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Influence of Teacher Characteristics in Use of Project Method in Teaching Physics in Kenyan Secondary Schools

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Abstract:

Physics is one of the science subjects offered in Kenyan secondary schools. Several methods are employed by the teachers in teaching physics. Project method has been cited as a key method because it is learner-centered and very effective in enabling learners to acquire scientific knowledge and skills. The choice and use of project method is determined by several factors like nature of content to be learned, availability of teaching resources, time available for teaching, learner and teacher characteristics among others. The purpose of this study was to determine the relationship between teacher's characteristics and the level of usage of project method in the teaching of physics. Stratified random sampling was used to select 84 teachers from the former eight provinces of the Republic of Kenya. Data relating to teacher characteristics and their level usage of project method was collected using a questionnaire. SPSS computer package was used to analyze the data. Level of usage of project method was determined by analyzing the mean score from the responses given by the teachers on the frequency of using the method. Hypotheses were tested at 95% level of confidence. Relationship between teacher characteristics and level of usage of project method was analyzed using Chi square. The key findings of the study were that teachers with pedagogical skills have high level of use of project method in teaching physics than those without, whereas age and gender did not influence level of use of the method. In view of the findings, the researcher recommends that physics be taught by qualified teachers with pedagogical skills and frequent in-servicing of physics teachers to be undertaken irrespective of their age and gender.

Keywords: Teacher characteristics, project method, physics

1. Introduction

Teachers are the implementers of curriculum and therefore they play a major role in the learning process. Their role involve the facilitation of learning process which include actual teaching, guiding experimentation, coordinating out of class learning activities and projects to be undertaken, preparing learners for examinations and managing discipline of students (Muriithi, 2013; Rutledge and Cannata, 2016). Some teachers implement curriculum effectively resulting to improved learning outcomes. The effectiveness of teaching is pegged on various factors like the nature of content taught, characteristics of students and teachers, availability and use of teaching resources, learning environment and teaching approaches employed when teaching a subject. Wayne and Young (2011) found out that there is a correlation between teacher's characteristics which include age, academic qualifications, gender and attitude and approaches used in teaching.

Physics is a science based subject that one studies about nature and the physical world and requires effective teaching methods and approaches. Mulei (1985) opines that the teaching of physics should emphasis on learner centered approaches as opposed to the traditional teacher centered approaches. She notes that the traditional methods of teaching sciences is mainly teacher centered involving talk and chalk and has been found unsuitable for teaching physics. Head (1999) supports this contention by indicating that traditional method of teaching sciences fail to show the relevance of the content taught. Further alluding to this, Twoli (2005) observe that traditional methods of teaching make learners passive listeners and this denies them the opportunity to participate in the learning process. This is a clear indication that traditional teacher centered methods are not effective in teaching physics, hence there is need to employ learner centered approaches like use of project method which has been found to promote learner participation in the learning process. In support of this, Chiappetta and

Koballa(2006) and Muriithi (2013) observe that learner centered approaches enable learners to acquire the requisite scientific knowledge thereby boosting logical, analytical and critical thinking which is essential in the scientific world. Project method, also referred to as project based learning (Katz, 1994) involve learners in making actual projects following standards, parameters and milestones identified by the teacher. The method has been rooted as an effective way of learning physics as it boosts learner participation in the learning process (Howell and Mordini, 2003). This learner engagement leads to better understanding of physics concepts taught. Furthermore, it has led to paradigm shift where the teacher is no longer the centre of the learning process (Kilpatrick, 2000). The teacher's role in this method is to guide and facilitate the learning process. Alluding to this view, Validya (2003) opine that use of this method help learners to acquire and apply knowledge and skills gained to define and solve realistic problems using a process of extended inquiry.

In the Kenya education system, the secondary school physics syllabus identifies specific projects to be undertaken by students, implying that teachers should employ the project method of teaching. Learners are expected to apply previously acquired knowledge and use locally available materials to construct a working scientific device (KIE, 2012) which encourage learners to be self-directed, build skills and help them to determine their own needs (Miller and Osborn, 2007). The method draws from John Dewey's philosophy that effective learning takes place when learners are curious and actively engaged in the learning process (Wertz, 1997).

Teacher characteristics which include professional and academic qualifications, gender and age play a key role in use of project method in teaching sciences effectively (Maundu, 1996; Ellis, 2007). Furthermore, these characteristics affect their attitude and decisions made during the learning process. Attitude towards teaching career has great influence on the approaches and methodologies employed during the teaching and learning process (Morris, 2001). This is an indication that the use of project method is highly influenced by the teacher characteristics, hence the need to study how characteristics of physics teachers influence the usage of project method.

1.1. Statement of the Problem

Several studies have been done on the relationship between teachers' characteristics and learners' participation in the learning process. These studies have not shown the relationship between teacher characteristics and level of use of particular learning approach in specific subjects like physics. Most of them focus on teacher characteristic and the learning outcomes and not the learning process. There is need therefore to explore how specific teacher characteristics apply when a particular method is used in a specific subject.

1.2. Purpose of the Study

The purpose of the study was to determine the relationship between teacher characteristics and the level of use of project method when teaching physics in Kenyan secondary schools.

1.3. Objectives of the Study

The specific objectives were:

- To examine the relationship between teacher academic qualifications and level of use of project method in teaching.
- To determine the relationship between teacher age and level of use of project method in teaching.
- To assess the relationship between teacher gender and level of use of project method in teaching.

1.4. Study Hypotheses

- There is no relationship between teacher academic qualifications and level of use of project method in teaching
- There is no relationship between teacher age and level of use of project method in teaching
- There is no relationship between teacher gender and level of use of project method in teaching.

1.5. Significance of the Study

The findings are beneficial to teacher educators when determining the requisite skills needed for effective physics teachers. The findings are also useful to policy makers when determining the minimum teacher qualifications needed for effective curriculum implementation. The results are also useful in teacher management when determining whether age and gender is a factor to be considered when training, posting and in-servicing teachers.

2. Research Methodology

This study used post facto research design which shows the status of the factors under consideration as they are. The population involved all physics teachers in Kenyan secondary schools. In order to get the required sample, stratified sampling was used to select twelve teachers from each of seven out of the eight former provinces in Kenya. Selection of schools was based on their performance in Kenya Certificate of secondary Education (KCSE) examinations. Teacher questionnaires were used to collect data concerning teacher characteristics and the level of use of project method in teaching physics. The questionnaires were validated by education experts from the University of Nairobi. Data collected was analyzed using SPSS computer package. The mean score from the responses given by the teachers on the frequency of using the method was used to

determine the level of its use. Hypotheses were tested at 95% level of confidence. Chi square was used to determine the relationship between teacher characteristics and level of use of project method in teaching physics.

3. Results and Discussion

3.1. Teacher Academic Qualifications and Use of Project Method in Teaching Physics

The first objective was to examine the relationship between teacher academic qualifications and level of use of project method in teaching physics. Teachers gave their responses to the statements given in the questionnaire indicating their academic qualifications in section one and the frequency to which they used project method. Their responses of either always (A), often (O), rarely (R), or never (N) were coded to carry the values of four, three, two and one respectively. The weighted mean of each response was then calculated. This value enabled the researcher to calculate the percentage score of each category of teachers thus enabling comparison of the level of use of the project method. The results are summarized in Table 1.

	Always		Often		Rarely		Never		mean score	% score
	F	%	F	%	F	%	F	%		
Diploma	9	37.5	7	29.2	5	20.8	3	12.5	2.92	73.00
Bachelor of science (B.Sc.)	2	66.7	2	33.3	0	0.00	2	0.00	2.67	66.77
B.Sc. and PGDE	4	57.1	3	42.9	0	0	0	0	3.57	85.25
Bachelor of Education	24	49.0	12	24.5	7	14.3	6	12.2	3.10	77.50
Master of Education	3	75.0	1	25.0	0	0	0	0	3.00	93.75
Bachelor of Engineering	1	50	0	0	0	0	1	50	2.5	62.25

Table 1: Teacher Qualification and Level of Use of Project Method in Physics

Table 1 shows that diploma holders had an average mean of 2.92 out of the possible mean of four which represents 73.00% level of use of the project method. Teachers with a Bachelor of Science degree used project method at 66.77%, those with Bachelor of Science degree with post graduate diploma on education (PGDE) used project method at 85.25%; Bachelor of Education holders use project method at 77.5%; Master of Education degree holders used project method at 93.75% while those with Bachelor of Engineering used it at 62.25%. The lowest level of training is diploma, followed by Bachelor of Education degree which is at the same level of Bachelor of Science with PGDE, then the Master of Education degree as these categories have both academic and professional teacher qualifications. However, teachers with a B.Sc. degree and Bachelor of Engineering only have academic qualifications but lack pedagogical skills. Their level of usage was low implying they need pedagogical training to boost their teaching skills.

These results indicate high level of use of the project method as most of the teachers had a score greater than 75%. This implies that professional physics teachers have integrated the project method in the teaching of physics. In order to check whether the level of use was high or low, the weighted mean of the teachers' responses was calculated. Those with a mean of two and below were classified as low whereas those who scored above two were classified to have high level of use. Table 2 gives a summary of the findings

Qualifications	Level of usage	Frequency	% usage
Diploma	High	16	66.67
	Low	8	33.33
Bachelor of science (BSc)	High	4	75.00
	Low	2	25.00
BSc and PGDE	High	5	71.43
	Low	2	28.57
Bachelor of Education	High	36	73.47
	Low	13	26.53
Master of Education	High	3	75.00
	Low	1	25.00
Bachelor of Engineering	High	1	50.00
	Low	1	50.00

Table 2: Level of Use of Project Method

The findings in Table 2 show the number of teachers with either high or low level of use of the project method in teaching physics. Out of the twenty four teachers with diploma qualifications, sixteen of them representing 66.67% had high level of use while eight had low usage. When this was compared with teachers who had Bachelor of Education degree, out of forty nine teachers, thirty six had a high usage comprising of 73.47% whereas those with Master of Education degree had 75% level of usage implying that high academic qualifications led to high level of use of the project method. Teachers with Bachelor of Science and Bachelor of Engineering recorded low level of use attributed to lack pedagogical training. In order to test the hypothesis that there was no relationship between teacher qualifications and the level of use of project method, the views of the teachers were subjected to Chi-square test. The results are indicated in Table 3.

Qualifications	Calculated χ^2	Tabled χ^2	Level of significance	DF	Decision
Diploma	32.332	35.172	0.005	23	Accept
BSc	14.563	11.070	0.005	5	Reject
B.Sc. & PGDE	6.887	12.592	0.005	6	Accept
B.Ed.	39.405	43.773	0.005	48	Accept
Med	6.778	7.815	0.005	3	Accept
Engineering	4.667	3.841	0.005	1	Reject

Table 3: Chi Square Analysis of Relationship between Teachers Qualifications and Level of Use of Project Method

Table 3 shows that the calculated value of Chi-square for teachers with diploma, B.Sc. with PGDE, and B.Ed. and MED are 32.332, 6.887, 39.405 and 6.778 respectively which is lower than the tabled value leading to the acceptance of the null hypothesis. This implies that there is no relationship between teacher academic qualification and the level of use of the project method. This implies that all teachers with pedagogical have almost the same chance of employing the project method when teaching Physics.

However, the case was different for teachers with BSC and Engineering where the calculated value of chi-square was greater than the tabled value. These are teachers who have the academic knowledge but lack pedagogical skills.

The implications of these findings are that teachers with professional qualifications have no problem using project method as they have been trained in pedagogical skills. On probing teachers participating in the study, one teacher who had a Bachelor of Education degree had this to say about project method.

“The training I got in the university has enabled me to guide my students well in the construction of the required scientific devices. I got more encouraged when some of my students participated and won awards during last year’s annual science congress”

This confession was in sharp contrast to one teacher who had a Bachelor of Science degree without the professional qualification who said

“I had difficulty using the project method when I started teaching. No body prepared me to use this method. As time went on, I had to learn from my colleagues who are trained and have been in this business of teaching for long. When I started using this method, I noticed that the students were excited and started liking the subject”

From these findings, it is evident that teachers with high academic qualifications and pedagogical training have high level of using the project method when teaching physics.

3.2. Teacher Age and Level of Use of Project Method

The second objective was to determine the relationship between the age of the teacher and the level of use of the project method. Teachers were asked the frequency at which they employed project method when teaching physics. Their responses enabled the researcher to calculate their weighted mean and the percentage use of the project method. These responses were then matched with their ages so as to enable comparison. Table 4 gives the summary of the findings.

	Always		Often		Rarely		Never		mean	% score
	F	%	F	%	F	%	F	%		
Below 25	0	00.0	0	0.0	0	0.0	2	100	4.00	100
25-30	2	9.1	5	22.7	6	27.3	9	40.9	3.0	75.00
31-35	2	10.0	3	15.0	4	20.0	11	55	3.2	80.00
36-40	0	0.0	2	1.8	3	17.6	12	70.6	3.58	89.70
41-45	0	0.0	1	6.7	4	23.5	10	8.82	3.6	90.00
Above 45	0	0.0	1	6.3	6	37.5	9	6.3	3.5	87.50

Table 4: Influence of Teacher Age in the Level of Use of Project Method

Table 4 indicates that teachers of all ages were using project method at a level above 75%. Those of ages below twenty five had a mean of 4.00 translating to 100% implying that all of them were using project method. Teachers in the age bracket of twenty five to thirty used project method at the level of 75.0%, those between thirty one and thirty five had 80.0%, teachers of ages between thirty six and forty used it at 89.7%, those between ages forty and forty five used project method at 90% while those above forty five used it at 87.5%.

The study also sought to find out if there was any relationship between teacher age and the level of use of the project method. This was done by subjecting the data to chi-square testing whose findings are in Table 5.

Age	Calculated χ^2	Tabled χ^2	Level of significance	Df	Decision
Below 25	25.11	35.172	0.005	23	Accept
26-30	16.984	11.070	0.005	5	Reject
31-35	4.980	12.592	0.005	6	Accept
36-40	31.123	43.773	0.005	48	Accept
41-45	4.243	7.815	0.005	3	Accept
Above 45	2.967	3.841	0.005	1	Accept

Table 5: Analysis of Teacher's Age and Usage of Project Method

From Table 5, the calculated values of the chi-square were less than the tabled values leading to the acceptance of the hypothesis leading to the conclusion that there is no significance difference between teacher age and the level of use of project method. Hence teachers of all ages have the same probability of using project method when teaching physics. This could be explained by the fact that physics syllabus gives specific projects that have been suggested to be undertaken by students during the period of curriculum implementation. The exception was for the teachers aged between ages 26 to 30 years. Most teachers start teaching at an average age of twenty four years. They are put on probation for two years after which they are employed on permanent and pensionable terms. Once employed, it seems the enthusiasm of getting employment is high, hence the high score in the usage of project method. Once employed on permanent terms, there is some relaxation, hence the drop in the usage of the project method. But this is short lived probably on realization that they need to prove themselves worth of career progression as evidenced by the teachers with the ages above 31 who participated in the study. Moreover, teachers at age 31 and above will have acquired substantial teaching experience that makes frequent use of the project method.

3.3. Teacher Gender and Usage of Project Method

The third objective sought to find out the relationship between gender of the teacher and their usage of project method. In order to check the influence of gender on the usage of project method, teachers were asked to indicate the level of usage as either very often, often, rarely, or not at all. The responses given were decoded and then average level of usage calculated. The summary of the calculation is indicated in Table 6.

	Always	Often	Rarely	Never	Mean	% score
Male	13	19	32	26	2.83	70.75
Female	2	4	5	1	3.00	75
Total	15	23	37	26		

Table 6: Teachers' Level of Usage of Project Method

Table 6 indicates that most physics teachers in Kenya are male indicating that there is gender disparity in the teaching of physics. This may give the perception that physics is for the male gender as opposed to the expectation that physics is done by everyone. This observation concurs with the findings of Twoli (1996) that science subjects are dominated by male students. However, the mean score for both male and female teachers were comparable where male teachers had 70.75% level of use of project method which was close to 75% for the female teachers implying that both male and female teachers have equal chance of using the project method as supported by sentiments below from one female teacher who participated in this study;

"I have no problem using the project method. The aim of the project method is to develop scientific skills which are not gender based. I believe that what men can do, women can do better. I like competing with male colleagues."

4. Conclusions

From the analysis done and discussed in the previous sections, the study concludes that

- There is no relationship between teacher academic qualification and the level of use of project method. However, teachers with pedagogical skills had higher level of use of project method than those without.

- There is no relationship between age of the teacher and the level of use of project method implying that teachers of all age bracket have the chances of using the project method. However, those level of use of the method increase with age.
- There is no relationship between gender of the teacher and the level of use of project method. This implies that both male and female teachers are comfortable employing project method when teaching physics.

5. Recommendations

Based on these research findings, the researchers recommend that:

- Continuous training of teachers be enhanced as teachers of high academic qualifications performs better than those of low professional qualifications. This can be achieved through rigorous pre-service and in-service teacher training.
- There should be no barrier to training and teaching based on age as teachers of all age groups have the same chance of using project method when teaching.
- Both male and female teachers should be encouraged to teach physics as both have equal chance of using project method when teaching.
- Teachers without teacher professional qualifications to receive pedagogical training

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