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Teachers' pedagogical content knowledge, curriculum designing, and student's comprehension of secondary school ordinary level physics in Lusaka, Zambia

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Abstract
The purpose of this study was to analyse teachers’ pedagogical content knowledge and curriculum designing of secondary school ordinary level (O-level) physics in order to establish if they contributed to learners’ poor comprehension of physics. The embedded mixed methods research design was used with more of qualitative data than quantitative data informing the study. 172 participants comprising of 158 Grade 12 learners, 10 teachers of physics and 4 physics educational specialists were sampled for the study. Data was collected using questionnaires for learners, semi-structured interview schedules for teachers and educational specialists and a lesson observation guide. Thematic analysis aided the understanding of qualitative data while descriptive statistics were used to analyse quantitative data. Findings revealed that O-level Physics for secondary school in Zambia had some areas that affected Learners' comprehension due to the way the programme was designed. However, the major hindrance to Learners'' poor comprehension of the subject was teacher pedagogical content knowledge. Thus, it was concluded that teachers' poor physics pedagogical content knowledge and numerous skills acquisition demands that the subject put on learners contributed to Learners’ difficulties in comprehending the subject. Therefore, researchers in this study recommended that the Ministry of General Education in Zambia should come up with a deliberate professional development programme to up skill teachers in the teaching of physics from both the theoretical and practical points of view.

Keywords:
Curriculum designing. Ordinary level Physics. Pedagogical content knowledge.

Introduction
In 2013, the Ministry of General Education in Zambia started the revision of the primary and secondary school curricula which was concluded in 2017 with the implementation of Grade four. The rationale behind the revision, as explained by the Ministry of General Education (MoGE), was to come up with competency or outcome-based curriculum that would help learners acquire knowledge, skills, values, and attitudes that would eventually make them face challenges in a rapidly changing world (MoGE, 2013). Todays' societal rapid changes are influenced and biased towards technological innovations and thus to respond to these challenges, the education system should be tailored in such a way that it provides solutions to the challenges that are scientifically oriented. One of the aims of Zambia’s education, as stated in the 1996 education policy document, is that science and technology have a significant impact on Zambia’s economy and on the way of life of almost every citizen-state (MoE, 1996). It is further explained in the same document that the
scientific process was becoming a condition for human survival. Zhaoyao (2002) postulated that physics is an important base in science and technology since in it learners study the essence of natural phenomena and help them understand the increasingly technological changes in society. In the 2013 revised Zambian curriculum (MoGE, 2013), science is compulsory in both the academic and vocational career pathways because it forms a basis for increasing advancement in technology which aims at improving the overall quality of life. However, there has been a general decrease in the quality of science learners’ results obtained at grade twelve (12) school certificate leaving examinations as evidenced in the 2017 educational statistical bulletin, with the majority of the candidates obtaining just satisfactory or unsatisfactory grades. Good results in science are mostly obtained by candidates who sit for pure physics and pure chemistry but there has been a general decrease in the number of candidates taking pure physics since it is offered as an option (MoGE, 2017). Barmby and Deffty (2012) observed that the low marks in science are mostly attributed to the way physics is perceived by most learners in secondary school as a difficult subject. Pure physics and chemistry are offered to learners as optional subjects while physical science which is a combination of physics and chemistry is offered to the rest of the learners, who are the majority, as a compulsory subject (Examination Council of Zambia, ECZ, 2017). The performance of learners in two recent years according to the Examination Council of Zambia (ECZ) in sciences is summarised in Table 1. The 2018 results are not any better.

Table 1: Comparison of Performance by Subject in 2016 and 2017

<table>
<thead>
<tr>
<th>Subject</th>
<th>Mean Raw Score (%)</th>
<th>% Change</th>
<th>Direction of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>2017</td>
<td>2015-2016</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>48.33</td>
<td>48.83</td>
<td>+0.05</td>
</tr>
<tr>
<td>Chemistry</td>
<td>49.33</td>
<td>49.82</td>
<td>+0.70</td>
</tr>
<tr>
<td>Physical Science</td>
<td>17.76</td>
<td>17.65</td>
<td>-0.11</td>
</tr>
</tbody>
</table>

Source: ECZ (2017) examination performance review report

While physics and chemistry recorded a decline in candidature as shown in Table 1, the performance changed in the positive but physical science which is compulsory and a combination of physics and chemistry recorded a decrease in performance. The ECZ (2017) report on examination performance review confirmed that poor performance in physical science has consistently been attributed to physics and this has been noticed by physics having a lower percentage than chemistry. It is indeed likely that there is a poor perception among learners of science that physics is a difficult subject as can be seen from the lower marks for pure physics and as reported by Barmby and Deffty (2012) in the JICA/MoGE report on pupils’ perception of physics in Zambian secondary schools. This paper will focus on physics which is a component of physical science (combination of physics and chemistry) as it is the one that is offered as a compulsory subject and taken by the majority of the learners.

As earlier mentioned, physics in secondary schools in Zambia is taught in two ways. It is taught as an optional subject to pupils who are purported to have a strong background in science as pure physics. It is this type of physics whose candidature has been declining over the years. Most pupils who sit for this examination are very
few but they perform well as indicated in Table 1 which is showing an upward trend in performance. The other type of physics is general physics which is taught separately and examined separately but the results are combined with chemistry and it is recorded as physical science on the learners’ result transcript and school certificate. General physics is taken by learners who are purported not to have a strong science background and it is said to account for the poor performance of learners in physical science at school certificate leaving examination and this is the physics that this study focused on. Despite physics being one of the most important subjects in the Zambian education system as well as one of the oldest fields of study in the history of mankind, the performance of learners has been unsatisfactory for years (ECZ, 2017). This prompted the researchers to wonder why pupils find physics to be a difficult subject and if content was sequenced in a coherent manner. Moreover, scholars in this study questioned whether there was a problem in the way physics was taught in secondary schools in Zambia.

Statement of the problem
The research problem which was addressed in this study was that despite physics being a base subject in science and technology, it seems to have become unpopular among secondary school learners in Zambian secondary schools. This has been manifested by learners continued poor performance in general physics during the school leaving examinations. According to ECZ (2017) examination review report, despite physics being one of the most important subjects in Zambia’s education system, the performance of learners had been unsatisfactory for years. The poor results that the country has continued to record in O-level physics are an indication that there was something wrong with physics education in secondary schools in Zambia. If the physics problem is not addressed, the knowledge base relevant for the advancement of science and technology will decline and that is likely to lead to stagnation in the technological and economic development of the country. Hence, the study focused on the curriculum designing and the pedagogical content knowledge (PCK) of the teachers of O-level physics.

Aim of the study
The aim of this study was to analyse the effect of the O-level physics curriculum designing on learners’ comprehension and teachers’ pedagogical content knowledge of the subject.

Objectives

1. To establish the effect of physics curriculum designing on learners’ comprehension of the subject.
2. To analyse the effectiveness of teachers’ pedagogical content knowledge on learners’ comprehension of physics.
Research questions
1. How has the physics curriculum designing affected Learners’ comprehension of the subject?
2. What effect does the teachers’ pedagogical content knowledge have on Learners’ comprehension of physics?

Significance of the study
It is hoped that the results of this study would bring out information that may contribute to the existing literature on efforts to improve learner comprehension of physics in secondary schools in Zambia. The findings may also be used by other researchers for further studies about secondary school teaching of science.

Theoretical framework
In order to understand the problem that surrounded physics as a subject in secondary schools in Zambia, reference was made to the schema theory. According to Hewson and Posner (1984), a schema is a set of coherent knowledge that is created in a set of similar context or situation. Human beings use schemata to organise, retrieve and encode chunks of important information. If teachers use teaching strategies that conceptualise learners’ existing schema, new information will be easily integrated. McGovern (2017) explained that learners learn more effectively when they can relate new knowledge to previous knowledge by the use of schema. The problem at hand is that it seems learners are unable to acquire new knowledge of physics during the process of teaching and learning and hence the need to analyse the way it was packaged or designed in the curriculum and the teacher’s knowledge of how they taught it (pedagogical content knowledge).

Literature review
The importance of physics in society
Science is recognised widely as being of great importance both for the economic well-being of nations and for having a scientifically literate citizenry (Kyriakides, Christoforou & Charalambous, 2013). The knowledge of science and technology has been going through rapid evolution since the industrial revolution of the 17th Century. Building on the knowledge and skills of the fathers of modern physics such as Sir Isaac Newton, Galileo Galileo, and Albert Einstein, physics has claimed its space in the sciences to the extent that technology depends on its basic principles. It is through physics that new methodologies were developed that helped improve the quality of life in machines such as cars and aeroplanes which have made human mobility easy as well as modern construction which makes the earth a beautiful place to live in. For example, the smooth operations of a car will not be possible without depending on the mechanisms which are all made possible by physics principles. Topics like thermodynamics explain the functions of the engine and how the coolant helps in cooling the engine; electromagnetism explains how the car battery works, starter and headlamps. Vibrations and mechanical waves are also part of the content knowledge in physics (Serway & Faughan, 1999).
Orientation and focus of the 2013 Zambian revised curriculum

A curriculum, being a programme of education as Mulenga (2018) defined it, is a vital catalyst for the social and economic development of both developed and developing countries. The way a curriculum is conceptualised in theory and then designed, organised and developed for practical implementation depends on a country’s particular philosophy of education. Delgado (2012) described a curriculum design as the structure or arrangement of the components or elements of the curriculum in a coherent manner. The O-level physics curriculum designing for Zambian secondary schools is arranged in such a way that it introduces learners to international standards of measurements known as SI units standing for System Internationale (Serway & Faughn, 1999). This knowledge enables learners to acquire the skill of measuring, accuracy and precision as well as the conversion of units. It contains other important topics which fall under mechanics, thermal physics, wave motion, static electricity, current electricity, basic electronics, and nuclear physics. According to MoGE (2013), the 2013 revised curriculum has adopted an outcome-based curriculum as one of its guiding principles. The guidelines in teaching this type of curriculum as given by the Ministry of General Education are that learners should be given practical experiences during the teaching and learning process that would help them acquire life skills.

In order to achieve the Ministry of General Education’s desire, the teachers’ content and pedagogical knowledge of the subject is critical. Every teacher needs to possess pedagogical content knowledge in order to manage the important task of achieving outcome-based education. The pedagogical content knowledge (PCK) helps the teacher to guide learning in ways which are appropriate as prescribed by the curriculum in order to achieve the aspirations for education of a nation. Shulman (1987) described pedagogical content knowledge (PCK) as an important aspect of teaching that allows teachers to effectively relay and make the subject matter and curricula knowledge comprehensible to the learners. Mulenga (2015) in his doctoral study contended that a teacher with PCK would know how to effectively sequence the teaching and learning materials and formulate very good questions that probe for alternative views.

The state of ordinary level physics in Zambia

Physics in Zambia has been taught since political independence in 1964. In the early 1980s, Physics was taught to only form IV and form V pupils as the curriculum demanded. By mid-1980s, the curriculum and education structure were changed from two years to three years in senior secondary school. This allowed for more time for learners to prepare for O-level examinations. In turn, the number of pupils sitting for O-level physics gradually increased. However, the number of pupils sitting for O-level pure physics examinations has not continued to increase (ECZ, 2017), and there has been a gradual decrease in the number of examination centres for it. In the meantime, learners that are doing general physics do not perform well in the school certificate leaving examinations that they write at the end of secondary school. The grades are mostly in the levels of lower credit, satisfactory and unsatisfactory. Buabeng and Ntow (2010) explained that in Zambia, ordinary level acceptable performance is a grade of higher credit or better. The situation is that most physics
candidates obtain grades lower than the O-level standard. According to Kafata and Mbetwa (2016), one of the perennial problems of the education system in Zambia is the high failure rate of learners at Grade twelve in science with physics being the major contributor.

**Research design and approach**

This study employed a mixed method embedded design approach which involved the use of qualitative and quantitative methods of collecting and analysing data. Qualitative data and quantitative data were collected simultaneously. Quantitative data was collected to play a supporting role to qualitative data.

**Sample size**

A total of 158 Grade twelve learners from ten secondary schools participated in this study. The schools were selected using stratified and simple random sampling. The learners were also selected using stratified and simple random sampling. The ten teachers of physics and four physics specialists two from the Examination Council of Zambia and two from the Curriculum Development Centre were selected using purposive sampling and this gave the study a total of 172 participants.

**Data collection tools**

According to Kombo and Tromp (2006) questionnaires, interview schedules, observation checklists and focus group discussion guides are the most commonly used research instruments. For this study, semi-structured interview schedules were used to conduct face to face interviews. Lesson observation checklists were also used as well as structured questionnaires. The three different instruments of data collection helped to triangulate in order to ensure the validity and reliability of the research findings.

**Method of Data Collection**

The questionnaire was used to collect information from learners. The Grade twelve learners were required to rate statements on a five-point Likert scale using strongly disagree, disagree, neutral, agree and strongly agree. This helped to generate quantitative data and qualitative data from open-ended questions of the questionnaire. The semi-structured interview schedules were used to collect information from the teachers of physics and the physics specialists in order to obtain qualitative data by having face to face interviews. The lesson observation checklist was used to collect information on the instructional process. All these procedures were carried out by the researchers themselves.
Reliability and validity

In this study, validity and reliability were achieved in various ways including seeking participant member checking of data. Triangulation of data collected through interviews and the questionnaire helped to validate most of the findings. Additionally, questionnaires were pilot tested so as to ensure that questions were understood by participants. Reliability of results was mainly done through factor analysis in which the Cronbach’s alpha (α) values were used to check the reliability of the questionnaire items. With coefficients ranging from 0.00 to 1.00, the large indices indicated a higher degree of reliability. The researchers accepted Cronbach’s alpha of 0.8 to 0.94. These values were accepted because they were more than 0.70 which is the threshold value of acceptability as advised by scholars such as Creswell (2003). During the coding process, qualitative and quantitative data was scrutinised to eliminate errors and omissions.

Findings and discussion

What was the effect of Physics Curriculum Designing on Learners’ Comprehension of the subject?

Effect of curriculum design on learners’ comprehension of physics

Physics specialists from the Examination Council of Zambia (ECZ) and the Curriculum Development Centre (CDC) were asked during the interviews to explain if the way O-level physics curriculum was designed had been negatively affecting Learners’ comprehension of the subject. All the specialists held the view that the way the curriculum was designed had no negative effect on the comprehension of physics by learners. For instance, one of the specialists from the CDC commented that;

Care is taken in the way the content is selected and organised to the extent that the curriculum is appropriate for learners at secondary school level and that is the case with O-level physics in Zambia.

A physics specialist from ECZ also stated that;

From the assessment point of view, what we notice in students’ answer scripts points to the fact that teachers seem not to be teaching the subject well. Some mistakes learners make are so basic that one does not expect a student at this level to have such deficiencies in the subject. Thus, the designing of the curriculum is not the issue but how teachers teach this subject.

However, teachers of physics had a different view from the specialists. For example, one teacher explained that;

The physics curriculum has content which is irrelevant to the learners, as a result, it poses challenges to the Learners’ comprehension of physics. And some of the content is very high pitched to the extent that learners struggle to comprehend some of the concepts.

This view was shared by six other teachers who though express it in different ways. As one of them said that;
The skills that students are expected to learn in physics are so many. For instance, they will need to calculate, draw, measure and many others. And yet we do not have the appropriate and enough teaching and learning resources in our schools, private schools do well because they have the resources. Physics curriculum need to be redesigned with the help of teachers.

Learners were also asked to give their views about the effect of the number and nature of topics in the syllabus on their comprehension of physics. The views were given on a five point Likert scale by strongly disagreeing, disagreeing, neutral, agreeing or strongly agreeing to the statement that “I do not perform well because physics has too many topics which are difficult to understand”. Twenty-six (26) learners strongly disagreed, twelve (12) learners disagreed, twenty-one (21) learners were neutral, fifty (50) learners agreed and forty-nine (49) learners strongly agreed. Figure 1 shows percentage distribution of the Learners’ responses.

![Percentage distribution of learners views on the number and nature of physics topics](image)

The learners also said that physics had too many topics which had different modes of learning and this posed a challenge to them. As can be seen from the findings, teachers and learners had a different view from those of physics specialists. While the physics specialists were insisting that the curriculum was well designed and all it needed was good teaching, those who taught it and the learners themselves had issues with the curriculum. These results showed that there was a blame game between the teachers of physics and the Curriculum Specialists. One specialist even claimed that;

*Teachers were part of the curriculum designing process and he saw no reason why teachers should blame their failures on such a fine document.*

Teachers and specialists held different views on this issue and like other studies; teachers have complained that they were not part of the curriculum development process in most cases. The teachers' complaints have been confirmed in studies such as those by Mulenga and Mwanza (2019) who said that teachers were not well represented during the curriculum designing process.
What was the effectiveness of teacher’s pedagogical content knowledge on learners’ comprehension of physics?

**Learners’ comprehension of physics in relation to teachers teaching skills**

As already noted from the previous section, physics specialists attributed learners’ challenges in physics to the way teachers presented the subject to the learners. It should be realised that teachers knowing and understanding of physics, content knowledge, is one thing and having the skill to effectively make the learners acquire desirable knowledge and skills in it, pedagogical content knowledge, is yet another thing. A teacher with appropriate pedagogical content knowledge can effectively teach learners the knowledge and skills contained in physics in such a way that learners will be able to realise that physics was actually usable in real life.

In order to understand teacher’s pedagogical content knowledge of physics, researchers presented a Likert scale in the learners’ questionnaire which had several statements on which learners needed to express their views about how teachers taught them in relation to their comprehension of the subject. The results are given in Table 1.

### Table 2.0: Frequencies and percentage distribution of learners’ views about why they found physics difficult

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most of the time my teacher goes on teaching without me understanding</td>
<td>17 (1.8%)</td>
<td>17 (10.8%)</td>
<td>16 (10.1%)</td>
<td>69 (43.7%)</td>
<td>39 (24%)</td>
</tr>
<tr>
<td>My teacher understands physics for himself only but fails to make me learn it as well</td>
<td>24 (15.2%)</td>
<td>28 (17.7%)</td>
<td>9 (5.7%)</td>
<td>70 (44.3%)</td>
<td>27 (17.1%)</td>
</tr>
<tr>
<td>We do not do any experiments during Physics lessons and that makes it difficult to understand it</td>
<td>18 (11.4%)</td>
<td>14 (8.9%)</td>
<td>32 (20.3%)</td>
<td>59 (37.3%)</td>
<td>35 (22.2%)</td>
</tr>
<tr>
<td>Since my secondary school days, I have not had a teacher who has made me understand Physics</td>
<td>28 (17.7%)</td>
<td>14 (8.9%)</td>
<td>13 (8.2%)</td>
<td>54 (34.2%)</td>
<td>49 (31.6%)</td>
</tr>
<tr>
<td>If only we had a teacher who can teach us well Physics is not a difficult subject</td>
<td>40 (25.3%)</td>
<td>12 (7.6%)</td>
<td>7 (4.4%)</td>
<td>52 (32.9%)</td>
<td>47 (29.7%)</td>
</tr>
</tbody>
</table>

The statements in Table 2.0 described aspects of teachers’ pedagogy for physics in relation to learners’ comprehension of the subject. The learners’ responses gave the researcher very important feedback about what aspects of the teacher’s pedagogy affected their comprehension and thus their performance in the subject. The results clearly indicated that according to learners, their lack of understanding of the subject had a lot to do with how they were taught. This indicated to the researchers that the teachers’ way of teaching the subject greatly affected learners’ comprehension. This
confirms what Bishop (1985) had rightly stated that the quality of a curriculum is as good as the quality of its teachers. In this case, learners’ understanding of physics seemed to have been impeded by teachers’ pedagogical skills. In order to give a deeper understanding of teachers challenges in relation to their pedagogical content knowledge, researchers asked learners how their teachers specifically handled some aspects of the lessons. The sections that follow give the details.

The pedagogical content knowledge of the teachers of physics

A five-point Likert scale presented statements that reflected teachers’ pedagogical skills and learners were required to rate by strongly disagreeing, disagreeing, neutral, agreeing or strongly agreeing. The learners’ responses were analysed using the mean and standard deviation. The results are presented in Table 2.

Table 3.0. Mean and Standard Deviations of Learners’ Views of Teachers’ Pedagogical Content Knowledge

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics seems to be complicated even to my teacher</td>
<td>158</td>
<td>1.00</td>
<td>5.00</td>
<td>3.341</td>
<td>1.583</td>
</tr>
<tr>
<td>My teacher does not explain difficult scientific terms</td>
<td>158</td>
<td>1.00</td>
<td>5.00</td>
<td>3.6076</td>
<td>1.26610</td>
</tr>
<tr>
<td>My teacher does not connect what we learn to everyday aspects of our life</td>
<td>158</td>
<td>1.00</td>
<td>5.00</td>
<td>3.3038</td>
<td>1.35303</td>
</tr>
<tr>
<td>Physics is taught in a very theoretical manner without us doing experiments</td>
<td>158</td>
<td>1.00</td>
<td>5.00</td>
<td>3.5000</td>
<td>1.25048</td>
</tr>
<tr>
<td>My teacher’s attitude towards our challenges in physics is very discouraging</td>
<td>158</td>
<td>1.00</td>
<td>5.00</td>
<td>3.5190</td>
<td>1.45734</td>
</tr>
<tr>
<td>My teacher makes us think that physics is not for everyone but for some very intelligent pupils only</td>
<td>158</td>
<td>1.00</td>
<td>5.00</td>
<td>3.4367</td>
<td>1.42513</td>
</tr>
</tbody>
</table>

The standard deviations of 1.58 and below showed that learners had difficulties with the pedagogical skills of their teachers and this is the case with the results in Table 3.0. It is worth noting that most of the learners indicated that physics was complicated even to their teachers. Learners probably arrived at this conclusion having experienced that teachers were unable to explain the concepts of the subject to them.

More information about the teachers’ teaching skills was obtained through the lesson observation schedule, interviews, as well as open-ended questions from the Learners’ questionnaires. Through observation of the lessons, the findings revealed that four of the lessons observed were mostly about teacher exposition. There was a lack of creativity and critical thinking and the chalkboard was the only available teaching and learning aid. No learner centred method was fully employed and time management was poor as reflected by the failure to engage the learners in a class activity such that two out of the four lessons, class activity was given as homework while the other two ignored it altogether. However, the teachers displayed appropriate knowledge of the subject matter but learners remained passive throughout the lesson hence the researchers could not tell if learners had learnt something by the end of the lessons.
The findings revealed that learners felt that their teachers of physics did not connect what they learnt to everyday activities. The same sentiments were expressed by the physics specialists who thought that there was probably a compromise in the quality of the teacher education programmes of science teachers being offered by colleges and universities. The physics lessons which were observed revealed that learners were mainly passive participants. The findings of this study actually confirm what Hewson and Posner (1984) explained about the schema theory. If teachers use teaching strategies that conceptualise learners existing schema, new information will be integrated and if they did not, new information was not to be integrated. Therefore, learners’ difficulties with physics can be attributed mostly to the lack of effective teacher pedagogical content knowledge and not to curriculum designing.

Mulenga and Luangala (2015) explained that teachers play an important role in the facilitation of the learners’ acquisition of desirable knowledge, skills, values, and attitudes. In this case, it is up to the teacher to make the learners aware of the rare knowledge, skills, and attitudes that they can acquire only from learning a certain topic in physics. In order to have a detailed understanding of teachers’ PCK, the researchers isolated some outstanding areas in Table 3.0 as presented in the sections that follow.

**Teacher’s ability to explain scientific terms in physics**

Most of the learners agreed to the statement that the teacher had difficulties in explaining scientific terms in physics. When the Likert scale for this statement was analysed in percentage, the results were as in Figure 2.0.

![Figure 2.0](image)

**Figure 2.0.: Percentage distribution of teacher’s inability to explain scientific terms of physics**

Figure 2.0 indicates that teachers had challenges in the way they explained physics concepts. From the lesson observation, the researchers found out that some terms were being explained but not all of them. For example, during one lesson observation on current electricity, the teacher did not explain the difference between the potential difference (P.D) and electromotive force (E.M.F) but just referred to both as voltage. During interviews with teachers, one of the teachers explained that;

*It is a waste of time to explain all the scientific terms we come across because to our learners, nothing makes sense. All we do is a formality. The government should think of excluding some schools like ours from taking science subjects like physics because in the end all they do is blame the learners’ failures on the teacher.*
Another teacher revealed that;

*Even if you break your back to explain in the simplest terms, the learners further ask you to repeat the explanation in Nyanja, the local language, honestly, how can you achieve science education in Nyanja?*

On the same theme, the specialists confidently said that the terms that are contained in the secondary school physics content are not difficult and can be adequately handled by any teacher of physics who has been trained. One specialist said that;

*The teachers of physics have been trained adequately to handle all the scientific terms that are in the content and besides all textbooks are accompanied by teachers’ handbooks where the teacher can be given further guidance about the terms.*

The findings also revealed that learners strongly agreed to the statement that “physics is complicated even to our teacher”. A total of 99 learners (62%) agreed to the statement while those who disagreed were 32.9% and 4.4% chose to remain neutral. Findings of the interview with teachers revealed that it seemed teachers felt bothered to simplify some of the terms that learners did not understand. Park and Oliver (2008) explained PCK as what the teacher understands and the enactment of how to help a group of learners understand specific subject matter using multiple instructions. Therefore, if teachers of physics were failing to simplify physics content to their learners, then it can be attributed to their lack of pedagogical content knowledge for the subject.

**Applicability of physics content to everyday life**

Good and effective teaching helps learners link what they are learning to their everyday lives. “*My teacher does not connect what we learn to everyday life activities*” was one of the statements learners needed to respond to as shown in Table 3.0. Those that strongly agreed and agreed to the statement were 44.3% and 17.1% respectively and when combined it came to 61.4% of all those who agreed that the teacher did not connect what they learn to everyday life.

![Figure 3.0.: Percentage distributions of learners’ views about the applicability of physics](image-url)

Figure 3.0.: Percentage distributions of learners’ views about the applicability of physics
In a follow up open-ended question one of the learners wrote that;

The problem is that from Grade ten (10) to Grade eleven (11), we were given a very complicated teacher who complicated things for us, but the one we have now makes physics simpler but what are we going to do about our Grade ten (10) and eleven (11) topics.

The findings from one lesson observation on calculating the cost of electricity were that the teacher correctly applied the formula based on an example from the textbook about Singapore without making reference to the domestic calculations of electricity costs by the Zambia Electricity Supply Corporation (ZESCO) units. It was also noted that the learners did not inquire from their teacher if domestic electric energy was also calculated in the same way. Hence, when one of the teachers was asked whether they connected what they taught to everyday life activities, the teacher commented that,

The learners we teach think in a very shallow way. They have no ability to connect what we teach them to what they go through in everyday life. For example, explaining to them after the lesson to go and sensitise others about changing from using incandescent bulbs to energy savers in order to save energy, my learners refused to let go of the misconception that energy savers cause cancer, so what can you do with such learners.

Another teacher added that;

Our learners fail to function at the knowledge level, what more if you push them to higher levels such as application and analysis; nothing can come out of it.

This teacher went on to say that;

The problem is with the process of selection to Grade nine to Grade ten after the national examination. Schools like ours are left with low performers while the high performer learners are taken to grant-aided schools and technical schools but when it comes to Grade twelve (12) results they compare us using the same standards, we are not miracle workers you know.

However, different views were expressed by subject specialists who contended that;

There is a paradigm shift in the way teaching is done nowadays but teachers are still lagging behind in their teaching approaches. For instance, the rationale for each lesson should be explained in order for learners to know why they are learning a certain topic in a particular lesson session. But our teachers still adhere to the old lecture method even in science-based subjects. What do you expect?

In his explanation of how teachers fail to teach well, the specialist gave an example relating to the electromagnetic spectrum and how it works in radios and televisions which learners are familiar with other than just introducing the electromagnetic spectrum as it may seem theoretical to the learners. He further commented that;

Teachers lack the art of teaching these days. All they do is follow what has been prescribed by the book without contextualising the content into what learners can identify themselves with.
The specialist’s response further exposed the blame game that was going on between the specialists and the teachers of physics and learners seem to have no advocate in this matter as the findings have revealed a self-defense pattern emerging from the teachers as well as the specialists.

The blame game
The participants in this study namely; learners, teachers, and subject specialists were holding different views on the same matter with the teachers of physics taking the larger share of the blame. Learners rated their teachers’ pedagogical skills as being poor. This finding was significant since learners are the direct beneficiaries of the teaching process. Therefore, their views about the teachers’ pedagogical skills and the curriculum design were genuine. On the other hand, the teachers’ blame on the learners’ attitude and ability to learn physics could be as a result of the teacher’s inability to teach well. Referring to teachers as significant factors in curriculum implementation Mulenga and Lubasi (2019:64) explained that ‘the problems that may arise during implementation can cause disparities in the intended curriculum, implemented curriculum and achieved curriculum’. In this case, the achieved curriculum is under threat of not being effectively achieved since teachers seem to have challenges with their pedagogical skills.

Conclusion
Scholars in this study concluded that learners in the selected secondary schools in Lusaka district faced difficulties in comprehending physics because the syllabus had too many topics in which learners had to master different skills such as note-taking, calculations, experiments as well as graphing techniques in one subject and this may be too much for the learners and thus made comprehension of the subject difficult. It was also concluded that the failure by the teacher of physics to explain scientific terms, relate physics content to everyday life and to simplify terms was a major contributor to the learners’ failure to comprehend physics leading to learners’ poor performance. The blame game between the curriculum developers and the curriculum implementers, teachers, which left the learners stranded needed to be corrected by ensuring that teachers take part in curriculum development and were provided with teaching and learning resources.

Recommendations
The Ministry of General Education in Zambia should pay particular attention to the teaching and learning of physics in secondary schools in order to realise the obvious importance of the knowledge of physics in today’s technological world. Secondary schools should be regarded as nurseries where scientific ideas and innovations should be tried out and the desire for discovery inculcated in the learners. Schools should grow young scientists since secondary school learners are in their prime age where experimentation is done without fear. The researchers are particularly recommending that;
The rationale for teaching and learning a topic should be clear to the learners. It is incumbent upon the teachers of physics to bring the learners to a point where they appreciate why they are learning a certain topic right at the beginning of the lesson. There should be a better reason why they are learning the topic beyond the experiment performed in the laboratory and the passing of an examination.

The experiments done during lessons should be related to everyday life activities. In order for the learners to gain valuable skills, attitudes, and worthwhile knowledge, they need to know that what they learn in class can be used in society.

Learners should be left to do experiments and not just watching the teacher demonstrate. Learning by doing is more effective and, therefore, teachers of physics should be preparing worksheets with instructions so that learners discover more information on their own rather than following procedures performed by the teacher.

References


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