EARLY YEAR TEACHERS' UNDERSTANDING AND IMPLEMENTATION OF SCIENCE PROCESS SKILLS

Ayodele Ogegbo[1], and Umesh Ramnarain[2]
[1,2]Department of Science and Technology Education, University of Johannesburg (South Africa)

Abstract

The quality of South African learners' performance in science and mathematics continues to remain poor as reflected in National and International assessments. However, it is believed that learners' poor performance in these subjects could be attributed to their weak and/or disproportional exposure to science instructions during early childhood development. The research objective of this study was to explore teachers' understanding and implementation of science process skills (SPS) in the early years. Accordingly, data were collected using a qualitative research design of one on one interviews and lesson observations with eight Grade R teachers that were purposively and conveniently selected. The result showed that though participants believe it is important to start teaching science to children in the early years, most of them don't have an adequate understanding of the science concepts in the Grade R syllabus. Though teachers engaged learners in activities that allowed them to observe, describe, measure, classify, predict and communicate ideas during the observed lessons, most of the teachers were unable to describe SPS. However, six of the teachers attributed their ability to demonstrate the process activities to years of experience and indicated that the teaching qualification they have did not accurately prepare them to teach science in the early years. Besides, teachers expressed a low level of confidence and competency in planning and demonstrating science activities in the early year classrooms.

Keywords: *(Early childhood education, Early year teachers, Early years science, Science Process Skills, max. 5, separated by commas) (Times New Roman, 10 pt., italic, justified).*

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1. Introduction

Science and Technology pervade nearly every aspect of everyday life and lays claim to addressing existing and future economic, environmental, education and associated global problems. The Next Generation Science Standards (NGSS) of the United States suggests that the key goals of science education are to enable learners to investigate, feed their curiosity, improve their understanding of scientific practices, promote their cognitive and analytical skills in understanding the natural world (National Research Council (NRC), 2012). To accomplish this aim, teachers must focus on teaching learners how to think within a scientific framework. In this regard, many countries have adopted common standards for the improvement of science education and learning outcome to compete in the global economy (DeBoer, 2011). Despite the renewed efforts to set high standards for learning outcomes in science education, South Africa continues to suffer from challenges associated with learners' low level of confidence in their ability to solve science problems. This is evident in international studies like TIMSS where South African learners performed poorly in science and mathematics as compared to other countries (Reddy, Visser, Winnaar, Arends, Juan, Prinsloo, & Isdale, 2016). Furthermore, South Africa has a history of progressing learners from one grade to the other with a pass mark of 30% in science and mathematics (Van Staden, & Motsamai, 2017), this, in turn, influences the quality of learners' performance at National assessments (Seo, 2018).

Research attributes learners' poor confidence in solving science problems to weak nurturing and development of scientific knowledge and skills during early childhood development (Letaba, 2017). Worth (2010) establishes the increasing awareness and belief that science is an important area for developing effective learning skills and attitudes in the early years. In this regard, the National Science Teachers Association (NSTA) of the United States affirms that teaching and learning science in the early years lays the foundation for fostering the interest, enthusiasm, and trust of learners in solving problems as they advance in their education and career lives (NSTA, 2014). Nonetheless, many South African learners are not exposed to science activities in the early years, because of the confining of science topics

within Life Skills' subject in the foundation phase curriculum (Minnaar, & Naude, 2016). Thus, many early year teachers tend to limit children's chances to study science and many children tend to use their childlike interpretations of scientific phenomena, since they are not exposed to activities that allow them to objectively learn, see and understand their environment (Minnaar, & Naude, 2016). Although the importance of science education in the early years is been globally stressed by researchers and educators (Worth, 2010), its practice seems to be limited and problematic within the South African context. Hence, this study explored teachers' perspectives on science teaching and science process skills (SPS) in the early years. More specifically, the following research question guided this study:

1. What are teachers' understanding and implementation of science process skills in the early year classroom?
2. What are the perceived factors that influence teachers' understanding and implementation of SPS in the early year classroom?

2. Conceptual Framework

"Science is both a body of knowledge that represents the current understanding of natural systems and the process whereby that body of knowledge has been established and is continually extended, refined, and revised. Both elements are essential: one cannot make progress in science without an understanding of both. Likewise, in learning science, one must come to understand both the body of knowledge and the process by which this knowledge is established, extended, refined, and revised" (Duschl, Schweingruber, & Shouse, 2007, p. 26). Thus, Irvanto, Rohaeti, Widjajanti & Suyanta (2017:1) described SPS as "cognitive and psychomotor skills" that children use in exploring and "solving problem" in the world around them. SPS could be basic or integrated, and it includes indicators such as observing, measuring, sorting/classifying, inferring and predicting, communicating information, hypothesizing, experimenting, controlling variables, and representing data (Worth, 2010; Irvanto et al., 2017). This implies that SPS is a vital outcome in science education across all levels of learning and it is required as a useful skill in enhancing learners' critical thinking (Irvanto et al., 2017). Since these skills enable learners to formulate questions and find out answers systematically, they become important in supporting children's basic abilities for learning science, mathematics, and language literacy in early childhood (Worth, 2010). Thus, a teacher's awareness and understanding of process skills and science content in the curriculum becomes very crucial to the development of SPS in young children. With regards to this study, teacher's understanding and implementation of science in the early years is explored based on the development of teaching/play activities using SPS indicators. It is assumed that classroom implementation of these processes would stimulate teachers' autonomous recognition of relationship with the children.

3. Method

A qualitative research paradigm (Creswell, & Creswell, 2017) was adopted, as the study aimed at investigating the understanding and implementation of science process skills (SPS) by teachers in the early years. Eight Grade R teachers from four different schools in an inner-city of South Africa were involved in this study. The rationale for using a multiple case design was to inform the case by generating possible outcomes for predetermined reasons on how teacher's interpretation of SPS relates to the nature of science teaching and learning in early childhood classrooms. The mean age of participants was 39 years with the youngest being 23 and the oldest being 60. All eight participants were females with teaching experience ranging from two to twenty years as shown in Table 1. The sampled schools have inadequately resourced science corners. Two methods of data collection namely: one on one interviews and lesson observations were used. The different methods of data collection employed in this study provided researchers the ability to evaluate and examine observed lessons and then modify the teacher interview procedure to provide more clarity and follow up on important responses and findings (Corbin & Strauss, 2015). Data collected from participants were analyzed using content analysis of direct, selective, and condensed codes (Erlingsson & Brysiewicz, 2017).

Table 1. Biographic Information of participants

School	*Participants (Teacher)*	*Age*	*Qualification*	*Teaching experience (Years)*
S1	T1	27	National Diploma in Educare (N6)	3
	T2	23	Bachelor of Education (Early Childhood Development).	2

S2	*T3*	*43*	*Diploma in Human Resource Management*	*9*
	T4	*35*	*National Diploma in Educare (N4)*	*6*
S3	*T5*	*32*	*Diploma in Grade R teaching*	*9*
	T6	*42*	*National certificate*	*6*
S4	*T7*	*53*	*National Diploma in Educare (N6)*	*20*
	T8	*60*	*Diploma in Primary education*	*25*

4. Findings

To explore teachers' perspectives of SPS in the early years, it is believed that teacher's awareness of the importance of teaching science in the early years could influence their understanding and implementation of SPS in Grade R classroom. The discussion reflects two key ideas based on patterns arising from data analysis. These are the teachers' awareness of science concepts in the Grade R syllabus which included their understanding of SPS, and challenges influencing teachers' implementation of SPS.

4.1. Teachers' awareness of science concepts in the Grade R syllabus

It was evident from the interpretation of interview responses that all participants believe that teaching science in the early years plays a significant role in preparing children for future challenges in the academic endeavor. This was obvious from their answers to a question that explored teachers' awareness about the value of teaching science in the early years and how they teach science in their classrooms. According to their responses, T5 believes that teaching science at a younger age "brings interest to the young child because they learn to experience science more and more". Here the participants focused on fostering learners' interest in science at an early age. Furthermore, T5's perception to science teaching in early years was similar to those of T7 and T8, as they also indicated that exposing children to science in early years develops their interest in the subject and help to overcome the common perception of science as a difficult subject among South African learners. T2 mentioned that teaching science in early childhood exposes children to basic information required for understanding their environment. However, further explanation on how participants teach science in their classrooms revealed that five of the teachers do not have an adequate understanding of science concepts that are included in the life skills subject taught in the Grade R curriculum. For example, T1 indicated that if children are taught science in early childhood, "they get the opportunity and foundation on how to explore things and when they grow it becomes part of them, but erm, I don't really teach science to these children. Though sometimes I just take them outside to show them some plants and let them feel or see it". Here, T1 seems not to be sure if teaching plants was part of science even though she engages children in activities related to growing plants.

4.1.1 Teachers understanding of science process skills

Since science process skills are regarded as important outcomes in science education. Thus, participants were required to explain their understanding of science process skills and identify the SPS indicators that they practice in class. SPS according to T6: "Hmmm...my understanding is like...maybe children ability to take time to understand what I am teaching and sometimes they understand their way, not the way I expect them to understand". This implies that T6 lacks an adequate understanding of what SPS entails. However, during her explanation on SPS indicators practiced in her class she said: " For instance when I use blocks, I do tell the children to sort out the blocks according to colours, and in so doing, the children get to first observe the different colours available and then they can build their ability to classify". T7 however, believed that SPS entails -

> "teaching them how to weigh different things, observing like for instance when we are dealing with different plants, growing plants…. you see, I teach them how to observe plants (when they are dead, when they start to grow and sometimes we can plow a bin and see how it grows up…if we put in the shade it won't grow because it needs sunrays to make it grow)….The see and experience it for themselves".

This implies that T7 teaches measuring and observation as SPS indicators as explained in her response, which was also observed during her lesson presentation on colour mixing. T7's response relates to that of T5, where SPS is seen as allowing children to observe, communicate ideas, draw conclusions and sort out things according to shapes or colours. This was indicated when T5 said "Most times I explain to kids what they are expected to do first before carrying out the task, as a teacher I carry out the activity in their

presence, then ask them questions such as did you see what happened, then I allow the kids to explain to me what they have seen that just happened ….this will allow me to know if they understand what I am teaching. I allow them to see what they want they want to do and before finishing the whole thing, I ask them about their thought…as in what they think is going to happen if I do one thing or the other. Nevertheless, during the interview, the other five teachers were not able to give a definite description/explanation of their understanding of SPS. However, analysis of observed lessons revealed that all teachers engaged learners in activities that allowed them to observe, describe, measure, classify, predict and communicate ideas during their lesson presentation. For instance, during T1 and T8's lesson on my body, learners were required to interact with one another using pictures of body parts displayed on the board to identify and describe parts of their own body. From another point of view, during T3 and T6's lesson presentation on my environment, children were given a task to draw their school. In this regard, they were expected to use the teacher's example to identify objects in their diagram, sort out the different shapes in the diagram using specific colours and describe their drawing using specific attributes.

4.2. Factors influencing teachers' understanding and implementation of SPS in the early years.

Analysis of participants' responses during the interview and lesson observation revealed a lack of confidence and competence in planning and demonstrating science activities as a factor influencing teachers' understanding and implementation of SPS in the early years. Some of the teachers attributed their lack of confidence and poor competency to a lack of learning resources. For example, T3 said "teaching science and this SPS is not difficult but the problem is we don't have any resources to teach the children. So, it becomes difficult for a teacher like me to plan a science activity effectively". This statement was also established by T7 when she said, "you see, teaching science to young children is not about talking, and though schools might not have enough resources for science teaching, teachers need to be creative around the lesson they want to teach". She believes that most teachers don't know how to implement science concepts for young children and teachers' ability to improvise resources serves as a way of building confidence and competency in science teaching.

The second challenge affecting teachers' confidence and competency as revealed in this study is poor background knowledge in terms of science content and pedagogical knowledge. For instance, T8 indicated during the interview that teaching science is very challenging because "I did not get enough exposure in terms of the various methods to use to help young children understand a lesson better, and I don't even attend professional development program/workshop. So it is affecting me as a teacher because I just teach my lesson based on the available topics covered in the textbooks we use". T1's response was similar to T7's view on teachers not knowing how to teach science in the early years. Early year teachers who find it difficult to teach science are not aware of the various teaching strategies that can be used to scaffold science activities for young children. T8 indicated that she also struggles with planning certain activities because she was not exposed to science content during her education program. She further explained that the kind of academic training she received was not okay to teach science subjects in the early years. Given T8's response to academic qualification, six of the teachers however indicated that their experience over the years had greatly contributed to the science activities and process indicators that were implemented in the observed lessons. For instance, T5 said "You see, I believe my academics came in later. It is my experience that made me interested in getting the certificate which I believed I did just to back me up. In the real sense of it, my experience contributed a great deal to the knowledge and approach I now use in teaching science-related activities to young children".

5. Discussion and Conclusion

The data findings, in general, revealed that participants are receptive to teaching science in the early years but did not feel qualified and/or confidence to teach science due to their academic qualification, and lack of resources. Though a majority of the participants are qualified early year teachers according to South Africa's qualification framework, it was observed that their qualification did not adequately prepare them to meet the needs of science teaching in early years classrooms. It is believed that early year teachers do consider themselves confidence and competent in teaching science when science corner within the school/classroom is equipped with rich teaching materials, visual materials and hands-on activities that can be used to teach science concepts (Dogan & Simsar, 2018). Findings also revealed that years of teaching experience was found to be associated with participants' awareness of science teaching, and implementation of SPS indicators as observed in their classroom practice, but not on their understanding of SPS. Science process skills of observing, and communication was commonly found in all the observed lessons, only two of the teachers implemented measure, classify, predict and communicate.

To encourage the development and implementation of science literacy in the early years, findings from this study suggest emphasis be put on developing early childhood teachers' conceptual and operational understanding of SPS during teacher education programs. Also, education stakeholders, childcare workers, policymakers and ECD practitioners should be actively involved in the formation and maintenance of support structures that enhance early year teachers' science knowledge and practice. This will help improve the quality of early year teachers in enhancing learners' participation and growth in science education within the larger South African context. Furthermore, engaging children in inquiry projects and more hands-on play activities that are scientifically oriented at a very early age may also lead to improving the quality of early childhood education in the country.

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