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Exploring the teaching of the concepts of floating and sinking: Cases from science learning in the Reception Grade

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Abstract
In this research study we explored how teachers in the Reception Grade (Grade R) taught the concepts "sinking" and "floating" in science learning. Teachers' abilities to convey knowledge, skills, attitudes and values play a critical role in facilitating their learners' knowledge of concepts. Pedagogical content knowledge was used as a theoretical framework to guide this study. The qualitative research method, underpinned by the interpretivist paradigm, was employed through the engagement of multiple case studies. Four Grade R teachers were purposely and conveniently selected as sample to be interviewed and observed. Furthermore, their lesson plans on floating and sinking were analysed. We adopted a thematic analysis approach to analyse the data. The findings reveal that teachers had useful knowledge in organising their classroom and materials for science inquiry. However, their strategies to implement inquiry-based learning were limited. They confused whole-class presentation with groupwork and we observed low learner engagement and active participation during classroom activities. We conclude that teachers' knowledge of young learners' understanding of science was inadequate, and that their knowledge of instructional strategies was limited. It is, therefore, recommended that Grade R teachers be capacitated with instructional strategies appropriate to conveying scientific knowledge to their learners for effective classroom practices.

Keywords: early childhood; floating and sinking concepts; reception grades; science learning; science teaching

Introduction
Research on the teaching of the concepts of floating and sinking has been conducted by several researchers in different fields of education. Zoupidis, Spyrtou, Pnevmatikos and Kariotoglou (2021) addressed the concepts by engaging the didactic transformation approach. They noted a significant level of success in the teaching of floating and sinking to young learners in the European community. Qonita, Syaodih, Suhandi, Maftuh, Hermita, Samsudin and Handayani (2019) explored teachers' performance in relation to the emergence of 5- to 6-year-olds' science process skills to construct the concepts of floating and sinking. It was concluded that teachers lacked understanding of early science and that learners' skills in learning were, therefore, not effectively used. Draganoudi, Kaliampos, Lavidas and Ravanis (2023) emphasise that pre-school teachers need to develop strategies that nurture and support young learners in enhancing their innate curiosity and natural inclination towards learning science.

Moreover, Leuchter, Saalbach, Studhalter and Tettenborn (2020) examined Swiss pre-school teachers' beliefs about science learning and teaching in relation to their pedagogical content knowledge (PCK), which refers to an understanding that extends beyond mere subject matter knowledge, encompassing the knowledge of how to teach the subject effectively (Shulman, 1987), and scaffolding practices within a curriculum when teaching floating and sinking. They found that teachers often applied scaffolding strategies to support topic-specific learning and that their beliefs and PCK improved the quality of pre-school science instruction. Ibarra and Galindo (2022) employed social interaction to construct knowledge of floating and sinking using the precursor model. They found that learners were able to express and regulate their ideas in relation to what happened and why it happened. In a study conducted in the United Kingdom, McNerney, Carritt, Dealey and Ladbury (2020) concluded that pre-school teachers were able to develop scientific inquiry skills by asking open-ended questions.

Wei and Karpudewan (2018) explored learners' understanding of the concepts of sinking and floating using social and emotional learning (SEL) strategies. Their findings suggest that the strategies used to teach learners were inappropriate. Larsen, Venkadasalam and Ganea (2019) examined the role of conceptually rich explanations and anomalous evidence regarding the concepts of sinking and floating. They found that when prior instruction was not given before learners' exposure to anomalies, the learners' misconceptions persisted.

Various studies have contributed to the body of knowledge in the teaching of the concepts of sinking and floating in early childhood education. However, few studies have used Magnusson, Krajcik and Borko's (1999) model of teaching science to explore how teachers taught the concepts of sinking and floating, particularly by means of knowledge of learners' understanding (KLU) of science and knowledge of instructional strategies (KIS). Hence, we aimed to explore the following research question: How do Grade R teachers teach the concepts of sinking and floating? With the findings we aim to contribute to new knowledge on the use of

Magnusson et al.'s (1999) model focused on KLU and KIS in science teaching, especially in early childhood education. In the next section, we discuss Grade R learners and their science learning.

Literature Review

The Reception Grade learner and science learning

Grade R is associated with perceptible learners' construction of knowledge and skills that influence their later social competencies and performance at school (Essa & Burnham, 2019). The main goal is to ensure a smooth transition to and readiness for Grade 1 (Lesotho Ministry of Education and Training [MoET], 2021). Hence, classroom teachers are expected to create the conditions for learners to actively construct concepts, facts and principles in applicable subject areas (Essa & Burnham, 2019). Grade R teachers are expected to support learners with strategies that enhance their understanding of the content, based on what they already know, to build their new knowledge.

Young learners are inquisitive and like to interact with their environment to understand what they are manipulating and observing (Bosman, 2020). Their learning begins the moment they inquire about things. Palaiologou (2019) advocates for support to understand their inquiry. The support needed is to bring forth their ideas using scientific skills such as comprehending, communicating, researching and observing to understand their everyday encountering of scientific concepts such as floating and sinking (James, Beni & Stears, 2019).

The concepts of floating and sinking are taught in Grade R as reflected in the life skills syllabus (Lesotho MoET, 2021). However, these concepts pose challenges, as they relate to misconceptions held by the learners, probably passed on by their teachers (Larsen et al., 2019). It is problematic for learners, even in higher grades, to understand the relationship between the densities of the objects and water in relation to buoyant force (Zoupidis et al., 2021). According to Larsen et al. (2019), objects float only when the force of gravity is equal to the buoyant force and sink when the gravitational force is stronger. At the Grade R level learners can explore why different objects float by observing factors such as their shape, mass and material type (Maraisane, Jita & Jita, 2024). Through hands-on activities they discover how the shape of an object affects how it interacts with water, how lighter objects tend to float more easily, and how materials like wood or plastic are more likely to stay afloat compared to heavier materials like metal. Unfortunately, if their teacher is not able to explain the concepts of sinking and floating correctly, even in simple illustrations, this could influence Grade R learners' later scholastic understanding of those concepts. Palaiologou (2019) maintains that the choice of what should be facilitated as content to learners is crucial, especially for young learners as they develop.

Science teaching

Approaches and methods of teaching science include teacher- and learner-centred approaches. Nonetheless, scholars in education recommend inquiry-based learning as the favoured method in teaching science in the Foundation Phase (Bosman, 2020; Lazonder & Harmsen, 2016). Ogegbo and Ramnarain (2022) add that the use of inquiry-based learning activities contributes to learners' understanding of science concepts. Through inquiry-based learning learners engage in hands-on activities to try to understand the natural world they live in. Like real scientists, they do so by "making observations, asking questions, using tools to collect, analyse and interpret data, drawing tentative conclusions, and sharing information and communicating scientific results" (Bosman, 2020:82). Moreover, Baysen and Baysen (2022) suggest experimentation as an important method of teaching science.

Learning science concepts is more learner-oriented than teacher-oriented because learners are given opportunities to inquire, explore their ideas and come up with solutions (James et al., 2019). This helps them learn science concepts in a meaningful way. However, Flanders' (1970) law of two thirds observes that teachers use two thirds of their time for teaching, while learners take only one third of the time to respond to what the teacher wants them to do. In any science teaching space in which an inquiry-based approach is used, the idea is for teachers to facilitate, while learners control their learning. Good science teaching is characterised by teachers' requirements of previous knowledge, good classroom and material organisation, opportunities to learn and teachers' knowledge of content and pedagogy (Magnusson et al., 1999).

The teacher's role in teaching science concepts using the inquiry-based approach is to support learners' curiosity to understand their natural world (Bosman, 2020). This is guided by the teacher's knowledge base of learners as well as their PCK (Marake, Jita & Tsakeni, 2022). This means that teachers should be able to facilitate understanding of science content in such a way that it would be accessible to learners. Moreover, classroom organisation and resources should allow learners to work together as a team or in pairs to inquire about a phenomenon (Fraser, 2015). When engaging in this kind of learning, both child-initiated and teacher-supported learning takes place. This means that the teacher stimulates learners' inquiry and learning by infusing content and skills in a manner that will extend their thinking to a higher level. It is expected that teachers connect what learners already know to

new knowledge, skills, and attitudes (Magnusson et al., 1999). Barendsen and Henze (2019) consider lesson planning, teachers' orientation to teaching, and learning opportunities as examples of factors that influence how teachers teach. We explored how Grade R teachers facilitated the teaching and learning of the concepts of sinking and floating to Grade R learners.

Theoretical Framework

PCK anchors the frame of this study. PCK is among the seven knowledge bases initiated by Shulman (1986). It is defined as that "which goes beyond knowledge of subject matter per se to the dimension of subject matter for teaching" (Shulman, 1987:9). This means that teachers should know the subject matter they are teaching and be in a position to translate that knowledge into information that could be accessible to the learners. In other words, teachers should know the content, its organisation, structures, and facts.

Several researchers have augmented research around PCK. Of interest in this study is a model by Magnusson et al. (1999) which comprises a PCK model for science teaching. The model focuses on orientations to teaching science, knowledge of science curricula, knowledge of learners' understanding of science, knowledge of instructional strategies and knowledge of assessment of scientific literacy (Magnusson et al., 1999). According to Fraser (2015), this model accords for practical teaching to be clarified, measured and supported. Only two components of Magnusson et al.'s model are used to understand how teachers facilitate the teaching of the concepts of sinking and floating. They are KLU of science and KIS.

1) The KLU comprises teachers' awareness about the requirements from learners to learn specific content and the expected learner difficulties in learning that particular content (Bayram-Jacobs, Henze, Evagorou, Shwartz, Aschim, Alcaraz-Dominguez, Barajas & Dagan, 2019). This means that Grade R teachers should know the prior knowledge and skills that leaners require to understand the concepts of floating and sinking. They should also be able to deal with learners' difficulties in understanding these concepts.
2) The KIS component addresses targeted teachers' subject-specific strategies (e.g., argumentation) and topic-specific strategies (representations and activities used to teach the concept of floating and sinking) to teach science content (Magnusson et al., 1999).

Through these components we were able to explore how teachers taught science concepts based on KLU and KIS in early childhood settings. Teachers' PCK influences the way they plan to use different learning strategies in consideration of learners' understanding of the topic, bearing their difficulties in mind (Şen, Demirdöğen & Öztekin, 2022). It remains imperative to discern how teachers teach the concepts of sinking and floating according to Shulman's (1987) argument that teaching is vital because it replicates the ability to support the cognitive, emotional and social well-being of the child. By the time teachers teach the concepts of floating and sinking, their PCK on KLU and KIS can be explained.

Methodology

In this study we followed a multiple case study research design which is premised on the qualitative research method (Yin, 2018). The design is underpinned by the interpretive paradigm because data was generated from Grade R teachers in their respective schools (Thanh & Thanh, 2015). Each participant had a unique PCK, experience and educational background. Hence, we adopted this design to fully understand and interpret how each participant taught the concepts of sinking and floating.

The population of this study comprised the four Grade R teachers who received certification in early childhood education in Lesotho. They were purposively and conveniently sampled based on the idea that they possessed certain attributes that made them holders of the desired data (Cohen, Manion & Morrison, 2018). Their selection was informed by the findings from a larger study in which a mixed methods approach, based on a sequential explanatory design, was employed. These teachers provided a representative sample of the larger group, ensuring that the in-depth qualitative data gathered through interviews, classroom observations, and lesson plans analyses would be meaningful and relevant. The focus on how they taught the concepts of floating and sinking allowed for a detailed exploration of their teaching practices, providing insights that would not have been possible with a larger, less focused sample. Therefore, we were able to maintain credibility and depth, ensuring that the findings are both reliable and applicable to the broader context of Grade R science education. The participants (all female) held the same qualifications, but were of varying ages and had varied years of experience. Rich data was generated when participants were asked to talk about their KLU of science and their teaching strategies, which may influence their styles of teaching. Literature shows that experience and college-acquired knowledge contribute to the attainment of content knowledge by exposing teachers to theory and practice (Marake et al., 2022).

Data was generated using interviews, observations and lesson plans that replicate the concepts of sinking and floating. We asked permission to record the interviews and lesson observations on audio to capture every detail of classroom interactions and participants' views (Creswell & Creswell, 2018). The arranged

pre-observation interviews were conducted only once for each participant before the lesson presentations took place, while post-observation interviews were conducted after each classroom observation, with 24 interviews conducted in total. During classroom observations, teachers allowed learners to speak in their mother tongue while translation was done in English. In this research study, after interviewing and observing the participants, their lesson plans were carefully analysed. This happened five times for each participant. Permission was sought to photocopy their lesson plans so that they could be referred to while analysing the data at home. This step was important for the credibility of the study. It allowed for an assessment of whether the teachers effectively aligned age-appropriate objectives with their activities, assessment, conclusions, and teaching materials. The goal was to verify whether the teachers' reported practices in the teaching of the concepts of sinking and floating were reflected in their actual lesson documentation. This analysis was guided by the research questions and objectives, ensuring a thorough evaluation of the participants' instructional approaches. The purpose of analysing the participants' lesson plans was to triangulate information generated from interviews and observations.

When dealing with people, we are mindful of the fact that we enter their personal space, therefore, it was important to gain the participants' trust through obtaining informed consent. Creswell and Creswell (2018) affirm that researchers need to observe participants' rights, values, needs and desires. As such, we considered ethical issues before data collection. Ethical clearance was sought and obtained from the Ethics Committee of the University of the Free State (clearance number: UFS-HSD2017/1015). Subsequently, approval was sought from the Lesotho MoET, as the participants were employed in schools. Permission was then requested from the principals of the respective schools to conduct the research at their schools. Lastly, participants were asked to volunteer and were informed of their rights, anonymity and confidentiality. To further safeguard the participants' identities, pseudonyms (e.g., Neo, Mpho, Thato and Maria) were used.

The qualitative data analysis used in this study was interpretive. Central to the interpretive analysis is the conceptualisation of what the participants have said so that it can be understood (Coolican, 2014). This demanded a deep understanding of the data so that we could interpret and explain the participants' experiences. Most of the interview questions required of the participants to reflect on their KLU and KIS regarding the teaching of the concepts of sinking and floating. After the interviews, we familiarised ourselves with the data by listening to the audio recordings and transcribing them. The data was arranged and categorised into themes, sub-themes, and categories, which led to a descriptive and narrative synthesis.

The analysis of classroom observations focused on how participants facilitated the concepts of floating and sinking. An observational grid was prepared before the lessons, gaps were filled in during the classroom discourse, and audio recordings were used where clarification was needed. The word-processed record was printed and coded manually into themes, sub-themes, and categories for data analysis and interpretation.

Lesson plans in which the concepts of floating and sinking were analysed, were reviewed. Guided by theoretical perspectives, the content of the lesson plans, where teachers reflected on learners' prior knowledge, scientific skills, and teaching strategies, were taken into account. This information was compared to data collected from the interviews and observations. The objective was to triangulate participants' views with their classroom pedagogies and their plans to enhance the validity of the findings.

Results

Knowledge of Learners' Understanding of the Concepts of Sinking and Floating

Data generated from the participants' interviews, lesson observations and lesson plans were sorted to determine participants' KLU of science, requirements for learning and areas where learners were likely to encounter difficulties in the teaching of the concepts of sinking and floating. In this case, the participating Grade R teachers (Neo, Mpho, Thato and Maria) were required to be thoughtful of what could contribute to making learning of the concepts of sinking and floating easy or difficult. Teachers needed to know the skills that could be used to reorganise learners' preconceptions which could be misconceptions of scientifically acceptable concepts.

In this study we wanted to establish what teachers needed to consider understanding learners' prior knowledge before they could engage with new knowledge (Bayram-Jacobs et al., 2019). This is based on Magnusson et al.'s (1999) model that science learning, constituted on KLU, requires teachers to know activities in which learners should be engaged before new content can be taught. In other words, learners are not considered as *tabula rasa* but rather are active processors of content, skills and attitudes towards learning a new concept. Learners' preconceptions can shape (or misshape) what they are learning if not properly addressed (Larsen et al., 2019). To capture this information, the participants were asked to reflect on what learners should be able to know when learning about the concepts of floating and sinking.

Neo indicated that learners should know about the heaviness and lightness of the objects and what

happens when they are immersed in water. Mpho said that they should know that objects that float are light. Thato indicated that learners should know that objects float because of their densities, while Maria emphasised that they should know that floating objects are light. Essa and Burnham (2019) affirmed that teachers needed to know facts about the subject they were teaching, which are reflected in the above participant narrations.

Besides the above, participants were asked to elaborate on the scientific skills that learners would acquire while learning about the concept of floating and sinking. Due to Grade R learners' developmental capabilities, teachers are expected to instil scientific skills such as predicting, observing, experimenting, classifying, communicating, measuring and inferring in their learners (Bosman, 2020).

Neo stated that learners would acquire observation skills, while Thato mentioned communication, observation and experimentation. She said: "*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*."

When probed, Neo explained: "*Oh, they will be observing, right! Then we sit down to check whether they understood or not, whether they really observed; we will ask questions on what we have just done.*"

Mpho and Maria were confused when they had to mention the scientific skills that would be developed by the learners. For example, Mpho could not come up with one, as she murmured while she said: "*The skill that they will have will be … Eh*."

Participants were further asked to explain the difficulties that learners were likely to encounter when being taught the concepts of floating and sinking (Şen et al., 2022). All of them declared that learners would not encounter difficulties as they liked to play with water. For instance, Maria said: "*Most of these kids like to swim and play with objects in water; they like racing their toys where water is flowing in a form of game to see whose toy will be faster than the other*."

The interviews with participants yielded consistent results regarding their PCK identification of how they could help learners understand the concepts of sinking and floating. This reflects teachers' KLU component. The information was established from their presented and planned lessons. For example, their activities included asking learners some questions, discussing with them and doing some experiments.

Knowledge of Instructional Strategies Relating to the Teaching of Floating and Sinking

According to Magnusson et al. (1999), certain strategies could be implemented to help learners comprehend certain conceptions using examples, demonstrations, simulations, problems or experiments. Strategies considered in this category include science-specific strategies (inquiry-based) and topic-specific (floating and sinking) activities and representations.

Participants were asked about teaching strategies that they would employ when teaching floating and sinking. In line with Fraser (2015), all participants indicated that they would use groupwork. However, during teaching they used whole-class presentation and asked selected learners to pick objects and put them in water while others were observing. Maria, however, divided her class into four groups and handed out the prepared objects for the lesson on floating and sinking. Even though she formed groups, she was the one telling learners what to do in their groups. The quote below shows Mpho's response on groupwork:

> *They will work in groups; one would take a stone out of the water and drop it, and again another would take a leaf and drop it in the water and see what happens. They will see the difference between the ones that sink in water and those that float in water.*

The above quote shows that the participant planned to use groupwork in her lesson. However, her use of "one" in her narrative could mean "one learner" and not "one group", as she did not elaborate. The analysed lesson activities planned by the participants did not reflect their intended use of groupwork. It was neither reflected nor indicated in the lesson presentations, which contradicted the claims in their planning of teaching. Nevertheless, in agreement with Marake et al. (2022), teachers' knowledge base helps them to plan activities that engage learners when teaching the concepts of floating and sinking.

All the participants organised materials to be used in class (Barendsen & Henze, 2019). It was unique for Thato to read a Bible story that relates to floating in her classroom, while Maria used drawn pictures to introduce her lessons. Both these activities helped to activate learners' prior knowledge and interest in what they were about to learn. Below are excerpts of lesson segments presented by participants when teaching the concepts of floating and sinking.

> Neo: *Where do you suppose we are going to see floating and sinking objects?*
> All: *In water*.
> Neo: *What is sinking?*
> Learner 1 (shyly): *Sinking is when they get in the*

water.

Neo: *She says sinking is when something gets in the water, and that something goes down, down, down. That is sinking. For example, if you have taken something and you put it in the water, it will go …* (waits for the learners to complete the sentence).

All: … *down*.

In accordance with Bosman (2020), Neo began her lesson by requiring of learners to draw on prior knowledge. She observed Flanders' (1970) law of two thirds and concluded for the learners that sinking objects go down. She explained sinking as the process in which objects would go down in the water, while floating was when objects stayed on top of the water. A segment of a lesson by Mpho is presented below.

Mpho: *We are going to see what happens when we put objects in water. Let's start with a stone.* (She asks one learner to put the stone in water.) *What is happening with the stone?*

Learner 1: *Sinking*.

Mpho: *Why is it sinking?*

Learner 2: *Because they* [*sic*] *are heavy.*

Mpho did not require of learners to draw on prior knowledge; instead, she told learners what they were going to do. The lesson progressed with the participant asking learners to put different objects in the water and communicated what happened to them. In Mpho's lesson, we noted that she emphasised that objects floated because they were heavy and sank because they were light. The following is a segment from Thato's lesson:

Thato: *Okay, in the story we heard that the boat was floating. Now, tell me, what are the other things that you think can float in water?* (She repeats the question.)

Learner 1: *A plastic bottle top*.

Thato read the story about Noah's ark and brought the concept of floating to the learners' attention. She then probed their prior knowledge about the things they saw floating. The following segment is from Maria's lesson.

Maria (begins her lesson asking learners to tell what happens when they swim): *Okay, le re motho ha sesa o ba ka holima metsi, lejoe lona?* (You say a person when swimming stays on top of the water, what about the stone)?

All: *Lea teba*. (It sinks.)

Maria: *Le etsang lejoe ha le teba*? (What happens with the stone when it sinks)?

All: *Le ea tlase*. (It goes down.)

Maria: *Okay, ntho ha e phapamala ka metsing, it is floating. Empa ha e teba, it is sinking.* (When an object is on top of the water, it is floating. But when it goes below the surface of water, it is sinking).

Maria drew learners' attention to their knowledge of what they knew about people swimming. She instructed learners in their mother tongue, namely Sesotho. This is in line with the language policy, which explains that learners in the Foundation Phase should be taught in their mother tongue (Lesotho MoET, 2021).

The participants' intent for groupwork, although not effectively used, aligns with Fraser's finding (2015) that classroom organisation should allow learners to work together as a team to inquire about a phenomenon. Data also shows that the participants' presentation of their lessons varied. Elements of teacher-dominated practice were evident in the way that they facilitated content and according to Flanders' (1970) law of two thirds. Requiring of learners to draw on prior knowledge corresponds with features of science learning in the Foundation Phase (Bosman, 2020).

Discussion

With this study we revealed that participants were able to organise their classroom environment such that they prepared spaces for learners to manipulate objects and place them in water. This assisted learners with the opportunity to inquire about the concepts of sinking and floating. Even though the environments were created by the participants, learners were able to observe, experiment by putting objects in water and come up with ideas and share them. It is significant to note that all participants considered aspects of creating a classroom culture that supported inquiry-based learning and teachers' KLU about the requirements of learners to learn specific content (Bayram-Jacobs et al., 2019). This means that they were aware of what should be in place before starting to teach the concepts of sinking and floating.

Another finding indicates that the participating Grade R teachers confused the whole-lesson presentation with groupwork. Although they expressed the intention to use groupwork, a key component of inquiry-based learning, they demonstrated a limited understanding of how to effectively implement it. This was revealed when one of the participants asked a learner from the class to pick an object and drop it in water. The other learners were asked to confirm whether the object was floating or sinking. The nature of effective inquiry-based learning environments for teaching the concepts of floating and sinking involves creating a setting where learners actively explore, question, and construct understanding through hands-on experiences, guided discovery, and reflection (McNerney et al., 2020). This approach is in agreement with Magnusson et al.'s (1999) KIS in which group activities are encouraged for inquiry learning. If the teachers had KIS, they might have recognised that groupwork was not simply about participation, but about engaging learners in collective reasoning, hands-on manipulation of materials, and collaborative meaning-making. For example, learners were encouraged to ask questions like "Why does this object float?" or "What makes it sink?". Through the teacher's guidance, the

learners could test various materials (wood, metal, plastic, sponge, etc.) in water to discover patterns and draw conclusions. Only one participant engaged in groupwork in one of her lessons, despite limitations in the way it was conducted. Scientific inquiry often involves learners working in pairs or teams to share, reflect and record their understanding (Bosman, 2020).

The last finding reveals limited evidence of learners' engagement and active participation during classroom interactions, which could imply teachers' limited knowledge of KLU, also found by Lazonder and Harmsen (2016). Few learners responded to the teachers' questions or followed their instructions, which may point to a gap in the teachers' KLU, a core component of PCK as conceptualised by Magnusson et al. (1999). This dimension involves an understanding of learners' prior knowledge, misconceptions, and developmental readiness to engage with specific scientific concepts. The Grade R teachers did not appear to effectively anticipate or address how learners might understand or struggle with the concepts of floating and sinking. For instance, the excerpts presented show little indication of how the teachers assessed or responded to the learners' grasp of the concept. The minimal interaction and low learner responses suggest that teachers may not have adequately considered how to engage learners cognitively or how to build on their existing experiences with water and materials. This reinforces the earlier observation that groupwork and inquiry-based learning were either misunderstood or superficially applied.

Conclusion

Considering the above, participants showed consistent results with their PCK identification of how they could help learners understand the concepts of sinking and floating. This reflects teachers' KLU component. The information was established through their planned and presented lessons. For example, their activities included asking learners some questions, discussing with them and doing some experiments. However, the participating Grade R teachers' KIS revealed that they confused groupwork with whole-class presentation. Their use of inquiry-based learning was limited and they often professed to do one thing but wrote the opposite in their planning.

The findings of this study are limited to four Grade R teachers based in one district. This means that the results of this study cannot be generalised. However, the results can be useful in providing insight into how Grade R teachers teach science concepts. Future research may include a larger sample that could yield better results in research focused on early childhood. It is important to pay attention to the methods that teachers use in science classrooms so that they conform to inquiry-based learning. We recommend that teacher training institutions and the MoET do the adequate groundwork to equip teachers with skills needed in their KLU and KIS that would lay the foundation for early learning of science concepts in the Foundation Phase setting. Furthermore, we recommend that professional development initiatives be implemented to equip teachers with the necessary skills and strategies to effectively facilitate inquiry-based learning.

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Authors' Contributions

MLM wrote the article while TJ worked on the technical aspects and language editing of the manuscript.

Notes

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