

EARLY PRIMARY SCHOOL TEACHERS' PERCEPTIONS ABOUT SCIENCE AND SCIENCE PROCESS SKILLS: A CASE STUDY IN SOUTH AFRICA

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Abstract

Early primary school (grades R to 3) science education has been in the spotlight in recent years, as science education scholars are increasingly acknowledging the need to provide a strong foundation in science education, to motivate learners to study the subject in subsequent years. Literature suggests that most early primary school teachers lack the basic knowledge required to introduce young learners to science, and to motivate them in the study of science. Primary school teachers' limited knowledge of science and its processes could affect how they introduce and develop science concepts in early primary school learners. In the South African context, there is limited literature on early primary school teachers' knowledge of science and its processes, as well as on teachers' attitudes towards the teaching of science to early primary school learners. The purpose of the study was to investigate early primary school teachers' knowledge of the concepts of science and science process skills, and to determine their perceptions regarding the teaching of science in early primary school. The study involved four purposively selected early primary school teachers, in the Gauteng province of South Africa. Qualitative data were collected using semi-structured interviews, and the findings showed that the participating teachers had limited knowledge of the concepts of science and science process skills, and that they mostly had negative perceptions about the teaching of science in early primary school. These findings have implications on the training of early primary school teachers.

Keywords: *Perception, knowledge, science process skills, primary school.*

1. Introduction

For most people, primary school is the place where interest in science begins or ends. In other words, primary school science education forms the foundation for children's love, fear or the hate of science. If teachers do a bad job when teaching science to primary school children, it will be very difficult to get them interested and successful in science related subjects at secondary school or university levels. Early primary school children (5 to 9-year-olds) are naturally curious and want to explore the world around them, as they seek to integrate information about their surroundings (Jirout & Klahr, 2012), which is precisely what scientist do. Early primary school (Grades R-3) science education therefore presents an opportunity to harness young people's curiosity, by directing it towards an understanding of science and its processes, with the purpose of developing scientifically minded individuals.

Early primary school teachers in South Africa are expected to introduce and motivate learners in the study of natural science and to develop science process skills (DBE, 2011). For early primary school teachers to teach science effectively, they need to have a basic understanding of what science entails, and the processes involved. In addition, they need to have positive attitudes towards the teaching of science. Science as a concept is broad, and it is defined differently by different scholars and disciplines. In the context of this study, science refers to the Natural science, taught in the Foundation phase (early primary school), in South Africa. In this study, I adopted the definition of science provided by the National Academy of Sciences (2008), which is; "The use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process. p.10". Scientific knowledge is generated by scientists using specific science process skills, which are the processes used by scientists during their work, and the competencies displayed in solving scientific problems (Fugarasti, Ramli, Muzzazinah, 2019). According to Padilla (1990), science process skills are classified into basic and integrated process skills. The South African Foundation phase Curriculum and Assessment Policy Statement (CAPS) prescribes the development of basic science process skills, which include; observing, comparing, classifying, measuring, experimenting, and communicating (DBE, 2011). Explicit instruction of science process skills is considered effective in helping learners to gain skills that could enable them to approach science as scientists do, and it is necessary for mastering science content and to better prepare

learners for careers in science (Coil, Wenderoth, Cunningham & Dirks, 2010). It is therefore imperative for early primary school teachers to understand the essence of science and its processes.

Despite the advocacy in the South African CAPS to teach science and its processes at different educational levels, the performance of South African learners in science, including international science assessments, such as the Trends in International Mathematics and Science Study (TIMSS), has been consistently poor (Pretorius, 2014). While many factors could account for this poor performance, ineffective teaching of science in the Foundation phase could be a contributing factor (Shidiq & Falkhmta, 2020). Unfortunately, most primary school teachers are not trained as science teachers or as scientists (Gerde, Pierce, Lee, & Van Egeren, 2018), therefore lack science knowledge. For instance, a study conducted by Beni, Stears and James (2012), titled “Teaching natural sciences in the Foundation phase: Teachers’ understanding of the natural science curriculum”, found that Foundation phase teachers lacked the scientific knowledge that could enable them to teach science effectively. These researchers pointed out that teachers’ lack of science content knowledge could affect their confidence to teach science, which could influence their attitudes towards the teaching of science, and the ways they teach it. In this regard, Ualesi and Ward (2018) found in their study on; Teachers’ attitudes toward teaching science in a New Zealand Intermediate School, that teachers’ attitudes determined the amount of effort they put in their lessons, as well as their willingness to go the extra mile. According to these researchers, the major contributor of negative attitude towards the teaching of science is teachers’ lack of science knowledge.

The purpose of this study was to find out how early primary school teachers understand science and science process skills, and their perceptions regarding the teaching of science to early primary school learners. This investigation is particularly important because teachers’ knowledge and perceptions about science could influence the way they introduce it to young learners (Abungu, Okere & Wachanga, 2014).

2. Objectives

1. To determine early primary school teachers’ understanding of science.
2. To establish early primary school teachers’ knowledge of science process skills.
3. To explore teachers’ perceptions about the teaching of science to early primary school learners.

3. Conceptual framework

As mentioned earlier, teachers’ knowledge and perception of science could influence their confidence in teaching and guiding learners during science lessons, which could ultimately shape learners’ interest, understanding and their decisions about future careers in science (Shidiq & Falkhmta, 2020). This understanding is the basis of the Science, Technology, Engineering and Mathematics (STEM) conceptual framework used by Shidiq and Falkhmta (2020) in their study titled; “Exploring the relationship of teachers’ attitudes, perceptions and knowledge, towards integrated STEM”. The framework shows that teachers’ cognitive, affective and self-efficacy influence their attitudes towards science, and these attitudes interact with perceptions and knowledge to ultimately influence teachers’ integration of STEM in their teaching (Shidiq and Falkhmta (2020). This framework guided the investigation of early primary school teachers’ knowledge of science and science process skills, and their perceptions about the teaching of science to young learners, in this study.

4. Methodology

A qualitative research approach, involving multiple case studies, was used to investigate early primary school teachers’ knowledge of the concepts of science and science process skills, and perceptions about teaching science to early primary school learners. Four teachers purposively selected from different township (peri-urban) schools in Johannesburg, South Africa, participated in the study. All four participating teachers taught Foundation phase learners, and their profiles are provided under their narratives in the results section.

5. Data collection and analysis

Face-to-face semi-structured interviews were used to collect qualitative data. Interview items focused on teachers’ description of science, their knowledge of science process skills, and their views regarding the teaching of science to early primary school learners. The interview schedule was piloted using two teachers who did not participate in the main study, to identify and revise items which were not clear to the interviewees. Data collected from interviews were transcribed, coded and sorted according to each participant’s responses.

6. Study findings

The profile of each participant, interview questions related to the objectives of the study and the responses provided by the participant are presented below.

Teacher 1

This participant was a female teacher, who held a Bachelors' degree in Business Management, and later obtained a Post-Graduate Certificate in Education (PGCE). She had 6 years' experience in Foundation phase teaching. She confessed, prior to the interview, that she has limited knowledge of science. The following were her responses to the interview questions.

- i. How would you describe science as a concept, to someone who does not know what it is?

Response: *"Science is more about solving problems using machines or medicine. I would say science is more technical, you know! Working with mixtures in the lab and finding cures. People who are science orientated solve things for themselves, because they do not trust God".*

This teacher seemed to believe that science is all about finding cures, solutions to problems, and working in the lab, and that scientists do not trust God.

- ii. What is your understanding of science process skills? Provide examples to clarify your response.

Response: *"(Coughs) Process skills you say? Like processes of what?" Are these process skills in the CAPS document or is it something from America or Europe?"*

The interviewer informed her that they are in the CAPS document and provided an example of process skills (measuring). The teacher said that she does not know them.

- iii. How do you feel about teaching science to early primary school learners?

Response: *"From a religion point of view, it is a bit early to introduce science to Foundation phase learners. Science tends to be against Christianity, and learners at this age like to ask 'why' and finding out more about things. So, they can easily get confused and stop believing in God".*

According to teacher 1, teaching science to young learners could confuse them and prevent them from accepting religious teachings.

Teacher 2

This was a male teacher who held a Bachelor of Education (B.Ed.) degree and had a 3-year Foundation phase teaching experience. The following texts display his responses to interview questions.

- i. How would you describe science as a concept, to someone who does not know what it is?

Response: *"Science is a way of life, it makes things easier for people. Science is innovation, changing the world and coming up with new technologies to make life easier and better. Science is everywhere, and it is in everything; in medicine, our food, our clothes, just about anything is made with science, even life".*

This teacher seemed to know the benefits and products of science, but he did not refer to the nature of science and its processes, in his description of science.

- ii. What is your understanding of science process skills? Provide examples to clarify your response.

Response: *"Skills are basically what you should be able to do, like read and write; and a process is a continuous thing, something that goes on. So, what they should always be able to do in science is to read, write, calculate and estimate. You know! The teacher appeared to have limited understanding of science process skills.*

- iii. How do you feel about teaching science to early primary school learners?

Response: *I think science should be taught very early in school. I mean, look at the rest of the world; science is introduced to learners at a very young age. In places like China, they start in pre-school to make electric houses and cars, while our (South African) learners only really start to engage fully with science in grade 4, which disadvantages them a lot. If you only start to learn something at age 10, you won't really like it, as you will feel like it is just a subject that you need to learn to pass, and with science, your attitude determines your outcome.*

The teacher seemed to advocate for early introduction of learners to science, to motivate them to love and appreciate it, as well as to perform well in the subject.

Teacher 3

The third participant was a female teacher holding a Teaching Diploma and an Advanced Certificate in Education (ACE). She had 10 years of primary school teaching experience, but she indicated that she is not a science person, therefore she was not sure whether she was the right person for the interview. Below are her responses to interview questions.

- i. How would you describe science as a concept, to someone who does not know what it is?

Response: *"Science as a concept is broad; it can be anything, which is why we have different sciences, such as; social sciences, financial sciences, medical sciences and even technological science. It depends on the context. If you are dealing with a sick person you need medical science to heal the person, but if you are battling with finances you also need financial science to help you".*

When requested to focus on the natural science taught in Foundation phase, she responded that; *“Natural science is self-explanatory, it is about the science of natural things. So, it is about anything that is natural”*. She gave an example of plants as one of the natural things. Teacher 3 seemed to understand science broadly, as she could not provide a specific description of science.

ii. What is your understanding of science process skills? Provide examples to clarify your response.

Response: *“Science process skills? I’m not sure! Are they in the CAPS document? I only know processed materials”*. The teacher reiterated that she does not know science process skills, after the interviewer had clarified the question.

iii. How do you feel about teaching science to early primary school learners?

Response: *“To be honest, I don’t have any feelings about science teaching. The department says we must teach it, so I teach it, so that I can get my salary as a teacher. Besides, my learners do not really like studying science, as they prefer to go out on the ground to play”*.

When encouraged to provide her opinion regarding the teaching of science at early primary school, she said learners should learn science that is relevant to their daily lives, such as how to prevent influenza, how to farm, and traffic rules, instead of reciting what scientists discovered a long time ago.

Teacher 4

The fourth teacher held a Bachelor of Education (B.Ed.) degree in foundation phase teaching, with 6 years teaching experience. She was a head teacher in a Foundation phase programme, and she admitted that she lacked science knowledge. She responded to the interview questions as follows.

i. How would you describe science as a concept, to someone who does not know what it is?

Response: *“Science as a concept? Mmmh, Eish! I’m not sure, but I would say science is something that is against religion. It is for independent thinkers and doers, who do not believe in the existence of God. It is for people who create things for themselves not depending on God. Science and religion are a total contradiction”*. This participant had very little understanding of science as implied by her response, and she also believed that science contradicts religion.

ii. What is your understanding of science process skills? Provide examples to clarify your response.

Response: *“Mmmh! to be honest, I have no understanding of them. Are they in the CAPS document? Wait! Science skills are lab-based. I think mixing things and knowing the names of the mixtures”*.

The teacher did not know science process skills, and like the other teachers, she did not know that they are part of the Foundation phase science curriculum, which she is expected to implement.

iii. How do you feel about teaching science to early primary school learners?

Response: *“Personally I think science in the Foundation phase should be taught, but should be kept to a minimum, because Foundation phase teachers are not taught science in depth or even the basics, in teacher training institutions, where much emphasis is placed on numeracy and literacy. Teachers are not miracle workers, they cannot teach what they do not know. In addition, she stated that; “Young kids are easily influenced. For example, when they watch a movie, they believe everything happening there, as they cannot differentiate between real life and fantasy or fiction. So, it’s best to wait before teaching them too much science, which might confuse them”*. From her response, it could be assumed that teacher 4 equates science to fantasy or fiction and believes that it could mislead young learners.

7. Discussion and conclusion

Three main findings emerged from the study, the first is that the participating teachers had very little understanding of what science entails. They perceived science as something done by people who do not believe in God. Three of the teachers declared that they do not have science background, which is worrying since these teachers, who lack knowledge about science, are entrusted with the responsibility of introducing and motivating learners in the study of science (Coil, Wenderoth, Cunningham & Dirks, 2010).

The second finding is that the participants had no or had little knowledge of science process skills, and they were not even aware that these skills are prescribed in the curriculum they were implementing. This is disturbing because science process skills are used in science to study natural phenomena. It is unlikely that teachers who are ignorant of these skills would develop them in their learners and use them to teach science effectively (Abungu, Okere & Wachanga, 2014). Early primary school teachers’ lack of science knowledge has been highlighted in literature both in South Africa (Beni, Stears & James, 2012) and elsewhere (Wang, et al., 2011). This deficit might partly account for learners’ lack of motivation to study science or their poor performance in science related subjects (Shidiq & Falkhmta, 2020).

The third finding is that three of the participating teachers had negative attitudes towards the teaching of science in early primary school. This poses the pertinent question of whether these teachers introduce young learners to the study of science, adequately. Interestingly, the teachers seemed to believe that science contradicts religion, and that it could therefore negatively influence young people’s belief in God. This view of science seems to emanate from the belief, by some religious sectors, that science and religion advocate conflicting positions on how reliable knowledge can be obtained (Billingsley, et al., 2016).

The findings from this study are worrying, given the fact that early primary science is envisaged to lay the foundation for learning science at higher educational levels. If teachers have a poor understanding of science and its processes, and they have negative perceptions about the teaching of science to early primary school learners, then they are not likely to introduce science to learners adequately or to motivate them to study science and to take up science related careers in the future (Ualesi & Ward, 2018). This could partly explain the poor performance of most South African learners in science assessments (Pretorius, 2014).

The findings from this study are important in view of the need to develop scientific skills and to motivate in young learners in the study of sciences. The findings have implications on the training of early primary school teachers, who might not be sufficiently prepared to effectively introduce young people to the study of science, and to prepare them for future science education and careers. However, the number of participants in this study was very small (four teachers) and all the participating teachers taught in peri-urban (township) schools. Therefore, the findings from the study might not be a true reflection of the ability and perceptions of early primary school teachers in Johannesburg or in South Africa as a country.

8. Recommendations

I recommend the inclusion or strengthening of science education programs in early primary school teacher training institutions. I further recommend regular professional development workshops for in-service primary school teachers, to enhance their understanding of the nature of science and science process skills. Furthermore, there is need to conduct similar large-scale studies, to either corroborate or nullify the findings from this study.

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