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An Assessment of Factors Influencing Science Teachers' Use of Practical Lessons In Public Secondary Schools of Kabwe District - Zambia

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Abstract

The main aim of the study was to examine factors that influence science teachers' use of practical lessons in public secondary schools. The study considered a total of five factors; science laboratory, science teacher attitude, training, workload and laboratory assistant. Primary data was collected from 80 secondary science teachers using a self-administered questionnaire consisting of a 5 point Likert scale. Statistical package for the social sciences (SPSS) program 16.0 was used to analyze data. Data analysis involved the use of descriptive statistics, factor analysis and regression. The results showed that out of the five factors examined only science laboratory and laboratory assistant were significantly correlated with practical lessons with P-value < 0.01. The other three factors, science teacher attitude, teacher training and workload were not significant. A regression model was applied to determine the magnitude of influence of each of two significant factors. The results revealed that laboratory assistant has a greater influence on practical lesson than science laboratory with standardized coefficients of 0.368 and 0.209 respectively. The implication of these results is that public secondary schools in conjunction with government will do well to consider giving priority to construction and rehabilitation of science laboratories as well employing more qualified laboratory assistants in order to enhance teaching of science practical lessons.

Keywords: public, secondary, practical lessons, laboratory, workload, laboratory assistant,

Introduction

Practical work is widely regarded as essential feature in the teaching and learning of science around the world [17; 25]. Although the nature and approaches to science practical have evolved over the years, practical lessons continue to occupy a central position in most science curriculums in Africa and around the world [20].

To avoid misunderstanding it is important to quickly contextualize the term "practical work". The practical work being referred to in this research is that intended for teaching and learning purposes. It is defined as any teaching and learning experience where learners engage in observing or manipulating real objects to prompt understanding of scientific concepts as well as the environment [20]. It involves hands on activities through laboratory techniques or field work to help in the understanding of scientific concepts and natural phenomena [11].

Several studies acknowledge that this practical work is important in science education as it promotes learners' interest, understanding of concepts and development of knowledge [1]. Despite the wide acknowledgement of practical work as a useful teaching and learning strategy in science, there is a lot of doubt regarding its effective implementation. [15] observed that in most of the schools, practical work is usually a poorly thought out process and unproductive as it contribute little to the learning of science.

Recently, the Ministry of General Education (MOGE) in consultation with the Examination Council of Zambia (ECZ) introduced guidelines for the administrations of school based continuous assessment in Zambian secondary schools for the year 2019 [7]. The guidelines are intended to improve the science education throughout the country by improving science teaching practices. The science teachers in secondary schools are expected to conduct continuous practical assessment in all science subjects and then submit results online via the ECZ portal, to be included in the compilation of the final marks when final Grade 12 theory examination are marked.

The implementation of school based continuous assessment is a step in the right direction as the Ministry of General Education recognizes the role of science and technology in the attainment of the 2030 vision [10]. However the huge implication of this new guideline is that public secondary schools are now expected to conduct practical lessons regularly in all science subjects like biology, chemistry and physics so as to feed into termly practical assessments. This is unlike years before when practical assessments were only conducted once at the end of Grade 12 year and mostly restricted to few pure science classes.

Purpose of the study

Since the implementation of the new guidelines entails continuous and consistent teaching of practical lessons in secondary schools, it is important to assess factors that will have great influence on science teachers' use of practical lessons in secondary schools. This study will therefore assess and identify factors that will play a key role in the teaching of practical lessons in science subjects at public secondary schools of Kabwe district. The findings from this study will be crucial to the successful implementation of school based continuous assessment in science subjects not only in Kabwe but across the country at secondary school level.

Literature review

Some of the factors that have been found to adversely affect science teachers' ability to use practical lesson include, state of laboratory facilities, work load of science teachers, teachers' practical competencies and technical support [21].

Laboratory facilities

Since the 1960s laboratory activities have been an integral component of science education curriculum [23]. A laboratory is regarded as the main place in school where proper understanding of science concepts and development of skills can take place [18]. Laboratory activities have been found to be useful in enhancing students' understanding of science concepts and applications through attainment of practical skills; development of scientific mindset and stimulating interest [8]. A study by [13] found a significant correlations between students' laboratory learning and their performance in science.

However, some studies have since emerged questioning the effectiveness of school laboratories in improving science learning [16]. It has particularly be reported that many schools especially in developing countries are struggling to conduct practical work due to poor state of science laboratories [29].further revealed that majority of the laboratories were dilapidated with no proper supply of water, electricity and gas supplies. The other major barrier to proper implementation of practical lessons is the lack laboratory apparatus and equipment. Another study has reported that in developing countries most of the laboratory infrastructure in public school is too dilapidated to support proper learning [21].

Science Teachers' attitude

A study by [30] showed that teachers' attitude toward science has a significant influence on the method of instruction used in their lessons. A recent study evaluating the science teaching in Nigerian secondary schools showed that most science teachers had a negative attitude towards practical lessons and most of their teaching was dominated by theory [3]. Another study also found that traditional teacher centered lessons are very common among teachers adversely affecting the participation of learners [9]. Despite most science teachers acknowledging the value of practical to students' understanding of science, their teaching practices remain dominated by theory teaching through "chalk and talk" and occasional teacher demonstrations [14].

Several studies show that many science teachers focus on teaching theory while neglecting practical lessons. It has been observed that despite some laboratories in school being well stocked apparatus and equipment, they are rarely used by teachers. These materials have been found to be gathering dust to a point of even deteriorating [30].

Science teacher training

Most studies in science education recommend that science teachers adopted an inquiry oriented approach which offers more opportunity for students to participate in practical lessons in order to gives them a more realistic experience of science [28]. In order effective inquiry teaching to take place a science teacher should possess the required knowledge and skills to successfully deliver practical lessons to the students. The knowledge and skills can be acquired by science teachers through appropriate pedagogical training and practice [31].

The most common teacher training method in most education system around the world is pre-service training at universities and colleges. Many developing countries have also adopted in-service teacher training programmers as a cost-effective way of equipping serving teachers with knowledge and pedagogical skills for them to become more effective. Continuous professionally development programmers (CPDs) have been also introduced to update knowledge and skills of serving teachers as they endeavor to cope with todays' ever changing education system [4].

Despite the widespread use of these training approaches, the effectiveness of pedagogical methods of science practical teaching in schools remains highly questionable. A study by

[27] observed that despite science teachers undergoing professional training some cannot conduct practical lessons. [27] Also noted that most science teachers are not able provide appropriate laboratory experiences that reinforces desired conceptual understanding amongst their learners. It has been found that some science teachers deliberately avoid practical lesson due to lack of confidence in their ability to successfully execute them [6].

Science teachers' workload

Workload can be defined as the amount of work in a workplace beyond a person's capabilities resulting in anxiety and frustration [2]. [5] Noted that workload can be a direct source of stress which can affect an individual's physical and psychological wellbeing to handle an assigned task in an organization.

Studies have found that workload has become quite a huge burden among teachers in schools as teaching is now characterized by overloads and ambiguity [19]. Teachers assume a lot of responsibility which include lesson delivery, maintaining order, instilling discipline, meeting high and sometimes conflicting demands of administrators, parents and the community. All these responsibilities can overload and overwhelm teachers leaving them with little time to accomplish their academic tasks [19].

Surprisingly very few studies that have investigated the effect of workload on the teaching of sciences despite extensive research work in art related subjects. A study by [22] found workload of biology teacher to have significant impact on secondary school students' academic performance in Nigeria. [24] Cited high workload as a big hindrance to conducting practical lessons. The study found that teachers in schools do not have enough time to prepare for practical lessons because they have too many responsibilities resorting to simple ritualistic practical demonstrations which are teacher centered.

Laboratory assistant

It is widely acknowledged that laboratory assistants play an important in promoting quality science education. According [12], the functions of laboratory assistant in school includes preparing of solutions and reagents, setting up equipment and ensuring all the required materials are available prior to the practical. They are responsible for training science teachers on usage of advance and newly acquired equipment. They also help in procurement materials, obtaining and caring for live specimens to be used for practical science lessons. They are also charged with the responsibility of ensuring there is adherence to safety standards, ethics and health requirement during practical lessons.

Numbers of concerns have been raised regarding the status of laboratory assistants in schools and these include lack of proper qualification, undefined roles, staffing levels and career structures [26]. A study by [12] found most laboratory assistants in Australian schools did not receive technical or professional training while those with qualification, where not adequately trained to handle science subjects in schools. [12] Cited the school management's lack of understand of technician's role in school as a barrier to proper practical support to science teacher. The study further noted the lack of professional recognition and opportunity for career progression growth has frustrated a lot of laboratory assistant leading to a poor work culture in contribute little towards practical work in schools.

Interestingly most of the literature available laboratory assistants in schools is from developed countries. It will be interesting to see whether some the concerns raised regarding laboratory assistant would also apply in an African country like Zambia.

Research Methodology

Primary data was collected using a self-administered questionnaire which consisting of 37 item questions belong to six constructs. The questionnaire utilized a five-point Likert scales ranging from strongly agree to strongly disagree.

The questionnaire was administered to science teachers teaching in public secondary schools located in the urban area of Kabwe district. The study target science teachers teaching classes from Grade 8 to 12. A purposive sampling was utilized to selected 80 respondents for the study.

Data analysis

Statistical Package for the Social Sciences (SPSS) version 16.0 was used to analyse the data collected through the questionnaires. Descriptive statistics of frequencies were used to give some perspective on the target population and as well as significance of the study.

The reliability of the questionnaire was achieved with Cronbach's alpha of 0.837 for 37 items, an indication high internal consistency of the measuring instrument. Factor analysis was used to check the validity and reliability of data collected. Kaiser-Meyer-Olkin Measure of Sampling Adequacy was > 0.7 and Bartlett's Test of Sphericity was < 0.01 for all items under each constructs used. The Correlation analysis was used to determine there was any significant relationship between the dependent and independent variables. Regression analysis was used to establish the magnitude and direction of influence of significant factors on practical lessons.

Results

Information on demographics of respondents was summarized using descriptive statistics in form of frequencies and percentages as indicated in the tables below
.

Table 1 Gender of respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	58	72.5	72.5	72.5
	Female	22	27.5	27.5	100.0
	Total	80	100.0	100.0	

Table 1. Shows that the majority of the respondents are males with 72.5% compared to females 27.5%. This statistics suggests that there more male sciences teachers participated than female science teachers in public secondary schools.

Table 2 Qualification of science teacher

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diploma	40	50.0	50.0	50.0
	BSc	38	47.5	47.5	97.5
	MSc	2	2.5	2.5	100.0
	Total	80	100.0	100.0	

Table 2 Indicates that a largest proportion of the science teachers who participated in the study were diploma holders with 50% compared to 47.5% and 2.5% for science teachers with a Bachelor of Science degree and Master Degree respectively. This suggests that most of the science teachers in public secondary schools are still under-qualified.

Table 3 Major area of specialization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Biology	33	41.2	41.2	41.2
	Chemistry	22	27.5	27.5	68.8
	Physics	15	18.8	18.8	87.5
	Integrated Science	10	12.5	12.5	100.0
	Total	80	100.0	100.0	

Table 3 Shows that most of science teachers are trained as biology and chemistry subject areas with a percentage frequency of 41.2% and 27.5% respectively compared to physics and Integrated science with 18.8% and 12.5% respectively.

Table 4 Work Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5	27	33.8	33.8	33.8
	6-10	20	25.0	25.0	58.8
	11-15	15	18.8	18.8	77.5
	16 and above	18	22.5	22.5	100.0
	Total	80	100.0	100.0	

Table 4 shows a more balanced science teaching work force with fresh graduates and veteran teachers well represented 33.8% and 22.5% respectively.

Table 5 Distribution of respondents

	Name of secondary school	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Mwashi	8	10.0	10.0	10.0
	Chindwin B	13	16.2	16.2	26.2
	Broadway	6	7.5	7.5	33.8
	Mukobeko	6	7.5	7.5	41.2
	Kasanda	5	6.2	6.2	47.5
	Highridge	9	11.2	11.2	58.8
	Kabwe	7	8.8	8.8	67.5
	Kalonga	14	17.5	17.5	85.0

	Bwacha	6	7.5	7.5	92.5
	Jesmine	6	7.5	7.5	100.0
	Total	80	100.0	100.0	

Table 5.Shows the distribution of respondents among the 10 public schools that participated in the study. The highest participation came from Kalonga and Chindwin B secondary schools.

Table 6. Correlations

		Practical lessons	**Science Laboratory**	**Teacher Attitude**	**Teacher Workload**	**Teacher Training**	**Lab-Assistant**
Practical lessons	Pearson Correlation	1	.410**	-.050	.244*	-.053	.482**
	Sig. (2-tailed)		.000	.662	.029	.641	.000
	N	80	80	80	80	80	80
Science Laboratory	Pearson Correlation	.410**	1	.036	.441**	.311**	.545**
	Sig. (2-tailed)	.000		.749	.000	.005	.000
	N	80	80	80	80	80	80
Teacher Attitude	Pearson Correlation	-.050	.036	1	-.062	.399**	-.152
	Sig. (2-tailed)	.662	.749		.586	.000	.178
	N	80	80	80	80	80	80
Teacher Workload	Pearson Correlation	.244*	.441**	-.062	1	.191	.473**
	Sig. (2-tailed)	.029	.000	.586		.090	.000
	N	80	80	80	80	80	80
Teacher Training	Pearson Correlation	-.053	.311**	.399**	.191	1	.021
	Sig. (2-tailed)	.641	.005	.000	.090		.850
	N	80	80	80	80	80	80
Lab-Assistant	Pearson Correlation	.482**	.545**	-.152	.473**	.021	1
	Sig. (2-tailed)	.000	.000	.178	.000	.850	
	N	80	80	80	80	80	80
****. Correlation is significant at the 0.01 level (2-tailed).**							
***. Correlation is significant at the 0.05 level (2-tailed).**							

Table 6. Shows that out of six factors used in the correlation analysis only science laboratories and laboratory assistant were significantly correlated to practical lesson at 0.01 level if significant. Laboratory assistant is more correlated with practical lesson with a Pearson correlation coefficient of 0.482 compared to science laboratory with 0.410. Teacher attitude, teacher workload and teacher training were not significant at 0.0l level of significance. Therefore, science laboratory and laboratory assistant have significant influence on the teaching of practical lessons in public secondary schools.

Table 7 Model Summary

							Change Statistics		
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.613a	0.463	0.344	0.74694	0.363	13.766	2	77	.000
a. Predictors: (Constant), Lab-Assistant, Science Laboratory									
b. Dependent Variable: Practical lesson									

Table 7 shows an application of a linear regression model which indicates that there is a positive moderate relationship between practical lessons and the two factors laboratory assistant and science laboratory, ($R= 0.613$, $p < 0.01$). The R2 indicates that 46 percent of the variance in practical lessons can be explained by the two variables, Laboratory assistant and Science laboratory.

Table 8. Coefficients

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**Correlations**			**Collinearity Statistics**	
1	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	1.872	0.349		5.358	0.000					

Science Laboratory	0.204	0.114	0.209	1.794	0.077	0.41	0.2	0.175	0.703	1.422
Laboratory Assistant	0.295	0.094	0.368	3.157	0.002	0.482	0.339	0.309	0.703	1.422
a. Dependent Variable: Practical										

Table 8. Standardized coefficients show the degree of influence that independent variables have on the dependent variable. According to the results, laboratory assistant variable has greater influence on practical lessons with a coefficient of 0.368 than science laboratory with a coefficient of 0.209.

Discussion

The study examined five factors that affect teachers' use of practical lessons in public secondary schools. Out of all the five factor considered only science laboratory and laboratory assistant had significant positive influence on practical lesson with Laboratory assistant variable having a greater influence.

The finding in this study means that an improvement in the work performed by laboratory assistant would result greater improvement in the teaching of practical lesson in public secondary schools. These result are similar to a study conducted by [12], who found laboratory assistant to a significant effect on the learning of science. He found laboratory assistants to be key players in the teaching of science in schools as they actively participate in the preparatory and implementation stages of practical lessons.

This study also revealed that science laboratory is another important factor which can positively influence the teaching of practical lessons. The findings on science laboratory are consistent with those of [13] who found strong correlations between students' laboratory learning and their performance in science. Another study by [8] also showed that laboratory activities help students to grasp science concepts by aiding in the development of a scientific thinking and stimulating interest.

This study further revealed that science teachers' attitude, training and teacher workload were not important factors and thus had no influence on science teachers' use practical lesson. This is however contrary to other studies which have found these factors to be quite important when it comes teaching and learning of science practical in schools [19; 31].

Conclusion

According to this study laboratory science and laboratory are the two most important factors when it come science teachers' use of practical lessons of practical, with laboratory assistant having a much greater influence. Science teachers 'attitude, workload and training on the other hand had not effect whatsoever on teachers' use of practical lessons in public secondary.

Recommendation

- There is need for government give priority to construction and rehabilitation of science laboratory facilities in public secondary schools if actual science teaching and learning is to take place.
- There is also need to employ more qualified laboratory assistant to help in the preparation and implementation of practical lessons in schools.

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