according to school category

The sample schools have been put into Extra County schools, County schools and Sub County schools (Table 3).

Table 3: Types of Sample Schools in the Sub County

School Type	Numbers of schools	Percent	Number of students	Percent
Extra County	3	25.0	134	23.3
County	3	25.0	126	21.9
Sub-County	6	50	315	54.8
Total	12	100.0	575	100.0

In this study, there were three types of school categories which were Extra County schools having 134 students (23.3%), County schools had 126 students (21.9 %) and Sub County schools had 315 students (54.8%). Secondary schools in Kenya are grouped into various categories such as National, Extra County, County and Sub-County Schools. This form of grouping helps the Government in making decisions regarding funding and equipping of schools that is done according to existing categories. However, this form of categorization results into inequalities, such as, unequal staffing levels and disparities in school infrastructure (Institute of Policy and Research (IPAR, 2008). As such, disparities witnessed in students' achievement in national examinations may be attributed to this phenomenon.

Respondents' Gender

The analysis took into consideration the gender of students that participated in the study (Table4).

Table 4: Gender Composition of the Respondents

Gender	Frequency	Percent
Boys	297	51.7
Girls	278	48.3
Total	575	100.0

Generally, both genders were equitably represented in the study. There were 297 boys (51.7%) and 278 girls (48.3%).

Achievement of Students in Agriculture Achievement Test

The results in Table 5 were the pre-test scores obtained by the students in agriculture subject before they were exposed to any intervention. The test was administered and marked out of 100 percent. This variable was used as a covariate in the subsequent analysis.

Table 5: Pre-test Scores of Student Achievement in Categories

Score Categories	Frequency	Percent	Mean	Median	Mode	Standard Deviation
Below 10	4	0.6	31.8	30	30	12.01
11-20	36	6.3				
21-30	122	21.2				
31-40	129	22.4				
41-50	136	23.7				
51-60	97	16.9				
61-70	43	7.5				
71-80	8	1.4				
Above 81	0	-				
Total	575	100.0				

The pre-test mean score obtained by students in agriculture achievement test was 31.8 with a standard deviation of 12.01. The students had a mode and median of 30 marks respectively while the highest mark was 73% and the lowest marks scored was 7%. The low performance in the pre-test was expected because students had not been taught the topic nor exposed to its parts.

Achievement of Students According to Teaching Methods

The analysis presented on teaching methods show the achievement of students in PBL method and Demonstration teaching method (Table 6).

Table 6: Descriptive Statistics for the Teaching Methods

Learning method	Mean	Std. Deviation	N
Demonstration Teaching (Control)	48.4000	16.14758	295
Problem Based Learning	57.4750	13.19740	280
Total			575

As clearly shown in Table 6, students who were exposed to PBL achieved better results with a mean of 57.475 as compared to the mean score achieved under demonstration teaching method (48.4). The calculated mean difference between PBL and DTM was 9.075. However, the difference between pre-test and post-test mean scores under PBL was 27.475, while, the difference in mean scores between pre-test and post-test under demonstration teaching method was 18.4. This implies that PBL had the highest effect on students' academic achievement compared to demonstration method. Therefore, teaching through PBL produced better mean score when compared to teaching using demonstration method. This implies that PBL is superior teaching method because it has produced higher students' learning outcomes as compared to demonstration teaching method.

Hypothesis testing

The hypothesis was stated as: *There is no statistically significant difference on academic achievement of students in secondary school agriculture due to teaching using PBL and demonstration teaching method.*

The results of ANCOVA for the unadjusted and adjusted means for the Demonstration teaching method and PBL are tabulated in Table 7.

Table 7: Adjusted and Unadjusted Means and Variability for Post-intervention Score with Pre-intervention Score as a Covariate

		Unadjusted		Adjusted	
Teaching methods	N	Mean	Std. Dev.	Mean	Std. Error
Demonstration	295	48.40	16.14	48.61	.469
Problem Based Learning	280	57.47	13.19	56.81	.469
Total	575				

Students in PBL method achieved a mean score of 57.47 compared to Demonstration teaching method mean of 48.4 (Table 7). The mean difference between PBL and DTM is 9.07 showing a marked difference between the two teaching methods. This implies that PBL method is more effective in bringing better results in students than DTM in livestock production topic. Using the results in Table 7, PBL is more effective teaching method as compared to demonstration teaching method. The success of PBL use is mainly linked to very close and useful interactions of students in PBL classrooms. Learning through interactions in sharing and discussing learning issues in small groups motivates most of the students, especially after gathering information through independent study. The post-test findings are broadly in-line with the findings conducted by Yildizay and Leman (2017) study found that PBL is a better and effective teaching method that improves students' achievement in chemistry. The researchers reiterated that students taught through PBL acquire skills that are useful in actual life situations. Similarly, Jonassen and Hung

(2012) study concluded that studies testing the effectiveness of PBL method confirmed that PBL has far reaching benefits to students, therefore, this has made students in PBL classes to consistently perform better than students taught through other teaching methods.

The researcher sought to determine if there are any statistically significant group differences between DTM and PBL after adjusting for the covariate by conducting one-way ANCOVA. The results are presented with the Tests of Between-Subjects Influence as shown in Table 8.

Table 8: Tests of Between-Subjects Influence

Source	Type III Sum of Squares	df.	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	61310.598[a]	1	61310.598	1170.431	.001	.800
Intercept	22108.570	1	22108.570	422.057	.001	.590
Control (Pre-test)	61310.598	1	61310.598	1170.431	.001	.800
Intervention	.000	0	-	-	-	.001
Error	15348.202	278	52.383			
Total	767714.000	280				
Corrected Total	76658.800	279				

R Squared = .800 (Adjusted R Squared = .799)

The researcher adjusted for pre-intervention agriculture score, the results obtained pointed to the fact that there were statistically significant difference in post-intervention score between the intervention, F (1, 278) = 1170.43, $p < .001$, partial $\eta^2 = .800$. Therefore, the results led to rejection of null hypothesis. This implies that statistically significant differences exist among students that were exposed to the treatment (PBL) and students who were taught through demonstration teaching method. The study results conforms with other studies conducted in chemistry subject, for example, Mabrouk (2007) study established that application of PBL in chemistry improved students chemistry outcomes. The study contradicted (Furo et al., 2014) study that found demonstration teaching method is more appropriate in teaching secondary school students because the teaching strategy have the advantage of involving students during classroom teaching. Likewise, according to Iline (2013) DTM has the potential of giving the students the opportunity to see and hear the whole demonstration process, thus making students to be proficient. However, this study is in agreement with Boaler (1997) study, which established that PBL students performed better than their colleagues who were instructed through other traditional teaching methods in the national standardised examination in United Kingdom. Therefore, PBL was confirmed to have significant impacts in improving students' attitudes towards learning, hence, increasing academic achievement of students.

Univariate analysis using the F and Eta Squared tests

One of the univariate test performed was F test with the objective of establishing the effect of the teaching method on the post-test results in agriculture subject. The other test was eta squared (n^2) or partial eta squared (n^2p) which is basically indices that provide the measures of effect size for use in ANOVA. Table 9 show the results for the univariate tests.

Table 9: Univariate Analysis

	Sum of Squares	df	Mean Square	F	*P*	Partial Eta Squared
Contrast	61310.598	1	61310.598	1170.431	.001	.800
Error	15348.202	278	52.383			

R Squared = .800 (Adjusted R Squared = .799

According to Stevens (1992), the effect size eta-squared, is usually interpreted as small, medium and large influence if it has the following values 0.01, 0.06 and 0.14, respectively. Since η2p=0.800 for this study, the effect size was large. Therefore, after completion of the analysis, the resulting effect size was considered adequate, because the partial eta squared (n^2p) was equivalent to .800. This validates the comparisons as well as analysis.

The findings presented are based on test results conducted for both for PBL and DTM groups respectively. The students' achievement in pre-test showed that the learning outcomes were low, however, test scores for PBL and Demonstration teaching methods showed significant differences in learning outcomes. Using PBL as a teaching method improves students learning outcomes more than teaching through demonstration teaching method. The implications of teaching students using PBL method gave students the advantages of using small group discussions and individualized learning that motivated the students to improve their learning outcomes.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Teaching using Problem Based Learning (PBL) significantly improves students learning outcomes in agriculture subject. The research further demonstrated that teaching through demonstration method is less effective in teaching agriculture as compared to teaching through PBL. Therefore, teachers of agriculture should augment the application of demonstration teaching method with PBL in teaching agriculture subject to mitigate against low achievement of students in agriculture.

Recommendations

Problem Based Learning method should be incorporated among other teaching methods currently used in teaching agriculture. Universities and Teacher Training Colleges should prepare students pursuing education by incorporating PBL method in student preparation programmes.

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