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The provision of quality science education in primary teacher training colleges: A case of selected colleges in Kitwe district

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Abstract
This study explored factors that affected the provision of quality science education in selected colleges of education in Kitwe. The objectives were to assess the preparations lecturers undertake before teaching science education lessons, examine the instructional strategies used in the teaching of science education and establish factors hindering the provision of quality science education in primary teacher training colleges. The sample consisted of 4 lecturers and 50 students from selected primary teacher training colleges, a total of 54 respondents. In order to address the issue, the study used a descriptive survey design. Data was collected using questionnaires, documents review check list and classroom observations. All stages of data collection generated qualitative data which was thematically analysed. The study found that most lecturers lacked adequate preparations before teaching; their lessons had no objectives and therefore had no direction. Additionally, there was lack of supervision on lecturers' work. Lack of professional meetings also exacerbated the situation. Furthermore, the lecturers used teaching strategies that alienated students from lessons, predominantly lecture method which fail short of promoting active and reflective learning. Amidst all these, lecturers were also found to have bad attitude towards students. Lack of resources led to poor science education lessons delivery. The calibre of enrolled students was also low. These problems made teachers receive low quality science education. Based on these findings, the study recommended that preparations of science lessons by lecturers should be supervised and their lessons observed regularly. There should be specialization in the way science education is taught at colleges. In addition to O-level results, there should also be aptitude tests as a pre-requisite entry requirement for enrolment into the programme. Lastly, lecturers should develop positive and conducive learning environments that are friendly and promote learner participation.

Keywords: factors, quality science education

Introduction

The Zambian Government recognizes the role of education in the development process. Investing in education and training enhances skills, knowledge, attitudes and motivation for national development. Critical to the development of education is the role played by teachers and their training (UNESCO, 2003). The government is the main provider of education and training, and the church has been complementing it in this endeavour since colonial times. Nevertheless, following liberalization of educational provision, other players like private organizations, individuals, local communities and religious bodies have also come on board (MOE, 1996) [12].

The quality of education in Zambian schools reflects the quality of the teachers operating in these schools, while the quality of the teachers reflects the quality of training they received from institutions that trained them. The focus of concern in an effective teacher training college is on transforming its students into competent and committed teachers (MOE, 1992). In view of this, the Government of the Republic of Zambia through its education policy document "*Educating Our Future*" has outlined some measures to ensure that quality education at all levels is attained (MOE, 1996) [12].

The Government has also been supporting colleges financially through the National budgets. In addition the government has fogged partnerships with some co-operating partners and non-governmental organizations in providing resources to improve the quality of education. A good example is that of the Flemish Association for Development and Technical Co-operation also known as VVOB. This has been supporting teacher training through Continuing Professional Development (CPDs), improvement of learning and teaching skills (VVOB, 2008). The other co-operating partner assisting in provision of quality education is the Japanese International Co-operation Agency (JICA); it has been helping in capacity building through the National Science Centre by publishing a journal for exchange of ideas and provision of educational materials (ZJTPG, 2014). Despite all the efforts made by the government and co-operating partners to improve the quality of education generally and in particular in colleges of education, much has not been achieved. According to VVOB (2008), the training for future teachers in colleges of education lacks quality. The report on MDGs progress attests to this. In its findings it was noted that low quality education marked by low achievement levels have continued to affect the education system in Zambia (MDGs, 2013). An indicator of low quality education in colleges of education can be seen in the failure of teachers to teach properly in classrooms which is reflected in the examination results. This is shown in the findings of the research conducted by the Examinations Council of Zambia (ECZ) as shown in the Junior Secondary school syllabus (MOGE, 2015) [11]. The report states that "Over the years, it has been noted with sadness that there has been persistent poor performance of

learners in schools, particularly in the areas of English, Mathematics and Science, as revealed by National Assessment (NAS) and Southern African Consortium for Measuring Education Quality (SACMEQ) surveys. Furthermore, the results of the survey revealed serious training gaps in teachers in terms of content and pedagogy where teachers performed almost as good as their learners in English, Mathematics and Science. A very weak linkage between the college curriculum and the school curriculum has also been observed, which resulted in student teachers graduating with little or no understanding of the school curriculum at all. This had a negative impact on the quality of teachers produced from our colleges.

The training programme offers various courses. Upon graduating, the teachers are expected to teach all the subjects. Good quality teacher training entails understanding the different courses in terms of both content and methodology. One of the subjects offered at a primary school, is integrated science. To teach this subject, student teachers' at colleges of education are prepared through a course called Science Education. For attainment of quality education at primary schools, among other courses students doing Science Education have to be equipped with the necessary competences from their colleges. The provision of Science education from these colleges is of low quality. This is evidenced from students' lack of pedagogical skills and knowledge of the content matter during their teaching practice. Equally, the serving teachers fail to show the pre-requisite skills, knowledge and values for a teacher handling integrated science. The effect of all this is poor performance in learners as noted in NAS surveys. These deficiencies arise because of the way teachers are trained from their colleges. Some factors within teacher training are working against quality provision of Science education. These factors, however, are not known; hence, the need to undertake the study. Once factors are established, it would be easy to come up with measures of how to raise the provision of quality science education to acceptable standards.

Literature Review

A lecture outline is especially useful in organising a lecture and providing an overview of the general structure, subordinate points and transitions (Barbara, 1993). Additionally, a lecturer is also expected to keep a list of major points, which will highlight the lecture's key ideas or issues to be covered. Organising a good lecture also involves incorporating it with tools for delivery. These tools may include; overheads, lecture notes, demonstrations, computer simulations/images and slides (Wooster, 1992). A good lecture will also be accompanied by a teaching strategy which is learner-centred e.g. discussions, role-play, experiments etc.

A study on lecturers' preparations before teaching by Erica De Bruin (2013) brought out some salient points. In her study at Yale university, she noted that the first consideration in lecture preparation were lesson objectives, these helped in gathering supportive materials. The other thing involved was content to be covered; lecturers were covering sufficient content and a lot of ideas were brought out. Doing so helped to reiterate main points, provide examples, and comment on the content to students' own experiences – all of which aided students' retention. In order to scale down on time a lecture takes, lecturers were assigning readings that provided students with basic facts and background information about the topic. This left the lecturer with time to focus on problems, puzzles, debates that made the subject interesting. Good preparation also involved students doing some work. Lecturers planned mini discussion sessions, group work or other activities that allowed students to engage with material actively. Preparation for teaching by lecturers also involved consulting colleagues on the materials that were to be considered before teaching took place.

On effective teaching strategies, the trend globally in our modern times for science education is that it should focus on critical thinking and independent learning (De Hann, 2005). To achieve good teaching, the best approaches for teaching methods in education are required. Lesson planning is important before leading lectures in class. The selection of teaching methods is important on the basis of students' knowledge with some learning process in the presented academic syllabus or curriculum (Carpenter, 2006). In addition, teaching methods and facilities need to be adopted by teachers to increase the learning abilities and achievement in effective ways, such as presenting interactive lectures, facilitating group discussions during class to allow students to express opinions, and student presentation of seminars and workshop to expand their capacities (Henson and Eller, 2012). An effective teaching method needs to include students in learning activities and promote their interest, in science, and develop scientific process skills and development. Therefore, students need to develop skills with traditional lectures and laboratory work. Innovative methods need to be presented to students from time to time to give them a chance to integrate their knowledge to their existing ideas. Also, it is critical to develop and renew the teaching and method of science to get student satisfaction about their learning process (Alshehry, 2009). Educators need to select from different techniques of teaching methods and strategies in the colleges and classrooms (Melita & Peklej, 2007). Although, there is no best way to teach science, experience shows that some general principles apply (American Association for the Advancement of Science, 1990, McDermott *et al*, 1994; Mazur, 1996). These principles entail that an educator must (i) teach scientific ways of thinking, (ii) actively involve students in their own learning, (iii) Help students to develop a conceptual framework as well as problem solving skills, (iv) promote student discussions and group activities, (v) help students experience science in varied, interesting and enjoyable ways and (iv) assess student understanding at frequent intervals. John Dewey supported many of these principles when he wrote that education is not an experience of telling and being told but an active and constructive process (1916).

When it came to factors hindering provision of quality science education, a study done in Nigeria attributed this to (a) Lack of visionary college administrators, (b) Lack of committed lecturers, (c) Poor professional development, (d) bad admission policy and Lack of science teaching equipment (Aina, 2014) [2].

The studies covered in literature on how lecturers' prepared their work before teaching were mainly done in developed countries, no studies done in colleges of education in Zambia and Kitwe in particular. On teaching strategies used, the literature showed that effective strategies were those that were interactive and involved students. Not much is

explored on teaching strategies used in science education in colleges. On factors affecting provision of quality education other than lecturer preparations and teaching strategies, the literature showed that globally various reasons were forwarded and studies were quantitative and were mainly done in secondary schools. However, for colleges of education no such information existed.

Purpose of the study

The purpose of the study was to investigate factors affecting the provision of quality science education in primary teacher training colleges.

Research Objectives

The objectives of the study were to:

1. Assess the preparations lecturers undertake before teaching science education lessons.
2. Examine the teaching strategies used in the teaching of science education in the selected colleges.
3. Establish factors affecting the provision of quality science education in primary teacher training colleges.

Research questions

The research was guided by the following research questions:

I. What preparations do lecturers undertake before teaching science education?
II. Which strategies do lecturers use in the teaching of science education?
III. What factors affect the provision of quality science education in primary teacher training colleges?

Methodology

A descriptive survey design was used in conducting this research. The descriptive survey design is ideal for gathering original data for purposes of describing certain perceptions, opinions, attitudes, habits, relationships and orientations that are held by a population too large to observe directly (Tichapondwa, 2013). This type of design is not only restricted to fact-findings, but also may often result in the formulation of important principles of knowledge and solution to significant problems (Kombo and Tromp, 2013). The descriptive survey research design enables the researcher to obtain in-depth information (Maree, 2007). This is the reason why this study was undertaken through such a design.

The sample size for the whole study was 54. The sample consisted of 4 lecturers and 50 students from the two selected primary teacher training colleges in Kitwe. The non-probability sampling procedure was employed in this study. The method of sampling used under non-probability design was *purposive sampling*. The research made use of the following research instruments: Questionnaires for students and lecturers, observation schedule and the Documents Review Check list from the selected colleges.

Data analysis

The analysis of data for this study revolved around the idea of themes. The themes reflected the objectives of the research and echoed main areas arising from the review of literature. Firstly, the data was collected; this was followed by describing it and finally followed by interpretation of the descriptions. Wolcott (1994) refers to this process as the process of *description*, *analysis* and *interpretation*. For a richer dimension, the respondent data was cross-referenced by linking different themes thereby adding cumulative meaning.

Results and Discussion

This study investigated factors affecting the provision of quality science education in primary teacher training colleges. In order to carry out the study, the following sub questions were used as guides and will be used in this discussion as sub-themes: lecturer preparations; teaching strategies used in teaching science education and factors affecting provision of quality science education.

Lecturer Preparations

The first question looked at what preparations lecturers undertook before teaching. The responses were as shown in the table below.

Table 1: Lecturer preparations

Particulars	Yes	No
Evidence of an approved Science Syllabus	4	0
Well documented Schemes / lecture Plans	3	1
Evidence of records of work covered	3	1
Evidence of Professional Meetings	0	4
Records of monitored Instruments	0	4
Use of teaching/learning Aids (audio-visual)	2	2
Records of assessments /tests marks/marking schemes	3	1
Use of a variety of pedagogical skills	0	4
Evidence of practical work	2	2
Evidence of lecture notes, worksheets, laboratory manuals and study guides	4	0

From the findings presented in the study, it was clear that the teachers were not adequately prepared in some aspects of lesson preparations as shown in the documents checklist. In some areas they were prepared for example all the lecturers (100%) had the necessary working documents i.e. the schemes of work and the science syllabus. The documents were helpful in making of lecture plans. The lecture plans helped in knowing (i) what to teach, and (ii) how to teach. Despite having the syllabus and the schemes of work, the findings revealed that one (1) out of four (4) lecturers were not preparing lecture plans. They were just going to lectures without knowing how the lecture would proceed. Such lessons lacked objectives and the lecturer did not know what type of knowledge, skills and values his students should acquire at the end of the lesson. The teacher needs to have a clear purpose of the learning objectives which are essential for effective teaching (Muzumara, 2011) [10]. The unprepared lesson is characterised by the following features; (i) *incomplete subject matter* – unless one has a subject at his finger-tips, it is difficult to recall all facts, (ii) *incorrect facts* – unless the teacher is prepared he is likely to make incorrect decisions with the consequence loss of face when students learn the truth, (iii) *lack of detail and illustrative material* – the unprepared teacher presents lessons which lack detail and illustrations and certainly teaches without teaching aids and lastly the unprepared lesson has (iv) *disorderly presentation of information* – in an unprepared lesson there is lack of logical or interesting sequence (Farrant, 1980) [7]. By having a lesson plan, a teacher is able to manage his time, effort and resources efficiently.

The other aspect which was noted in the documents

checklist was that some lecturers were not keeping records of what they were teaching or assessments they were giving. The results show that again one(1) out of four(4) lecturers were not keeping records of what they had covered whereas three(3) kept the records. Some lecturers were also not recording the assessments of the work they gave to students. The keeping of records reassesses the student/lecture relationship. The records help in informing the teaching and learning process by guiding the lecture on content coverage and duration involved. The records also help in planning for daily lectures and the accompanying tutorials.

The study also showed that lecturers were not having Continuing Professional Development (CPD) meetings. CPD is a form of an in-service training which can be organised for a short period and often within the location of school (Konstatinos, 2015). The benefit of CPD for teachers is in the enhancement of one's teaching practice through keeping abreast of knowledge and developments in one's practice.

Teaching strategies

On teaching strategies used an observation schedule and questionnaire for students were used. The results from an observation schedule are shown in the table below.

Table 2: Responses from observation schedule on teaching strategies

Factors	Excellent	Apparent	Not displayed
Varieties of teaching strategies which are inquiry-based were used	1(25%)	3(75%)	0
Teaching strategies used involved learners.	2(50%)	2(50%)	0
Lesson had activities, which directly addressed stated learning objectives.	0	2(50%)	2(50%)
Lecturer continually assessed the depth of student understanding of objectives during the lecture.	1(25%)	3(75%)	0
Strategies used drew upon ideas and experiences of students.	1(25%)	2(50%)	1(25%)
Lecturer employed instructional aids and technology i.e. computer, video and overheads in the lesson.	0	1(25%)	3(75)
The lecturer provided time for collaborative science discourse	0	1(25%)	3(75%)
Higher order questions which engage students intellectually with ideas were posed.	1(25%)	1(25%)	2(50%)
Teaching strategy used allowed students to continually refine their understanding through revision	1 (2^{50}6)	3(75%)	0
Students were provided with an opportunity to question, reflect and challenge ideas	0	1(25%)	3(75%)
A summary of the main points of the lesson in written,or oral form at the end	0	2(50%)	2(50%)

From the findings presented in the study, it was clear that most lecturers three (3) out of four (4) did not use a variety of teaching strategies which were inquiry-based whereas only one (1) used a variety of teaching methods which were inquiry-based. This was not good as students have different learning styles. Inquiry-based approach, well executed, leads to understanding and makes provision for regular reflection on what has been learned, so that new ideas are seen to be developed from earlier ones. It also involves students working in a way similar to that of scientists, developing their understanding by collecting and using evidence to test ways of explaining the phenomena they are studying. There is growing evidence that this has a positive influence on attitudes to science. This assertion is supported by Abdulahi (2007) [1] whose study revealed that inquiry-based learning can lead to greater depth in understanding. This belief is supported by Harrison (2014) and Salter and Atkins (2013) who state that inquiry methods of learning should be included in all science courses because inquiry skills are essential to prepare students to think critically in solving problems and to motivate them in learning science.

The second research question looked at what strategies did lecturers use in teaching science education. The responses from students were as shown below.

Table 3

Teaching Strategy	Frequency	Percentage (%)
(a) Lecture	36	72
(b) Lecture + other Methods	14	28
Totals	50	100

According to the data the lecturers predominantly used the lecture method. Those who used exclusively the lecture method were 36 which translated into 72%. But some lecturers also incorporated other methods into the lecture method, these constituted 28%. The methods used in combination with the lecture method included; discussion, projects, question and answer, and demonstration. The majority of the lecturers solely owned the process of teaching and learning as noted in the study, dictating every pace and direction of the lesson. Student ownership and independence were limited. Students spent the bulk of these lessons receiving information and listening to lecturers. The lecturers carried the heavy load of thinking and working. According to Marzano (2014), such classrooms place a high value on compliance and less emphasis on building cognitive skills. Within classrooms, there should be ample evidence of students wrestling with new content as they build the stamina to reach higher levels of thinking. Therefore teaching strategies that do not involve learners stifle their cognitive growth and they do not gain much from instruction. This negatively affects the quality of science education.

The other issue looked at was use of teaching aids. Student responses were as shown below.

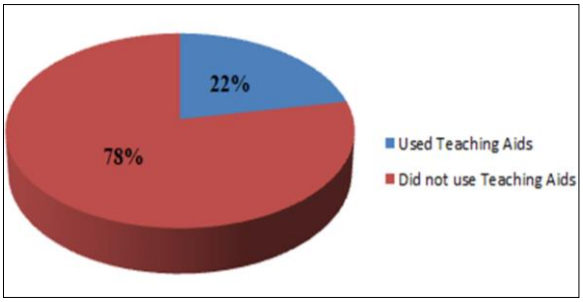

Fig 1

As reflected in the pie chart above, 78% of the lecturers did not use teaching aids. Their lectures were purely explanatory. This was further attested by what some students who said;

> *"No teaching aids. If she wants to teach a lesson which involves teaching aids, she has to ask us to bring aids for our selves so that she can use them when teaching. But we also do not bring."*

Another participant agreed with the above respondent on the issue of teaching aids and had this to say;

> "*She uses nothing when teaching, she only comes with a piece of paper where she writes some points when she is teaching*."

Ngozi, B.O. Samuel, A.O. and Isaac, O.A. (2012), stressed the importance of audio-visual materials by unanimously agreeing that audio-visual materials are very important and useful in education because, the normal learner in so far as the functions of his preceptor mechanisms are concerned, gains understanding in terms of multiple impression recorded through the eye, ear, touch and other senses. This is to say that audio-visual materials are the equipment through which that function can occur, that is does not occur in isolation, rather through a balance pattern from any preceptor mechanism that are stimulated by external occurrences.

Even though the majority of lecturers were not using teaching aids, 22% of them were utilising them in their teaching. The teaching aids that were mostly used included; charts, videos, real objects and models.

The third research question looked at hindering provision of quality science education in teacher training colleges. The typical responses from lecturers' questionnaires read as follows:

> "The *classes were too big to give proper attention to students. The numbers of students ranged between 50 and 90. This had even made some rooms which were meant to be laboratories to be used as permanent classroom for some classes. As a result of this some science lessons are taught from ordinary classrooms. A case far from what should be the ideal. The other problem hindering the provision of quality science education was lack of teaching/learning resources. There was a critical shortage of materials such as reference books in the department. The problem has further been exacerbated by a poorly stocked college main library with modern science books. Lack of internet facilities and poor internet connectivity has further compounded the situation. The other problem was identified was lack of motivation. Despite handling large numbers and extra work being done, the remuneration was poor and this dampened the morale of the lecturers."*

Some respondents also emphasised that the number of students per class was also affecting the delivery of quality science education as it was too big to handle. One lecturer said:

> "*The classes were too big to give proper attention to students. The numbers of students ranged between 50 and 90. This had even made some rooms which were meant to be laboratories to be used as permanent classroom for some classes."*

The study revealed that the classes for science education were too large and lecturers were finding it hard to give individualised attention to the students. The lecturers added that it was difficult to process assessment items such as assignments and tests in such an environment. Furthermore, the use of certain teaching methodologies was hampered. This is in conformity with the study done in Ghana by Effah (2003) [4] where on his part he noted that large class size in recent times has become a necessary evil for public universities in the country. He went on to say that the seriousness of the problem is directly linked to the quality of teaching and assessment of students, and finally, the quality of graduates turned out onto the job market. This is supported by the studies undertaken by the researchers like Yaman and Uygulamada (2009) [14] who found that large classes can force teachers to abandon student centred learning and focus more on teacher centred lessons so this teaching strategy then becomes the culture of teaching.

Students were candid on factors hindering provision of quality science education as captured by the following comments:

> *"Short of materials to use during science lessons. Experiments are not usually conducted in the laboratory due to one science laboratory. There is also absenteeism of lecturers*"

In agreement with the above respondent, another student had this to say:

> *"There are no experiments done except during exams. There is also lack of learning and teaching materials. Some lecturers skip lessons and too much story telling. The schemes of work is not given to students on time and sometimes not given at all."*

From the students' point of view, the study revealed that their lessons lacked practical and field work. Learning is best done when there is an aspect of doing. This is supported by Dewey, a proponent of hands-on learning when he elaborated in Enoh's (1995) [5] book, Dewey states that "there is no such thing as genuine knowledge and fruitful understanding except as the offspring of doing". By implication, this means that learning by doing is important for developing a strong knowledge base among learners. In contradiction with Dewey's view, however, practical science at the Colleges of Education were the study was undertaken was devalued, and most of the lessons are done only by theory.

The study also revealed that lecturer attitude had a negative effect on quality of science education offered as noted in their absenteeism. The study done by Etsy (2005) [6] in Ghana found that the teacher factors that significantly contributed to low academic achievement were incidences of lateness to school, incidences of absenteeism, and inability to complete the syllabi.

The other finding the study brought out is that most lecturers' had bad attitude towards work and students. This also contributed to poor quality science education. This is evidenced by the following comment from one of the students:

> "*Her attitude towards our class is bad. She likes threatening when it comes to marking assignments and tests. She has got pride, she doesn't consider students opinions, and she doesn't even encourage us."*

Cambron-McCabe (2000) and Friere (2001) added an ethical and moral competency for teaching. These described teacher qualities that influence student learning as justice, fairness, liberty, honesty, equity, and respect. Within Friere's work, teachers who positively impact student achievement enveloped respect, tolerance, joy, and hope. Quality becomes grounded in beliefs, values, attitudes, and behaviours defined by moral and ethical standards of the teacher. This is contrary to what the study found where some lecturers were using abusive language and did not want to be criticised. Furthermore, the lecturers did not want to hear any opinions from the students.

Conclusion

The preparations done by most lecturers were inadequate; they did not plan for their lectures in advance. The teaching strategies used by lecturers were mostly teacher centred, did not promote active learning and critical thinking. This is an indication of lack of pedagogical and content knowledge. The teaching and learning resources were inadequate; lack of books, equipment and laboratory space also had a negative effect on quality of science education. The situation was further compounded by lecturers' bad attitude towards work and students.

Recommendations

The Heads of Sections for Science Education in colleges should constantly monitor preparation of lessons by lecturers and also observe their teaching. There should be specialisation in the way science education is taught at colleges. Schemes should be made according to subjects; for example for biology topics, only lecturers with biology major will teach and so on. The lack of competency in content knowledge and pedagogy in some lecturers, could be averted by capacity building and holding CPDs in the department. Lecturers should encourage learners to participate actively, enthusiastically, critically, and passionately in learning science education and doing the very best for their students to attain vital knowledge and skills.

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