



### THE ROLE OF THE PHILOSOPHY OF SCIENCE IN THE DEVELOPMENT OF EDUCATIONAL TECHNOLOGY

**Alyan Fatwa<sup>1\*</sup>, Wisnu Djatmiko<sup>2</sup>, Suyitno Muslim<sup>3</sup>**

<sup>1,2,3</sup> Educational Technology, Universitas Negeri Jakarta, Indonesia

\*email: alyan.fatwa@mhs.unj.ac.id

#### Abstract

Philosophy of science, as a discipline that examines the nature of knowledge, the ways of acquiring knowledge, and its application in human life, plays a strategic role in understanding and formulating the direction of educational technology development. This research aims to explore the role of the philosophy of science in developing educational technology, highlighting how philosophical thinking can guide the design, implementation, and evaluation of more humanistic and meaningful educational technology. This research uses a qualitative approach with descriptive analysis to explore the relevant literature on the relationship between the philosophy of science and educational technology. The research results show that the philosophy of science provides a strong foundation for understanding how educational technology can be used to support more effective, inclusive, and sustainable learning. Moreover, the philosophy of science plays a role in guiding educational technology to remain oriented towards profound educational values, such as freedom of thought, critical thinking, and creativity. The conclusion of this research is that the philosophy of science serves as an important theoretical foundation in the development of educational technology and as a critical reflection tool necessary to create a balance between technological advancement and profound educational goals.

**Keywords:** *philosophy of science, educational technology, technological development.*

#### I. Introduction

The development of science and technology has several impacts on its users, and these impacts are not only positive but can also be negative.(Heryadi,2024). Society 5.0 as the centre of human needs based on technology. The emergence of an evolving movement in industry and society is expected to give birth to a new societal order filled with aspects of human life. Amsal Bakhtiar's research concludes that the substantial historical aspects of philosophy, including science or knowledge, play a very important role in human life because they integrate with the challenges of human

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civilization changes. Hidayatullah's research explains that Greek civilization was the beginning of philosophy's discovery, and its development has brought about the well-being of humanity today.

The perspective of the philosophy of science and its implementation with other sciences is very different, which happens due to misconceptions among the general public. Initially, philosophy was knowledge of curiosity and excessive doubt, which drove the desire to know about what we know and do not know. The understanding of concepts and methods of a discipline is considered as humanity's effort towards philosophy with science or knowledge. The existence of modern society with the acceleration of technology means that all aspects of community life are dominated by rapid technological advancements, which will impact changes in human social interactions, with the swift development of technology disrupting various aspects of human life. In the era of the 4.0 industrial revolution, where almost all aspects of human life are supported by technology, the social order is undergoing significant transformation.(Aldianti,2024).

Philosophy always has a role to stand as an answer to the demands of the times. The concept of the study in this research is substantial, specifically focusing on the author's examination of contemporary philosophy. Another study by Nafiur Rofiq states the position of the philosophy of technology in the development of science as a dialog partner and being holistic-integral-integrative. Further research by Sulhatul Habibah mentions the impact of the philosophy of technology on the enhancement of knowledge and the technological era, which culminates in the diversification and specialization of technological knowledge, alongside technological innovations in achieving new discoveries. Meanwhile, the research by Pirhat Abbas states the relationship between the philosophy of science and religion in the pursuit of truth using ontological theory. As a branch of philosophical science, epistemology is essentially a philosophical study that aims to comprehensively and fundamentally examine general issues to discover the general and essential characteristics of human knowledge.(Nurhayati,2021).

The theory of epistemology only reveals scientific applications as methods considered the truth of beliefs and justifications related to the problem of scepticism in the criteria of knowledge with justifications linking knowledge to its philosophical branches, so rational thinking alone is not enough to see the relationship between the branches of philosophy and knowledge.(Budiatmaja,2024). The novelty in this research uses the philosophy of life from the Tao Te Ching and epistemological theory in the discussion of branches of philosophy related to the theory of knowledge, which means that knowledge is not only known as rational thought but also employs scientific methods to see the correlation and relevance of philosophy with science in relation to

the 4.0 industrial revolution and the 5.0 society towards the acceleration of technology and innovation development.

The study of philosophy is not merely a search for truth, as absolute truth belongs only to God Almighty. The study of philosophy has several statements that need to be answered. These statements include: the definition of philosophy, the definition of science, an overview of the position of philosophy with science or knowledge, the differences and similarities between philosophy and science, the correlation of philosophy with science or knowledge, and its relevance in the context of rapid technological development leading to the evolution of Industry 4.0 or Society 5.0. The technology and knowledge that increasingly pamper humans have garnered significant attention, especially among the millennial generation (Handraini, 2023).

Finally, researchers have concluded that there is a correlation and relevance of philosophy with science in the context of the Industrial Revolution 4.0 and Society 5.0, as a technological development in the current human civilization. The history of educational technology is inseparable from the philosophical foundations that underlie it. Philosophical thinking provides a deep perspective on the goals of education and the methodologies used, influencing the development of technology that supports the learning process.

The development of educational technology has made rapid progress in line with advancements in information and communication technology. In this context, the use of technology is not merely for delivering learning materials, but also for creating interactive and adaptive learning experiences. However, along with the ongoing innovations, it is important to consider the philosophical foundations underlying the application of technology in education. The philosophy of science seeks to restore the spirit and noble purpose of science so that it does not become a boomerang for human life (Alfiyanti, 2022).

The philosophy of science, as a discipline that studies the origin, development, and structure of knowledge, plays a crucial role in helping us understand the goals and implications of educational technology. Through a philosophical approach, we can explore fundamental questions regarding what constitutes good education, how technology can support the learning process, and the ethical values that must be considered in its implementation. The development of culture in the past few centuries has been so rapid, not only due to the increase in population but primarily because of the rapid advancement of science and technology. (Nugraha,2022).

This article aims to examine the role of the philosophy of science in the development of educational technology, with an emphasis on how philosophical thinking can help define and shape better educational practices. Through this analysis, it is hoped that a more comprehensive understanding of the integration between theory and practice in technology-based education can be achieved, as well as its

implications for the future of education in the digital era. Thus, it is important to explore the synergistic relationship between the philosophy of science and educational technology, in order to create an approach that is not only effective but also meaningful and ethical in the context of contemporary education.

## II. Research Method

The method used is descriptive qualitative. The research was conducted at K.H. Abdurrahman Wahid University Pekalongan. Where this article has a material object for science, its formal object is philosophy, which is qualitative in nature and used in several literature sources. In analyzing philosophy in relation to knowledge and the development of educational technology to provide an explanation of several fundamental issues, this article receives attention in presenting research findings clearly. Choosing several concrete cases where educational technology is implemented and analyzing them in depth. This research can include interviews, observations, and related document analysis, thereby providing a holistic picture of the context, challenges, and outcomes achieved.

Bogdan and Taylor (1982) state that qualitative research is a research procedure that produces descriptive data in the form of written or spoken words from people and observable behaviors; its approach is directed at the context and individuals holistically. Kirk & Miller explain that qualitative research is a specific tradition in social science that fundamentally relies on the observation of humans in their own contexts and engages with those individuals in their own language and terminology.

In the study of the role of the philosophy of science in the development of educational technology, a qualitative approach can be applied using the following methods:

### 1. In-Depth Interviews

Conducting interviews with educators, in this case, lecturers teaching Educational Technology courses, educational technology developers, and philosophers to explore their views and experiences regarding the application of the philosophy of science in educational technology. This method provides deeper insights into how philosophical theories and values influence daily practices. An interview is a question-and-answer activity conducted by two people to exchange information, which can then be constructed into a meaning that refers to a specific topic. According to (Zuriah, 2009), an interview is a tool for collecting information by asking a series of questions to be answered orally. The observation technique is often combined with in-depth interviews to uncover more accurate information. Therefore, the data obtained from observations will be further explored using in-

depth interview techniques. This is one of the efforts to ensure the accuracy of the obtained data.

## 2. Focus Group Discussion (FGD)

Organizing group discussions with various stakeholders, such as lecturers, students, and educational technology developers. This FGD can help identify challenges, opportunities, and different perspectives regarding the role of the philosophy of science in the development of educational technology. FGD is a form of semi-structured interview with a focus on a pre-established topic and guided by an expert moderator. The process begins with questions from the moderator, followed by responses and discussions among the participants. The moderator plays a key role in ensuring the creation of a productive discussion and the collection of maximum opinions within a certain time frame. The entire discussion is designed in a relaxed atmosphere to provide each participant with the space to express their opinions without feeling pressured. The general objective of a Focus Group Discussion (FGD) is to unify perceptions regarding specific issues, topics, or interests in the workplace, with the hope of reaching agreements and new understandings related to the discussed issues. After learning about FGD, another important thing to know is the steps to conduct the FGD. In general, six stages include:

### a) Selecting a Moderator

The first step in a Focus Group Discussion is the selection of a moderator. In this case, it is important to understand the role of the moderator in the discussion activities. A moderator has the responsibility to manage the discussion so that the planned objectives can be achieved. The main criteria that must be considered in selecting an FGD moderator include: Professionalism, Critical thinking ability, Analytical expertise, Clear and concise communication, Objective and neutral attitude, Ability to be assertive yet calm, Listening and observing skills.

### b) Preparing the Team

After that, a team needs to be formed to facilitate the discussion process. The number of team members can be adjusted according to needs. In this case, it is necessary to distribute tasks or roles among the discussion participants. After the team is formed, the next step is to determine the date and location for the FGD implementation.

### c) Introducing the Topic and Asking Questions

The next stage involves dividing participants into small groups. The number of members in each group can be adjusted; for mini discussions, it can consist of 4-5 people, while larger discussions can include 8-12 people. After the group division, the moderator introduces the topic, explains the rules, and allocates time. The questions posed should be open-ended to encourage participation and perspectives from group members.

d) Summarizing the Discussion Content

The team assigned as the minutes-taker must carefully note all important points and responses from participants during the discussion. The use of recording techniques can also be an effective tool to ensure complete information.

e) Analyzing Data

After the discussion ends, the team responsible for analyzing the data will evaluate the notes that have been made. The analysis includes evaluating the opinions of each participant, how they maintain their views, the patterns of discussion that occur, and the general conclusions. This analysis is important to achieve the FGD's objective, which is to produce in-depth and comprehensive information.

f) Making Decisions

The final step in the FGD is making decisions based on the analysis results. These decisions can reflect the general views related to the discussed topic. If the FGD is conducted as part of a selection process, the decision may involve determining which participants meet the criteria and are eligible to proceed to the next stage.

### 3. Participatory Observation

Directly observing the learning process that uses technology, while participating in the activities. This approach allows researchers to gain a contextual understanding of how technology is applied and how philosophical values play a role in educational interactions.

### 4. Document Analysis

Analyzing documents and educational materials, such as curricula, technology usage guidelines, and educational policies. In this way, researchers can see how the concept of the philosophy of science is integrated into official documentation and educational practices. Documentation is a way to collect information visually, verbally, or in writing. According to (Zuriah, 2009), documentation is a method of collecting data through written records such as archives, including books on theory, opinions, arguments, or laws, and other materials related to research issues. So documents can be used as records of activities, events, or occurrences that have taken place, which are noted and compiled into an archive. The documents in question can take the form of writings, images, or monumental works by an individual. Observation and interview methods are used as complements in data collection for qualitative research.

By applying this qualitative method, researchers can delve deeper into the meaning, values, and impact of the philosophy of science on the development of educational technology. This approach allows researchers to understand the

perspectives and experiences of subjects more richly, and to make significant contributions to the development of educational theory and practice.

### **III. Results and Discussion**

#### **A. Research findings**

One of the main findings is that the philosophy of science makes an important contribution to establishing ethical principles in the use of educational technology. In a world of education increasingly dominated by technology, the philosophy of science helps identify ethical challenges related to data privacy, access equality, and the social implications of technology. Concepts such as justice, responsibility, and respect for human rights are very important in designing and implementing educational technology, especially in the context of inclusive education.

Research on the role of the philosophy of science in the development of educational technology shows that the philosophy of science serves as a profound theoretical foundation in guiding the development and implementation of better and more meaningful educational technology. Here are some key findings from the research that has been conducted: This research also found that the philosophy of science, particularly in the study of epistemology, provides insights into how knowledge is generated and understood through technology. Different epistemological paradigms—such as constructivism, pragmatism, or positivism—can influence the way technology is applied in education. Educational technology, such as computer-based learning and online platforms, can support constructivist theory which emphasizes active and experiential learning, enriching the educational process in a more individual and collaborative manner.

The philosophy of science encourages critical reflection on the traditional education paradigm that tends to prioritize a one-way approach. Research shows that the philosophy of science helps deconstruct the view that technology is merely an auxiliary tool in education, by considering it as a medium to redefine how learning is conducted. Technology opens up space for new ideas in education, such as project-based learning, collaborative learning, and lifelong learning, which are more in line with the needs of the modern era.

Research also found that the philosophy of science enables the development of educational technology that not only focuses on technical aspects but also on broader educational goals, namely the holistic development of individuals. For example, a humanistic-based philosophy of education emphasizes that technology should support the development of students' character, moral values, and social skills, not just cognitive achievement. Therefore, the role of the philosophy of science in educational technology is to ensure that technology does

not overlook the greater educational goal, which is to shape wise and competitive individuals in an increasingly complex world.

Other findings show that the philosophy of science opens up space for interdisciplinary dialogue, enriching perspectives in the development of educational technology. For example, the combination of ideas from the philosophy of education, psychology, and information technology can produce innovative solutions that are more effective and aligned with real needs in the field. The philosophy of science teaches the importance of critical and reflective thinking that can connect various disciplines in creating a more inclusive, flexible, and human-centred technology-based education system.

The philosophy of science plays a crucial role in the development of educational technology. Through a profound philosophical approach, educational technology can be developed more wisely and ethically, as well as more deeply in its aim to support holistic learning. The philosophy of science not only provides a theoretical foundation for the use of technology but also encourages the development of more responsible and humanistic innovations in the context of future education. In the tradition of classical philosophy, such as the thoughts of Plato and Aristotle, education is considered an effort to shape character and intellect. These ideas form the foundation for the development of teaching methods that were later adapted in educational technology.

During the Middle Ages, scholastic thought influenced formal education. With the invention of the printing press during the Renaissance, the philosophy of knowledge accessibility began to emerge, creating new opportunities for broader information distribution. The philosophy of progressivism by John Dewey directed the focus on practical experiences in education. This encourages innovation in educational technology, such as visual aids and interactive learning devices. The entry of digital technology brings new challenges, including ethics and access equality. Contemporary philosophy, including critical theory, helps explore the social and cultural impacts of educational technology, encouraging discussions about inclusivity.

The philosophy of science provides a deep framework for understanding fundamental concepts in education and technology. Through this approach, educators and technology developers can better understand the goals and meanings behind educational innovations, such as technology-based learning and the implementation of new teaching methods. The philosophy of science encourages criticism of existing educational practices. This stimulates the development of educational technology that is more relevant and aligned with students' learning needs. For example, discussions about the ethics of data usage in technology-based education encourage more responsible innovation.



The philosophy of science teaches the importance of values and ethics in educational technology.

In this context, technology is not only seen as a tool but also as a medium that must consider moral and social aspects, such as equitable access to education and the social impact of technology. Through philosophical thinking, educators can develop better teaching methods. For example, the constructivist theory rooted in the philosophy of science emphasizes the importance of experience and reflection in learning, so educational technology can be designed to support more interactive and personalized learning experiences.

## **B. Discussion**

The philosophy of science plays a very significant role in the development of educational technology, which is not only limited to innovations in devices or applications but also includes critical thinking and deep reflection on the goals of education itself. In this context, it is important to understand how the philosophy of science contributes to the development and application of educational technology.

First, the philosophy of science serves as a theoretical foundation that strengthens educational practices. By understanding the underlying educational theories, educators can choose the appropriate technology that aligns with the learning objectives. For example, in the context of online learning, it is important to adopt technology that supports social interaction and collaboration, not just as a tool for delivering information. Second, the philosophy of science also encourages innovations that are more responsive to societal dynamics. In facing challenges such as unequal access to education and shifts in learning methods, the approach of the philosophy of science emphasizes the need for the development of inclusive technology. By considering social perspectives, educational technology can be designed to reach various groups, including those who are underserved. Thirdly, ethics become an important aspect that is often overlooked in the development of educational technology.

The philosophy of science invites developers to reflect on the impact of the technology they create. For example, the use of algorithms in student assessment must consider bias and fairness, so that educational technology does not exacerbate existing injustices. Overall, the philosophy of science not only provides a theoretical foundation but also encourages better innovative practices in education. By paying attention to these critical aspects, educational technology can develop not only as a tool but also as a more holistic solution in addressing the challenges of contemporary and future education. In this context, the collaboration between the philosophy of science and educational technology becomes key to creating a better, more relevant, and ethical learning experience. Thus, the role of

the philosophy of science in the development of educational technology is not only important but also essential to ensure sustainable and quality education.

The philosophy of science plays a role in designing technology-based curricula that not only prioritize technical content but also consider the values underlying education itself. Educational philosophy, such as pragmatism or critical theory, can guide the creation of curricula that balance practical knowledge with character formation and social values. Technology-based curricula designed with a strong philosophical foundation can optimize technology to encourage critical thinking, creativity, and collaborative skills among students, which are essential in this digital era.

The philosophy of science helps ensure that the development of educational technology does not diminish the autonomy of educators in the teaching and learning process. Rapidly advancing educational technology often emphasizes the use of fully automated and data-based devices, which can lead to a reduction in the role of educators in determining the most suitable approaches for students. In this context, the philosophy of science, particularly the theory of education as a social and cultural process, emphasizes the importance of the teacher's role as a facilitator who mediates the interaction between technology and students. Therefore, the philosophy of science serves to maintain the balance between technology as an aid and the central role of educators in guiding and shaping the learning process.

The philosophy of science plays a role in underpinning the understanding of the paradigm shift in learning that occurs with the adoption of technology. The philosophy of education provides a new perspective on how technology can change the structure of learning, from the traditional model that focuses on one-way teaching (teacher-centered) to a model that is more based on active and independent learning. (student-centered). Technology, such as project-based learning, e-learning, and gamification, can introduce more integrated, collaborative, and practical skills development learning experiences, all of which align with ideas in contemporary educational philosophy.

The philosophy of science also highlights the potential impact of technology in promoting the democratization of education. Research shows that with the wider dissemination of technology, education can be more easily accessed by various layers of society, including those in remote or underprivileged areas. The philosophy of science emphasizes the importance of integrating principles of social justice in the use of educational technology, so that technology is not only a right for those who are more economically advanced, but also accessible to all groups without discrimination. Thus, the philosophy of science plays an important role in

ensuring that the development of educational technology can create equal opportunities for everyone to obtain quality education.

The philosophy of science encourages a deeper evaluation of the effectiveness and long-term impact of technology in education. In this research, it is suggested that evaluations not only measure technical aspects, such as access speed and affordability, but also assess their impact on students' cognitive, social, and emotional development. The philosophy of science, through ontological and epistemological approaches, helps in assessing whether technology truly facilitates deeper learning and whether educational technology is used for purposes aligned with a humanistic and integrative vision of education. In the era of globalization and digital transformation, the philosophy of science offers a framework for understanding the global challenges faced by education. This research shows that the philosophy of science plays a role in delving into questions about how education must adapt to the rapid changes in the digital world, including issues of cultural identity, social interaction, and economic changes influenced by technology.

The philosophy of science provides tools to explore how educational technology can function not only to transfer knowledge but also to shape global values that are inclusive and appreciate cultural and intellectual diversity. Overall, the research findings indicate that the philosophy of science plays an integral role in guiding the development and application of educational technology. The philosophy of science not only provides a strong theoretical foundation and ethical principles but also encourages innovations that prioritize human values and social justice in education. By instilling critical and reflective thinking, the philosophy of science allows educational technology to develop in a more holistic and directed manner, aligning technological advancements with the long-term goals of education that focus on the comprehensive development of individuals, and creating a more just, inclusive, and sustainable education system. Further research shows that the philosophy of science plays a key role in designing educational technology that is more contextual and relevant to the social and cultural needs of students. The philosophy of education, particularly the phenomenological and hermeneutic schools, helps guide the development of technology that not only focuses on technical or theoretical aspects but also takes into account the local context and individual student experiences. For example, technology can be tailored to the needs and cultural backgrounds of students, allowing them to relate new knowledge to their life experiences. This makes learning more meaningful and enhances motivation and learning outcomes.

The philosophy of science can guide the use of artificial intelligence (AI) in education. Research shows that the philosophy of science, particularly in the fields

of ethics and epistemology, helps design AI applications that can create more personalized and adaptive learning experiences. Technologies such as AI-based recommendation systems, which tailor educational materials to the needs and abilities of individual students, can be developed by considering a profound philosophical approach to the uniqueness of each individual in the learning process. On the other hand, the philosophy of science also warns about the potential misuse of AI technology, such as excessive surveillance or unethical use of personal data.

The role of the philosophy of science in enhancing student engagement through educational technology. Philosophical approaches such as existentialism, which emphasize the importance of choice and individual responsibility, can be applied in the design of technology that encourages active student engagement. For example, technology that supports project-based learning, creative exploration, or the use of gamification can change the way students interact with learning materials, creating a more immersive and motivating learning experience. The philosophy of science encourages the design of educational technology that not only prioritizes test or quiz results but also values the learning process as a form of personal and intellectual achievement.

In the context of distance education, the philosophy of science makes an important contribution in assessing how technology can be used to create meaningful learning experiences even without face-to-face interaction. Research shows that the philosophy of science, particularly in the study of hermeneutics and phenomenology, helps us understand that distance education is more than just the transfer of information through online platforms. Technology must be able to create space for social interaction, collaborative learning, and emotional experiences that motivate students. The philosophy of science provides a foundation for understanding the complexity of the relationships between teachers, students, and technology in the context of distance education, as well as its impact on engagement and learning outcomes.

Research shows that the philosophy of science can facilitate an understanding of how educational technology can serve as a means to democratize access to knowledge. With the existence of technology such as online education platforms (MOOCs), learning materials can be accessed by anyone, anytime, and anywhere. However, the philosophy of science, particularly critical theory and social philosophy, emphasizes the importance of maintaining equal access to prevent social disparities. The use of technology in education should be encouraged with the principle of social justice to ensure that all groups—both those in urban and rural areas—can utilize technology fairly. In this regard, the philosophy of science reminds us that educational technology should not only function as a tool to enhance learning efficiency but also as an empowerment tool for the less fortunate.

One of the important findings in this research is the role of the philosophy of science in evaluating the psychological impact of educational technology use on students. Some schools of philosophy of science, such as existential and humanistic psychology, can be used to understand the emotional and psychological impacts of educational technology, such as screen addiction, social isolation, or digital stress. Educational technology should not only facilitate cognitive learning but also consider the psychological well-being of students. In this regard, the philosophy of science provides a critical perspective on how technology can be used to support the balance between students' intellectual and emotional development, as well as create an environment that supports their mental health.

In a world that is changing ever more rapidly, the philosophy of science serves to examine the impact of the acceleration of technological innovation on education. Research shows that the philosophy of science provides a framework to assess whether the rapid technological changes are always heading in a positive direction in education. The philosophy of science can provide critical insights into excessive dependence on technology and remind us that technology applied too quickly without a strong philosophical foundation can lead to negative impacts, such as information overload or disparities in educational access. Therefore, the philosophy of science helps design more sustainable educational technology, with careful consideration of the future of education itself. More in-depth research on the role of the philosophy of science in the development of educational technology shows that the philosophy of science not only serves as a theoretical foundation that provides ethical and philosophical guidance but also as a tool to understand and address the challenges that arise with the rapid advancement of technology.

The philosophy of science provides the necessary perspective to design educational technology that is more humanistic, inclusive, and aligned with the desired values in education. Thus, the philosophy of science not only enriches the concepts and practices of educational technology but also ensures that this technology continues to serve a greater purpose, namely the holistic development of humans within the context of fair and meaningful education. Further research shows that the philosophy of science, particularly Critical Theory, plays an important role in guiding educational technology to avoid capitalist domination that can reduce educational autonomy. According to Habermas (1984), critical philosophy focuses on emancipation and critical awareness, which means educational technology should be positioned not only as a tool for effectiveness and efficiency but also as a means to enhance students' critical capacity in facing an increasingly digitalized world. Educational technology should enable students to question, analyze, and critique the information they receive, as well as help them

develop sharper critical thinking skills. Critical philosophy emphasizes the importance of education not just to adapt to the status quo, but to change it.

Abraham Maslow, in his theory of human needs (Maslow, 1943), emphasized the importance of fulfilling basic psychological needs for individual development. The humanistic philosophy in education, influenced by thinkers such as Carl Rogers and Abraham Maslow, views educational technology as a means to support learner-centered education and enable each student to develop to their fullest potential according to their needs. Educational technology, when applied correctly, can support inclusive education that addresses the unique needs of each student. In this context, the philosophy of humanistic education provides the foundation that technology not only conveys information but also builds an environment that supports personal growth and emotional development of students.

Research conducted by Vygotsky (1978) in his social development theory emphasizes the importance of social interaction in the learning process. Educational technology can accelerate the creation of spaces for collaborative learning, where students not only act as recipients of information but also as active participants who discuss and work together to solve problems. The philosophy of science provides deep insights into how social interactions can be supported through digital platforms that facilitate collaborative learning, such as the use of video conferencing applications, online discussion forums, or project-based learning. (project-based learning).

Philosophy of science teaches that learning should not only focus on the individual but also on social dynamics that can develop interpersonal, communication, and collaboration skills. One of the major challenges in the digital era is how to develop students' digital literacy. The philosophy of science, especially in the context of epistemology, plays a role in exploring ways in which technology can be used to enhance students' abilities to understand, evaluate, and critically use digital information. Paul & Elder (2006) in "Critical Thinking: Tools for Taking Charge of Your Learning and Your Life" suggest the importance of education that develops critical and reflective thinking, which not only relies on technology to access information but also teaches students to think critically about that information. The philosophy of science guides us to design educational technology that not only introduces digital tools but also develops students' abilities to sift through and analyze information in an increasingly complex world.

The philosophy of science, in the study of the philosophy of technology, also participates in evaluating the impact of automation in education. Heidegger (1977) warned about "technological enframing," which is the way technology can shape human perspectives on the world. In the context of education, automation—such as through the use of AI-based teaching tools or platforms that automatically

assess learning outcomes—can provide advantages in terms of efficiency and scalability. However, the philosophy of science reminds us not to sacrifice the aspect of personalization in education. Carr (2014) in his book *The Shallows* criticizes the impact of technology on the depth of human thought, which can diminish critical thinking skills if we become too reliant on automation. Therefore, the philosophy of technology invites us to find a balance between technological efficiency and the need for critical reflection and human interaction in learning. Gamification or game-based learning is becoming increasingly popular in educational technology.

The philosophy of education, particularly that inspired by John Dewey (1916), which emphasizes the importance of direct experience and activity-based learning, can be applied to understand how games and digital simulations can be used to deepen students' learning experiences. Dewey argued that education should be based on active and participatory experiences. In this regard, gamification offers a way to actively engage students in the learning process, giving them the opportunity to experiment, make mistakes, and learn from their experiences. The philosophy of education that emphasizes experiential learning is highly relevant in designing interactive educational technology based on the application of active learning principles. Research also shows that the philosophy of science provides important insights in creating more inclusive education through digital technology, especially in the context of cultural diversity and global access. In this regard, the social and political philosophy of education, as articulated by Paulo Freire (1970) in *Pedagogy of the Oppressed*, teaches that education is not only a tool for conveying knowledge but also a tool for social liberation. Educational technology can democratize knowledge, providing opportunities for students from various cultural and economic backgrounds to access quality education. Freire reminds us that education must give a voice to the marginalized, and technology can be a means to achieve this by ensuring that technology-based education is not only available to those who are more capable but also accessible to less fortunate groups.

Deeper research into the role of the philosophy of science in the development of educational technology increasingly emphasizes that the philosophy of science is an important foundation in guiding educational technology to support broader and more holistic educational goals. The philosophy of science provides theoretical, ethical, and practical perspectives that help us understand and design better, more inclusive, and more humane educational technology. By utilizing the philosophy of science, educational technology is not merely a tool for knowledge transfer, but also a means to develop students' critical thinking, creativity, and reflective thinking skills in an increasingly digitized world.

Technology-based learning must be driven by greater values, such as social justice, inclusivity, and appreciation for diversity, so that technology can truly support education as an empowering tool for a better future.

#### **IV. Conclusion**

Philosophy has played a crucial role in shaping the history of educational technology development. By understanding this relationship, we can create better solutions for educational challenges in the modern era. The philosophy of science plays an important role in the development of educational technology by providing a deep and critical framework of thought. First, the philosophy of science helps educators understand the fundamental concepts underlying educational practices, making the technology used more relevant and effective. Second, it encourages innovation that is responsive to social challenges, including access and equity in education. Third, the philosophy of science emphasizes the importance of values and ethics, ensuring that educational technology not only functions as a tool but also as a means that supports justice and sustainability. In the future, collaboration between these two fields will be key to addressing educational challenges in the digital era.

The philosophy of science plays a very important role in the development of educational technology, both in terms of theory and practice. As a study that delves into the foundations of knowledge and the scientific thinking process, the philosophy of science provides a critical and systematic framework for developing educational technology. One of the main contributions of the philosophy of science is to clarify the goals, foundations, and impacts of applying technology in education. The philosophy of science helps formulate the ethical principles underlying the use of technology in education. In the digital era, where technology can easily access and distribute information, questions regarding privacy, equality, and justice become highly relevant. The philosophy of science encourages us to think more deeply about how technology can be used responsibly, ensuring that technological innovations are not only efficient but also fair and humanizing for users. Second, the philosophy of science enriches our understanding of the relationship between technology and knowledge. In the context of education, technology is not just a tool, but also a way to change how people learn and access information.

The philosophy of science opens up space for critical reflection on traditional educational paradigms and introduces new ideas, such as constructivism, which emphasizes active and experiential learning. Technology, such as video-based learning, online platforms, and simulations, enables a more flexible and personalized approach to education, but it must always be grounded in



a deep understanding of the educational goals themselves. The philosophy of science helps us understand how technology can facilitate or even shape the way we think and learn. In this context, the philosophy of science not only serves as a tool for evaluating technology but also as a guide for designing a more humane, inclusive, and sustainable education system.

The importance of the philosophy of science also lies in its ability to challenge existing assumptions in the use of educational technology. Through critical reflection, the philosophy of science enables educators and technology developers to not only focus on technical efficiency but also on the social and cultural impacts of the technology. In other words, the philosophy of science serves as a guardian of fundamental values in education, ensuring that technology continues to serve the greater educational purpose of holistic human potential development. Thus, educational technology does not only develop in technical aspects but also aligns with the evolution of profound philosophical thinking about education itself. The philosophy of science provides a strong foundation for the development of educational technology that is not only innovative but also aligned with humanitarian values and long-term educational goals.

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