Obstacles to Teaching Science in Primary School and Strategies to Overcome Them

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Abstract
This paper addresses primary school teachers' challenges in teaching science and provides practical strategies for overcoming the obstacles. Science education plays a crucial role in developing critical thinking, problem-solving skills, and scientific literacy, which are essential for students in the 21st Century. However, teaching science in primary schools can often be hindered by a lack of resources, teacher training, and student engagement. This paper will explore the current research on these challenges and provide evidence-based strategies for overcoming them. By implementing these strategies, teachers can create an environment that promotes student engagement and supports their learning of science.

Keywords: Science Teaching, Primary School, Obstacles


Introduction
Science education is integral to the primary school curriculum (Hurd, 2000). It helps children understand the world (Harlen, 2006) and become scientifically literate citizens (DeBoer, 2000). In addition, it prepares students for a rapidly changing and technologically advanced society. It is also essential to promote critical thinking and develop critical thinking skills (Harlen, 2018), problem-solving skills (Holbrook & Rannikmae, 2007), and an appreciation for the natural world and its processes (Mikkonen, 2022). However, despite its importance, teaching science in primary schools is challenging. This paper explores the obstacles to effective science education in primary schools and suggests ways to overcome them. The obstacles to effective science education in primary schools can be summarised as follows.

Lack of Resources
More resources are needed for effective science education in primary schools. This can include a lack of funding for science equipment, materials, and technology (Akuma & Callaghan, 2016) and a shortage of trained science teachers (Wiggan, 2021). With increasing demands on the curriculum, science often becomes relegated to a lower
priority, with limited instructional time and resources. This can result in inadequate teacher preparation and support, limited science materials and equipment access, and limited opportunities for hands-on, inquiry-based learning. For example, schools with limited funding may not have access to laboratory equipment, making it difficult for teachers to provide hands-on learning experiences. Similarly, schools with inadequate facilities may not have access to science-specific classrooms or outdoor learning spaces, limiting the opportunities for science instruction (Bohlmann & Palacios, 2023). Additionally, teachers not adequately trained in science education may not have the skills and knowledge to teach science concepts and engage students in the subject effectively (Gómez-Carrasco et. al., 2020).

Despite the challenges posed by the lack of resources in science teaching, several strategies can be employed to address this issue. These include:

- Promoting community engagement and partnership with local businesses and organisations to secure additional funding and resources.
- Implementing cost-effective solutions, such as using low-cost laboratory equipment and materials.
- Providing professional development opportunities for teachers to enhance their knowledge and skills in science teaching.
- Technology, such as virtual and augmented reality, enhances science instruction.

**Lack of Time**

Another major obstacle in science education at the primary level is a lack of time (Russell & Martin, 2023). Science is often given a lower priority in the school curriculum than mathematics and language arts. This results in limited instructional time for science, making it difficult for teachers to cover all the essential topics. Primary schools face increasing pressure to cover a wide range of subjects in a limited time. As a result, science education often takes a back seat to subjects such as mathematics, reading, and writing. This lack of time significantly impacts science teaching in primary schools, as teachers cannot provide students with adequate hands-on experiences, experiments, and discussions that are crucial for developing a deep understanding of science concepts. Furthermore, many primary schools lack the resources necessary to teach science effectively, such as science labs and equipment. This exacerbates the problem of limited time, as teachers must rely on limited or outdated equipment or forego hands-on experiences altogether (Hirsch et al., 2001). This limits students' ability to engage in active, inquiry-based learning and undermines the development of their scientific reasoning skills.

One solution to the lack of time and resources for science education in primary schools is to incorporate science into existing subjects, such as mathematics and literacy. For example, science can be integrated into language arts using science-based texts and mathematics by incorporating scientific data and concepts. This approach allows teachers to provide students with science exposure and hands-on experiences without having to devote additional time or resources to science education.

Another solution is providing teachers with professional development opportunities focusing on science teaching and learning. This could include workshops, courses, and conferences focusing on effective science teaching methods and provide teachers with
opportunities to practice these methods in real-life situations. Additionally, providing teachers with access to science resources and equipment can help overcome the challenges of limited resources.

Generally, a good strategy to overcome the lack of time and resources for science education in primary schools is to increase instructional time and allocate more resources to science education. This can be achieved by implementing science-focused educational policies and programs and providing teachers with professional development opportunities and support.

**Inadequate Teacher Preparation and Support**

Teachers limited scientific knowledge (Bartos & Lederman, 2014) is another obstacle to primary school science education. Many primary school teachers are not trained in science and struggle to teach science concepts effectively. They have limited science training and may not have the necessary subject matter knowledge to teach science effectively. This can result in students receiving an incomplete or inaccurate understanding of science. This significant obstacle to effective science education in primary schools is inadequate teacher preparation and support. Furthermore, lacking professional development opportunities and support can result in low teacher confidence and a negative perception of science teaching as a challenging and complex subject. Inadequate teacher preparation is a significant challenge facing science education in primary schools. Many primary school teachers lack the knowledge and skills to effectively teach science (Garraway-Lashley, 2019), limiting students' opportunities to engage in hands-on science experiences and develop critical thinking and problem-solving skills. Research has shown that teachers who are not well-prepared in science teaching tend to rely on rote learning and teacher-centred approaches rather than student-centred and inquiry-based approaches that promote student engagement and understanding (Smith et al., 2012).

In addition, inadequate teacher support and resources can hinder the delivery of high-quality science education. Teachers who lack access to resources, such as laboratory equipment and instructional materials, are less likely to incorporate hands-on activities and experiments in their teaching. Furthermore, the lack of collaboration and professional development opportunities can limit teachers' ability to stay current with the latest advancements in science education and implement evidence-based teaching practices (Duschl et al., 2018).

Several strategies have been proposed to address the challenges of inadequate teacher preparation and support in science education. These include:

- **Comprehensive teacher preparation programs**: Teacher preparation programs must be comprehensive and evidence-based, providing teachers with the necessary knowledge and skills to teach science effectively (Freeman et. al., 2014). This includes hands-on science experiences and opportunities for teachers to learn about inquiry-based teaching approaches and develop scientific literacy skills.

- **Ongoing professional development**: Teachers must have opportunities for ongoing professional development (Postholm, 2012; Kennedy, 2016), including workshops, courses, and conferences. This will enable them to stay current with the latest science education advancements and implement evidence-based teaching practices.
Adequate resources and support: Schools must provide teachers with the necessary resources, such as laboratory equipment and instructional materials, to deliver hands-on science experiences. Additionally, schools must provide teachers with opportunities for collaboration, such as regular meetings and professional learning communities, to encourage the sharing of best practices and ideas.

Lack of Professional Development

Another obstacle to science education in primary schools is a lack of professional development opportunities for teachers (Yates & Goodrum, 1990; Postholm, 2012). Science education can be complex and fast-paced, and teachers must keep up to date with the latest teaching methods and technological advances. A lack of opportunities for professional development can make it difficult for teachers to keep pace with the changing landscape of science education, leading to a lack of confidence and competence in the classroom. Without continuous professional development, science teachers cannot stay current with the latest advancements in science and technology, and as a result, their teaching approaches become outdated and ineffective. Additionally, science teachers who lack access to professional development opportunities are less likely to incorporate new and innovative teaching strategies, resulting in a lack of engagement and motivation among students. Furthermore, the lack of professional development can lead to a lack of confidence and competence in science teaching, negatively affecting student learning outcomes. Science teachers who are not adequately trained in the latest teaching methods and techniques are more likely to struggle with engaging students, creating meaningful learning experiences, and communicating science concepts effectively. As a result, students may develop misconceptions or misunderstand science concepts, hindering their ability to grasp the subject matter. Several measures can be taken to address the lack of professional development for science teachers. Firstly, school systems should provide ongoing professional development opportunities for science teachers, ensuring they remain current with the latest advancements in science and technology (Admiraal et al., 2021). This could include workshops, seminars, and online training programs. Secondly, science teachers should be encouraged to participate in research activities, such as conducting experiments and analysing data, to deepen their understanding of science and improve their teaching practices. By participating in research activities, science teachers can gain a deeper understanding of scientific concepts and develop a more comprehensive understanding of how to teach these concepts effectively. Lastly, science teachers should be provided with educational resources, such as science kits, equipment, and technology. This will enable them to integrate hands-on learning experiences into their lessons, making science more accessible and engaging for students.

Inadequate Curriculum

An inadequate curriculum is another obstacle to science education in primary schools. Science curricula are often limited in scope, covering only a few basic concepts (Kotsis et al., 2023). Teachers may also struggle with a lack of flexibility in the curriculum, which makes it challenging to adjust lessons to the needs of their students. This can result in students not being exposed to the full range of science concepts, leaving them with limited knowledge and understanding of the subject. An inadequate curriculum
refers to a curriculum that is not fit for purpose, either because it is poorly structured, outdated, or does not meet the needs of the students. Several key factors contribute to the inadequate curriculum in primary schools, including insufficient funding, teacher training, and lack of resources (Mupa & Chinooneka, 2015). Funding is a critical factor in the development of a comprehensive science curriculum. Schools with limited funding often struggle to provide the necessary resources for science education, including laboratory equipment, textbooks, and teacher training. Another significant factor that contributes to the inadequate curriculum is the lack of teacher training. Science teachers need to be adequately trained to deliver quality science education, but in many cases, they are not provided with the necessary training. This lack of training can result in teachers delivering science lessons that are poorly structured, unengaging, and ineffective (Bennett, 2005). The lack of resources, such as laboratory equipment, textbooks, and educational software, is another major contributor to the inadequate curriculum. This lack of resources can limit students’ learning opportunities and hinder their understanding of science concepts. The impact of inadequate curriculum on science teaching can be significant and result in students missing out on essential learning opportunities. Inadequate curriculum can lead to a lack of engagement and motivation among students, which can negatively impact their academic performance. Additionally, students who receive inadequate science education are less likely to pursue careers in science-related fields, which could limit their future opportunities.

Student Attitudes and Perceptions

A lack of student engagement is another challenge in teaching science at the primary level. Student attitudes and perceptions play a significant role (Nilsson & Driel, 2011) in the effective teaching and learning of science in primary schools. Students with positive attitudes towards science perform better academically than those with negative attitudes (Osborne et al., 2003). Some students may view science as boring or irrelevant, while others may negatively perceive their ability to succeed in science. Even gender plays a crucial role in perceptions of physics (Reid & Skryabina, 2003; Gavrilas et al., 2023). Moreover, students with negative attitudes towards science are less likely to pursue science-related careers in the future. So, it is difficult for teachers to maintain their students’ attention. This can result in a lack of motivation, engagement, and interest in science, negatively impacting academic achievement and future career opportunities. Teachers must find ways to make science engaging and relevant to students to keep them motivated and interested.

The attitudes and perceptions of students towards science are shaped by their experiences in the classroom. For example, a study by Scott and Sadler (2013) found that students who participate in hands-on science activities have more positive attitudes towards science than those who do not. In addition, students with positive experiences with science in the classroom are more likely to view science as an exciting and essential subject (Tsoumanis et al., 2023; Vlachos et al., 2024).

Despite the importance of student attitudes and perceptions towards science, primary schools often struggle to engage students in science learning. Arizaga et al. (2010) found that science teachers often lack the skills and resources to make science learning enjoyable and engaging for students. This can lead students to develop negative attitudes towards science and view the subject as boring and unimportant.
Teachers and Students have the same Misconceptions

The important role of misconceptions in science teaching is well known (Kotsis, 2023). Misconceptions about a science concept can have profound implications on the learning process, influencing the trajectory of how human beings acquire knowledge. Often rooted in faulty assumptions or incomplete understanding, these misconceptions can lead learners astray and hinder their progress. The impact of these misconceptions is not limited to a single academic subject but extends to the broader framework of how individuals perceive and interpret the world around them. By distorting fundamental concepts in physics, such as motion or energy, these misconceptions create cognitive barriers that impede deep comprehension and hinder intellectual growth. Students who hold onto initial misunderstandings without challenging or questioning them become ingrained in their mental framework. As a result, subsequent learning becomes filtered through this flawed lens, leading to further misinterpretations and reinforcing existing misconceptions. This perpetuates a vicious cycle where inaccurate ideas are continuously reinforced instead of corrected or replaced with accurate ones. Furthermore, misconceptions can lead to confusion and cognitive dissonance when encountering new information contradicting previously held beliefs. This cognitive dissonance arises from the clash between pre-existing misconceptions and new knowledge that challenges those beliefs. Individuals may experience perplexity and uncertainty as they grapple with conflicting ideas, making integrating new information into their mental schema difficult. Teachers must find methods to change their science misconceptions to real science knowledge. The advantage is that the teacher, knowing the students' misconceptions, uses appropriate teaching strategies to build science knowledge (Driver et al., 1985). Unfortunately, have been reported that students and primary education teachers have the same misconceptions about science concepts and phenomena (Kotsis, 2023). The same has been reported for the Pre-service teachers (Gavrilas & Kotsis, 2023); Stylos et al., 2023), making the problem very important. Under these circumstances, the teacher cannot use the proposed methods to change the students' misconceptions since he has the same perceptions as his students. Then, the misconceptions hinder conceptual development, reinforce incorrect beliefs, lead to cognitive dissonance, and influence teaching strategies. Recognising and addressing these misconceptions is crucial for fostering deep comprehension and facilitating effective learning in physics.

Firstly, teachers should embrace a multidimensional approach to teaching, incorporating diverse instructional techniques that cater to students' varied learning styles. This could encompass hands-on experiments, interactive simulations, and engaging discussions (Stylos & Kotsis, 2021a; Stylos & Kotsis, 2021b). By diversifying the learning experience, individuals are more likely to grasp complex concepts and dispel any lingering misunderstandings.

Another strategy involves leveraging technology as an educational tool to address physics misconceptions effectively. Virtual reality simulations or augmented reality applications can provide immersive experiences that allow students to visualise abstract concepts tangibly (Evangelou & Kotsis, 2023). By manipulating virtual objects or observing simulated experiments, learners can observe firsthand how their preconceived notions may not align with empirical evidence.

The educational community can effectively address and overcome misconceptions about science by implementing multifaceted teaching experimental approaches and technological advancements. By adopting these strategies, students can embark on a
more fruitful learning curve that dismantles existing misconceptions while cultivating a deep and accurate understanding of fundamental physics concepts.

Lack of Parental Involvement

The role of parents is crucial for their children’s education (Halim et al., 2018). The lack of parental involvement is a crucial obstacle to teaching science in primary schools. Many parents may not understand the importance of science education or may not have a background in the subject (Perera, 2014). Also, due to communication barriers between teachers and parents (Ozmen et al., 2016), teachers may struggle to engage parents in science education and promote the subject at home, impacting student performance and interest. A study by the National Science Foundation found that students whose parents were involved in their education showed higher academic achievement and motivation in science than students whose parents were not involved (Henderson & Mapp, 2002).

However, many primary schools struggle to engage parents in their children’s science education despite the clear benefits. This can take many forms, from a lack of attendance at parent-teacher conferences to a lack of interest in helping children with homework or taking them to science-related activities outside of school. The lack of parental involvement in science education can significantly affect teaching science in primary schools.

First, a lack of parental involvement can make it difficult for teachers to engage students in science. Teachers often rely on parents to support learning in the classroom, for example, by helping students with homework, talking to them about science-related topics, or taking them on field trips to science museums. When parents are not involved, teachers may struggle to maintain students' interest in science, as they do not have the support, they need to make science lessons engaging and relevant to students' lives.

Second, a lack of parental involvement can also lead to a lack of resources for science education. Parents not involved in their children's science education may not be as likely to support school-based science initiatives, such as science clubs or field trips to science museums. This can limit the resources available to teachers, making it harder for them to provide high-quality science education to their students.

Finally, a lack of parental involvement can also contribute to a lack of diversity in science education. When parents are not involved, children from disadvantaged backgrounds may be less likely to have access to the resources and opportunities that can help them succeed in science. This can further widen the achievement gap in science education and limit the number of students who can pursue careers in science, technology, engineering, and mathematics (STEM) fields.

Conclusion

In conclusion, teaching and learning science in primary schools is critical for student success in science and technology and other areas of study. Teaching science in primary schools can be challenging but essential for developing critical thinking, problem-solving skills, and scientific literacy. However, various obstacles hinder effective science education in primary schools, including a lack of time and resources, inadequate teacher preparation and support, and negative student attitudes and
perceptions. To overcome these challenges, it is essential to implement strategies such as increasing time and resources for science education, enhancing teacher preparation and support, and promoting positive student attitudes and perceptions toward science. Schools can provide teachers with access to resources, teacher training, and strategies for promoting student engagement. By implementing these strategies, primary school teachers can create a learning environment that supports student learning and promotes student engagement in science.

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Conflict of Interests

No conflict of interest.

References


