**Journal of Childhood, Education & Society**
Volume 5, Issue 2, 2024, 283-293
DOI: 10.37291/2717638X.202452387

ISSN: 2717-638X
Research Article

# Engagement of science process skills for teaching science concepts in early childhood

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**Abstract**: This study aimed to explore how early childhood teachers engage science process skills for teaching science concepts in early childhood settings. Social constructivist theory was employed as the guiding framework for this study. Four Grade R teachers were purposefully selected and engaged through qualitative research methods. Data generation was informed by semi-structured interviews, classroom observations, and document analysis. Thematic data analysis was used to unpack the aim of the study. Results reveal that the low engagement of science process skills by participants was strongly influenced by their limited knowledge of content and science process skills when teaching the concepts. This finding implies that the training of early childhood teachers needs to improve and be supported with continuous development programs. This finding may inform teacher training programs and curriculum development efforts geared toward improving science education in the crucial early years of a child's academic journey.

**Article History**
Received: 29 January 2024
Accepted: 07 July 2024

**Keywords**
Early childhood; Science concepts formation; Teaching and learning science; Teaching experiences

## Introduction

This research centers on the learning of science in Early Childhood Education (ECE), with a specific focus on the science process skills instilled by Grade R teachers to facilitate learners' understanding of floating and sinking concepts. Grade R is a crucial component of the Foundation Phase, commonly referred to as ECE (South Africa Department of Basic Education [South Africa DBE], 2011). Grade R is shortened from Reception Grade, and its primary objective is to prepare preschool learners for a seamless transition to Grade 1 in primary school (Lesotho Ministry of Education and Training [Lesotho MoET], 2021). During this phase, Grade R learners receive formal instruction in a classroom setting, adhering to structured learning plans aligned with the prescribed curriculum. They are expected to comply with classroom rules for easy facilitation of the implementation of structured lessons. These lessons encompass mathematics, languages, and life skills, incorporating science concepts through play-based activities (South Africa DBE, 2011).

The integration of science, technology, engineering, and mathematics (STEM) education has propelled science learning in ECE, emphasizing the consensus that science education should commence as early as preschool (Schmitt et al., 2023). This approach advocates for appropriately structured learning facilitation. In this regard, teachers play a crucial role in supporting children's learning through a combination of content knowledge and pedagogical content knowledge (Shulman, 1986). Nevertheless, Kazeni (2021) highlighted that early primary school teachers may be inadequately prepared to support young children, especially in STEM fields (Schmitt et al., 2023). This inadequacy poses a concern regarding the development of science concepts through the application of science process skills.

The term *science process skills* is defined as a collection of versatile abilities applicable across various

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science disciplines and reflective of scientists' conduct (Mulyeni et al., 2019). Early primary school teachers leverage these skills to guide learners in making observations; posing questions; utilizing tools for data collection, analysis, and interpretation; formulating tentative conclusions; and sharing and communicating scientific findings effectively (Naudé & Meier, 2020). This approach facilitates the development of learners' science process skills, encompassing basic skills such as communication, observation, classification, prediction, measurement, and inference during science instruction (Karademir et al., 2019; Mostert, 2018; Yildiz & Guler Yildiz, 2021). Young children, characterized by their inherent curiosity, naturally gravitate toward exploring the world around them (Roberts, 2021) using science process skills. When guided by teachers possessing ample science content knowledge and adept science process skills, these young learners emulate the behaviors of genuine scientists (Naudé & Meier, 2020), which is crucial in their education.

Early childhood teachers play a pivotal role in nurturing learners' comprehension of science concepts through science process skills, facilitating the integration of new knowledge, and encouraging the application of these skills when learning. In the observation phase, learners are encouraged to employ their senses to make informed decisions based on analytical thinking (Mulyeni et al., 2019). Additionally, teaching science concepts involves integrating other essential process skills such as estimating, counting, collaborating, recording, making generalizations, and problem-solving (Yildiz & Guler Yildiz, 2021). Stears et al. (2019) expressed concern by highlighting limitations in early primary school teachers' content delivery due to a lack of science process skills. As a result, Yildiz and Guler Yildiz (2021) suggested that many learners appear to rely on their naïve explanation of science concepts, attributed to challenges with teacher preparation or curriculum instruction.

Developing science process skills is essential for societal progress, highlighting the necessity of introducing these skills early in learners' education (Limatahu et al., 2018). The acquisition of these skills through learning experiences empowers learners to master science processes (Kazeni, 2021), equipping them to address everyday challenges (Schmitt et al., 2023). Furthermore, these skills cultivate creativity and instill positive attitudes toward science learning among learners (Limatahu et al., 2018). Engaging in science process skills during the early years emerges as a strong predictor of subsequent academic success in science for learners (Saçkes, 2014). As such, they need to be capacitated with the necessary guidance when embarking on the learning of concepts (Trundle & Saçkes, 2021).

Despite the widespread acknowledgement of the importance of teaching science in the early years, there exists a noticeable gap in the discourse regarding Grade R teachers' employment of science process skills for effective teaching. The prevailing focus tends to concentrate on the science process skills of early primary school teachers (Kazeni, 2021; Stears et al., 2019), with limited attention given to how the teachers engage these skills to facilitate the grasping of content knowledge by the learners. Consequently, it becomes crucial to delve into the experiences of Grade R teachers in developing science process skills in their teaching of science concepts, especially in Lesotho where such a phenomenon has not been explored. The accompanying aim is to contribute valuable insights to the existing body of literature. To guide this study, the following research questions have been expressed:

a) What is the understanding of science process skills by Grade R teachers?

b) How do Grade R teachers engage in science process skills when teaching science concepts?

**Theoretical Framework**

This study engaged social constructive theory developed by Vygotsky (1978) as a lens to explore the experiences of Grade R teachers when engaging science process skills in the teaching of science concepts. Vygotsky (1978) argued that "[e]very function in the child's cultural development appears twice: first, on the social level and, later on, on the individual level" (p. 57). This means that learners construct interpersonal knowledge of concepts through meanings and structures promoted by their peers or teachers. In that way, they are motivated to complete tasks in a meaningful and constructive way. During teaching and learning, teachers' knowledge is transferred to learners when learners first conceptualize what should be known. They relate new knowledge to the previously acquired knowledge, and then internalize, store, and socially mediate it. They do that through the teacher posing questions or helping them to construct meaning and solve problems. This theory guided us to observe and ask questions that elicited data on the experiences of teachers when engaging science process skills for their learners to understand the concepts of floating and sinking.

**Literature**

The literature review in this study is organized based on the teaching of science and science process skills taught in ECE.

***Development of Science process Skills in Early Childhood***

The development of science process skills is essential for understanding science concepts in ECE (Mulyeni et al., 2019). The skills have been demonstrated to be effective in enhancing learners' learning of scientific approaches (Dilek et al., 2020). This suggests that active engagement of learners in science process skills such as observation, classification, and inference contributes significantly to their science understanding. Sutiani (2021) emphasized that when science process skills are effectively taught in a well-prepared science environment, that establishes the groundwork for young learners to acquire scientific knowledge, content, and skills.

Engagement of these science process skills in different contexts of the world has yielded positive results, while some limitations have also been observed in certain areas. For illustration, in Zimbabwe, Pakombwele and Tsakeni (2022) found that Early Childhood Development (ECD) teachers were familiar with science process skills, including observation, classification, communication, measurement, prediction, comparing, and inference. They also concluded that the most effective way to teach science process skills is through child-centered methods, including explorations, play, experiments, and guided discovery. These approaches foster active participation among learners.

In the context of preschool education in Türkiye, Kuru and Akman (2017) indicated that the teaching of science plays a crucial role in imparting to learners science skills that are pertinent for advancing the economic growth of the country. Accordingly, students undergo instruction in science process skills to enable them to proficiently predict, discuss, describe, explain, and evaluate information embedded within science content. Likewise, in Nigeria, science holds a pivotal position as a subject integral to industrial development, and the instruction of science skills serves as a means of providing young learners with pertinent science knowledge, content, and skills essential for the demands of the twenty-first century (Leedy & Ormrod, 2013). In addition, in Indonesia, Mulyeni et al. (2019) observed a positive outcome following the implementation of an inquiry-based approach as an intervention to enhance fundamental science process skills among second graders when learning science concepts.

However, South African studies by Stears et al. (2019) and Kazeni (2021) scrutinized the comprehension of science concepts and science process skills among early primary school teachers. The findings indicate that the teachers under investigation demonstrated limited knowledge in these domains. The teaching of science in ECD classrooms is undeniably significant. Therefore, it becomes crucial to explore the engagement of science process skills in the teaching of science concepts in the Grade R classes of Lesotho with a focus on the concepts of floating and sinking, which have not been explored by previous studies.

***Science Process Skills in the Early Years of Schooling***

Science process skills encompass both physical and mental abilities that involve collecting and organizing information in various ways (Mulyeni et al., 2019). These skills are applied in predicting, explaining phenomena, and solving problems (Naudé & Meier, 2020). They play a crucial role in processing new information during concrete learning, facilitating the construction of new concepts and a deeper understanding of science (Pratamawati, 2022). They mirror the techniques employed by scientists in their research endeavors (Karademir et al., 2019; Naudé & Meier, 2020).

There are two distinct categories of science process skills: basic processes and integrated processes (Mulyeni et al., 2019). Basic science process skills include observation, classification, measurement, inference, prediction, and communication (Naudé & Meier, 2020). On the other hand, integrated science process skills involve tasks such as identifying and controlling variables, formulating and testing hypotheses, interpreting data, defining operationally, experimenting, and constructing models (Karademir et al., 2019). The focus of this study is on basic skills only because they form a base for the early learning of science concepts. The approach to teaching science using science process skills to actively involve young learners is important because retention of content and interest to learn will be achieved (Kazeni, 2021). However, it should be kept in mind that skills utilized in embarking on the activities should respond to inquiry-based learning and play-based activities to encourage exploration and discovery.

## Method

Based on the case study design, this study followed a qualitative approach to understand Grade R teachers' views and experiences in their engagement of science process skills in teaching the concepts of floating and sinking. This design is supported by the interpretive paradigm because data were generated from participating teachers in their respective schools (Creswell & Creswell, 2018). Each participant's explanation of science process skills, the application of the skills in teaching and learning, and the enhancement of learners' understanding helped to explain their understanding and knowledge of skills. Henceforth, the design was adopted.

To address issues of transparency, clarity, and reliability, several strategies were employed. Triangulation, which involves using multiple data collection sources, increased the rigor and trustworthiness of the research findings (Creswell & Creswell, 2018). This included interviews, observations, and lesson plan analysis to ensure consistency and reliability. Another strategy to build credibility was member checking, a powerful tool that validates the accuracy of the data and fosters a collaborative relationship between the researcher and the participants (Cohen et al., 2018). This process allowed participants to clarify or expand on their experiences, enhancing the richness and depth of the data. Peer debriefing was also used to enhance the credibility of this research (Creswell & Creswell, 2018). This study is derived from a larger project and was guided by experts who evaluated the research process and findings to ensure due diligence and rigor.

### Participants

The study population comprised early childhood teachers who had obtained a Certificate in Early Childhood Education. Four Grade R teachers from four different schools were purposefully chosen, guided by the notion that their attributes aligned with the desired data (Cohen et al., 2018). To illustrate, these participants actively engaged in teaching Grade R learners within schools situated in the Maseru district of Lesotho. Additionally, the selection criteria included teachers with more than five years of experience, as guided by Teffo (2020), who posited that experienced teachers possess a wealth of content knowledge. Moreover, Barenthien et al. (2020) asserted that a teaching certificate obtained from a teaching college equips educators with the necessary curriculum content for effective teaching. This reinforces the rationale for specifically focusing on Grade R teachers with this qualification, underlining their preparedness to handle the curriculum demands in the context of ECE. Participants' names were not used throughout this research; rather, pseudonyms were used to conceal their identities.

### Data Collection

Semi-structured interviews were employed to elicit comprehensive insights from participants. Conducted on a one-on-one basis, these interviews were designed to extract specific information from participants regarding their understanding of science process skills engaged when teaching the concepts of floating and sinking. Each interview had an approximate duration of 30 minutes. Planned interview schedules facilitated focused questioning, enabling the researcher to actively listen to responses and make appropriate field notes. Additionally, permission was obtained to audio record the interviews, aligning with ethical considerations (Creswell & Creswell, 2018), thereby capturing participants' perspectives with fidelity.

Observation served as another valuable instrument for data generation. Participants were observed and their lessons were recorded in their respective classrooms while teaching learners the concepts of floating and sinking. Attention was on discerning how participants employed science process skills to convey content effectively. To achieve this, an observation grid was prepared, allowing systematic commentary on each process skill employed during instruction. The use of observation served a dual purpose. Not only did it provide a method for triangulating participants' views, but it also facilitated an examination of their classroom practices in terms of fostering the development of science process skills in teaching the concepts of floating and sinking.

Lesson plans as the third source of were used to enhance the reliability of the study. This was achieved by utilizing Creswell and Creswell's (2018) perspective on documents as a "stable" and manipulable source of information. In conjunction with observation and interviews, the analysis focused on participating Grade R teachers' lesson plans, particularly those covering the concepts of floating and sinking. The examination specifically assessed planned activities to determine the incorporation of science process skills. Permission was sought to photocopy participants' lesson plans for reference during home-based data analysis. This methodological approach enriched the study by offering a holistic perspective that combined participants' insight with their practical application in the teaching environment.

**Data Analysis**

The analysis of the data commenced with a comprehensive analysis of the audio-recorded interviews, observation grids, and lesson plans. Initially, we immersed ourselves in the data by actively listening to the audio recordings and thoroughly reviewing the written documents. This approach, aligned with Coolican's (2017) guidance, underscores the significance of gaining a profound understanding of participants' statements and actions. Subsequently, the data underwent transcription to facilitate thematic analysis, employing an inductive approach. Multiple readings were conducted to identify recurring themes across data from all participants. These emergent themes were then organized based on conceptual similarities, and each cluster received a distinct code. The manual coding process involved a meticulous review of written documents using highlighters and pens.

After the initial coding, these codes were structured into coherent themes that directly addressed the research questions. A rigorous review and refinement process ensured that these themes aligned seamlessly with the study objectives. This meticulous procedure resulted in a descriptive and narrative synthesis of the data, enabling the formulation of informed conclusions and interpretations.

**Ethical Considerations**

Ethical considerations were meticulously adhered to throughout the study. Initially, ethical clearance was obtained from the university of the Free State Ethics Committee overseeing the research. Subsequently, approvals were sought from both the Ministry of Education and Training (MoET), Lesotho and the respective school principals, securing the necessary permissions to carry out the study within their educational institutions. In the recruitment process, participants were invited to participate voluntarily, ensuring their informed consent. They were explicitly assured of their right to confidentiality, anonymity, and the freedom to withdraw from the study at any point if they chose to do so. To safeguard participants' identities, pseudonyms were employed, concealing their real names and enhancing the overall confidentiality of the research. This multifaceted approach underscores the commitment to ethical integrity, establishing a foundation of trust and respect for the participants involved in the study.

## Results

This section presents the findings on how participants explained and engaged science process skills in their teaching of floating and sinking concepts to their preschool learners. The following responses were gathered from the participants and are presented under the themes that were generated from the research questions.

**Theme 1: Understanding of Science Process Skills**

Participants were asked to explain their knowledge of skills involved in learning science. From their responses, it was gathered that they had little understanding of science skills. Two of the participants seemed to understand the word *skill*; however, their explanations were not relevant to science skills. Their explanations are captured as follows:

> Skills are things that you can do. In language, we talk about reading and writing. As for science process skills – I do not know (laughing). (Pinki)

This participant seemed to know skills related to language, but not science process skills. Another participant, Thando, responded: "*Science process skills are when you are good at science.*" She regarded being good at science as science process skills. The other two participants lamented not knowing the skills involved in science. Pula said that she had no idea about skills in science learning, as follows: "*Process skills? I have no idea!*". Sbaby said that she had never heard of science skills.

The researcher had to probe more based on the common concepts dealt with in Grade R, which are floating and sinking. The following question was posed: *If you are to teach floating and sinking concepts, what skills will you engage?* Participants responded as follows:

> As they are learning, they will gain communication skills because they will be communicating; maybe they will get new words from that, they are going to observe, they are going to experiment. (Pula)

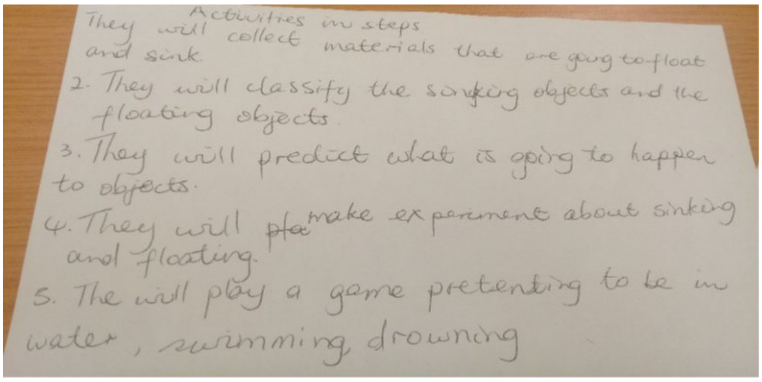
> Oh, they will be observing, right? Then when we are done with their activities, we sit down and discuss things that float and sink. (Pinki)

Pula mentioned communication and observation skills. Pinki mentioned observation skills only. However, it could be said that Pinki knew what she would discuss with learners, which is communication, even though she did not specifically mention it as one of the science process skills. Sbaby did not mention any skill: "*The skill that they will have will be... Eh.*"

Thando said this*: "I think it will be why things float and why some things will sink. The other one will sink because of its weight or the material it was made of, like metal.*" Thando's response was not relevant to the skills. This indicates that she had no idea what science skills were. The researcher explained to the participants what skills meant in science learning and provided examples of skills that could be used in the teaching of science.

**Theme 2: Engagement of Science Process Skills**

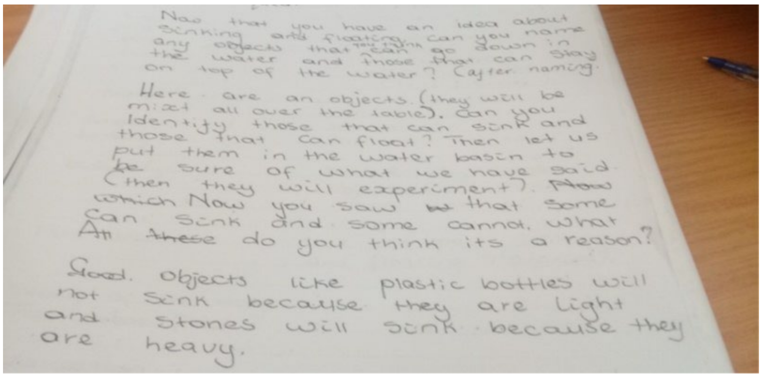
This section sought to explore, through lesson plan analysis and classroom observation, how participants in this study engaged in science process skills in their teaching. Figure 1 presents a photograph of Sbaby's lesson activities that show the science process skills she planned to engage with learners.



Activities in steps
They will collect materials that are going to float and sink.
2. They will classify the sinking objects and the floating objects.
3. They will predict what is going to happen to objects.
4. They will ~~pla~~ make experiment about sinking and floating.
5. The will play a game pretending to be in water, swimming, drowning

**Figure 1.** Sbaby's lesson activities

In Sbaby's planned lesson activities, she wrote that learners would classify objects between those that would float and those that would sink. Prediction is another skill she would expose learners to by asking them to predict what will happen to the objects. This was followed by classification. Kuru and Akman (2017) suggested, however, that after prediction, learners could be asked to observe and make conclusions, which did not happen in this case. This indicates that Sbaby was not clear on how one skill could add more knowledge to the preceding activity. Figure 2 presents a photograph of Pinki's lesson activities that show the science process skills she planned to cover.

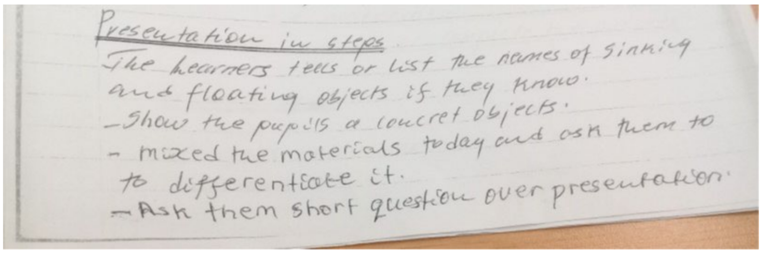

Now that you have an idea about Sinking and floating can you name any objects that can go down in the water and those that can stay on top of the water? (after naming

Here are an objects. (they will be mixed all over the table). Can you Identify those that can sink and those that can float? Then let us put them in the water basin to be sure of what we have said (then they will experiment). ~~Now~~ which Now you saw that some can sink and some cannot. what An ~~these~~ do you think its a reason?

Good. objects like plastic bottles will not sink because they are light and stones will sink because they are heavy.

**Figure 2.** Pinki's lesson activities

Pinki asked learners to share their ideas on the objects that would float and those that would sink. The communication skill was employed in the activity. Having been presented with various objects, the learners were asked to predict which ones would float and sink in water. By identifying floating and sinking objects, the learners utilized the science process skill of observation through their sense of sight, and, lastly, confirmed their predictions. Science process skills, such as observation and communication, are highlighted in this lesson. We can appreciate that the participant knew what to do with learners in the classroom, although the knowledge of how to properly instill skills in learners was not appropriately administered, as the learners were told what to do by the participating teacher. This finding does not align with Sutiani's (2021) view that learners should take an active role in learning science concepts. Figure 3 presents a photograph of Thando's lesson activities.


Presentation in steps

The learners tells or list the names of sinking and floating objects if they know.

-Show the pupils a concret objects.

- mixed the materials today and ask them to to differentiate it.

-Ask them short question over presentation.

**Figure 3.** Thando's lesson activities

Thando's lesson presentation does not explicitly show science process skills that are targeted at young learners. This affords an explanation of why she could not provide an answer when asked about the science process skills she wanted to develop in learners. Only the first activity was related to floating and sinking, as learners were expected to list the floating and sinking objects they knew, which, we could relate to communication. Pratamawati (2022) asserts that science process skills contribute to the construction and deeper understanding of science concepts. However, Thando's planning shows activities that do not engage skills that could contribute to a deeper understanding of the concepts. Figure 4 illustrates how Pula planned her lesson activities.

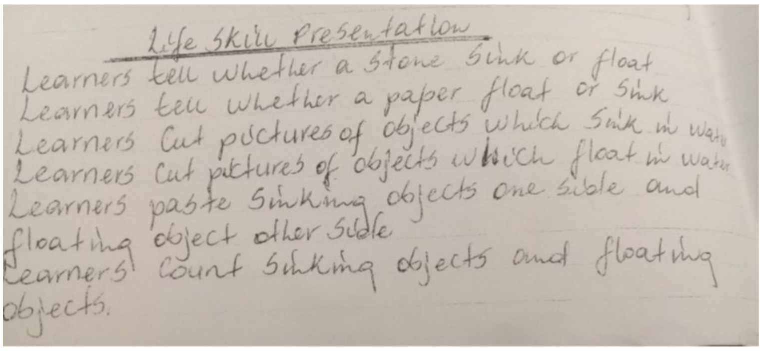

Life Skill Presentation
Learners tell whether a stone sink or float
Learners tell whether a paper float or sink
Learners cut pictures of objects which sink in wat
Learners cut pictures of objects which float in wat
Learners paste sinking objects one side and
floating object other side
Learners count sinking objects and floating
objects.

**Figure 4.**Pula's lesson activities

Pula planned to ask her learners to tell, cut, and paste objects, thus requiring them to communicate by sharing their work with their classmates. In addition, when learners count sinking and floating objects, they also communicate. Even though Pula did not specify and write the science process skills that the learners were to engage with, it seems that they were to use communication (Karademir et al., 2019).

In all the lessons observed, participants arranged tables and materials for the learners to do experiments on objects that would float and sink. Most of the participants facilitated experiments in which learners were asked to predict and classify objects according to those that would float and sink. They asked the learners to observe the phenomenon about which they had made a prediction and to observe the actual results. This corroborates the idea that science process skills are not taught in isolation (Pakombwele & Tsakeni, 2022). For illustration, Pinki asked the learners: "*Come and see which objects float and which ones sink in water.*" Learners moved closer to the experiment table to observe. She added: "*Which one do you think will float and which one will sink*?" The learners responded to her question by indicating the ones that would float and the ones that would sink. Lastly, she said: "*Classify them according to the ones that sink and the ones that float in water.*"

These instructions show that the participating teachers used science process skills in their teaching. However, they did not engage learners in a hands-on way, as is effective in the facilitation of science learning (Mulyeni et al., 2019). Vygotsky (1978) argues that learners construct their knowledge through the guidance of the teacher was minimal. None of the participants engaged learners in measuring and inferring. Instead, they told them that objects float because they are light and sink because they are heavy. In none of the classrooms observed did the learners measure the objects by comparing them even with arbitrary units. Pakombwele and Tsakeni (2022) argued that inference is one of the most fundamental skills taught to ECD learners. When given a chance to do so, learners will use their acquired knowledge to conclude the behavior of the object. Even though communication skills were used in all the classrooms, Sbaby's lesson stood out above the others because she asked learners to draw objects that float and sink and then asked them to interpret their drawings. We could see a lot of communication, active participation, and sharing of knowledge in that class.

## Discussion

The key finding of this study indicates that the engagement of science process skills was strongly influenced by the participants' limited understanding of science process skills and floating and sinking concepts. The major finding of the first theme indicates that the participants had minimal or no knowledge of science process skills. This finding is similar to that mentioned by Kazeni (2021) and Stears et al. (2019), even though their studies were not focused on Grade R teachers. It shows that teachers are not familiar with the basic science process skills (Karademir et al., 2019; Mostert, 2018; Yildiz & Guler Yildiz, 2021). Participants were not aware that science process skills are developed in the teaching of science concepts. This is worrying because the sole purpose of Grade R is to prepare learners for subsequent grades. This finding implies that learners are not active participants in their learning but are rather told facts about the concepts prescribed in their curriculum.

The second theme indicates that participants in this study had inadequate knowledge of how to engage the basic science process skills, as measurement and inference were not mentioned at all. Again, even the skills that were mentioned were not clearly explained as to how they could be engaged in the teaching of science concepts. Learners were not given opportunities by their teachers to observe using **all** their senses, a finding similar to the one indicated by Mulyeni et al. (2018). This could imply that teachers know some of the process skills but do not know how to execute them. Notably, little knowledge of science process skills could account for poor performance and decreased motivation for learners to participate in science subjects.

There are strategies to address the limited knowledge of science process skills among teachers. One effective approach is to organse professional development workshops that focus specifically on these skills and teaching strategies. Teachers can also form learning communities where they can share their expertise in teaching science concepts using science process skills. In these communities, less experienced teachers can benefit from mentorship by seasoned educators who are proficient in science education and process skills. Additionally, the teacher training curriculum should be enhanced to ensure that teachers are equipped with the necessary knowledge and tools to effectively teach these skills. Lastly, the development and distribution of interactive teaching resources, such as lesson plans, activity guides, and visual aids, that focus on science process skills can help teachers engage learners in science concepts through hands-on activities more effectively.

## Conclusion

The significance of teachers' expertise and instructional expertise in imparting science process skills to Grade R learners is highlighted by their paramount role in fostering the development of these essential skills. Teachers become key contributors to the overall growth and understanding of science concepts in young minds during their formative years. This role is particularly important in the context of Grade R, where foundational learning experiences lay the groundwork for future academic success. Integrating science process skills at this early stage not only aligns with the objectives of integrating STEM subjects into the ECE curriculum and national educational goals but also recognizes the importance of instilling a scientific mindset from a young age. It prepares children to engage with the world through the lens of inquiry, curiosity, and problem-solving skills that are increasingly vital in an evolving and complex global landscape.

In essence, the conclusion drawn highlights the transformative potential that teachers hold in shaping the trajectory of a child's scientific understanding and engagement. The emphasis on science process skills in ECE is not merely an educational strategy; it is a holistic approach to nurturing well-rounded individuals equipped with the skills needed to navigate an increasingly complex world. As educators continue to play a central role in this developmental journey, the recognition and enhancement of their expertise become paramount for the successful integration of science education in ECD settings. By exploring the practices of early childhood teachers, this research contributes valuable insights into effective pedagogical approaches for teaching foundational science concepts, ultimately enhancing the quality of early science education. When educators design and implement lessons that actively engage students in using these science process skills, they are employing a pedagogical approach that emphasizes hands-on, experiential learning. This approach helps students develop a deeper understanding of scientific concepts and fosters critical thinking and problem-solving abilities. Therefore, integrating science process skills into teaching is indeed a pedagogical strategy aimed at enhancing science education.

## Recommendations

This study recommends continuous development programs for early childhood teachers to capacitate them with science process skills and content needed in this setting. Capacitating them can be achieved by focusing on the content covered in the ECE curriculum to ensure a sufficient depth of knowledge for effective instruction. It is important to acknowledge the limited generalizability of the results of this study due to the small sample size, making it suitable as a foundational exploration. Consequently, this study can serve as a valuable starting point for a more extensive investigation. While the findings may not be universally applicable, they contribute valuable insights to the existing literature on science process skills in ECE. In addition, the study was limited in that it involved only four Grade R teachers, which may impede the generalization of the findings. Therefore, we propose that this study be extended to a larger scale by conducting a subsequent quantitative study to further explore the science process skills taught in ECD classes.

## Declarations

### *Authors' Declarations*

***Acknowledgements:*** We would like to acknowledge the participants and the language editor who contributed their time and efforts to the development of this research paper.

***Authors' contributions:*** L. Maraisane carried out a research study by organizing, collecting, analyzing, and interpreting data as the principal investigator in her PhD research. L Jita and T. Jita provided critical guidance in writing up the research as well as providing technical guidance for all aspects of writing the article and reviewing and editing it. The final version of the manuscript was approved by all the authors.

***Competing interests:*** The authors declare that they have no competing interests.

***Funding:*** This research paper is derived from a PhD study that was supported by the South African National Road Agency Limited (SANRAL) chair of the University of the Free State.

***Ethics approval and consent to participate:*** Ethical clearance to embark on the study was approved by the University of the Free State Ethics Committee. The ethics number is NO.UFS-HSD 2017/1015 and the school principals to conduct the study within their educational institutions. Lastly, participants' consent to be involved in the study was prioritized, with the understanding that they could withdraw whenever they wished. They were also made aware that they would be protected from harm.

### *Publisher's Declarations*

***Editorial Acknowledgement:*** The editorial process of this article was completed under the editorship of Dr. Mesut Saçkes through a double-blind peer review with external reviewers.

***Publisher's Note:*** Journal of Childhood, Education & Society remains neutral with regard to jurisdictional claims in published maps and institutional affiliation.

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