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Physical Science Teachers' Self-efficacy Beliefs on Conducting Laboratory Experiments

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ABSTRACT This non-experimental exploratory quantitative study examined secondary school Physical Science teachers' self-efficacy beliefs in conducting selected key experiments. The respondents were 190 Physical Science teachers (males = 54.6%, teaching experience ranging from 1 to more than 30 years) from the central province of South Africa. They completed a science teaching efficacy belief scale and a self-rating scale on how confident they are in conducting the selected experiments. Data was analyzed for rank-order in different outlined experiments for Grade 10 to 12 as prescribed by the Curriculum and Assessment Policy Statement (CAPS) of the Physical Sciences. The influence of demographic factors on confidence to conduct practical work and self-efficacy beliefs was also established. Findings suggest that the teachers' confidence to perform experiments was higher for Physics than for Chemistry, and that self-efficacy to perform experiments was influenced by demographic factors, mostly for Chemistry experiments rather than for Physics experiments.

INTRODUCTION

The level of preparedness of teachers to teach in terms of content knowledge and the ability to conduct and facilitate practical work tends to influence their sense of efficacy positively or negatively. Until recently, lack of practical work in Physical Science classrooms was attributed to poorly resourced laboratories. Muwanga-Zake (2001), however, highlighted that teachers had misconceptions of their own problems, whereby there was evidence that those who had access to equipment did not use it. The main reason why teachers did not use practical approaches was that they were deficient in practical skills and did not understand the Science concepts they were supposed to teach (Muwanga-Zake 2001).

Well-equipped laboratories enhance the teaching and learning of Science subjects. Moreover, the provision of laboratories and laboratory equipment needs to be carefully planned and executed so as to effectively support the teaching and learning of Science. Ajileye (2006) argues that insufficient resources for the teaching and learning of Science constitute a major cause of student underachievement. Insufficient resources include laboratories, Science equipment, and specimens to be used as teaching aids (Ajileye 2006).

Onwu (1999) reports on research conducted in selected schools in the then Northern Province (now known as the Limpopo Province) of South Africa. It was found that in all ten schools used in the study, there were great variations in the resources and facilities available for the teaching and learning of Science at Grade 12 level. Although all the schools in the study, with the exception of one, were public schools, which depended on the provincial government for the bulk of their funding, the five poorly/low-performing schools were so impoverished that some did not have the basic necessities. This included sufficient desks per class, classroom space to sit and move around, sufficient textbooks and exercise books, not to mention facilities like laboratories, Science equipment, libraries, teaching aids (audio-visual teaching equipment), storage space, chemicals and other consumables (Onwu 1999). In 2005, after the implementation of the Outcomes-based Curriculum, Onwu and Stoffels argued that teacher competence in teaching reform-based Science in large classes remained one of the challenges in the continuing reform of South Africa's education system. Most teachers had little experience,

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meager training, and operated in large and poorly resourced Science classrooms (Onwu and Stoffels 2005).

Muwanga-Zake (2001) emphasizes that a well-equipped laboratory stimulates learners' interest and promotes practical tuition in Science. Not so for Eastern Cape learners, where according to Jennings and Everett (1996, in Muwanga-Zake 2001), only twenty-three percent of Black schools had laboratories. These authors also found that the six out of the 21 schools that had laboratories were high schools. Junior schools, the level at which interest in Science should be inculcated, often did not have laboratories and were overcrowded. Thus, the learners' construction of knowledge was likely to be limited to textbook information (Muwanga-Zake 2001) since they did not have facilities to conduct practical work. It is thus important to note that learning in schools is influenced by, among others, school organization resources and the climate, which involves teacher skills, curriculum structure and content. According to Ramnarain (2014), some Physical Science teachers believe that their explanations are better than when they are conducting a practical work to enhance the students' comprehension of concepts. The teachers apportion the blame to the lack of apparatus and other contextual factors like overcrowded classrooms (Ramnarain 2014).

The Science Community Representing Education (SCORE) report examined the state of practical work in Science in the United Kingdom. The report emphasized that the importance of practical work in Science is widely accepted and it is acknowledged that good quality practical work promotes the engagement and interest of students, as well as developing a range of skills, Science knowledge and conceptual understanding (SCORE 2008). In Turkey, Science teachers argued that Science process skills could only be gained effectively through laboratory activities in which both teachers and learners engage (Gultepe 2016). The situation is no different in South Africa. Ngema (2011) conducted a study to explore how Physical Science teachers used practical work in their teaching. The exploration sought to ascertain whether there was any relationship between teachers' perceptions of the purpose of practical work and their use of practical work. Similarly, the findings revealed that teachers value using practical work in the teaching of Physical Science to promote conceptual understanding, and to verify theory through non-inquiry practical instructional practices and strategies (Ngema 2011). This paper, therefore, examines Physical Science teachers' confidence in conducting experiments.

Theoretical Framework

This study is underpinned by Bandura's Social Cognitive Theory. The Social Cognitive Theory is the overarching theoretical framework of the self-efficacy construct (Bandura 1986, 2000). Self-efficacy beliefs are defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura 1986: 391). In Science teaching, teachers are expected to be competent not only in the theoretical content knowledge, but also in the execution of practical work in the laboratory. Self-efficacy beliefs provide the foundation for human motivation, wellbeing, and personal accomplishment. It is also a critical determinant of self-regulation. Bandura (1995: 2), at a later stage, defined self-efficacy as "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations", while Pajares (2000) defined it as people's confidence in their ability to do the things that they try to do. The ideas that come through in these definitions are one's judgments, beliefs and confidence in one's abilities to perform a particular task. Bandura's (1997) key contentions regarding the role of self-efficacy beliefs in human functioning are that "people's level of motivation, affective states and actions are based more on what they believe than on what is objectively true". Bandura (1986, 2000) calls this three-way interaction of behavior, personal factors (in the form of cognition, affect and biological events), and environmental influences or situations the "triadic reciprocity".

The four sources of information relevant to the forming or altering of self-efficacy perceptions are mastery experience, vicarious experience, verbal persuasion at motivational discussions, and physiological and emotional states (Bandura 1997, in Hoy and Spero 2005; Steyn and Mynhardt 2008). In mastery experience, one's direct experiences help in the successful performance of tasks, which reinforce optimistic self-efficacy perceptions. Vicarious experience involves self-efficacy when people are observed performing challenging tasks. Verbal persuasion involves skillful persuaders who focus on an individual's skills, counteracting doubt and obsession with personal shortcomings and weaknesses. In physiological and emotional states, a person's mood, stress and pain has an effect on his or her self-efficacy beliefs (Bandura 1997; Cantrell and Young 2003; Steyn and Mynhardt 2008).

Self-efficacy beliefs embrace a person's belief in him or herself performing a specific task, thus the more efficacious a teacher is in Science, the more confident he or she will feel about conducting Science practical.

Objectives

This paper sought to explore:

1. The impact of teachers' level of preparedness regarding practical work on their teaching efficacy.
2. Teachers' competence to conduct selected examinable Physical Science experiments as prescribed in the Curriculum Assessment Policy Statements (CAPS).

The following research questions guided this study:

1. What is the level of teachers' self-efficacy in practical work in Science?
2. How do teachers self-rate their confidence to conduct selected Physics and Chemistry experiments, as prescribed by CAPS?

METHODOLOGY

Research Design

The research design employed in this study was a non-experimental, exploratory quantitative design. A questionnaire, the Science Teaching Efficacy Belief Instrument (STEBI-A), with some self-constructed questions was used as a data collection instrument to assist the researcher to assess teachers' level of confidence in conducting selected Physical Science experiments.

Participants

A sample of 190 teachers from a province in central South Africa (the Free State) participated in this study, and 54.6 percent were males. Sixty percent of the respondents had teaching experience of less than 10 years.

Table 1 presents the characteristics of the study sample in terms of the major Science subjects taken by the respondents during their pre-service training, and Table 2 outlines the sections of Physical Science they taught, from Grade 10 to 12. Information on the major Science subjects taken by the respondents during their tertiary training was requested in order to determine the Science exposure the respondents had received during their formal training as teachers.

Table 1: Chemistry and Physics taken as major subjects during training (N=190)

Chemistry	*Frequency*		*Physics*	*Frequency*	
Yes	142	(74.7%)	Yes	146	(76.8%)
No	43	(22.6%)	No	39	(20.5%)
Total	185	(97.4%)	Total	185	(97.4%)
Missing system	5	(2.6%)	Missing System	5	(2.6%)
Total	190	(100.0%)	Total	190	(100%)

It can be seen from Table 1 that the respondents appear to be well prepared in terms of Chemistry and Physics content preparedness. Three-quarters of the respondents took both components of Physical Science as major subjects during their studies.

This paper focused on Grade 10 to 12 Physical Science teachers. They teach either Physics or Chemistry, or both as Physical Science.

The sections of Physical Science that they teach are explored in the next section.

It is worth noting from Table 2 that 14 (7.4%) of the teachers teach Chemistry only, and 167 (87.9%) teach both Chemistry and Physics, and thus a total of 172 (95.5%) teach Chemistry. This contradicts the results in Table 1 that indicated that 74.4 percent of the teachers majored in

Table 2: Physical Science sections currently taught by respondents (N=190)

	Frequency	*%*
Physics only	5	2.6
Chemistry only	14	7.4
Chemistry and Physics	167	87.9
Total	186	97.9
Missing system	4	2.1
Total	190	100.0

Chemistry during their training. This shows that 21.1 percent of the teachers do not qualify to teach Chemistry.

Instruments

An open-ended questionnaire, employing a 5-point Likert-type scale, was used as the main data-gathering instrument. It comprised of the Science Teachers' Efficacy Belief Scale (STEBI-A), which was designed by Riggs and Enochs in 1990 (and was tested for reliability), and the self-constructed questionnaire that required information on the teachers' biographical data and their level of preparedness in teaching Physical Science.

The two sub-scales in the STEBI-A, which is designed for in-service teachers, are entitled Personal Science Teaching Efficacy Belief (PSTE) and Science Teaching Outcome Expectancy (STOE). PSTE measures a person's belief in his or her ability to do what needs to be done in order to bring about a desired result and STOE measures the belief that teaching has a profound effect on student learning.

The long version of the STEBI-A consists of 25 items, 13 positively written and 12 negatively. The Cronbach alpha coefficient of the Personal Science Teaching Efficacy Belief is 0.92, while the alpha for the Science Teaching Outcome Expectancy Scale is 0.77 (Riggs and Enochs 1990). This is recommended for use with in-service teachers. This scale asks for a self-report of teacher beliefs and is constructed using a five-point Likert-type response scale with the options of strongly agree, agree, uncertain, disagree, and strongly disagree, according to a scale of 1 to 5, respectively.

For the purpose of this study, a self-constructed teaching confidence ranking scale for specific Physical Science experiments was prescribed for Grade 10 to 12. This scale used a 4-point Likert-type scale ranging from 1 = *I need help to develop my knowledge and skills*, 2 = *I can manage but depend on advice from others*, 3 = *Confident with a little guidance*, to 4 = *Fully confident*.

Ethical Issues

Permission to conduct the study was sought from and approved by the provincial Department of Basic Education and Training. Consent was requested from principals and teachers. Participation in the study was voluntary. The benefits of participating in the study were explained to the respondents. They were also assured of their anonymity and confidentiality. The paper was revised by an accredited language editor.

Data Analysis

Data was analyzed using the Statistics Package for Social Sciences (SPSS) version 20 on the profile of teachers' confidence to conduct the selected Physical Science experiments. The extent of the respondents' practical work between Physics and Chemistry, against the major subjects taken during their pre-service training, was taken into consideration.

RESULTS

To determine the respondents' level of confidence to conduct experiments, the teachers were requested to rank their confidence to conduct Physical Science experiments according to the ranking as follows, that is, *Fully confident* = 4, *Confident with a little guidance* = 3, *I can manage but depend on advice from others* = 2, and *I need help to develop my knowledge and skills* = 1, as shown in Table 3.

Generally, teachers needed some kind of support to perform experiments, as they battled to survive on their own when it came to practical work. They were mostly confident with a little guidance, as their scores ranged between x = 2.61 and x = 3.48.

Experiment 5 (Preparation of esters) and experiment 6 (How do you use the titration of oxalic acid against sodium hydroxide to determine the concentration of the sodium hydroxide?), both from the Chemistry section of Physical Science, were the two experiments that most respondents had the lowest confidence in. Generally, respondents showed the highest confidence levels in performing Physics experiments, that is, in experiment 2 (Electric circuits with resistors in series and parallel-measuring potential difference and current), 8 (Determining the internal resistance of a battery), and 9 (Setting up a series-parallel network with known resistor and determining the equivalent resistance using an ammeter and a voltmeter and compare with the theoretical value).

Table 3: Respondents' confidence levels to conduct experiments

*Experiment number and title		Mean ($\bar{x}$)	Section
1.	Heating and cooling curve of water.	3.23	Chemistry
2.	Electric circuits with resistors in series and parallel-measuring potential difference and current.	3.48	Physics
3.	The effects of intermolecular forces: boiling points, melting points, surface tension, solubility, capillarity.	3.13	Chemistry
4.	Investigating the relationship between force and acceleration (Verification of Newton's second law).	3.24	Physics
5.	Preparation of esters.	2.61	Chemistry
6.	How do you use the titration of oxalic acid against sodium hydroxide to determine the concentration of the sodium hydroxide?	2.90	Chemistry
7.	Conservation of linear momentum.	3.27	Physics
8.	Determining the internal resistance of a battery.9. Setting up a series-parallel network with known resistor.	3.27	Physics
	Determine the equivalent resistance using an ammeter and a voltmeter and compare with the theoretical value.	3.32	Physics

*Prescribed practical activities formal assessment from CAPS (Department of Basic Educaiion 2012)

The next section provides the results of the relationship between practical work frequencies, the teachers' confidence in conducting experiments, and their self-efficacy beliefs based on PSTE and STOE.

Multivariate analysis of variance (MANOVA) was used to determine the relationship between the frequency of the extent to which practical work is conducted and teachers' self-efficacy beliefs in conducting experiments. The results of this relationship are presented in Table 4.

There was a significant positive correlation between the frequency of practical work and scores on the PSTE sub-scale ($r=0.192$; $p=0.008$). This means that the higher the frequency of practical work conducted, the higher the teachers' scores on the PSTE sub-scale. After Bonferroni adjustment for multiple correlations, there was a significant correlation between the frequency of practical work and the STOE sub-scale ($r=0.158$; $p=0.030$). Even though $p<0.05$, it was still not a significant result since multiple correlations were done and the significance level was also adjusted. There was no meaningful relationship between the frequency of practical work conducted and the teachers' scores on the STOE sub-scales.

MANOVA was also used to determine the relationship between the teachers' perceived confidence in conducting experiments against their measured PSTE and STOE, as displayed on Table 5.

There was a significant positive correlation between the confidence of the teachers in conducting experiments and scores on the PSTE sub-scale ($r=0.284$; $p=0.000$) as shown in Table

Table 4: Practical work frequency against PSTE and STOE sub-scales

Correlations					
		PSTE total	*Extent of practical work total*	*STOE sub-scale total*	*Extent of practical work total*
PSTE sub-scale total	Pearson Correlation	1	.192**	.158*	1
	Sig. (2-tailed)		.008	.030	
	N	190	189	189	189
Extent of practical work total	Pearson Correlation	.192**	1	1	.158*
	Sig. (2-tailed)	.008			.030
	N	189	189	190	189**.

Correlation is significant at the 0.01 level (2-tailed).

Table 5: Teachers' confidence in coonducting experiments against PSTE and STOE

Correlations

		Total of practical work confidence	*PSTE sub-scale total*	*STOE sub-scale total*	*Total of practical work confidence*
Total of Practical Work Confidence	Pearson Correlation	1	.284**	-.005	1
	Sig. (2-tailed)		.000	.942	
	N	189	189	189	189
The Personal Science Teaching Efficacy total	Pearson Correlation	.284**	1	1	-.005*
	Sig. (2-tailed)	.000			.942
	N	189	190	190	189**.

Correlation is significant at the 0.01 level (2-tailed).

5. This means that the higher the teachers' confidence in conducting experiments, the higher their scores on the PSTE sub-scale.

There was no significant relationship between the teachers' confidence in conducting experiments and their scores on the STOE sub-scale (r=-0.005; p=0.942). Once again, it seems that teachers' confidence in conducting experiments and the frequency of practical work had an influence on scores on the PSTE sub-scale, but not on the STOE sub-scale scores.

Most of the respondents were of the opinion that their confidence in teaching Science was compromised by their lack of skills to conduct experiments. When asked about which section of Physics and Chemistry they were more confident in, the majority of the teachers said none, while some said Physics, and very few chose Chemistry. The reasons for their lack of confidence in conducting Chemistry experiments ranged from lack of apparatus and chemicals, to fear of dealing with hazardous materials that might put the lives of learners at risk. Those who chose Physics indicated that most of the material was available, making it easy to execute, and that the results were more specific and to the point. They also indicated that improvisation was explored, but emphasized that it was not always feasible.

To confirm the above findings that the teachers preferred Physics to Chemistry, the findings of the questionnaires showed that of the nine Physical Science experiments prescribed by CAPS for Grade 10 to 12 classes, teachers rated themselves highest in Physics, when compared to Chemistry (see Table 3). The five Physics experiments were rated the top five, while the four Chemistry experiments were rated the lowest.

DISCUSSION

Even though the teachers felt confident about practical work, the situation in their schools was not favorable for conducting practical work due to a lack of facilities. Mji and Makgato (2006) indicated in their study that with regards to laboratory use, learners and teachers complained about the lack of practical equipment to enhance their teaching and learning of Science (Mji and Makgato 2006). The teachers further emphasized that this situation resulted in them losing interest in practical activities. This correlates with the findings of Ogunleye (2009) that a significant number of teachers experienced difficulties in teaching many of the topics of the Science curriculum, depending on whether they had adequate knowledge of the Science content of the curriculum and on how often they carried out the practical activities specified in the curriculum. In fact, Mudau and Tabane (2015) established that teachers operated within faulty frameworks and as such the practical work which they desired to do might only happen by chance, and not by design (Mudau and Tabane 2015). Also, De Jager (2015) points out that Physical Science teachers are not always adequately trained to use laboratory equipment to conduct experiments. Danjuma and Adeleye (2015), on the other hand, found that the greatest hindrance to the effective teaching of Physics in schools was not a lack of the necessary laboratory apparatus and equipment, but rather a lack of their usage. It was also established that the effective utilization of these materials had a positive influence on the students' attitude towards Physics, which could indirectly affect their academic achievement in the subject (Danjuma and Adeleye 2015). Thus, it is imperative that teachers embark on continuing professional development that involves sharpening their skills on laboratory management and the actual execution of experiments. This, in turn, will enhance their confidence in practical work. Eventually, their confidence will be restored and enhanced in line with mastery experience as a source of efficacy, whereby their direct experiences with practical work will help in the successful performance of tasks, which reinforces optimistic self-efficacy perceptions.

The findings of this study showed that teachers' confidence in conducting experiments and the frequency of practical work had an influence on their scores on the PSTE sub-scale, but not on their STOE sub-scale scores. From these results, one can understand that the teachers rated themselves more confident in conducting Physics experiments than Chemistry experiments. In a study that aimed to gain insight into the effect of Science coursework and teacher certification, Joseph (2010) found that the preservice teachers with Science majors had a significantly higher PSTE, but their STOE was not different from their non-Science counterparts. Conversely, studies by Cantrell, Young and More (2003) have shown that the more Science courses a teacher took, the higher their STOE. In another study, Mustafa (2007) found that STOE was positively and significantly correlated with the number of college Science courses taken during training.

Well-equipped laboratories enhance the teaching and learning of Science subjects. Thus, officials from the Department of Basic Education, school principals and heads of departments should strive to maximize the use of existing laboratories in their schools. The provision of laboratories and laboratory equipment needs to be carefully planned and executed so as to effectively support the teaching of Science.

CONCLUSION

This study has revealed that practical work is integral to the teaching and learning of Physical Science and that the higher the frequency of practical work conducted, the higher the teachers' scores on the PSTE sub-scale. Teachers need to be prepared optimally to enable them to execute their duties efficiently and effectively. However, most of the teachers in this study preferred the Physics part of Physical Science to Chemistry precisely because they were more qualified to teach Physics than they were to teach Chemistry. Consequently, they also felt that Chemistry practical work is more demanding than that of Physics. This is because of the hazardous substances involved in Chemistry experiments, the extensive preparation needed, and their fear of unsuccessful experiments.

RECOMMENDATIONS

The Department of Basic Education in collaboration with teacher training institutions should offer workshops and in-service training on practical work. This will enhance teachers' confidence in conducting experiments. To ensure that teachers perform experiments in their own classes without the excuse of a lack of resources, science kits should be supplied for these experiments. Practical work requires apparatus to be set up, and most of the respondents raised time as an inhibitory factor, and it is thus recommended that laboratory technicians be appointed to assist in setting-up the experiments and ensuring that the laboratory is properly maintained at all times. Another factor to be taken into consideration is that Physical Science falls into Group B with other elective subjects that do not have a practical aspect. Group B subjects are allocated four hours per work in terms of the policy document. Therefore, it is recommended that Physical Science should be allocated an extra hour on top of the four hours per week, which could be utilized for the purpose of practical work.

LIMITATIONS

The size of the sample may make it impossible for generalization of the results to be made to the greater Republic of South Africa. Classroom observations of teachers performing the experiments could have given more rich data. Interviews could have assisted in the interrogation of some of the outcomes of the study.

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REFERENCES

Ajileye OO 2006. Towards effective science education: Issues in universal basic education programme. *Journal of Sports Management and Educational Research*, 1(2): 337.

Bandura A 1986. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura A 1995. *Self-efficacy in Changing Societies.* New York: Cambridge University Press.

Bandura A (Ed.) 1997. *Self-efficacy in Changing Societies.* New York: Press Syndicate of the University of Cambridge.

Bandura A 2000. Exercise of human agency through collective efficacy. *Current Directions in Psychological Science*, 9: 75-78.

Cantrell P, Young S, Moore A 2003. Factors affecting science teaching efficacy of preservice elementary teachers. *Journal of Science Teacher Education*, 177-192.

Danjuma TT, Adeleye M 2015. The effect of the availability and utilization of laboratory apparatus in the teaching of Physics: A case study of secondary schools in Karu. *Research Journal of Educational Studies and Review*, 1(5): 118-122.

De Jager T 2015. Using a DVD to illustrate Grade 12 Physical Science experiments: A teaching aid to support learners. *International Journal of Educational Sciences,* 8(1): 83-91.

Department of Basic Education 2012. *Curriculum and Assessment Policy Statement. Grades 10-12 Physical Sciences.* Pretoria.

Gultepe N 2016. High school science teachers' views on science process skills. *International Journal of Environmental and Science Education*, 11(5): 779-800.

Hoy A, Spero RB 2005. Changes in teacher efficacy during the early years of teaching: A comparison of four measures. *Teaching and Teacher Education,* 21: 343-356.

Joseph J 2010. Does intention matter? Assessing the science teaching efficacy beliefs of pre-service teachers as compared to the general student population. *Electronic Journal of Science Education,* 14(1): 1-14.

Mji A, Makgato M 2006. Factors associated with high school learners' poor performance: A spotlight on mathematics and physical science. *South African Journal of Education*, 26(2): 253-266.

Mudau AV, Tabane R 2015. Physical Science teacher's perspectives of the types and nature of practical. *Journal of Baltinic Science Education*, 14(3): 327-338.

Mustafa S 2007. *An Analysis of Efficacy Beliefs, Epistemological Beliefs and Attitudes Towards Science in Pre-service Elementary Science Teachers and Secondary Science Teachers.* Masters Dissertation, Unpublished. Middle East: Middle East Technical University.

Muwanga-Zake JWF 2001. Is science education in a crisis? Some of the problems in South Africa. *Science in Africa.* Africa's First On-line Science Magazine, Issue 2, May 20, 2008.

Ngema SH 2011. *An Exploration of Grade 11 Teachers' Conceptions of Practical Work in Physical Sciences Within the National Curriculum Statement (NCS) Curriculum.* KwaZulu-Natal: University of KwaZulu-Natal.

Ogunleye A 2009. An investigation into Nigerian teachers' knowledge of primary science curriculum content and involvement in practical activities: Implications for the UBE Scheme. *Contemporary Issues in Education Research*, 2(3): 65-72.

Onwu GO 1999. *An Investigation on the Availability and Use of Learning Materials in Grade 12 Classes in Some Selected Schools in the Northern Province.* Johannesburg. Joint Education Trust.

Onwu G, Stoffels N 2005. Instructional functions in large, under-resourced Science classes: Perspectives of South African teachers. *Perspectives in Education,* 23(3): 79-91.

Pajares F 2000. Self-efficacy Beliefs and Current Directions in Self-efficacy Research. From <http://www.emory.edu/EDUCATION/mfp/effpage. html.> (Retrieved on 4 March 2014).

Ramnarain U 2014. Teachers' perceptions of inquiry-based learning in urban, suburban, township and rural high schools: The context-specificity of science curriculum implementation in South Africa. *Teaching and Teacher Education*, 38: 65-75.

Riggs I, Enochs L 1990. Toward the development of the efficacy belief instrument for elementary teachers. *Science Education,* 71(6): 625-637.

Steyn R, Mynhardt J 2008. Factors that influence the forming of self-evaluation and self-efficacy perceptions. *South African Journal of Psychology,* 38: 563-573.

SCORE 2008. *Practical Work in Science: A Report and Proposal for a Strategic Framework*. London. Gatsby Technical Education Projects.

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