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THEORETICAL FOUNDATIONS OF USING THE PISA INTERNATIONAL ASSESSMENT PROGRAM IN TEACHING PRIMARY SCHOOL SCIENCE

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Abstract: The Programme for International Student Assessment (PISA) provides a theoretical foundation for enhancing primary school science education through inquiry-based learning, critical thinking, and contextual teaching. Integrating PISA methodologies fosters scientific literacy by encouraging problem-solving, collaboration, and real-world application of scientific concepts. This paper explores how primary educators can implement PISA's principles to improve student engagement and academic outcomes. It highlights the role of technology, assessment-driven instruction, and cultural inclusivity in fostering effective science learning. Aligning primary education with PISA's theoretical framework prepares students for future academic challenges and equips them with essential scientific competencies for lifelong learning.

Keywords: PISA, scientific literacy, inquiry-based learning, primary science education, problem-solving, contextual learning, assessment-driven instruction, technology integration.

The Programme for International Student Assessment (PISA) is one of the most significant international evaluation systems used to measure students' abilities in reading, mathematics, and science. Conducted by the Organisation for Economic Co-operation and Development (OECD), PISA assesses 15-year-old students' competencies in applying their knowledge to real-world situations. While primarily aimed at secondary education, the theoretical foundations of PISA can be effectively integrated into primary school science instruction. Understanding these foundations helps educators implement inquiry-based learning, critical thinking, and problem-solving strategies that align with international educational standards. Applying PISA principles in primary education lays the groundwork for developing scientific literacy, preparing students for higher-level academic challenges and future problem-solving scenarios.

Scientific literacy is a central focus of PISA, which evaluates students' ability to engage with scientific concepts, interpret data, and apply reasoning skills to everyday problems. In primary education, fostering scientific literacy means encouraging students to think like scientists by observing, questioning, and experimenting. PISA's framework is based on constructivist theories of learning, particularly those of Piaget and Vygotsky, which emphasize active engagement with knowledge. Piaget's theory of cognitive development suggests that children learn best through hands-on experiences and exploratory learning, making PISA's emphasis on real-world application relevant even for younger students. Vygotsky's theory of social constructivism further supports the integration of PISA methodologies in primary science education by highlighting the role of collaboration and guided discovery in knowledge acquisition.

A key theoretical principle behind PISA's assessment of science education is inquiry-based learning. This approach moves away from rote memorization and passive instruction, instead promoting student-led exploration of scientific concepts. Inquiry-based learning aligns with PISA's focus on problem-solving, as it encourages students to investigate real-world questions, gather evidence, and draw conclusions. In primary school classrooms, teachers can integrate inquiry-based learning by designing experiments, encouraging open-ended discussions, and guiding students

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through the scientific method. By fostering curiosity and independent thinking, this approach helps young learners develop the foundational skills necessary for later success in science education.

Critical thinking and problem-solving are also core components of PISA’s theoretical framework. The assessment measures students' ability to analyze information, identify patterns, and apply logical reasoning to solve complex problems. These skills can be nurtured in primary school science instruction by presenting students with scenarios that require them to evaluate evidence and make predictions. For example, rather than simply teaching students that plants need sunlight to grow, teachers can design an experiment where students compare the growth of plants exposed to different light conditions. Engaging students in discussions about their observations reinforces their ability to interpret data, draw conclusions, and apply scientific reasoning.

Another fundamental aspect of PISA’s theoretical foundation is contextual learning, which emphasizes the relevance of science to everyday life. Science education should not be confined to textbooks and laboratory experiments but should instead help students understand how scientific principles apply to the world around them. In primary education, teachers can achieve this by incorporating real-world examples into their lessons, such as discussing the water cycle in relation to weather patterns or exploring basic physics concepts through playground activities. By connecting science to students’ daily experiences, educators can make learning more meaningful and engaging, fostering a deeper interest in scientific inquiry.

Assessment-driven instruction is another critical component of PISA’s theoretical foundation. The assessment not only evaluates students’ existing knowledge but also informs teaching practices by identifying strengths and areas for improvement. In primary science education, formative assessments—such as observational checklists, student reflections, and hands-on projects—can be used to monitor student progress and adjust instruction accordingly. Providing students with opportunities to demonstrate their understanding through multiple modalities ensures that all learners can develop scientific literacy at their own pace. Additionally, self-assessment and peer assessment encourage students to take an active role in their learning, reinforcing metacognitive skills that are essential for academic success.

The role of technology in PISA’s assessment framework highlights another important theoretical foundation relevant to primary science education. Digital tools and interactive learning platforms can enhance students’ understanding of scientific concepts by providing immersive, hands-on experiences. Simulations, virtual experiments, and educational games allow students to explore scientific phenomena that may be difficult to replicate in a traditional classroom setting. For example, virtual reality can be used to teach students about ecosystems by allowing them to experience different habitats firsthand. Integrating technology into primary science instruction aligns with PISA’s emphasis on innovation and prepares students for a technology-driven future.

Collaboration and communication are also central to PISA’s assessment of scientific literacy. Science is a collaborative discipline, requiring individuals to work together, share ideas, and build upon each other’s discoveries. In primary school settings, teachers can encourage collaborative learning by organizing group projects, facilitating discussions, and promoting inquiry-based teamwork. When students work together to investigate scientific questions, they develop not only their scientific knowledge but also essential communication and social skills. By integrating PISA’s emphasis on collaboration into early science education, teachers help students develop the ability to work effectively in scientific and academic communities.

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Cultural and contextual diversity in science education is another theoretical consideration emphasized by PISA. The assessment acknowledges that students from different backgrounds may have varying levels of exposure to scientific concepts, making it essential for educators to create inclusive learning environments. In primary classrooms, teachers can incorporate diverse perspectives by using examples and case studies that reflect students' cultural backgrounds and real-world experiences. Recognizing and valuing diverse ways of understanding science ensures that all students feel included and engaged in the learning process.

The theoretical foundations of PISA provide a valuable framework for improving primary school science education. By incorporating inquiry-based learning, critical thinking, contextual relevance, and assessment-driven instruction, educators can create a more engaging and effective science curriculum. The integration of technology, collaboration, and cultural inclusivity further enhances the learning experience, ensuring that all students develop the foundational scientific literacy skills necessary for future academic and professional success. Aligning primary science education with PISA’s principles not only prepares students for future assessments but also equips them with the problem-solving abilities and analytical skills needed to navigate an increasingly complex and scientific world.

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