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Holism in Teaching Science

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Abstract—This article examines the concept of holism in science education and argues for the integration of diverse knowledge systems that extend beyond the traditional scientific methodologies, which have come to dominate educational systems over the past two centuries. The analysis questions the rationale of limiting knowledge acquisition to empirical observation and systematic experimentation while excluding other ways of knowing, such as religious and Indigenous perspectives. Examples from embryology and water quality assessment methods used by Indigenous peoples illustrate how these diverse epistemologies can complement and enrich scientific understanding. The paper proposes a holistic approach to science education that fosters a more comprehensive and culturally sensitive understanding of the natural world, thereby preparing students to address complex, interdisciplinary challenges in an increasingly interconnected global society. This framework promotes inclusivity and acknowledges the validity of multiple perspectives in the pursuit of knowledge. Such an approach is particularly timely in the current era, as education is increasingly shaped by artificial intelligence, which operates beyond the constraints of our formal curricula by utilizing diverse resources, including non-scientific ones.

Keywords_ Holistic Education; Science Pedagogy; Religion; Indigenous Knowledge; Epistemology; Interdisciplinary Learning

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I. INTRODUCTION

In the era of the emergence and rapid development of artificial intelligence (AI), educators must adapt — and perhaps rethink — many aspects of teaching: what to teach (which knowledge), how to teach (pedagogical methods), and how to assess students' knowledge (assessment). Among these challenges, issues arising in the teaching of Science, as a core subject, occupy a special place. To carry out this process of renewal and reform productively, we

must first determine our current pedagogical position: where we stand.

A logical starting point is terminology. The term “Science” in English and “les sciences” in French convey a meaning that, in languages such as Azerbaijani, Arabic, or Russian, is translated as “natural sciences” or “exact sciences,” encompassing disciplines such as physics, biology, and chemistry, and sometimes mathematics. The Encyclopædia Britannica defines “Science” as “any system of knowledge

that deals with the physical world and its phenomena and that relies on unbiased observation and systematic experimentation.” This definition, rooted in the scientific revolution of the seventeenth century, is widely accepted in the contemporary academic community. In this paper, we will adhere to a similar conceptual basis in our use of the term “Science.”

Teaching of Science within the mainstream pedagogical system is based on the postulate that Scientific knowledge can be obtained “exclusively” through “unbiased observation and systematic experimentation.” Science education has traditionally been characterized by a focus on the transmission of empirical knowledge, skills, and the scientific method. However, contemporary educational paradigms increasingly emphasize a holistic approach that recognizes the complex interplay of cognitive, cultural, philosophical, and socio-epistemic factors shaping learners’ understanding of science. Holistic science teaching aims to develop not only scientific literacy but also the capacity of students to critically engage with socio-scientific issues, appreciate diverse worldviews, and foster ethical reasoning (Eisner, in Matthews, 1998). Recent debates underscore the importance of integrating religious, cultural, and indigenous epistemologies into science curricula to make learning more relevant and inclusive (Taslaman, 2020; Sardarli, 2013). These perspectives challenge the notion of science as a purely objective enterprise, highlighting instead its situatedness within specific cultural and philosophical contexts. Furthermore, constructivist pedagogies advocate for inquiry-based, student-centered learning that encourages learners to connect scientific concepts with their own beliefs and lived experiences (Matthews, 1997).

This paper reviews current literature on the holistic approach to science teaching, emphasizing the significance of integrating diverse knowledge systems, fostering dialogical classroom environments, and promoting sustainable and culturally responsive science education. Exploring these facets provides a compelling pathway toward cultivating

scientifically literate, socially responsible citizens capable of addressing global challenges.

In this paper, I argue that science, while a powerful and systematic methodology, is not the sole path to reliable knowledge, nor can the purely technological limitations of scientific experiments be ignored. I will provide examples showing that knowledge acquired by non-scientific methods can not only be coherent but also consistent with, and complementary to, scientific observations. In my view, this justifies the need for a holistic approach to science education — an approach that integrates reductionist analysis with systems thinking and recognizes the value of diverse epistemological traditions, including Indigenous knowledge and revelation.

II. METHODOLOGY

This review adopts a qualitative, synthesizing approach, integrating insights from a selected range of scholarly sources on holistic science education. The sources include academic books, peer-reviewed journal articles, and credible online publications that address philosophical, cultural, and pedagogical dimensions of science teaching. The inclusion criteria focused on works that explore the intersection of science, religion, Indigenous knowledge, and constructivist pedagogy, emphasizing both theoretical frameworks and practical implications.

The review process involved a systematic analysis of the literature to identify common themes, debates, and research gaps. Key themes were categorized into constructivist epistemology, cultural and religious integration, indigenous and local knowledge systems, and pedagogical strategies for inclusive science education. An interpretative synthesis was employed to connect these themes, critically examining the implications for curriculum development and teacher practice.

While empirical data evaluation was beyond the scope of this review, the cited studies provided qualitative evidence and conceptual models supporting the adoption of holistic strategies in science classrooms. The synthesis aims to inform educators, policymakers, and researchers about practical approaches and to highlight areas requiring further empirical investigation.

I will use two examples to support my arguments.

Example 1. References to Embryology in The Holy Qur'an. Several verses in the Qur'an describe human development in the womb (approximate translation from Arabic): Sura 23 (Al-Mu'minun), verses 12–14: "We created man from an extract of clay. Then We made him a drop (nutfah) in a secure lodging. Then We made the drop into a clot ('alaqah), then We made the clot into a lump (mudghah), then We made the lump bones, then We clothed the bones with flesh; then We produced it as another creation. Blessed is God, the best of creators." Sura 22 (Al-Hajj), verse 5: mentions stages; Sura 39 (Az-Zumar), verse 6; Sura 40 (Ghafir), verse 67; Sura 76 (Al-Insan), verse 2; Sura 32 (As-Sajdah), verses 7–9; and Sura 16 (An-Nahl), verse 4 contain related references.

Example 2. Water Quality — Indigenous and Local Knowledge. Based on experiences from rural communities in Goranboy (Azerbaijan) and interviews with Elders from the Peepeekisis and Kahkewistahaw First Nations (Saskatchewan, Canada), practical indicators included whether horses drank from a source unforced and observed changes in shorebird presence and clutch size — criteria long used to evaluate water quality.

III. RESULTS AND DISCUSSION

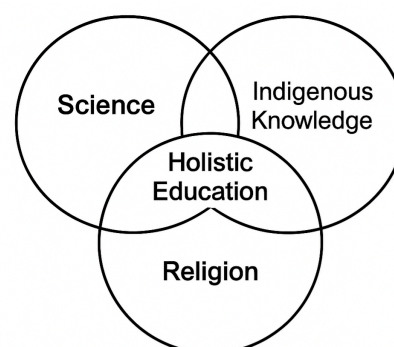
Dr. Keith L. Moore, a renowned embryologist and author of a leading textbook on clinically oriented embryology (Moore, 2018), stated that the descriptions in the Qur'an "could not have been obtained based on the scientific knowledge available in the 7th century A.D. ... It follows, I think, that not only is there no conflict between genetics and religion, but in fact religion can guide science by adding revelation to some of the traditional scientific approaches." Dr. Moore incorporated Qur'anic descriptions into several editions of his textbook and co-authored a volume titled *The Developing Human: with Islamic Additions*. Although not a specialist in embryology, I note that the study and observation of human embryos dates back to the 17th century — e.g., Antonie van Leeuwenhoek's microscopic observations in the 1670s (Howards, 1997). Early

compound microscopes are attributed to the late 16th century (Janssen family), with historical overviews provided by Britannica (Shannon, 2025). Embryology advanced substantially in the 19th century, notably via Karl Ernst von Baer's work, including description of the human ovum in 1827 (Horder et al., 1986). The Qur'anic references therefore predate scientific embryology by centuries.

Similarly, correlations between water quality and avian clutch size, long observed by Indigenous Knowledge Keepers, have been supported by modern studies. For instance, calcium availability and food conditions during egg-laying significantly affect avian reproduction (Graveland & Drent, 1997; McClelland et al., 2021).

This perspective does not dispute science's essential role in understanding natural phenomena. Rather, it aligns with the concept of *Etuaptmumk* ("Two-Eyed Seeing"), articulated by Mi'kmaw Elder Albert Marshall: learning to see with the strengths of Indigenous knowledges and with the strengths of Western science, and to use both together for the benefit of all (Barlett et al., 2012). Extending this to include other channels of knowing (e.g., religion) further enriches inquiry.

Fig. 1. Holism in Science Education



Accordingly, this holistic approach should inform curricular design in schools and universities. Including historical narratives about how diverse methods — scientific and non-scientific — have been used to study natural phenomena can broaden perspectives and strengthen critical thinking.

Students increasingly encounter such cross-domain information through AI systems that operate beyond formal curricula. As educators have limited ability to control these inputs, it is vital to prepare learners to evaluate diverse sources critically and ethically.

Fig. 1. Knowledge Systems and Holistic Teaching

IV. CONCLUSION

This paper has explored the concept of holism in science education, advocating for the integration of diverse knowledge systems alongside traditional scientific methodologies. By examining examples from embryology and water quality assessment, it demonstrates how religious, Indigenous, and local knowledge can complement and enrich scientific understanding.

The limitations of a purely reductionist approach underscore the need for comprehensive, culturally sensitive understandings of the natural world. The “Two-Eyed Seeing” framework offers a practical path for integrating different ways of knowing. Expanding this approach to include other knowledge channels (e.g., religion) further enriches educational practice.

Given AI’s growing influence on learning, educators should incorporate historical narratives and acknowledge contributions from multiple knowledge systems to empower students with the critical thinking needed for complex, interdisciplinary challenges in an interconnected world. In short, to see more of the truth, we should learn to use all available eyes.

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