Application of Philosophy of Science and Scientific Ethics in The Development of Science and Technology

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Abstract:

This research intends to analyze scientist thoughts on philosophy of science associated witht their research and the mplementation of ethical principles in technology development. It used qualitative methode through literature study. The main source of data are quoted from scientists, reseaechers and related documents. The research result shows that many scientists have basic understanding about science philosophy but its implemention for research mostly they are limited to technical aspect and methodology without considering thoroughly the social and implication. Whereas, the implication of ethical principles in technology development tenda to be minimal, although some scientists show their awarness of how important the ethics in research is. This research identify that there is a gap between the theory of philosophy science and the ethics towards the reality. The implication of this research is the need for better intregation between science philosophy and scientific ethics in scientific education and research policy to create technology which is not only innovative but also accountable socially and morally.

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INTRODUCTION

An important issue that arises in the development of science and technology (IPTEKS) is the gap between the theories that develop in the academic world and the social facts that occur in society. Much scientific research is conducted on theoretical assumptions and is limited to laboratories or abstract concepts, so it has not been effectively applied in a wider social sphere. For example, rapid technological advances are often not accompanied by mature ethical considerations, which can lead to moral dilemmas and negative impacts on society. This gap reflects the incompatibility between the application of science and technology theory and social reality. Therefore, it is important to explore how philosophy of science and scientific ethics can act as a bridge to reduce this gap, so that science and technology becomes more responsible and relevant to the needs of society (Anwar, 2021; Efianingrum, n.d.).

Previous research has shown that the application of ethical principles in science and technology is often ignored or received less attention. For example, Latour (1987) in his book Science in Action reveals that science often operates in a space separate from the social world, with little attention to the social impact it causes. In addition, Gibbons et al. (1994) in The New Production of Knowledge emphasized the importance of the relationship between science and society. Although many studies encourage the integration of philosophy of science and ethics in the development of science and technology, its application in real practice is still limited. This research aims to bridge this gap by exploring how the philosophy of science and scientific ethics can be more effectively applied in the development of science and technology to produce more responsible innovations (Fadli, 2021a; Rofiq, 2020; SIBARANI, n.d.).

This research offers and introduces a more holistic approach in integrating philosophy of science and scientific ethics in the development of science and technology. Although many studies address ethics in scientific research, few have examined in depth the application of philosophy of science as a basis for responsible technological development. This research will develop a framework that not only covers ethical aspects but also the basic principles of philosophy of science that can help scientists in dealing with ethical and social dilemmas that arise as technology advances. Thus, this research aims to provide a new perspective that is more integrated in creating science and technology that is sustainable and beneficial for the wider community (Heryadi et al., 2024; Vanny et al., 2024).

This research paper aims to answer how philosophy of science and scientific ethics can be applied in the development of science and technology to produce innovations that are not only sophisticated, but also socially responsible. Based on preliminary studies, the application of philosophy of science and scientific ethics can face ethical and social dilemmas that arise along with technological advancements.

The argument on which this research is based is that the simultaneous application of philosophy of science and scientific ethics will help scientists and technologists to understand and consider the social and moral impact of their research. Philosophy of science in a reflective approach can provide a deeper understanding of how science is built, while scientific ethics can ensure that the development of science and technology is carried out with consideration of justice, social welfare, and environmental sustainability (Prayogi, 2021; Rahman, 2020; Rismanto & Sos, 2024).

RESEARCH METHOD

This study uses a qualitative research method approach. Qualitative research is carried out through literature studies, with the aim of understanding more deeply the application of philosophy of science and ethics in the development of science and technology in research institutions. literature studies were chosen to delve into the direct experience of scientists and technologists in integrating the two fields in their research (Adlini et al., 2022; Scott, 2020; Fadli, 2021b).

This research was carried out by reviewing the literature from previous researchers on the application of philosophy of science and scientific ethics in the development of science and technology. By analyzing the existing literature,

researchers can draw conclusions about the application of philosophy of science and scientific ethics in the development of science and technology (Santi et al., 2022; Sholihah, 2020).

The main sources of information in this study are respondents who are sourced from the work of scientists, researchers, and decision-makers at research institutions, as well as key informants who have a deep understanding of the application of philosophy of science and ethics in science and technology. Data is also obtained through texts, such as research manuscripts, institutional policies, and articles or news related to technology development and ethics. The data collection process was carried out with a desk-review to analyze the relevant literature (Alamsyah et al., 2024).

The data obtained will be analyzed through the data reduction stage, namely filtering and sorting data that is relevant to the research objective. Furthermore, the data display will be used to present the findings in an easy-to-understand form. The last stage is data verification, to ensure the validity and reliability of the analysis results. The analysis method used includes content analysis to analyze texts obtained from previous research and existing literature. In addition, analysis is used to explore how the values of philosophy of science and ethics are interpreted in scientific conversation and practice. Interpretive analysis is also applied to explore the meaning behind the data obtained, connect the findings with relevant theories and literature, and provide a deeper understanding of the relationship between philosophy of science, ethics, and the development of science and technology (Abdussamad & Sik, 2021; Sarosa, 2021).

RESULT AND DISCUSSION
Result

The application of philosophy of science and scientific ethics in the development of science and technology is measured by two main aspects: (1) scientists' understanding of philosophy of science related to their research and (2) the application of ethical principles in technology development. Philosophy of science can be interpreted as the skill of scientists in reflecting on the basis of scientific knowledge and its influence on society. Meanwhile, scientific ethics contains moral principles adopted by scientists to ensure that the research and technology developed are not only scientifically beneficial, but also socially responsible. The philosophy of science and scientific ethics are expected to be able to guide scientists to produce science and technology that is not only innovative but also pays attention to the impact on the socio-cultural environment.

From the results of several literatures, it can be concluded that although there is awareness about the importance of applying philosophy of science and scientific ethics in the development of science and technology, its application in the field is still very limited. Scientists often focus only on technical results and innovations rather than considering the social and moral implications that may arise. This shows that there is a gap between theory and practice in the development of science and technology. Although some institutions have tried to integrate the principles of philosophy of science and ethics, their implementation has not been optimal. Therefore, a more

structured and systematic approach is needed to address this problem, such as more intensive training on ethics and philosophy of science for scientists.

From the data above, it shows that there are two main patterns, first, although there is an awareness of the importance of philosophy of science and ethics, its application in the development of science and technology still focuses on technical results and technological advances. Second, there are efforts to apply the philosophy of science and ethics in several institutions, the process has not been carried out in depth and often seems to be just a formality. This pattern shows the need for a paradigm shift in the development of science and technology, namely making philosophical reflection and ethical considerations an integral part of every research and innovation process.

Based on the existing literature, the results of this study show a gap between theory and practice in the application of philosophy of science and scientific ethics in the development of science and technology. These findings are in line with research that states that despite the awareness of the importance of ethics in science, many scientists focus more on achieving technical results than considering their impact on society and the environment (Heryadi et al., 2024). Science often runs in a space separate from the social context, which explains the absence of philosophical reflection in many scientific projects. These findings reinforce the argument that the integration of philosophy of science and ethics in technology development is still a challenge, despite efforts to integrate them in some institutions. The implication of these findings is that although there is already an understanding of the importance of this approach, the gap between theory and practice still hinders the achievement of more responsible science and technology development (Rofiq, 2020).

The implications of this finding can be seen from two sides, first, the limited application of philosophy of science and scientific ethics functions as an obstacle in the development of more responsible science and technology, and leads to misuse of technology or unwanted social impacts. Such as the lack of ethical reflection in the development of technology can exacerbate social disparities or damage the environment. Second, if the philosophy of science and ethics is applied more widely, it can lead to the development of science and technology that is more useful and fair, taking into account human and environmental welfare. Thus, the positive implication is the creation of science and technology that is not only innovative, but also more socially and environmentally responsible (Prayogi, 2021).

The application of philosophy of science and ethics in science and technology has a significant impact on the direction and impact of the technology developed. Ethical principles and philosophical reflection if applied early in the research process, scientists are more likely to consider the social and moral consequences of their findings (Kusumasanthi et al., 2023). On the contrary, without these considerations, the development of science and technology can function dysfunctionally, resulting in sophisticated but irresponsible innovations. Therefore, the application of philosophy of science and scientific ethics in a more in-depth manner can form a more ethical and sustainable research structure, focusing not only on technological advances, but also on their impact on society and the environment. This shows the importance of building

stronger awareness in the scientific community about the importance of ethics in research and technological innovation (Fadli, 2021a).

This research suggests that research institutions and universities strengthen the integration of philosophy of science and scientific ethics in curriculum and research projects. This can be done through further training on ethical principles and philosophy of science for scientists, as well as creating more effective mechanisms to consider the social and moral impacts at each stage of research. Collaboration between scientists, ethicists, and society needs to be encouraged to ensure that the development of science and technology is not only scientifically beneficial, but also responsible and relevant to global challenges. The implementation of these recommendations is expected to reduce the gap between theory and practice, as well as create a more sustainable science and technology that has a positive impact on all.

Discussion

The results of this study show that although there is awareness about the importance of applying philosophy of science and ethics in the development of science and technology, concrete application in field practice is still very limited. In many cases, scientists tend to focus more on technical outcomes and technological advances rather than considering the social and moral implications of the innovations they develop. This creates a gap between theory and practice, where although the philosophy of science and ethics is recognized as important, its implementation in the development of science and technology has not been optimal. Scientists' awareness of ethical principles and philosophical reflection still needs to be strengthened, especially in the context of the application of technology that has a wide impact on society and the environment.

The first pattern found in this study is that although there is awareness of the importance of philosophy of science and ethics, the application of these principles in the development of science and technology is often limited to technical results and technological advancements alone. In many scientific projects, the main focus is on innovation and technical achievements, while consideration of the social and moral impact of the technology being developed tends to be overlooked. This reflects a tendency to set aside philosophical reflections that should be able to provide a deeper view of the purpose and impact of such technologies. In this context, the philosophy of science, which serves as a scientist's skill to reflect on the basis of scientific knowledge and its influence on society, often does not receive enough attention. Therefore, it is important to change the paradigm in the development of science and technology, by making philosophical reflection and ethical considerations an integral part of every research and innovation process.

The second pattern found is that although some institutions have tried to integrate the philosophy of science and scientific ethics in their activities, the implementation process is often in-depth and often only seems like a formality. This can be seen from the integration efforts that have not been optimal in many institutions, even though they have realized the importance of philosophy of science and ethics in the development of science and technology. Training on ethical principles and philosophy of science for scientists fand researchers still needs to be improved. In

many cases, scientists are only familiar with philosophy of science and ethics at the theoretical level, but awareness and ability to apply these principles in research is lacking. Therefore, a more structured and systematic approach is urgently needed to address this problem, such as curriculum development and more in-depth training on the philosophy of science and ethics for scientists.

The results of these findings also show that the gap between theory and practice in the application of philosophy of science and scientific ethics in the development of science and technology has a significant impact on the development of science and technology that is more responsible. In many cases, the lack of application of ethical principles can lead to the misuse of technology, or it can even exacerbate social disparities and damage the environment. For example, the development of technologies that do not consider social and environmental aspects can exacerbate social inequality or cause unwanted ecological damage. Therefore, the application of deeper and deeper philosophies of science and ethics in every research process is very important to avoid these negative impacts and create science and technology that is more useful and socially and environmentally responsible.

The implication of the results of this research is the importance of integrating philosophy of science and ethics in the development of science and technology so that the results of innovations not only create technical progress, but also ensure that these innovations can be accepted by the community at large and beneficial to the environment. This research supports the argument that when ethical principles and philosophy of science are applied from the beginning of the research process, scientists will be more likely to consider the social and moral impact of their findings. Thus, this can lead to the development of more sustainable and socially beneficial technologies, as well as ensuring that the technology developed not only benefits certain parties but also supports the well-being of society as a whole.

The application of philosophy of science and ethics in research and development of science and technology should not only be a formality, but an inseparable part of every step of research and innovation. As this study suggests, it is important for research institutions and universities to strengthen the integration of philosophy of science and scientific ethics in their curricula, both through further training on ethical principles and philosophy of science for scientists, and through the creation of more effective mechanisms to consider the social and moral impacts of each stage of research. In addition, collaboration between scientists, ethicists, and the public needs to be encouraged to ensure that the development of science and technology is not only scientifically beneficial, but also responsible and relevant to global challenges. Thus, it is hoped that it can reduce the gap between theory and practice in the application of philosophy of science and scientific ethics, as well as create science and technology that is more sustainable and has a positive impact on the entire community.

Overall, this study shows that despite the awareness and efforts to apply the philosophy of science and scientific ethics in the development of science and technology, there are still many challenges that must be faced. The gap between theory and practice, as well as the lack of deep application, hinders the development of technologies that are not only innovative but also socially and environmentally

responsible. Therefore, it is important to make a paradigm shift in the way we develop science and technology, emphasizing the importance of philosophical reflection and ethical principles as an integral part of any research and technological innovation.

CONCLUSION

The most important finding of this study is that there is awareness about the importance of applying philosophy of science and ethics in the development of science and technology. In reality, the integration of the two is still very limited in practice. This research shows that many scientists focus more on technical achievements and innovation outcomes, while social and ethical impacts are often overlooked. The lesson or wisdom that can be taken is the need for deeper reflection on the principles of ethics and philosophy of science from the beginning in every research and technology development process. Thus, scientists and researchers are expected to produce science and technology that is not only scientifically useful, but also responsible for society and the environment.

The main strength of this paper lies in its contribution to renewing perspectives in integrating philosophy of science and scientific ethics in the development of science and technology. The research not only identifies the gap between theory and practice, but also offers a more holistic approach by proposing a more systematic integration of the two fields in the process of research and technological innovation. By introducing a framework that combines philosophy of science and ethics, this paper contributes to the existing literature, introduces new methods in the development of more responsible technologies, and explores important questions about how scientists can apply ethical principles and philosophical reflection in their scientific work.

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