



Towards Learner Centred Science Lessons in Zambia: An Experience of Problem Solving Approach in Biology Lessons

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Abstract

Implementation of learner centred approaches can be a challenge for the classroom teachers in Zambia, if the curriculum places more emphasis on knowledge acquisition from textbooks and teachers use traditional knowledge-transmitting approaches. The Ministry of Education, Science, Vocational Training and Early Education (MESVTEE) has realised that, for meaningful learning, pupils should be responsible for their own learning. Therefore, several initiatives for in-service teachers have been strengthened by the government in order to introduce learner centred methods and approaches in teaching science. However, despite these interventions, students' performance in science at national and international examinations is still at unsatisfactory level. This continued poor performance prompted an action research to be conducted to seek core issues experienced by Zambian teachers which hinder effective conduct of learner centred lessons in science. This is an action research record on how Zambian science teachers are struggling to introduce problem-solving method of teaching science as one of their trials to make lessons more learner-centred. In the research, one science teacher at a secondary school was selected as a sample and requested to plan a biology lesson using problem solving method with a guidance of researchers. The planned lesson was firstly conducted at school with researchers as observers. After revising, the second lesson was conducted as an open class with additional observers in the venue of the workshop. Researchers analyzed two lesson plans and lesson process to see how the lesson was improved and how the teacher's perspective was changed. Several improvements were found in setting objectives, rationale and pivotal questions in the lesson; however, revelations were that problem solving way of teaching appeared problematic to the teacher which in turn affects the learning.

1. Introduction

Zambia through the Ministry of Education, Science, Vocational Training and Early Education has institutionalised In-service training of science teachers at secondary level since 1996. The Zambian Sixth National Development Plan 2011-2015 further developed a policy which advocates for school and college based Continuing Professional Development (CPD) of teachers at all levels to improve their knowledge and skills in science and other subjects [1]. The objective of science and mathematics learning according to the Zambian curriculum for basic education is to produce a learner that has an analytical, innovative, creative and constructive thought. This is realised through learner centred way of teaching based on a variety of approaches including problem solving and inquiry methods. Thus, there has been a trend of in-service training of science teachers to focus on the use of problem solving method in science and mathematics lesson. Almost two decades have passed since these initiatives were introduced; however, national and international examinations show unsatisfactory level of performance of Zambian students in science subjects across all levels.



In this context, an action research was conducted to seek core issues and challenges experienced by the Zambian teachers and education system which hinder effective conduct of learner centred teaching method in science.

2. Discussions on problem solving lesson

Problem solving method of teaching is one of the approaches which Zambian science teachers have been trying to learn and introduce to make their lessons more learner centred. The method includes integration of concepts and skills to get over the unusual complete situations [2]. The stages in the process of problem solving lesson include; presenting problem (task) for the day, understanding the problem by students, problem solving by students, comparing and discussing among students and summing up both by teacher and students. The problem solving approach, therefore, is aimed at;

1. Fostering students critical thinking and robust understanding that how to approach a problem is more important than getting the correct answer
2. Enabling the teacher to observe the students thinking process during the lesson.
3. Making students explore problem situations and discover things for themselves
4. Providing an opportunity for students to develop the ability to reason logically

3. Objective of research

The objective of this action research is to seek core issues experienced by Zambian science teachers which hinder effective conduct of learner centred lessons through analyzing a process of how a teacher practices on the introduction of problem-solving way of teaching into classroom teaching.

4. Method

A lesson study framework was used for this study. One science teacher at a secondary school was selected as a sample and requested to plan a biology lesson using problem solving method with a guidance of researchers. The planned lessons were first conducted at school with researchers as observers. After revising, the second lesson was conducted as an open class with additional observers in the venue of the workshop. Through this process, researchers analysed how the lesson was improved and how the teacher's perspective was changed.

The method of data collection and analysis used in this research is a modification to that which was used by Scott et al. in Fensham et al [3]. This included an observer being involved in the planning through to implementation, evaluation of the lesson. However, some of the modification included not being with the teacher when planning the lesson as well as not following specific students in the classes. The same teacher was followed by the researchers in a year. Two lessons observed at intervals (Lesson 1 and Lesson 2) are picked for this paper, one in Grade 11 and one year later one open lesson in Grade 12. The videos which recorded lessons, written reports, memos during the discussions and lesson protocols including lesson plans were used for the analysis.

5. Results and discussion on lesson process

The sample teacher who has been teaching for 23 years was considered experienced. Prior to preparing the 1st Lesson, the teacher was asked how long it would take to plan a problem solving lesson. The answer was 30 minutes. However, when the process started, teacher's facial expression changed to showing struggle and said, "I wasted a lot of stationary as I kept changing my lesson plan". Table 1 shows basic characteristics of two lessons analyzed in this research.



	Lesson 1	Lesson 2
Date conducted	20 th May 2012	19 th June 2013
Grade	11	12
Subject	Biology	Biology
Topic / Sub topic	Homeostasis / Osmoregulation, Thermoregulation, Sugar regulation by mammals	Genetics / Monohybrid inheritance
Duration of lesson	120 minutes	80 minutes

Table 1: Basic information on two lessons analyzed in the research

5.1 Lesson objectives

Objectives in both lessons are shown in Table 2. The objectives in Lesson 1 are written in view to mastery learning based on their traditional way of teaching as knowledge transmission. However, in Lesson 2, objective is at higher order, as it seeks for application of learnt knowledge.

Lesson 1	<ol style="list-style-type: none"> 1) Describe regulation of water by body, its necessity for health as well as the role of the kidney in this process 2) Describe regulation of temperature and role of skin in this process 3) Describe role of liver in regulation of blood sugar
Lesson 2	Apply the use of the terms homozygous, heterozygous, recessive, dominant, F1 (Filial 1) generation, offspring ratio, phenotype, genotype.

Table 2: Comparison of objective in lesson plans

5.2 Rationale

Table 3 shows rationales in the two lessons. Rationale in Lesson 1 is written in a positivist view which gets hindered, when one uses the constructivist view where problem solving skill belongs. Rationale in Lesson 2 shows more clarity than Lesson 1 and the teacher's view is changing and now thinking in line with the learners.

Lesson 1	To be taught are osmoregulation, thermoregulation and sugar (glucose) regulation, the main concept being used is negative feedback mechanisms which are the principal of homeostatic controls. The methodology will have emphasis on problem solving approach but will also include mastery-learning.
Lesson 2	"To be or not to be" is truly the question that inheritance poses in all living organisms. It is a predictable puzzle of applied statistics of real situations and a very good topic to which the problem solving methodology can be applied. During the lesson the concepts of simple Mendelian Crossing will be introduced to the learners in everyday language as will the terms recessive, dominant, genotype, F1 generation, F2 generation. This will remove the stigma that is often attached to the topic of genetics building a solid the foundation for the following subtopics within Genetics. The discussion questions will give them a collaborative experience that will relate to everyday issues.

Table 3: Comparison of rationales in lesson plans



5.3 Pivotal question

The planning in both lessons showed the presence of pivotal questions which are considered as key to problem solving lesson. However, in both cases the pivotal questions shown in Table 4 are more than three which are considered to be difficult for pupils to deal with in one lesson period. This indicates a struggle that the teacher faces in shifting from mastery learning to problem solving approach one year later. The level of pivotal questions in Lesson 2 appears to be well-constructed than those in Lesson 1 as a sign that the teacher was changing in the mind the way of developing a lesson. However, in both cases, nature of pivotal questions needs to be further improved. In the second lesson, it would have been better, if the three pivotal questions were summed to one overarching question. That would have given learners more time to think and struggle with the process of learning.

Lesson 1	1) What would you do if you discovered the two kg packet of sugar you bought from Zambia Sugar? (A) Weighed 2.4 Kg (B) Weighed 1.8 Kg What advice would you give Zambia sugar and why? 2) Yesterday morning a loving caring wife gave her hard working husband cold water to bath before going for work to plant cane in the Nakambala fields. Her mother in law was furious when she discovered. When he arrived home very hot and tired; she prepared him hot water for him to take his evening bath. Did the wife do a correct thing? Give reasons for your answer. 3) What are the reason(s) Ms Munachonga did not give you a lot of water and drinks before going to the field. Why did you urinate more yesterday than you would have if our “Sweet Science, Sweet Nakambala” in October. 4) Explain the different kinds of irrigation that you saw at Nakambala sugar estate. In your opinion which one is most advantageous and why.
Lesson 2	1) Why is it that some children resemble their mothers, while others their fathers and yet others resemble neither but rather resemble their grandparents or great grandparents? No wonder to be or not to be is the question! 2) Supposing your parents are both very tall but out of four children you are the only short child, the rest of your siblings (brothers and sisters) are very tall so they usually tease you. Apart from being short just like the rest, you strongly resemble your father. Discuss why this may be so. 3) A dark skinned man marries an equally dark skinned woman .When the woman gets pregnant both parents “to be” though excited that a baby is on the way both seem to be very worried as each of them have a secret. When the baby to the surprise of the people their son is an albino.

Table 4: Comparison of pivotal questions in lesson plans

5.4 Time allocation

Time allocation in Lesson 1 indicated that during lesson development which was allocated 115 minutes, 60 minutes (54.5%) was taken up by the teacher. The learners were given an option to ask questions where they were not clear or needed clarification as the teacher took the exposition approach which is masterly learning for 60 minutes. However, this situation improved in Lesson 2 in



which out of 75 minutes of lesson development, 25 minutes (33%) were taken up by the teacher. This meant that learners were given more time to struggle with the task.

5.5 Misconception on the science content

The 2nd pivotal question stated by the teacher in Lesson 2 revealed that scientifically un-confirmed fact, like an inheritance of body height of human beings, was believed by a teacher as a truth. It is a misconception if the teacher understands that body height inherits; however, the teachers can never be blamed if the teacher was taught like that at college and science textbook states the same. This indicates that there is a necessity of reviewing contents of teacher education programme as well as production process of teaching materials.

5.6 Cross cutting issues in the lesson process

During an open lesson – Lesson 2, the following cross-cutting comments were made by 160 observers comprising researchers, teacher educators, practitioners, classroom teachers and education policy makers:

1. Questions were thought-provoking and helped to elicit knowledge from students.
2. Real life questions enabled students understand and conceptualized the lesson
3. Students were given the opportunity to solve problems individually and in groups
4. Provision of teaching and learning materials helped the students in solving the questions
5. Collaborative effort/group work, promoted leadership through appointment of group secretaries and leaders

However, it was felt that even though the lesson was planned in a manner that supported learner centeredness, the teacher did not use a variety of methods for problem solving by the pupils. For example, only the tests cross was used when the Pun net square method could have also been used. When teaching, the teacher did not clearly address misconceptions brought by students such as effect of nutrition on height on monohybrid inheritance; however, it was generally agreed by observers that, despite these few challenges, the problem solving lesson observed had potentials of being a learner centred lesson.

6. Conclusion

Through this action research, it was revealed that a trial for science teachers in Zambia to introduce learner centred way of teaching such as introducing problem solving method of teaching appeared problematic to them which in turn affects the learning. Theories and aim of problem solving require a paradigm shift in them from the existing traditional approaches of teaching, where a teacher is a preserve and source of knowledge, to a new perspective where a teacher is a facilitator of the learning process. It is also considered that contents of teacher preparation and training as well as a production process of teaching/learning materials have to be reviewed to avoid misconception of teachers. The research gives us an idea that teachers as learners are responsible for their own professional development and, therefore, continuous learning opportunity such as lesson study gives the teachers to be aware of the core issues experienced and come to terms with them through reflective practice.

References

- [1] Government of the Republic of Zambia (GRZ) (2011), Sixth National Development Plan, Lusaka, Zambia



- [2] Stone, P., Veloso, M., & Blythe, J. (1994), The Need for Different Domain – Independent Heuristics. In Proceedings of the Second International Conference on Artificial Intelligence Planning Systems.
- [3] Fensham, P.J, Gunstone R.F, and White R.T (1994) The content of Science: A constructive approach to its teaching and learning. Routledge, New York