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The Role of Logic in Understanding Truth in the Educational Environment

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A B S T R A C T

This research explores the role of logic in the understanding of truth in educational settings, using a hermeneutical-philosophical approach. Logic, as a rational thinking tool, serves to develop students' critical and analytical thinking abilities, while science, through empirical methods, provides an evidence-based framework that supports the understanding of truth. However, the application of logic is often limited to theoretical aspects without a practical context, and science education tends to emphasise memorisation over process exploration. This paper proposes the integration of logic and science through an integrated curriculum, project-based approaches and the use of technology to create a holistic education that supports students' character and critical reasoning. This integration creates harmony between rationality and local values, relevant for 21st century education that respects cultural diversity. This research highlights the challenges of creating an inclusive yet value-based education and offers practical recommendations to improve the relevance of logic in learning.

Keywords: *Logic, Holistic Education, Critical Reasoning, Curriculum Integration*

INTRODUCTION

In the world of education, one of the fundamental issues that often arises is how to build an understanding of universal truth amid diverse perspectives, traditions, and cultures (Królikowski, 2020). On the one hand, education aims to develop critical, rational, and logical thinking skills in students (Fahim & Ghamari, 2011). On the other hand, education is also often framed in the context of moral values, spirituality, and specific local traditions, which influence how truth is understood and taught (Kaymakcan & Meydan, 2012). The challenge that arises is how to align a rational approach through logic with the need to understand and convey universally acceptable truths, without neglecting specific cultural contexts or values..

The process of thinking and the search for truth are greatly influenced by logic, which is one of the most important branches of philosophy (Brenner, 1993). In an educational setting, logic helps students develop valid arguments, detect errors in thinking, and construct coherent proofs (Osborne & Reagan, 1973). However, the application of logic in education is not always straightforward, especially when faced with a plurality of perspectives arising from differences in epistemology, such as between Western secular approaches and educational traditions based on spiritual values (Francis, 1983). For example, in Islamic education, there must be harmony between the principles of rationality ('aql) and the teaching of revelation (wahy) (Fahriana, 2017), which often raises the question: where is the boundary between universal truth derived from logic and truth derived from revelation or tradition?

It's getting more complicated with the pace of modern education, which needs logical thinking to deal with global issues while respecting local and spiritual values (KavooriP, 2009). Therefore, the discussion of the role of logic in shaping the understanding of truth, especially in the educational environment, is a significant issue to be researched.

This issue is important to discuss because it has significant implications for the design, implementation and evaluation of education, in the context of both the philosophy of science

and methods of thinking. Within this framework, logic provides essential tools for evaluating the validity of knowledge and distinguishing between valid and invalid arguments. It also ensures that human thought processes adhere to the standards of rationality (Piburn, 1989). Logic is a way of thinking that supports the development of individuals capable of critical thinking, a key competency in 21st-century education. (Bratislava, Slovakia dkk., 2023). Thus, applying logic in education contributes to mastery of the subject matter and equips students with the analytical skills necessary to overcome complex challenges in the modern world.

In addition to its practical value, the role of logic in understanding truth also touches on deeper metaphysical and epistemological issues. (Tahko, 2014). In philosophical tradition, logic serves as a link between humans and universal truth. However, if truth is considered universal, does it apply equally in all contexts, or is it shaped by specific values and perspectives? (Grattan-Guinness, 2015) In the context of education, this includes important questions such as: Can the education system accommodate a universal approach to logic without neglecting traditions and values? and How can logic be used to respect diversity of perspectives in a multicultural environment? (Breshkovskaya & Ezhkova, 2020)

How can educational systems, such as Islamic education, integrate logic as a method of thinking alongside transcendental and spiritual values in the learning process? Exploring this approach is important because it facilitates dialogue between different traditions of thought, enabling students to develop a more comprehensive and inclusive view of knowledge (Azmi & Wahab, 2013; Shohibul Kafi dkk., 2022). Thus, emphasising the integration of logic and local values can help create a curriculum that is not only academically relevant but also meaningful in the cultural context of students.

From the perspective of the philosophy of science, discussing the role of logic in understanding truth helps bridge the discussion between facts (which can be analysed rationally) and values (which are often rooted in tradition or spirituality) (Ushenko, 1954). It is also important to develop an educational framework that prepares students to face global issues without losing their epistemological identity. Effective education must be able to balance the teaching of logic and respect for cultural heritage, thereby creating an inclusive learning environment and encouraging critical thinking among students (Le Roux, 2001).

In the philosophy of science, logic has long been the main foundation for understanding the process of rational thinking. According to Immanuel Kant, logic, especially transcendental logic, plays an important role in enabling humans to produce universal knowledge. (Moroz, 2021; Schmucker, 1972). Kant distinguishes between 'general logic,' which applies to all thinking regardless of its content, and 'transcendental logic,' which deals with the a priori rules that enable knowledge of specific objects. (Giesinger, 2012). Within this framework, Kant's transcendental logic forms the basis for understanding the concept of synthetic a priori knowledge — an understanding that is universally valid, yet independent of sensory experience. This type of knowledge is evident in subjects such as mathematics and moral philosophy, and reveals truths that do not originate from empirical observation, yet are nonetheless essential and universally valid (Marshall, 2014).

However, Kant's idea of universal truth is often debated, especially when confronted with philosophical principles such as hermeneutics. Hans-Georg Gadamer, through his hermeneutic philosophy, criticises the idea of universality by emphasising the importance of the 'fusion of horizons,' which is a dialogical process that creates new understanding through interaction between historical and cultural perspectives. (Gomes, 2020; Piri & Avarsin, 2022). In the context of education, this approach challenges the universalism of logic to consider the socio-cultural context of learners, so that truth is not only theoretical but also practically relevant.

Meanwhile, in the tradition of Islamic education, logic has also long been an integral part of Islamic epistemology. Classical Muslim philosophers such as Al-Farabi, Al-Ghazali, and Ibn Sina used Greek logic, particularly Aristotelian logic, to support the integration between revelation and reason (Irfan Syahroni, 2022). In this approach, logic is used as a tool to ensure a correct understanding of revelation, while strengthening rational arguments in the Islamic scientific tradition. In modern education, this tradition plays an important role in

developing a harmonious approach between logic as a method of thinking and spiritual values in learning (Budianto & Fadholi, 2020; Piri & Avarsin, 2022).

The integration of logic in the philosophy of science and education—both in Western and Islamic traditions—shows that logic plays a significant role in bridging universal truths and particular contexts. (Hassan, 2016). Thus, this study is not only philosophically relevant, but also contributes practically to the design of more inclusive and value-based curricula and teaching methods in educational settings.

METHOD

This study uses a hermeneutic-philosophical approach to understand the role of logic and science in shaping the understanding of truth in the educational environment. Hermeneutics as a method of interpretation helps analyse texts and practices related to the concepts of truth, logic, and science, while the philosophical approach explores the basic meanings of these concepts and their role in developing students' critical thinking skills (Gadamer, 2006). This study explores how logic as a tool for critical thinking and empirical science shape students' understanding of truth. The analysis begins with an interpretation of philosophical works such as those of Aristotle and Kant, then continues with a study of the influence of logic and science on students' thinking patterns (Brenner, 1993).

Furthermore, this study focuses on educational practices that integrate logic and science to achieve a deeper understanding of truth. Using literature studies, this study reveals the role of logic in understanding truth in an educational environment. Data analysis was conducted through hermeneutic interpretation to critically and holistically evaluate the role of logic and science.

FINDINGS AND DISCUSSION

The Role of Logic in Understanding Truth

Logic, as an instrument of rational thinking, plays a significant role in shaping students' understanding of truth. Logic teaches students to evaluate information based on the principles of consistency, validity, and coherence. (Hogan & Maglienti, 2001). Logic is a tool for understanding truth through syllogisms and deduction. (Copi, Irving M. dkk., 2016). In modern education, the application of logic helps students develop analytical skills, including distinguishing between valid and invalid claims. (Girod, 2014).

However, logic teaching is often limited to mastering theory, without providing relevant practical context. Many studies have noted that abstract logic teaching can make it difficult for students to understand its benefits in everyday life (Bratislava, Slovakia dkk., 2023; Bronkhorst dkk., 2021; Francis, 1983; Maskill, 1988). To address this issue, a more contextual approach is needed, for example through case discussions or simulations that reflect the realities of the real world.

The Role of Science in Shaping Understanding of Truth

Science, through empirical methods, provides an evidence-based framework involving observation, hypothesis, experimentation, and analysis. Human understanding of truth requires the integration of empirical experience and the logical structure of thought. (Nuzzo, Angelica, 2005). Science education, therefore, is an ideal vehicle for teaching students about the relationship between empirical data and logical principles

However, challenges arise when students are directed more towards memorising scientific facts than understanding the scientific process itself. On the other hand, education should emphasise the logic of the process, not just the results. (Brown, 2012; Garrison, 1999). Therefore, science education needs to be redesigned to emphasise active exploration and evidence-based problem solving, so that students can internalise the values of scientific truth.

Integration of Logic and Science in Education

The integration of logic and science in education enables students to develop a holistic understanding of truth. From a hermeneutic-philosophical perspective, this integration reflects the dialectic between rationality and empiricism. For example, the scientific method

relies on deductive and inductive logic to build and test hypotheses. This integration enhances critical thinking skills and shapes students' characters, fostering intellectual honesty and curiosity (Robotti & Penna, 2019; Setiana dkk., 2021).

To achieve this integration, a curriculum that supports a multidisciplinary approach is needed. For example, logic lessons can be integrated into science lessons, so that students understand how logical principles are used in scientific experiments. In addition, project-based learning can be a practical solution for combining logic and science in a single integrated learning framework. (Hujjatusnaini dkk., 2022; Karahasanović & Culén, 2023; Singha & Singha, 2024).

Philosophical Implications for Character Education and Critical Thinking

A logical and scientific approach has significant philosophical implications for character education and the development of critical thinking. Education that integrates logic and science not only helps students understand the truth, but also shapes characters that are capable of facing moral and intellectual challenges. Education must create virtuous human beings who are capable of using reason to act correctly. (Brenner, 1993; Piri & Avarsin, 2022).

In this context, critical reasoning serves as a bridge between logic and character education. Critical reasoning involves the ability to question assumptions, analyse evidence, and make responsible decisions (Fahim & Ghamari, 2011). Thus, education based on logic and science can strengthen students' ability to make ethical and rational decisions.

Solutions for the holistic development of education

Based on the preceding analysis, the following strategies can be implemented to strengthen the role of logic and science in education: Firstly, it is essential to develop an integrated curriculum. This curriculum should intentionally connect logical reasoning with scientific knowledge, emphasising the relationship between theoretical understanding and practical application. Secondly, adopting a contextual learning approach, such as case-based or project-based learning, can significantly enhance students' ability to relate classroom concepts to real-world situations. This approach fosters critical thinking and enables learners to recognise the relevance and impact of logic and science in their daily lives (Morris, 2020). Thirdly, teacher training is crucial in enhancing the integration of logic and science in education. Educators should be equipped with interdisciplinary teaching skills to enable them to guide students in developing critical and creative thinking abilities. This includes training in instructional strategies that combine logical reasoning with scientific enquiry. Fourth, the use of educational technology plays a significant role in this process. Interactive digital tools and simulations can vividly demonstrate the application of logic and science in different contexts, making abstract concepts more tangible and engaging for learners (Dai & Ke, 2022). Based on the above explanation, the results and discussion of this study can be illustrated in Figure 1.
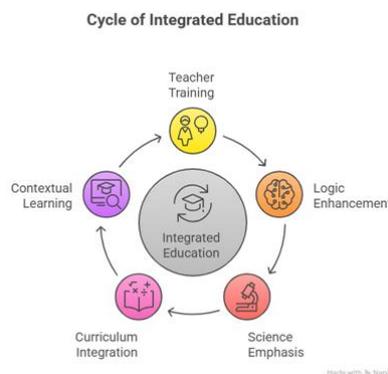

Figure 1. Integration of logic and science in education from a philosophical *perspective*

CONCLUSIONS

Logic plays a crucial role in shaping students' understanding of truth in educational settings. As a tool for rational thinking, logic supports the development of critical and

analytical thinking skills that help students evaluate information objectively and distinguish valid arguments. When integrated with science, logic strengthens the relationship between theory and practice, equipping students with the ability to make rational and ethical decisions in an increasingly complex and multicultural world. This research is theoretical in nature, thus requiring further empirical validation to test the effectiveness of the recommendations in a real educational context. The primary focus on formal education does not yet cover the non-formal or informal dimensions that are also relevant. In addition, integrating logic with local values presents complex challenges, particularly given the diversity of cultures and traditions that require specific and sensitive approaches to the local context. Further research is needed to test the application of logic and science integration in various educational institutions to measure its impact on the development of students' critical thinking skills. A project-based curriculum that connects theory and practice needs to be designed, taking into account global challenges and local needs. Additionally, teacher training to teach logic in an applied and interdisciplinary manner is crucial, supported by educational technologies such as interactive simulations that can enhance the relevance and effectiveness of logic learning in a modern context.

REFERENCES

Azmi, M. F., & Wahab, M. R. (2013). Kedudukan Akal dalam Pendalilan Akidah. *Jurnal Teknologi*, *63*(1). https://doi.org/10.11113/jt.v63.1563

Bratislava, Slovakia, Vartiak, L., Jaseckova, G., Comenius University, Faculty of Social and Economic Sciences, Institute of Mediamatics, Bratislava, Slovakia, Konvit, M., & Comenius University, Faculty of Social and Economic Sciences, Institute of Mediamatics, Bratislava, Slovakia. (2023). Logic as a Tool for Developing Critical Thinking. *Rupkatha Journal on Interdisciplinary Studies in Humanities*, *15*(2). https://doi.org/10.21659/rupkatha.v15n2.15

Brenner, W. (1993). *Logic and Philosophy: An Integrated Introduction*. University of Notre Dame Pess.

Breshkovskaya, K. Y., & Ezhkova, N. S. (2020). Multicultural Education From the Position of a Dialogue Approach. *Ethnic Culture*, *1 (2)*, 34–36. https://doi.org/10.31483/r-74910

Bronkhorst, H., Roorda, G., Suhre, C., & Goedhart, M. (2021). Student Development in Logical Reasoning: Results of an Intervention Guiding Students Through Different Modes of Visual and Formal Representation. *Canadian Journal of Science, Mathematics and Technology Education*, *21*(2), 378–399. https://doi.org/10.1007/s42330-021-00148-4

Brown, M. J. (2012). John Dewey's Logic of Science. *HOPOS: The Journal of the International Society for the History of Philosophy of Science*, *2*(2), 258–306. https://doi.org/10.1086/666843

Budianto, N., & Fadholi, A. (2020). Memahami Konsep Hermeneutik Dalam Pendidikan. *Auladuna : Jurnal Prodi Pendidikan Guru Madrasah Ibtidaiyah*, *2*(2), 42–58. https://doi.org/10.36835/au.v2i2.415

Copi, Irving M., Cohen, Carl, & McMahon, Kenneth. (2016). *Introduction to logic*. Routledge.

Dai, C.-P., & Ke, F. (2022). Educational applications of artificial intelligence in simulation-based learning: A systematic mapping review. *Computers and Education: Artificial Intelligence*, *3*, 100087. https://doi.org/10.1016/j.caeai.2022.100087

Fahim, M., & Ghamari, M. R. (2011). Critical Thinking in Education: Globally Developed and Locally Applied. *Theory and Practice in Language Studies*, *1*(11), 1632–1638. https://doi.org/10.4304/tpls.1.11.1632-1638

Fahriana, A. S. (2017). Islamic Education Dynamic In The Epistemology Of Learning Theory. *Didaktika Religia*, *5*(2), 289–306. https://doi.org/10.30762/didaktika.v5i2.623

Francis, L. J. (1983). The Logic of Education, Theology, and the Church School. *Oxford Review of Education*, *9*(2), 147–162. https://doi.org/10.1080/0305498830090207

Gadamer, H.-G. (2006). Classical and Philosophical Hermeneutics. *Theory, Culture & Society*, *23*(1), 29–56. https://doi.org/10.1177/0263276406063228

Garrison, J. (1999). John Dewey's Theory of Practical Reasoning. *Educational Philosophy and Theory*, *31*(3), 291–312. https://doi.org/10.1111/j.1469-5812.1999.tb00467.x

Giesinger, J. (2012). Kant's Account of Moral Education. *Educational Philosophy and Theory*, *44*(7), 775–786. https://doi.org/10.1111/j.1469-5812.2011.00754.x

Girod, R. J. (2014). *Logical Investigative Methods* (0 ed.). Routledge. https://doi.org/10.1201/b17482

Gomes, M. M. (2020). As contribuições da hermenêutica gadameriana para o processo ensino – aprendizagem. Dalam B. G. D. Jesus (Ed.), *Educação Contemporânea – Volume 11*. Editora Poisson. https://doi.org/10.36229/978-65-5866-013-2.CAP.02

Grattan-Guinness, I. (2015). Is Logic Universal or Hierarchical? Dalam A. Koslow & A. Buchsbaum (Ed.), *The Road to Universal Logic* (hlm. 307–318). Springer International Publishing. https://doi.org/10.1007/978-3-319-15368-1_14

Hassan, S. A. (2016). The Use of Logic in Contemporary Islamic Discourses. *Mediterranean Journal of Social Sciences*. https://doi.org/10.5901/mjss.2016.v7n5p171

Hogan, K., & Maglienti, M. (2001). Comparing the epistemological underpinnings of students' and scientists' reasoning about conclusions. *Journal of Research in Science Teaching*, *38*(6), 663–687. https://doi.org/10.1002/tea.1025

Hujjatusnaini, N., Corebima, A. D., Prawiro, S. R., & Gofur, A. (2022). The Effect of Blended Project-based Learning Integrated with 21st-Century Skills on Pre-Service Biology Teachers' Higher-order Thinking Skills. *Jurnal Pendidikan IPA Indonesia*, *11*(1), 104–118. https://doi.org/10.15294/jpii.v11i1.27148

Irfan Syahroni, M. (2022). Aliran Hermeneutika Dalam Pandangan Filsafat Pendidikan Islam: Sejarah Perkembangan Aliran Hermeneutika di Dunia Barat, Tokoh-Tokoh dan Pemikirannya, serta Implikasinya dalam Pendidikan Islam. *eJurnal Al Musthafa*, *2*(1), 68–84. https://doi.org/10.62552/ejam.v2i1.33

Karahasanović, A., & Culén, A. L. (2023). Project-based learning in human–computer interaction: A service-dominant logic approach. *Interactive Technology and Smart Education*, *20*(1), 122–141. https://doi.org/10.1108/ITSE-10-2021-0178

KavooriP, A. P. (2009). *The Logics of Globalization: Case Studies in International Communication*. Lexington Books.

Kaymakcan, R., & Meydan, H. (2012). Values in the Curricula of Religious Education and Social Studies in Primary Schools in the Context of Local-Universal Dilemma. *Kuram Ve Uygulamada Egitim Bilimleri*, *12*(2), 1588–1591.

Królikowski, J. (2020). Culture, Education and Truth. The Perspectives on Help Offered to Contemporary Youth. *Teologia w Polsce*, *13*(2), 95–109. https://doi.org/10.31743/twp.2019.13.2.06

Le Roux, J. (2001). Effective Schooling is Being Culturally Responsive. *Intercultural Education*, *12*(1), 41–50. https://doi.org/10.1080/14675980120033957

Marshall, C. (2014). Does Kant Demand Explanations for All Synthetic A Priori Claims? *Journal of the History of Philosophy*, *52*(3), 549–576. https://doi.org/10.1353/hph.2014.0067

Maskill, R. (1988). Logical language, natural strategies and the teaching of science. *International Journal of Science Education*, *10*(5), 485–495. https://doi.org/10.1080/0950069880100502

Moroz, O. V. (2021). Universal Transcendental Logic-Based Ontology. *Computer and Information Science*, *14*(2), 1. https://doi.org/10.5539/cis.v14n2p1

Morris, T. H. (2020). Experiential learning – a systematic review and revision of Kolb's model. *Interactive Learning Environments*, *28*(8), 1064–1077. https://doi.org/10.1080/10494820.2019.1570279

Nuzzo, Angelica. (2005). *Kant and the Unity of Reason*. Purdue University Press.

Osborne, A. R., & Reagan, G. M. (1973). Logical reasoning: An educational goal. *Theory Into Practice*, *12*(5), 263–265. https://doi.org/10.1080/00405847309542467

Piburn, M. D. (1989). Reliability and Validity of the Propositional Logic Test. *Educational and Psychological Measurement*, *49*(3), 667–672. https://doi.org/10.1177/001316448904900320

Piri, R., & Avarsin, S. M. (2022). Educational Philosophy of Islamic Hermeneutics and Its Application in Curriculum Studies. *DAYAH: Journal of Islamic Education*, *5*(2), 150. https://doi.org/10.22373/jie.v0i0.10317

Robotti, E., & Penna, W. B. (2019). Current Practical Concepts for Using Rib in Secondary Rhinoplasty. *Facial Plastic Surgery: FPS*, *35*(1), 31–46. https://doi.org/10.1055/s-0039-1677801

Schmucker, J. (1972). On the Development of Kant's Transcendental Theology. Dalam L. White Beck (Ed.), *Proceedings of the Third International Kant Congress* (Vol. 4, hlm. 495–500). Springer Netherlands. https://doi.org/10.1007/978-94-010-3099-1_49

Setiana, D. S., Purwoko, R. Y., & Sugiman, S. (2021). The Application of Mathematics Learning Model to Stimulate Mathematical Critical Thinking Skills of Senior High School Students. *European Journal of Educational Research*, *volume–10–2021*(volume–10–issue–1–january–2021), 509–523. https://doi.org/10.12973/eu-jer.10.1.509

Shohibul Kafi, M., Rizal Ma'arif, M., & Setiawan, E. (2022). Antara Logika, Etika, dan Estetika dalam Pendidikan Agama Islam. *JURNAL PUSAKA*, *12*(1), 34–42. https://doi.org/10.35897/ps.v12i1.780

Singha, R., & Singha, S. (2024). Application of Experiential, Inquiry-Based, Problem-Based, and Project-Based Learning in Sustainable Education: Dalam C. L. Goi (Ed.), *Practice, Progress, and Proficiency in Sustainability* (hlm. 109–128). IGI Global. https://doi.org/10.4018/978-1-6684-9859-0.ch006

Tahko, T. E. (2014). The metaphysical interpretation of logical truth. Dalam P. Rush (Ed.), *The Metaphysics of Logic* (1 ed., hlm. 233–248). Cambridge University Press. https://doi.org/10.1017/CBO9781139626279.018

Ushenko, A. P. (1954). Truth in Science and in Philosophy. *Philosophy of Science*, *21*(2), 101–117. https://doi.org/10.1086/287332