A Study of the Utilisation of Science Mobile Laboratories: A Case of Kitwe District

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Abstract: **- The purpose of this study was to explore the utilisation levels of science mobile laboratories when teaching science practical lessons and to assess the teachers' competencies in using the mobile laboratories and the challenges they face in this practice. A survey research design was used. It target science teachers from the three zones of Kitwe District of the Copperbelt Province. Purposive sampling was used to pick the participants of the study. Questionnaires, interview schedules and observation checklist were used to collect data. The findings from the study revealed that the quality of apparatus in these laboratories are good but they are in small quantities per unit compared to the class size and this negatively affects the teaching and learning process of practical lessons. The teachers' qualification has an impact on their ability to use the laboratory units. It was established that schools had financial challenges to acquire consumables for the practical lessons. Generally the teachers find the mobile laboratory units useful.**

Keywords: **Science Mobile Laboratories, Apparatus, Practical Lessons, Teachers' Competences**

I. INTRODUCTION

1.1 Context of the study

Through the Ministry of Education, the Government of the Republic of Zambia recognises the potential for science education in promoting technological development. It is for this reason that the Mobile Laboratories were introduced at both primary and secondary school levels as a way of assisting science teachers in delivering practical lessons in science to the learners effectively.

There has been an observation that the learners encounter a number of challenges in terms of the number of these mobile laboratories which are far much less than the number of learners. According to CDC (2010), a significant number of secondary schools do not have conventional laboratories to support practical aspects of teaching and learning. Therefore, this study sought to explore the challenges which teachers encounter in the use of mobile laboratories when teaching physics practical lessons in secondary schools.

1.2 Objectives of the study

The objectives of the study were to ascertain the state of mobile science labs in schools, Investigate teachers' views on the effectiveness of Mobile Laboratories in the teaching of Physics practical lessons in selected secondary schools and Identify academic challenges faced by teachers in teaching physics practical lessons using mobile laboratories in selected secondary schools.

1.3 Significance of the Study

It has been anticipated that the study generated information which can contribute to the pool of knowledge for curriculum developers and education policy makers by revealing the challenges faced by the teachers in the teaching of practical lessons in physics using mobile laboratories. The study may also go a long way to be of assistance to teachers and other stakeholders on how adequately the mobile laboratories could be used in teaching practical Physics lessons so that they may understand the areas of need in terms of teaching and learning resources provided.

II. OVERVIEW OF THE LITERATURE

2.1 A Brief History of Mobile Laboratories in Zambia

The government of the republic of Zambia has had a number of educational policies that have for a long time been the backbone of its main education programs. The MOE (1996) Educating our future and National Implementation Framework (NIF) (2008) advised that there was need for serious investment in science and technology teaching in Zambia.

To achieve this mammoth task, the National Science Centre embarked on the making of mobile science laboratory units and other low-cost teaching and learning aids/materials and in-service training of teachers. The mobile laboratory has been intended to be moved from one classroom to another with expediency, Ministry of Education (2012). The group dynamics and team building skills also equipped them with life-long skills, which can help them in their career in future (Hausamann, 2012).

The distribution of mobile laboratories to all provinces throughout the country hoped to propel the teaching of practical lessons in Science subjects including Physics. This is in a bid to counter the trend of poor performance in sciences amongst pupils in the country. This will not only enhance the acquiring of skills in learners but also raise the morale of teachers who should try out new ideas in the area of science practical and presentation of science lessons (Muzumara, 2008).

Teaching sciences using the laboratory promises to be an effectual mode of knowledge acquisition because it can extend the learning that transpire in schools to also take place outside the school environment (Schwan *et al*., 2014).

A study by Schwan *et al*., (2014) revealed that the capacity to meet social and economic needs critical for development any society must acquire knowledge, skills and technology. Science and technology are fundamental to sustain socio economic development of any nation. More considerate is the fact that learning to teach and mastery in teaching is a function of time and experience coupled with support from colleagues and other professionals. Muzumara (2008) affirms that it is essential to consider that growth in the profession requires a variety of life experiences in a teaching career.

With regards to Muzumara (2008), he observed that different factors are considered by researchers on the effectiveness in the usage of mobile laboratory units in teaching science in schools. For a number of reasons, both for managing the class and for good didactic reasons, students work in groups to carry out science investigations. Through learning science, learners will learn to refine, define and solve problems and concepts (Ryan, 2003). They learn to do this through pragmatic data collection, collecting information from different sources, translating that data to make broader generalisations, elucidating their outcomes and modifying their positions. According to Suttan *et al*., (2008), good practical work engages students to widen important skills, understand the process of investigating, and develop the understanding of the scientific ideas. These advanced reasons bring to light how this highly practical lessons can increase the learner's effectiveness as a learning experience and enable them to apply scientific knowledge hence stimulating and engaging learners to learn at different levels.

Other scholars also believe that concepts imbedded in students' knowledge there must be opportunities for them to encounter these concepts in a variety of contexts and expressed in a variety of ways. Teaching practical science using mobile laboratory is not helpful to teachers because it limits the teacher to make experiments that are only supported by the equipment found with the mobile labs (Hausamann, 2012).

Suttan *et al*., (2008) further suggest that teachers should adopt a more hands on approach to the teaching despite the challenges associated with the use of mobile laboratory. This direct involvement in scientific activities in the laboratory avails the learner the acquisition of a range of cognitive and psychomotor skills and processes.

2.2 Teaching of Practical Lessons

Teachers need to embrace and accept some measure of conscientiousness for the learner's struggles and failure to learn science. The measure of responsibility they accept hinge on the student's echelon of struggle to learn. If learners and teacher both work hard, the teacher should accept a large portion of responsibility when learners encounter difficulties or fail to learn. The teacher should also be able to modify instruction to help struggling and failing learners improve (National Research Council, 2007).

The uniqueness of the mobile laboratory as a medium for learning and teaching science has caused it to be the subject of interest for many research studies and several reviews since the 1960s. The reviews include a number of research publications inclusive Hofstein and Lunetta (2004) to mention a few. One study compared results of schools that taught science lessons using the mobile science laboratories (MSL) with schools that did not use the MSL showed that children find science more interesting when they are able to do experiments themselves (Hofstein and Lunetta, 2004). This finding brought forth knowledge of learner's development and new insights about the learning of science concepts. Typically, laboratory learning has meant experiences in school settings where learners interact with materials to observe and understand the natural world.

Anderson (2007) says that teachers have a responsibility to present practical lessons to their learners to enhance stimulation of children's intellectual development. The schools need to acquire a surer feel for contemporary cultural conditions. Research has shown that today's learners live in a world full of the products of scientific inquiry and engineering advancement. When learners complete their official schooling, they are expected to enter the world filled with products that will be the result of scientific inquiry and engineering development. Today's learners must learn how to do scientific inquiry and use scientific information to make decisions that will affect their personal lives, careers, and societies (National Research Council, 2007).

To train learners to live and work in tomorrow's world, science teachers must make opportunities for scientific inquiry by decreasing their stress on teaching science as a series of lectures and reading assignments on the body of scientific knowledge. In addition, teachers must greatly decrease their coverage of non-core scientific knowledge. While doing so, they must retain the core knowledge in the scientific disciplines and increase their emphasis on scientific inquiry as a core part of science content and as a method of instruction (National Research Council, 2007). What this implies is that if merit teaching and learning is to be achieved, a process to ensure the basic functionality of a school is put in place. In order to ensure that a school functions as required, a number of areas that are critical to its basic functionality have to be suitably organised (National Research Council, 2007). This includes the teaching of practical subjects practically with the learners in their classes.

In the study that looked at mobile laboratories, Clark (2009) found that the key benefit of a mobile science laboratory is that one set of equipment can be used to serve many schools. Learners do hands-on experiments which provide added educational value to the subject and provide inclusive teachers

with access to equipment and supplies that are difficult for most schools to purchase and maintain. .

III. RESEARCH DESIGN AND METHOD

In relation to this study, a survey design was used in collecting data. According to Zikmund (2003), a survey is a research technique in which information is gathered using a questionnaire. The research employed a quantitative method in collecting data with the use of a well-constructed questionnaire whose questions solicited the desired information. Interviews and classroom observation were used to enhance validity and detailed information about my study. This further helped to purge biasness that might have emanated if only one source of data was relied upon. Observation and interview schedule.

3.1 Research Questions

The study was guided by the following research questions:

1. What is the state of mobile science labs in secondary schools in Kitwe district?
2. What are teachers' views on the effectiveness of mobile laboratories in the teaching practical lessons?
3. What academic challenges do teachers face in teaching physics practical lessons using the mobile laboratories?

3.2 Sample

The sample for this study comprised of sixty (60) science teachers who were purposively selected based on the condition that they teach Science in their schools. Twenty (20) secondary schools which have mobile science laboratories will also purposively be selected to make a sample for the study. Msabila and Nalaila (2013) add that purposive sampling involves nothing but purposely handpicking individuals from the population based on the authority or the researcher's knowledge and judgment. The key participants in this study were science teachers; hence only chose teachers who taught science in those schools.

3.3 Data collection Procedure

For the purpose for soliciting views from the teachers teaching Science, questionnaires, interview schedules and an observation checklist was used to collect data needed for the study. The combination of these instruments helped to increase the reliability of information to be collected for the study.

Opportunity to interact with both the learners and the teachers. It became an added advantage in terms of acquiring information.

3.4 Data Analysis

Questions	Data Collection Tool	Data Analysis
1: What are teachers' views of the mobile laboratory for science practical lessons?	Questionnaire for the science teachers teaching Sciences	SPSS ver. 20
2: How do teachers teach practical lessons using mobile laboratories?	Semi- Structured Interviews	Thematic (formation of themes)
3. What is the role of the mobile laboratory in the teaching of practical lessons in science?	Interview schedule	Thematic formation of themes.

IV. THEMES

The views of these respondents on the research questions were presented into themes according to the questions they responded to. On each question, qualitative responses are also presented so as to present a complete analysis of an item before the next one is presented. This was because the methodology calls for the mixing of data at some point the study mixed the data during the presentation stage.

4.1 The Effectiveness of Mobile Laboratory units in Teaching of Science Practical Lessons in Secondary Schools

In responding to the main question regarding the effectiveness of the mobile laboratory units, three themes were drawn from the findings which were; adequacy of the material, beneficence of the material and the quality of the mobile labs.

Figure 1 above suggests that the majority of teachers (82%) consider the supply in mobile laboratories to be inadequate while only 29.9 per cent regard this laboratory supply to be well enough. Therefore, by the majority of the respondents expressing that the mobile labs were inadequate, it meant that the teaching of science practical was not effectively conducted.

4.1.1.2 Findings from the Interviews

Respondents were also asked on the adequacy of the mobile labs in the schools. Respondents revealed that the facilities were not adequate enough to enable teachers teach science effectively to the learners. This insufficiency of the facilities was echoed by the teachers where the majority of respondents shared the same view as one teacher who said *"Some materials needed for practical are not there in the mobile laboratory*" and another respondent added that *"The materials are very few and are only used for demonstrations".* The teachers further explained that, as compared to the number of students in schools, the mobile laboratories could not meet the needs for the practical activities in a lesson. This is shown in the following quotation from one participant: "*The number of learners in classes is usually above 40 which is quite a big number."* Therefore the mobile labs and its facilities were not adequate for the numbers of learners in schools where they

were supplied and this meant that the facility was not effectively in its utilization.

Table 1: Teachers' Response to the question: I am conversant in teaching science practical using the Mobile Laboratories

Response	Frequency	Percentage
Disagree	1	2.2
Neither agree nor disagree	4	8.9
Agree	33	73.3
Strongly agree	7	15.6
Total	**45**	**100.0**

Table 1 suggests that 40 teachers (88.9%) were conversant in teaching science practical using the mobile laboratories. While only 1 (2.2) teacher does not seem to be conversant with the use of the laboratories in schools. In addition, the science teachers could not strongly disagree with the conversance with the use of the mobile laboratories. The majority of the science teachers agreed that they were conversant with the use mobile laboratories yet they were not very conversant. The teachers were only conversant and not very conversant with the teaching of science using the mobile labs

Table 2: Test of Association between Teachers' Experience and Their Perception of Mobile Laboratories Use

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Experience in Teaching Integrated Science is the same across categories of My perception over the mobile lab is good..	Independent-Samples Kruskal-Wallis Test	.292	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

The results show that the teachers' experience does not affect their perception of the mobile laboratories used in their schools. The teaching experience was also verified with the conversance in the use of the mobile laboratories and the results are presented below.

Table 3: Test for Association between the Teachers' Teaching Experience and Their Conversance with the Use of Mobile Laboratories

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Experience in Teaching Integrated Science is the same across categories of I am very conversant with the use of the mobile lab.	Independent-Samples Kruskal-Wallis Test	.201	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

The analysis reveals that the teacher's experience does not determine the conversance in the use of mobile laboratories in the sample schools since the null hypothesis was accepted.

The research further sought to explore the teachers' views of their qualifications with regard to their influence of the focus of the practical lessons. The results are presented using the figure below.

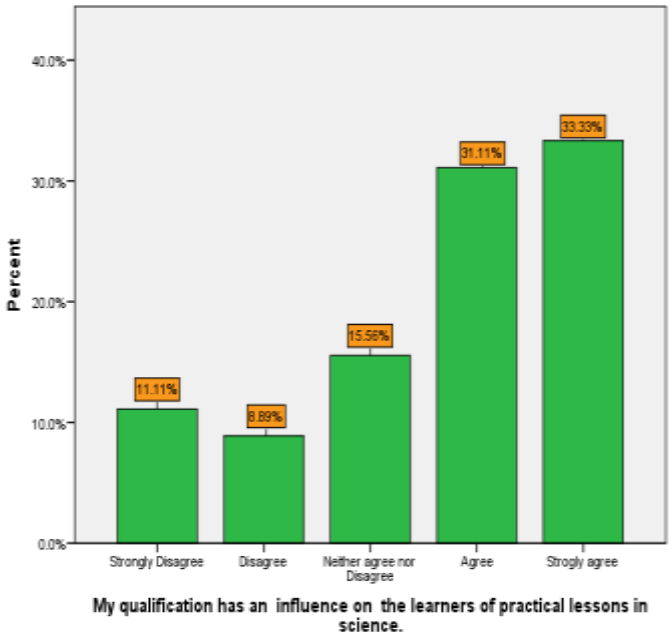

Figure 1: Teachers' Qualification's Influence on the Learners' Practical Lesson

The summary reveals that 15 out of 45 teachers (33.3%) strongly believe that their qualification really affects their use of laboratories for practical lessons. In general, 29 teachers, constituting 64.4 per cent of all sampled teachers attest to this assertion, against 9 or 20 per cent who held an opposite position to that.

Table 2: Teachers' Responses to the Administrative Support in Terms Replacement for Mobile Laboratories.

Response		Frequency	Percent
Valid	Strongly disagree	4	8.9
	Disagree	7	15.6
	Neither agree nor disagree	8	17.8
	Agree	18	40.0
	Strongly agree	7	15.6
	Total	44	97.8
Missing	System	1	2.2
Total		**45**	**100.0**

Despite teachers claiming not to be able to source for funds for purchasing laboratory materials, the majority of them, 25 or 55.6 per cent affirm that their administrations are always ready to release funds to replace the used materials. The

challenge was that the same administration had released funds towards the mobile labs mentioning that the facility was expensive to run for the small schools.

V. DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

5.1.1The Effectiveness of Mobile Laboratory units in Teaching of Science Practical Lessons in Schools

In exploring the effectiveness of using mobile labs in teaching physics practical lessons in the secondary schools of Kitwe District, three themes came up which were; adequacy of the material, beneficence of the material and the quality of the mobile labs. These will be the themes which will guide the discussion under this main theme.

5.1.2 Adequacy of the Mobile Laboratory units in Schools

The findings of the study exposed that the supplied mobile laboratories to the schools were not adequate to meet the growing demand for science practical. This claim was also confirmed by figure 4 which indicated that the majority of teachers (82%) consider the supply in mobile laboratories to be inadequate while only 29.9 per cent regard this laboratory supply to be well enough. The findings of this study have also agreed with the findings of Crebbin (2004) who noted that the teaching of sciences in the schools has not been practical despite the supplying of the mobile laboratories. He also observed that the mobile labs did not match the number of pupils in schools and that the teachers who were oriented on how to maintain them were moved to other school thereby leaving the labs vandalized and unrepaired. Lemke (2008) adds that teaching science has to be concerned with developing analytical, critical observation and problem solving abilities as well as the creativity of an individual has to be at play. With the scarcity of the apparatus on the mobile labs and their inadequacy, it was very precise that the teaching of science practical though was done, it was not effectively done.

The study findings on how teachers and learners benefited from the use of mobile labs in teaching science practical were varied. (Gilbert, 2009). Indeed science practical is very involving and calls for the teachers to be dedicated in order to help learners benefit from the facilities. The findings tally with the findings of (Hofstein and Lunetta, 2003; Jorgensen, 2010) who noted that the use of laboratories in teaching science helps proper understanding of science concepts which is achieved through practical activities that enable students to acquire important scientific skills such as collecting and recording data, communicating, analysing and making inference. Abrahams and Millar (2008) also disputed that practical teaching at times did benefit the teachers due to a number of challenges which they faced in their teaching like lack of chemicals and limited time to conduct the lesson. This findings backed by an observation made by Muzumara (2008) who revealed that the distribution of Mobile Laboratories to different provinces of the country was meant to boost the teaching of the practical aspects of Science in a bid to improve the learners' performance, as well as the teachers' enthusiasm in teaching the subject.

Through the teaching of science using mobile labs, the learners were able to participate in lessons consistently. This was shown in figure 5 which revealed that 72% of the respondents concerted that learners participated when practical were conducted using mobile labs while 28% disagreed. With such findings at hand, the Curriculum Development Centre (2010) comments that there was no justification as to how the learners did not participate in the lesson. In addition to the distribution of the science kits, laboratory equipment and chemicals are procured and distributed for teaching and examination purposes.

5.1.3 The quality of the mobile labs

The findings of the study indicated that the mobile laboratory equipment was not of high quality. This was concluded from figure 6 which revealed that 18 (or 40%) of the respondents against 17 (or 37.7%) judge the quality of the mobile laboratories available in their schools to be of high quality. However, another non-negligible percentage of respondents (22.2%) did not see any difference between the bad or good aspect of these laboratories for them to be made the major tool for practical activities in science. The findings are amplified by the MOE (2014) when they indicated that the National Science Centre embarked on the production of mobile science laboratories and other low-cost teaching and learning aids and materials and in-service training of teachers. The quality of the mobile laboratory has been designed to move from one classroom to another with convenience in the classrooms and outside but not in rough surfaces. This meant that the quality of the labs was not permanent like the conversional ones. The labs were then designed as a means to introduce practical in the absence of the built ones. This was the more reason they were not very strong.

Findings of the study are supported by Hofstein (2004) who indicate that for effective teaching or learning of science to take place, the learning environment of the pupils must be taken into account which should suit the lesson by organizing the needed equipment on time. He further adds that for effectiveness to occur, the learning also has to be consistent, not only with the Science and Technology Curriculum but also with the various aspects of science learnt in the classroom. The results meant that the effectiveness of the mobile labs could be achieved if the mentioned concerns were sorted out. The mobile labs were not effective since they could not provide the needed mobility to the class of science when needed due to faulty wheels and few apparatus.

5.2. The Effects of Teachers' Competencies on the Teaching of Science Practical Lessons in Secondary Schools

Qualitative findings also revealed that teachers with better qualifications apart from Diploma were more competent in

teaching science practical using the mobile labs unlike the teachers with lower qualifications. The findings of the study are in tandem with the conclusions made by Tezcan and Günay (2003) who noted that teacher qualification affected the teacher's use of the labs in teaching science positively. Further, the study findings concur with (Miller, 2004 and Yildiz, Akpinar and Ergin, 2016) whose findings concluded that teachers who had a higher qualification were very conversant with the teaching of science practical and they used the science labs more frequently and effectively than the teachers who were not well qualified in the subject. The newly graduated teachers with a degree in science and above had the interest to teach science practical in the schools using the available laboratory equipment in the schools unlike those who did not have the higher qualification.

The qualitative findings of the study established that the teachers' perceptions towards that use of the mobile labs were that the teachers' experience does not affect their perception of the mobile laboratories used in their schools. Leach (1999) add that a teacher's belief or conception of practical work can impact directly on the way she or he arranges practical work. Teachers should therefore have a clear understanding of what practical work entails and the purposes it serves in a given lesson.

Findings of the study in suggest that only 28 per cent of the teachers felt motivated to teach Science while 58.2 per cent do not feel motivated to do the job. The findings are in agreement with the study conducted by Ergin, Pekmez and Erdal, (2005) which revealed that the teachers' opinions related to the non-existence of labs and inadequate equipment in lab may diverge the teachers from the idea of doing simple experiments even under the current skimpy circumstances. Further, a study by Landolfi (2002) found that teachers who worked in schools where there were not fully equipment labs developed a negative attitude towards teaching science using the labs despite their qualification. Therefore, it was significant that teachers were provided with the needed facilities in schools so that they can teach effectively.

5.3. The Academic Challenges Faced by Teachers in Teaching Science Practical Lessons Using Mobile Laboratories

The first challenge was that the materials for use in mobile laboratories were not enough. This was confirmed from the 80 per cent of the respondents who stated that against the 20 percent who affirmed that the material was enough from figure 8. However, being enough or not only depends on the number of learners who needed to use the laboratory at the same time.

The classes were over enrolled. The classes were too huge that the apparatus were not sufficient to meet the learners. Even when learners were put in groups, the teaching and learning materials were still inadequate because the room where the facility was used from was also a challenge. The findings are supported by Belington (2012) who added that when classes are overcrowded and laboratory space is limited, learners fail to benefit from classroom instructions. As a result, the attention of learners is highly limited, and this is likely to hinder the aptitudes such as scientific creativity and critical analysis which is crucial as far as the goals of learning and teaching science are concerned. Also, Millar (2008) observed that a number of schools had no space where to store and use the mobile labs. This makes the teaching of practical lesson difficult as affirmed by Hofstein (2004) when he indicated that for effective teaching or learning of science to take place, the learning environment of the pupils must be taken into account which should suit the lesson by organizing the needed equipment on time.

Despite the mobile lab being in schools, the findings indicated that it was difficult to use them regularly because of time to organize and move them into a suitable classroom. Figure 11 revealed that the setting up process of the laboratory apparatus for the experiments or demonstrations to take too much of the time allotted for the lesson. This created a time crisis for the teachers and learners and they resorted to conducting practical in the afternoon after normal lessons. The findings of the study agree with Ramorogo (1998) when he said that the shortage of laboratories and the lack of laboratory assistants were serious impediments to teachers in involving students in meaningful practical activities. Learners were forced to be changing classes for them to meet the learning needs of the science classes. On the centrally, Donnelly et al., (1996) observed that the science class often fails to realize the significance of having practical due to teacher negligence and also the lack of proper supervision by the teachers which sparks a lot of noise in the process.

5.4 Conclusion

5.4.1 Conclusion

Arising from the discussion in the results of this study, the following conclusions were arrived at for this study. The mobile laboratory facilities and apparatus were not adequate in the selected secondary schools. This contributed to the ineffectiveness of the teaching of Physics practical lessons in the schools. Secondly, despite the mobile laboratories being inadequate, the teachers and learners benefited from them since they had some practical lessons at times using the facility. Lastly, challenges which were encountered in the process of teaching physics practical lessons using the mobile labs included the lack of adequate science materials and apparatus, over crowdedness in class and big groups during group discussion.

5.4.2 Recommendations

In line with the conclusions arrived at in the foregoing conclusions, the following recommendations were arrived at. Additionally the quality mobile laboratory units supplied to schools should be improved so that they can last longer in schools. This will reduce on the cost of maintenance.

The suppliers of the mobile labs should also be made to provide training to the teachers so that they do some minor

maintenance to the damages which would come. This will help to sustain the mobile labs and make them serve longer in the schools they are supplied. More qualified teachers should be assigned to handle and teach Physics practical lessons due to their ability to provide practical skills. This will enhance the quality teaching of science practical in schools.

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