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Barriers Experienced by Natural Science Teachers in Doing Practical Work in Primary Schools in Gauteng

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ABSTRACT The practical work in science is acknowledged and widely accepted as an important component in the teaching and learning of scientific concepts. However, in South Africa, there are concerns that schools are not conducting enough practical work. The aim of the present paper is to identify the barriers that are experienced by Natural Science teachers in doing practical work. A structured questionnaire was administered to Natural Science teachers in the Gauteng province of South Africa, to identify the barriers that they experienced in doing practical work in Natural Science lessons. Analysis of the data indicated that the main barriers that teachers experienced in doing practical work in Natural Science in primary schools was: a lack of resources and laboratories, time, classroom size and assessment pressures. If the above barriers are overcome, teachers will be able to do practical work effectively, hence improving the performance of learners in Natural Science.

INTRODUCTION

Practical work in science is acknowledged and widely accepted as an important component in the teaching and learning of science concepts (Toplis and Allen 2012; Kibirige et al. 2014), but is also regarded as a complex process (Donnelly et al. 2012: Abrahams 2009). Practical work means any teaching and learning activity which involves learners in observing or manipulating real objects and materials (Millar 2004). Millar (2004) points out that practical work has a central role in science education, it is an important tool for teaching about experimental design, is essential for giving students a 'feel' for the problematic of measurement and an appreciation of the ever-presence of uncertainty hence if there are any impediments to doing practical work, they need to be eradicated in order for learners to be successful in mastering scientific concepts and developing scientific knowledge. Research suggests that students design better investigations when they actually carry them out than when they are asked to write a plan; feedback from experience improves design (APU 1988: 100).

According to Millar (2004), the following are the main points about the role of practical work in science teaching and learning:

The practical works are essential components of science teaching and learning, both for the aim of developing students' scientific knowledge, making students curious (Kim and Tan, 2011), and that of developing students' knowledge about science. In thinking about the role of practical work, it is important to bear in mind the significant differences between the research laboratory and the teaching laboratory or classroom and between research scientists exploring the boundaries of the known and students trying to come to terms with already existing knowledge. In the context of teaching scientific knowledge, practical work is best seen as communication, and not as discovery. Practical work to develop students' scientific knowledge often requires students to make links between two domains of knowledge: that of objects and observables, and that of ideas. Where the aim is to help students learn a concept, relationship, theory or model, the task design needs to 'scaffold students' efforts to make these links. Practical work to develop students' scientific knowledge is likely to be most effective when:

- the learning objectives are clear, and relatively few in number for a given task.
- the task design highlights the main objectives and keeps 'noise' to the minimum
- a strategy is used to stimulate the students' thinking beforehand, so that the practical work task is answering a question the student is already thinking about.

Practical work is of a more open-ended, investigative kind can develop students' tacit knowledge of scientific enquiry. Attempts to include this in the mainstream curriculum, however, are liable to result in practical work that is

disappointingly different from that intended, especially if students' performance of investigative tasks forms part of coursework assessment. Targeted practical tasks can be very useful for developing understandings about data, experimental planning, and data interpretation. Like those aiming to teach scientific knowledge, effectiveness starts from clear and limited objectives.

Researchers like Haslam and Hamilton (2010), Abrahams (2010), Gyllenpalm et al. (2010). agree that practical work in schools can effectively and strongly support exploration, manipulation and development of concepts and can also make the concepts manifest, comprehensible and useful. Evidence of effective practice in the use of practical work comes from a range of studies. White and Gunstone's (1992) study indicates that learners must manipulate ideas as well as materials in the school laboratory. Furthermore, there is a growing body of research (Abrahams 2010; Lunetta et al. 2007; Haslam and Hamilton 2010) that shows the effectiveness of 'hands-on' and 'minds-on' activities in school science inside and outside the laboratory.

Although, researchers agree that practical work in science is important teachers face challenges in doing practical work. Mothlabane's study (Motlhabane 2014) into practical work has revealed that conditions in secondary schools are not satisfactory for doing practical work. Schools that have been provided with equipment do not make much use of it. Some expensive apparatus and equipment, which have never been used, were found deteriorating in storerooms and boxes in many of the schools visited. At schools where the equipment is available, teachers' claim that the school system does not allow enough time to do practical work. This is because teachers spend a lot of time doing administrative work and spend little or no time on practical work. Many of the teachers prefer to do demonstrations, which are very teacher-centered.

Aim

The aim of the present paper is to identify the barriers that are experienced by Natural Science teachers in doing practical work with a view to provide possible ways of overcoming these barriers that teachers encounter. According to Heeralal and Bayaga (2011: 100) dealing with and overcoming barriers as early as possible will contribute to among other things, addressing the issues of job fatigue, burn out and job satisfaction. Hence the main research question is: 'what barriers do natural science teachers encounter in doing practical work in primary schools?'

METHODOLOGY

Research Design

This study adopted a descriptive survey research design as it collected data on the target population (teachers) with the view of ascertaining barriers that they experienced in doing practical work in Natural Science in primary schools. The survey instrument was a self- administered questionnaire. The design is considered suitable because only a part of the population (though a portion that is representative of the entire population) was studied and findings could be generalized to the entire population. The target population for this article were Natural Science teachers from the Tshwane District of the Gauteng province.

Sampling and Sample Size

The sample for the study consisted of 25 primary school Natural Science teachers from the Tshwane District of the Gauteng province. The sample of teachers was randomly selected.

Instrument

A questionnaire consisting of two sections was administered to respondents. Section A was used to collect the bio-data/demographic characteristics of the respondents. Section B consisted of seventeen items on a 3-point Likert-type response rating scale: Agree (A); Disagree (D); and Uncertain (U), to ascertain the barriers that Natural Science teachers experienced in doing practical work in primary schools with a view of providing ways in which these barriers can be overcome.

RESULTS

Table 1 summarises the results of the survey conducted to determine the barriers that teachers experienced in doing practical work in Natural Science

Table 1: Summary of results

Items	*Agree %*	*Disagree*	*Uncertain %*
Availability of resources	80	20	0
Large class size	100	0	0
Learner discipline	60	20	20
Time	100	0	0
Teacher inexperience	80	0	20
Safety and health of learners	80	0	20
Inflexible curriculum	50	50	0
Assessment pressures	80	20	0
Technical support	80	20	0
Inadequate textbooks	80	20	0
Budget constraints	60	40	
Lack of support from management	20	40	40
No laboratory facilities	60	20	20
Theft of equipment	40	20	40
Teacher motivation	20	40	40
Lack of professional development activities	60	30	20
Preparation for practical work	40	20	40

DISCUSSION

According to Fisher (2010), there are three standard reasons regularly offered by teachers for not doing practical work in their classes. The first and most common one is that they do not have equipment. Haigh (2003) also identifies availability of equipment as a significant issue for teachers; the second is that there is not enough time and the third is that the classes are too big. The results of this research also indicate that class size and time constraints (where all 25 respondents agreed) are the main barriers that natural science teachers experience in conducting doing practical work

According to Mncwabe (1993: 216), eleven studies in Kenya, Tanzania, India and Argentina and other developing countries found that pupils in larger classes (about 40 pupils per class) performed just as well as pupils in smaller classes (10 to 20 pupils per class). In five studies, pupils working in larger classes actually performed better. Although teachers in South Africa believe that class size affects quality, this is a myth in South African education circles as international studies refute this claim made by South African teachers. It is quite possible that South African teachers are not aware of these studies or they simply do not want to accept these realities. It is precisely for these reasons that the education system in South Africa is failing the majority of its learners. Education practitioners, administrators, school management, governing bodies and parents therefore need to be made aware that research results, so that we can get rid of these myths and concentrate on providing quality education to learners. Surely if class size does not adversely affect quality of education, it will not be a barrier in doing practical work in Natural Science. Fischer (2010), notes that in many cases it is not class size itself that is a barrier, but a lack of teaching experience, concerns about discipline and class control, the organisation and planning of activities, noise levels and the perception of others that real work is not being done that inhibits the teacher from doing practical work.

Time constraint has been identified as another significant barrier to doing practical work. This finding is supported by the study carried out by Mothlabane (2014). Time constraints, as a barrier to doing practical work is a contentious issue as it suggests that either those who were responsible for drawing up the curriculum have erred in including more work than what can be covered or taught by the teacher in a calendar year or that schools do not allocate the required amount of time to the learning area. Another factor that further erodes into teaching time at certain schools is their over-extended extra and co-curricular programmes. In recent times, industrial actions by teachers, teacher and learner absenteeism have also contributed to a loss of teaching time. Teachers often cover the theory aspect of the curriculum at the expense of practical work when they are confronted with time constraints. Fisher (2010) argues that doing practical work is time consuming and that often teachers state that there just is not sufficient time to do activities/practical work and that practical work is peripheral to the real job of learning, however, she asserts that teachers need to be persuaded that doing practical work leads to a greater understanding and enhances learning. Teachers need to be punctual, well prepared and have the class ready, as simple starting points in time management. Therefore, the need for good planning and management of activities must be stressed as being critical along-side a well-trained class (Fischer 2010).

Availability of resources, teacher inexperience, safety and health of learners, assessment

pressures, technical support, and inadequate textbooks are also significant barriers (where 80% of the respondents agreed with these statements). Availability of resources, according to Fisher (2010) is a major issue for many primary schools in Africa, especially in rural areas as they have no standard equipment designated for science practical work. Fisher (2010) points out that with the exceptions of magnets, no formal equipment is required for the teacher to carry out a whole range of practical activities that cover most topics in the primary school curriculum. Teachers need to improvise using materials from their surroundings to do practical work, but due to teachers' inexperience, which is sighted as a significant barrier, this does not happen and teachers complain that they cannot do practical work because of a lack of resources. Mncwabe (1993), points out that the results of seven controlled experiments in seven different Third World countries shows that science pupils who had access to laboratories (implying that they had resources) did not perform better in science examinations than pupils from schools without laboratories. This is evidence that it is a myth that lack of resources is barrier. In order to obtain resources, teachers need to take the initiative to request school management to budget for the purchase of science equipment from the Department of Education's financial allocation made to the school or from school funds.

Teacher inexperience as a barrier to doing practical work is as a result of a lack of confidence and according to Fisher (2010) plays a major role in the reluctance of teachers to engage in practical work in primary schools. During teachers' training, many universities do not have a practical work component to the primary teacher training curriculum. This means that the prospective teacher is not exposed to any practical work during teacher training. Hence, they have no exposure to doing practical work and consequently do not do practical work when they start teaching Natural Science in primary schools. In order to overcome this barrier, education faculties at universities need to re-curriculate and include a practical work component in training of primary school Natural Science teachers.

Many teachers refrain from doing practical work out of concern for the health and safety of learners, as many science experiments can be potentially dangerous, if safety precautions are not heeded to. However, the real concern is that, as a result of a lack of discipline, safety measures are 'ignored' by learners, thereby exposing them the risk of accidents in the science classroom. To overcome the lack of discipline, the teacher resorts to rigid 'chalk and talk' lessons at the expense of doing practical work, thus compromising the teaching and learning of science.

Assessment of learners is an integral part of the teaching and learning process, however, if assessment requirements are too rigorous, as is the case of South African public schools, compulsory assessment tasks erode into teaching time. Teachers are, thus, under pressure to complete at least the theoretical aspect of the curriculum, in preparing their learners for assessment exercises, at the expense of doing practical work. This compromises effective teaching and learning of Natural science, which results in inadequate or poor performance in science. Teachers are also responsible for the administrative aspects of assessment such as marking of scripts, compiling mark lists and schedule of marks for departmental purposes. Often teachers use 'teaching' time to engage in these activities and this adds further pressure on the teacher. 'Assessment for the sake of assessment' is a dangerous practice, as it not only places pressure on the teacher but also on learners and parents.

This study reveals that 80% of the respondents indicated that availability of resources was a barrier to them doing practical work; hence it can be inferred than in most primary schools in South Africa basic science equipment is lacking. For those schools who are in the fortunate position of having science equipment, receiving technical support to do practical work in science is the least of the concerns of the management of a school, as they have other more pressing issues to attend to. Financial constraints of schools also prevent the allocations of funds for technical support such as laboratory assistance and servicing of science equipment. This means that the teacher has to prepare the laboratory for practical work, clear up after the work is done and also repair and maintain equipment. This they have to do in addition to their normal teaching responsibilities. Technical support is thus seen as a 'nice to have' service in school science teaching.

Teachers are not forced to buy specific textbooks. The Department of Basic Education has a comprehensive text book catalogue, from which teachers can select the text book that is

most appropriate for their learners' needs. Teachers need to exercise their right to choose a particular and suitable text book. Publishers usually provide schools with sample copies of their text books. Educators need to examine these sample copies for suitability. The cheapest book is not always the best or suitable book for learners at a particular school. Teachers should also take advantage of courses offered by publishing houses of how to use the materials that they publish. The use of more than one title is also advised as the teacher and learners will be exposed to different authors' viewpoints and approaches on a particular topic. If inadequate text books are a barrier to doing practical work in science then the teacher needs to adapt the material in the text book or develop their own materials so that practical work can be done effectively.

CONCLUSION

Practical work forms an integral component of teaching and learning in Natural Science. If teachers experience barriers in doing practical work, and these barriers are not overcome, they will be discouraged from doing practical work. Learners will not be able to acquire valuable skills that are required, especially in the work place; hence it becomes difficult for them to find employment. If practical work is added as an integral part of the teaching and learning process, scientific concepts, skills and values will surely be acquired by learners and this will enhance their performance in science. It is therefore imperative that barriers to doing practical work in the primary school be addressed and overcome.

RECOMMENDATIONS

As a result of this research the following recommendations are made so that barriers to doing practical work can be overcome:

- In-service courses in doing effective practical work should be conducted by subject advisors and experienced science teachers.
- The time allocated for the teaching of science in the primary school needs to be increased so that teachers can get themselves as well their students involved in practical work.
- Teachers need to form support groups to develop skills in doing practical work.
- Teachers need to request, from the school management, that a budget be made available for the purchase of necessary science equipment and resources. The school can also engage in fund raising activities for the purpose of purchasing of equipment needed to conduct practical work.

REFERENCES

Abrahams A 2009. Does practical work really motivate? A study of the affective value of practical work in secondary school science. *International Journal of Science Education,* 31(17): 2335-2353.

APU (Assessment of Performance Unit) 1988. *Science at Age 15: A Review of APU Survey Findings 1980-84.* London: HMSO

Donnelly D, O'Reily J, McGarr O 2013. Enhancing the student experiment experience: Visible scientific inquiry through a virtual chemistry laboratory. *Research in Science Education,* 43: 1571-1592

Fisher S 2010. Encouraging Practical Science in Primary Schools. Science, Technology and Society Commonwealth day 8 March 2010. From <http://www.sci-tech-soc.org/Encouraging-Practical-Science.html> (Retrieved on 13 March 2012).

Gunstone RF 1991. Reconstructing theory from practical experience. In: BE Woolnough (Ed.): *Practical Science: The Role and Reality of Practical Work.* Milton Keynes: Open University Press, pp. 67- 77.

Gyllenpalm J, Wickman PO, Holmgren SO 2010. Teachers' language on scientific inquiry: Methods of teaching or methods of inquiry? *International Journal of Science Education,* 32(9): 1151-1172.

Haigh M 2003. Enhancing Creativity Through Investigative Practical Work in Science. *Paper presented at the New Zealand Association of Research in Education 2003 Conference,* Auckland, 29 November – 3 December 2003.

Haslam CY, Hamilton J 2010. Investigating the use of integrated instructions to reduce the cognitive load associated with doing practical work in secondary school science. *International Journal of Science Education,* 32(13): 1715-1737.

Heeralal PJH, Bayaga A 2011. Pre-service teachers' experiences of teaching practice: Case study of a South African university. *Journal of Social Sciences,* 28: 2.

Kibrige I, Osodo J, Mgiba AN 2014. Exploring grade 7 teachers' perceptions regarding practical work in Limpopo, South Africa. *Mediterranean Journal of Social Sciences,* 5(4): 399-405

Kim M and Tan A 2011. Rethinking Difficulties of Teaching Inquiry-Based Practical Work: Stories from elementary pre-service teachers. *International Journal of Science Education,* 33(4): 465-485.

Lunetta VN, Hofstein A, Clough MP 2007. Teaching and learning in the school science laboratory. An analysis of research, theory, and practice. In: SK Abell, NG Lederman (Eds.): *Handbook of Research on Science Education*. Mahwah, NJ: Lawrence Erlbaum Associates, pp. 393–431.

Millar R 2004. The Role of Practical Work in the Teaching and Learning of Science. *Paper Prepared for the Meeting: High School Science Laboratories: Role and Vision.* National Academy of Sciences, Washington, DC, 3-4 June 2004.

Mncwabe MP 1993. *Post-apartheid Education – Towards Non-Racial, Unitary and Democratic Socialization in the New South Africa*. New York: University Press of America.

Motlhabane A 2014. The voice of the voiceless: Reflections on science practical work in rural disadvantaged schools. *Mediterranean Journal of Social Sciences*, 4(14): 166-173.

Topis R, Allen M 2012. "I do and understand?' Practical work and laboratory use in United Kingdom schools. *Eurasia journal of Mathematics, Science and Technology Education*, 89(1): 3-9.