FACTORS HINDERING SCIENCE TEACHERS FROM CONDUCTING PRACTICAL WORK IN SEKHUKHUNE DISTRICT, LIMPOPO

Romulus Asaph Mogofe & Israel Kibirige
University of Limpopo, South Africa
Email: Israel.Kibirige@ul.ac.za

Abstract
Practical work is important in learning science, yet research shows that many teachers in rural schools in South Africa ignore it. In order to understand factors hindering teachers from conducting practical work, a case study was carried out in Sekhukhune district in Limpopo Province. Four schools that offer Physical Sciences or Life Sciences were purposively selected. A total of eight teachers, two from each school were purposively selected because they taught Physical Sciences or Life Sciences in Grade 10-12. Data were collected using open-ended questionnaire, observation and interviews and were analyzed using contents analysis. Results show that most teachers do not understand the purpose of practical work, which may be a possible explanation for learners' poor performance. Also, many teachers misinterpreted the departmental policies, the former National Curriculum Statement (NCS) and the current Curriculum and Assessment Policy Statement (CAPS), where two practical tasks to be recorded in the mark schedule for Continuous Assessment (CASS) were construed to be the only ones to be conducted. The study recommends in-service teachers' workshops and compulsory modules on how to conduct practical work for pre-service teachers in all teacher education institutions. Furthermore, in order to reinforce the use of practical work in science classrooms, there should practical work in the final Matric examinations.
Key words: Purpose, practical work, factors, poor performance, hindering

Introduction

The teaching of science is incomplete without practical activities (work) (Faize and Dahar, 2011). This is why almost all science curricula around the globe encourage science teachers to involve learners in practical activities. For example, European countries like France, Hungary, Ireland, Italy, the Netherland, Portugal, Romania, Spain and the United Kingdom under the umbrella of Science Education for Development of European Citizenship (SEDEC) project encourage teaching of science using practical activities in order for learners to develop science process skills (Dambrăveanu, 2007). In the United Kingdom, more practical work takes place in science classes than in any other country (SCORE, 2008; Dillion, 2008). In Israel, practical work has been reintroduced in form of inquiry-based learning (SCORE, 2008). That is so because observation and experiment help learners to understand science concepts (Dambrăveanu, 2007). According to Dambrăveanu (2007), teachers in France and Romania contend that the little time allocated for Science lessons is a major contributing factor for teachers not to teach using practical work. In developing countries many teachers indicate that lack of resources is a major

contributing factor for not using practical work in science. For example, in Nigeria lack of equipment is attributed to insufficient funds (Asokhia, 2009). Also, it has been reported that: *"teachers have a myth that science teaching should take place in a laboratory as cooking belongs to the kitchen and gardening to the garden"* (Fraser and Onwu, 2006: 70). Thus, teachers view lack of laboratories as a license not to engage learners in practical activities.

Research indicates that teachers in South Africa also do not involve learners in practical activities, irrespective of whether they have laboratory equipment or not (Rogan, 2004, 2007: Muwanga-Zake, 2001). In Mpumalanga province few teachers involve learners in practical work (Rogan, 2004; Hatting, Rogan and Aldous, 2007). In the Eastern Cape Province, teachers had misconceptions about practical work as they continued to demand for more science equipment despite evidence of unused ones packed in school stores (Muwanga-Zake, 2001). This suggests that the lack of science equipment cannot be the only factor that hinders teachers from conducting practical work in order to develop learners' science process skills. Therefore, a research was undertaken to investigate factors hindering teachers from conducting practical work when teaching science.

Statement of the Problem

Practical work is important in learning science, and yet research has shown that many teachers in rural schools in South Africa ignore practical work (Muwanga-Zake, 2001; Rogan, 2004; Stoffels, 2005). The lack of practical work in schools could be one of the reasons why learners do not perform well in matric science examinations. Learners easily lose interest when they are taught using traditional approach and this may lead to students leaving science courses in preference of other subjects. For example, in 2009 the number of learners who registered for Physical Sciences was 220882 and decreased to 180585 in 2011, which is 18.2% drop (Department of Basic Education, 2010, 2011, 2012). To date, there are few studies dedicated to finding out factors hindering science teachers from conducting practical work, hence the need for this study.

Purpose of the study

The purpose of the study was to investigate factors hindering science teachers from conducting practical work in schools from Mpumalanga province.

Significance of the study

Although research indicates that many teachers in South African schools do not conduct practical work, little has been done to find the factors contributing to that in order to solve the problem. This research is aimed at finding factors hindering science teachers from conducting practical work so that steps can be taken to enhance the use of practical work in schools.

Literature Review

Practical work is a learning experience in which learners interact with material or with secondary sources of data to observe and understand the nature of science (SCORE, 2008; Dillion, 2008; Millar, 2010; Stoffels, 2005; Toplis & Michael, 2012). In practical work, learners should be engaged in designing and planning the investigation (experiments), laboratory procedures and techniques; and collecting and analyzing data (SCORE, 2008; Woodley, 2009). Hampden-Thompson & Bennett (2013:1340) affirm that learners benefit a lot when they do practical work through "interactions, hands-on activities, and application in science". In doing so, learners acquire science process skills. Practical work is important for the teaching of science (Dumbrăveanu, 2007). In Turkey, Dikmenli (2009), found that all biology student teachers agreed that practical work (experiment) is important in the teaching and learning of science. Despite this, it was found that most student teachers thought that the purpose of practical work in class was to verify existing scientific theories. Practical work strengthens theoretical knowledge, develops psycho-motor and creative thinking skills, relates scientific knowledge to daily life and develops manual dexterity by using tools as well as equipment (Dikmenli, 2009; Dillion, 2008; SCORE, 2008). Science teachers in France and Romania also underlined that educational methods must make it possible for learners to start from concrete problems in relation to everyday life (Dumbrăveanu, 2007). A study by Bhukuvhani, et al (2012) in Zimbabwe likewise points out practical work as an important and integral component of science teaching and learning. Moreover, recent studies indicate that strategies focusing on learners are successful in narrowing the achievement gap between boys and girls in Physical Sciences in high school (Baker, 2013, Michael, 2013). Therefore, if teachers really want to help learners understand the world they must frequently conduct practical work in science classrooms. Unfortunately, practical work is ignored in many countries, South Africa inclusive. In Mpumalanga, Hatting et al (2007) and Rogan (2004) found that many teachers did not involve learners in practical activities which could be a plausible explanation for the low learner enrolment in sciences.

Research Methodology

This study used a qualitative research method. Qualitative research was chosen because it offers opportunities for the exploration and deeper explanation of participants' views about what causes them to ignore the practical activities (Raborife & Phasha, 2010). The qualitative approach was thought to be most suitable since the study sought participants' views and beliefs concerning the use of practical work in teaching science (Lincoln & Guba, 2000). Using school settings or contexts, data were collected from face to face interactions with the selected persons.

Design of the study

A case study design was used. McMillan and Schumacher (2001, 2006), define a case study design as the one phenomenon the researcher selects to understand in depth, regardless of the number of settings, social scenes or participants in the study. A case study is also defined by Yin (2004) as an empirical enquiry that investigates a contemporary phenomenon within its real life

context, when the boundaries between phenomenon and the context are not clearly evident, and in which multiple sources of evidence are used.

Population

The study population was all Science teachers in the rural Sekhukhune District schools of Limpopo Province, South Africa.

Sample

The study sample consisted of 8 teachers (Labelled A-H) from four schools: one teacher from Physical Sciences and one teacher from Biology or Life Sciences from each school. Teachers were purposively selected based on the subjects they teach namely: Physical Sciences or Biology/Life Sciences.

Credibility and Trustworthiness

In order to ensure content validity, two experts were consulted to check for the suitability of the questionnaires and interview questions designed and necessary adjustments were made. To ensure credibility and trustworthiness, multiple data collection methods were used.

Data Collection

Three methods of collecting data were used, namely: open-ended questions, classroom observations and personal interviews. Observations lasted for two hours per school (8 hours of observation). After the classroom observations, teachers were given an open-ended questionnaire to fill. There were also informal interviews based on the responses on the open-ended questionnaire and classroom observation findings. The interviews lasted for 10 minutes and were audio-taped.

Data analysis

Data was analyzed using content analysis, which is a method that involves comparing, contrasting and categorizing data in order to draw meanings from the data (Gall, Gall & Borg, 2007; Taylor-Powell & Renner, 2003; Thomas, 2003). Open coding was employed in this case and the coding was done sentence by sentence to get main ideas. This was followed by axial coding where ideas were grouped to form themes (Barbie, 2010).

Ethical Issues

Permission was granted by the University research management team, District offices of the Department of Education and the school principals. The main participants in the research were science teachers. The recruitment process involved reading of the research proposal including the research methods and the benefits of the study to them (participants) and their schools. Ethical issues namely: volunteer participation and the right to withdraw without a penalty; and

anonymity and confidentiality were clearly explained to participants. Participating teachers had to sign a consent letter.

Results and Discussions

Findings and discussions are reported according to six themes generated during data analysis. These themes are: qualification, misinterpretation of departmental policies; lack of motivation; lack of team work; laboratory safety; and poor communication.

Theme 1: Qualification

Eight teachers took part in the study, all of them had formal qualifications (Secondary Teacher's Diploma STD), with science as a teaching subject. Their teaching experiences ranged from one year to nine years. It is not clear whether their teaching experiences translate into the way they teach science in the classroom. Nevertheless, their experience in conducting experiments was lacking and as such teachers did not have the desire to conduct experiments. This may mean that the teachers' laboratory experience was a factor for teachers using experiments when teaching science. This finding is in agreement to SCORE (2008, 2010) where experience was a factor for teachers to ignore practical activities in science classrooms. From teachers' responses in the questionnaires, it was clear that years of teaching had no relationship with how to conduct practical work because teachers used similar activities year after year. They seem to fear trying out new teaching methods. For example, one teacher was in possession of a departmental document that outlines how alternative practical work can be done with available resources, but this teacher, did not try any of those experiments.

Six out of eight participants could not define what practical work is and could not explain the purpose of practical work in science classroom. If teachers are unable to define what practical work is, then this may suggest a defect in the training of teachers. This is supported by Muwanga-Zake (2001); Faize and Dahar (2011) who blame poor teacher training colleges. One of them thought practical work is an "extra work" that is given to the learners to "expand theoretical knowledge". Also, extra work is done if an educator has got extra time and that learners can pass their exams without such extra work. Thus, there is a misunderstanding of the importance of the practical work and this deduction is in agreement with SCORE (2008). For example, in explaining the role of practical work in science, Teacher B said "it is there for learners to practice their accumulated theory into practice". Similarly, Teacher F said "it is the application of learnt theory".

Theme 2: Misinterpretation of departmental policies

The other factor emerging from the questionnaire is that all participants are doing practical work only meant for Continuous Assessment (CASS). The policy postulates that in Further Education and Training Band, teachers should conduct a minimum of 15 experiments (practical activities) and record two for CASS (National Curriculum Statement, Physical Sciences, 2003; and

Department of Basic Education of South Africa, 2010). They thought that the policy required them to do only two experiments for the sake CASS records. Judging from four teachers who claimed that they did not ignore practical work because they conducted two experiments and they had evidence in their portfolios as per policy. This misunderstanding on the policy requirements may be attributed to poor implementation of departmental policies and on what teachers think counts for learners to pass exams at the end of the year. For poor interpretation of policies, teachers are confusing formal and informal activities. All the teachers who took part in the study claimed that they ignored practical work because it forms a very insignificant part of the final assessment (examination) and that in Matric there is no final practical paper for examination. They felt that all 15 experiments would be a waste of time. Instead that time would be used to coach learners on what was likely to appear in the matric examination theory papers.

Participants talked about designing their own worksheets but there was no single evidence in their files or learners' files. One picked out the experiment to calculate the acceleration due to gravity as the most difficult one because there is no laboratory equipment. This sounded strange because for this practical work, you only need meter rules (which are in abundance in the South African schools) and stop watches. In the case of stop watches, a cell phone or a digital watch could be used. This suggests that teachers had poor contents knowledge and lacked creativity.

Theme 3: Lack of motivation

The main concept behind observations was the Hawthorne effect, which states that when subjects know that they are being observed by an outsider, they are likely to act in a way to impress (Broches, 2008). With this in mind, we expected teachers to do their best in an attempt to impress us as outsiders. We knew they would need time to prepare and therefore we gave them a two weeks' notice prior to my visit. During classroom observations it was clear that seven teachers used chalk-and- talk method during a 1 hour period. Seven teachers and their learners were not motivated to engage in science content in the classroom. Only one out of eight used multiple strategies like demonstration, role play, and panel discussion. In that class there were some creativity and learners were eager to talk. From classroom observations we discovered that teachers' did not take time to write lesson plans. This was evident from their files where only two experiments were filed as evidence of compliance to the policy concerning practical work. This background may in part explain why none of the teachers did practical work during my visit.

During lesson observation, it was evident that all teachers did not prepare written notes before going to class. They carried textbooks or a textbook which they read to the learners and interpreted what those statements meant. In one case, an educator told the learners that he should have told them to bring mirrors for the observation of "reflection" but he forgot. That teacher explained that a ray of light from an object is reflected back on the surface of the mirror. He drew ray diagrams on chalk board for learners to copy. Teachers complained about the learners

not participating in class discussion. In six cases, teachers asked questions that needed "Yes" or "No" answers. In such cases, I wonder how learners would engage in discussions. These suggest that science educators have poor methods of teaching science.

All teachers complained about heavy workloads, which left them with little time for science experiments. The other major factor is how teachers perceive science. There are science teachers who think that science is a difficult subject to teach and for learners to understand and it needs much of their time after school for preparation, which is considered an additional burden to their heavy workloads. So, to reduce stress on their part, practical work is avoided.

Theme 4: Lack of team work

Where teachers are empowered, team work becomes the order of the day (Carl, 2009). From interviews I got the impression that team work was like science fiction or horror stories where one hears about it but never gets the experience. Teacher A was asked to recommend practical assistance to science teachers and he was quick to point out team work, "I think team work is an effective strategy to enable teachers to conduct practical work and in that they can help out one another"; Teacher B concurred with Teacher A in recommending "team teaching". This is also one manifestation of un-empowered teachers (Carl, 2009). Whenever teachers are not empowered, they cannot perform up to their full capability and they cannot try out new things for fear of failure. Maybe that is why most science teachers cannot try alternative experiments with cheap locally available materials where there are no proper laboratory equipment. That is because their self-confidence is proportional to their level of empowerment. According to Carl (2009), the school principal's management style may also hamper the teacher empowerment process.

Teacher C, when asked to comment about the status of her school laboratory had the following to say: "Not sure because I have not checked eeh… on all what is in the laboratory, but I think it is poor". Teacher F was not sure about the status of his school laboratory. Teacher G who has been in this school for more than two years is still not sure what is in the laboratory and wants people from outside to understand her when she says she ignores practical activities because of lack of resources. Teacher F is not sure either. Does he need a departmental official to come and tell him what is in his own laboratory? These findings indeed support what Muwanga-Zake (2001) stated that teachers have misconceptions of their own problems because they keep demanding for science equipment whereas there is evidence of unused science equipment in schools.

Theme 5: Laboratory safety

Safety in the laboratory seems to be among the frontrunners in an attempt for teachers to prove their case. Teacher H when asked to comment on the general status of his school laboratory, as part of his comment, said "…apparatus eeh… no are not secured, as a result, the chemicals can cause explosion". Teacher E when asked to mention reasons why teachers ignore practical work

mentioned “the danger of chemicals”. So, as found by others, the danger of chemicals is among the reasons why teachers may ignore practical activities.

Theme 6: Poor communication

Poor communication of departmental documents and teachers’ lack of knowledge of departmental policies, as it was also raised in the discussion of the questionnaire, was also here reported as lacking. When Teacher D was asked to comment further he said “There should be money allocation from the department of education for maintenance of practical resources, where we may be able to buy resources…”. For sure that allocation is there and “60% of the total allocation must be spent on curriculum (Limpopo Department of Education, 2011, April 26). This was circulated in all districts and circuits of Limpopo, by the time of data collection; it was almost three months since the circular was distributed to schools. It is amazing that for that long teachers lacked the knowledge of the contents of this circular.

Limitations

The major limitation of interpreting qualitative research as a whole is its complexity and subjectivity (Yin, 2004). Qualitative data is very open to being influenced by researcher’s values and by the fact that actions always occur in specific situations within a social and historic context, which deeply influences how they are interpreted by both insiders and the researcher as an outsider and being familiar with the culture being researched may distort interpretation towards one’s biases, whereas being distant may inhibit understanding altogether (Cumming, 1994). The other weakness of a case study is that it allows little basis for generalization (Yin, 2004).

Conclusion and Recommendations

This study shows that the purpose of practical work in teaching science is not clear to many science teachers. This problem can be dealt with in both short and long term programs. The short term solution should include teachers’ training on practical work, and this training should take ample time to ensure that teachers master practical skills. For the long term solution, tertiary institutions that offer science education must ensure that those teachers who are to teach science pass a compulsory science practical work module.

Whenever there are curriculum changes, the introduction of the new/improved curriculum should give ample time to orientate all stakeholders in teaching and learning as well as to the changes.

To address the issue of workload on science teachers, new Further Education and Training (FET) colleges should be used to train laboratory assistants who would assist teachers in schools in setting up and managing science laboratories.

Lastly, the National Department of Basic Education should consider including a practical paper at Matric level. Thus, all schools should have laboratories where science process skills can be practiced and tested. These initiatives may act as a motivation to high school teachers and learners to take practical work more seriously than what it is currently.

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