

# Wolfram Alpha (AI): Between Technological Transformation and Ethical Ideas in Education

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**Abstract:** This article examines the development of the digital world with the presence of artificial intelligence such as *Wolfram Alpha* in fulfilling the accessibility of accurate and scientific information, as one of the important instruments in assisting human work. The logical consequence of modern civilisation makes "efficiency and effectiveness" an important milestone in a person's mobility, including the need for information with technological bargaining power in the aspect of analysis in decision making. On the other side, the ease of access offered by artificial intelligence has been criticised, especially in the field of education. I argue that artificial intelligence contributes to the flexibility of the learning process between teachers and students, especially in understanding learning materials, but other trends can threaten the creativity and reasoning process in students. I pointed out that the role of teachers is slowly being replaced by the presence of artificial intelligence with its millions of information databases spread across the internet. Thus, building an educated generation that will coexists with technology in the future, must also include the moral dimension and mentality of an educated person.

**Keywords:** Wolfram Alpha, artificial intelligence, education, ethics.

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## Introduction

Since the appearance of ChatGPT in November 2022, discussions about artificial intelligence have changed the landscape of human interaction in carrying out activities in various sectors. Basically, the term "artificial intelligence" was coined by a professor from the Massachusetts Institute of Technology, John McCarthy, in 1956 at the Dartmouth Conference which discussed the purpose of artificial intelligence, including a model of how machines work in order to imitate humans<sup>1</sup>. The development of technology in the global era, of course, provides a special understanding for humans in interpreting modern civilisation side by side with technology. The rapid flow of information in the current era has made the boundaries of territories accessible in a hand. This also gives a special tendency, that technology makes the style of modern civilisation today have

high mobility. The fundamental characteristic that modernity has changed the human paradigm with efficiency and effectiveness, which demands speed in completing work.

Artificial intelligence has also penetrated the world of education as a consequence of this technological development. Artificial intelligence has played a role in significantly influencing education, in terms of management, teaching, and the climate of an educational institution<sup>2</sup>. However, despite the optimism of technology in a system of progress, there is still an ethical dimension to the use of artificial intelligence in education. For example, sixth-grade students at Khan Lab School in California, USA, use a chatbot tutor to solve problems such as quadratic equations and graph functions through artificial intelligence. This also confirms that the students at Khan Lab School are the first school in America to use a conversational

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<sup>1</sup> Edi Wijaya, 'Analysis of the Use of Breadth Algoritma', *Jurnal TME*, II.2 (2013), 18–26.

<sup>2</sup> Danny Manongga and others, 'The Impact of Artificial Intelligence on Education', *ADI Digital Business Interdisciplinary Journal*, 3.2 (2022), 41–55 <<https://doi.org/10.34306/abdi.v3i2.792>>.

chatbot, to showcase the interaction of robots with humans called *Khanmigo*<sup>3</sup>. But the automated tutoring system also has the potential to make mistakes, encourage cheating, and threaten students' critical thinking. Sal Khan, the founder of artificial intelligence, argues that chatbots can help teachers with lesson planning tasks, streamlining the learning process and focusing more on the subject matter.

Developed countries in Europe such as the UK, for example, have high-quality regulations in the development of artificial intelligence. Hence, the UK created a 'white paper' which was released in March 2023 stating that the UK government recognises both the benefits and risks of artificial intelligence, thus maximising benefits over risks through regulation in an effort to maintain the UK as a global artificial intelligence leader<sup>4</sup>. Some EU countries that have been strong in the digital industry, have made artificial intelligence in public services better. In the context of education during the Covid-19 pandemic, artificial intelligence plays a role in learning needs<sup>5</sup>. By looking at the use case of artificial intelligence at Khan Lab School California, in line with Luckin and Holmes' argument in clustering artificial intelligence (AIED), namely the use of "Dialog-Based Tutoring System (DBTS)"<sup>6</sup>. The concept engages students in dialogue learning that leverages advanced language processing with Socratic dialogue methods. The autotutor helps the learner understand the answer, with the emphasis on error analysis in the concept.

In this section, I focus on one such artificial intelligence, Wolfram Alpha, which was released to the public in May 2009 by Stephen Wolfram. Although this artificial intelligence has been around for 14 years, it has gained momentum since the emergence of ChatGPT in November 2022. The

purpose of this research is to review the use of Wolfram Alpha artificial intelligence in education, looking at various aspects including opportunities and challenges. According to its official website, what differentiates this artificial intelligence from web search engines is its ability to display what is freely available on the web, and provide extensive and in-depth knowledge with judgement by experts<sup>7</sup>. With all the sophistication of features in Wolfram Alpha in its use in the field of education, there is a challenge to replace the role of teachers in several aspects, if there is no transformation in education policy regulations, especially in developing countries such as Indonesia regarding artificial intelligence.

## Material and Methods

This article is based on research on one of Wolfram Alpha's artificial intelligences, in relation to the world of education. Data collected through library research by collecting books, journals, and previous research results related to the research topic. The development of artificial intelligence technology, which seems to have become a global trend in helping human work, has a certain paradigmatic impact, especially in the field of education. In responding to the development of artificial intelligence as a computer system that can help human jobs, this research focuses on the impact of one artificial intelligence, Wolfram Alpha, in the field of education and its future ethical dimensions. The data collected describes the artificial intelligence of Wolfram Alpha, and the categorisation of artificial intelligence in education that has the impact of accelerating knowledge and research, and its potential threats. The use of artificial intelligence related to education can be divided into at least three areas, namely for learning, practical research, and training in the application of AI<sup>8</sup>.

<sup>3</sup> 'New A.I. Chatbot Tutors Could Upend Student Learning - The New York Times' <<https://www.nytimes.com/2023/06/08/business/khan-ai-gpt-tutoring-bot.html>> [accessed 8 October 2023].

<sup>4</sup> 'Artificial Intelligence: Development, risks, and Regulation - Library House of Lords' <<https://lordslibrary.parliament.uk/artificial-intelligence-development-risks-and-regulation/>> [accessed 8 October 2023].

<sup>5</sup> 'Artificial Intelligence: Threats and Opportunities | News | European Parliament' <<https://www.europarl.europa.eu/news/en/headlines/society/202009185TO87404/artificial-intelligence-threats-and-opportunities>> [accessed 9 October 2023].

<sup>6</sup> Mark Griffiths and Laurie B Forcier, *Intelligence Unleashed*, 2016 <<http://discovery.ucl.ac.uk/1475756/>>.

<sup>7</sup> 'About Wolfram|Alpha: Making the World's Knowledge Computable' <<https://www.wolframalpha.com/about>> [accessed 9 October 2023].

<sup>8</sup> 'Artificial Intelligence in Education | UNESCO' <<https://www.unesco.org/en/digital-education/artificial-intelligence>> [accessed 9 October 2023].

## Result and Discussion

### Artificial Intelligence in Education

The current stage of the digital world, which has entered the Industrial Revolution 5.0, has focused on combining technology and humans in developing more adaptive and efficient systems, to deal with changes in the global environment. The emphasis on the integration between advanced technologies such as AI and robot technology with human expertise has become the basis for global change in this modern century. In the field of education, there is also an increase in efficiency and productivity, as well as flexibility through advanced technology to build a new paradigm in future learning models. At least, some AI researchers have identified several areas of use in the educational aspect, such as Devedziy's research that applies Web Intelligence AI to improve learner convenience through automation of learner, teacher, and author activities with Web-based learning environments<sup>9</sup>.

Organisation of the International Conference on Artificial Intelligence in Education in the last 10 years since Memphis (2013)<sup>10</sup>, Madrid (2015)<sup>11</sup>, London (2018)<sup>12</sup>, Tokyo (2023)<sup>13</sup>, has presented a variety of research on intelligent systems and cognitive science for the improvement and advancement of education. Of course, in its development, the use of artificial intelligence technology is quite effective in helping students improve their abilities and knowledge, as well as teachers in learning activities<sup>14</sup>. The presence of artificial intelligence in education can also significantly accelerate some phases of

learning<sup>15</sup>. Digitalisation of the educational process has changed the landscape of practical pedagogical activities into digital didactics with the support of electronic information. This concept makes AI technology indirectly coexist with human life in various fields of life.

AI assistance not only helps students in the learning process, but also has an impact on teachers' skills in applying innovative and adaptive technology according to the times. UNESCO's recommendations in the first consensus on AI can be the basis for national regulations in the education development process. Several research results around the world show that teachers remain an integral part of the education process despite the presence of AI<sup>16</sup>. As a consequence of technological developments in modern education, AI will become an important topic in the future, including distance education, which is showing a popular trend of digitalisation, especially since the Covid-19 pandemic. However, it should be noted that data access issues are often a problem for artificial intelligence users, in protecting consumer privacy data. With the ease of today's advanced technology, it is also necessary to explore the potential of data privacy access permissions given to the need to access AI.

The era of disruption has made the concept of automation and connectivity into something great, through innovations that change the system and order of society at large. Through artificial intelligence, big fundamental changes are felt in its future development, seeing that the technology is able to replace human jobs. These changes are starting to become evident today with several human jobs potentially being replaced by artificial intelligence, such as jobs in media, programming technology, and education. I am of the opinion that policy makers need to seriously and quickly examine the issue of artificial intelligence for education, given its potential to indirectly threaten the paradigm and mentality of students and teachers. Some of the artificial intelligence below

<sup>9</sup> Vladan Devedziy, 'Web Intelligence and Artificial Intelligence in Education', *Educational Technology & Society*, 7.4 (2004), 29–39 <<https://www.jstor.org/stable/10.2307/jeductechsoci.7.4.29>>.

<sup>10</sup> Lane Chad and Yacef Kalina, 'Artificial Intelligence in Education', in *16 Th International Conference, AIED*, 2013, 7926 LNAI, 721–24 <[https://doi.org/10.1007/978-3-642-39112-5\\_97](https://doi.org/10.1007/978-3-642-39112-5_97)>.

<sup>11</sup> M.Felisa Conati, Cristina;Heffernan, Neil;Mitrovic, Antonija;Verdejo, 'Artificial Intelligence in Education (AIED)', in *17th International Conference, AIED*, 2015, LNAI 9112, 749–51 <<https://link.springer.com/book/10.1007/978-3-319-19773-9>>.

<sup>12</sup> Rose;Carolyn P. Roberto Martinez-Maldonado; H. Ulrich Hoppe, 'Artificial Intelligence in Education', in *19th International Conference, AIED*, 2018, pp. 241–55 <<https://link.springer.com/book/10.1007/978-3-319-93846-2>>.

<sup>13</sup> Wang, N; Genaro R. Mendez; Dimitrova, V 'Artificial Intelligence in Education', in *24th International Conference, AIED*, 2023, pp. 28–40 <<https://link.springer.com/book/10.1007/978-3-031-36272-9>>.

<sup>14</sup> Karyadi, B, 'Utilisation of Artificial Intelligence to Support Self-Directed Learning', *Journal of Educational Technology (JTP)*, 8.2 (2023), 253–58 <<https://doi.org/10.24114/jtp.v8i2.3329>>.

<sup>15</sup> Kamil Malinka and others, 'On the Educational Impact of ChatGPT: Is Artificial Intelligence Ready to Obtain a University Degree?', *ITI&CSE*, 2023, 47–53 <<https://doi.org/10.1145/3587102.3588827>>.

<sup>16</sup> Elena Y. Barakina and others, 'Digital Technologies and Artificial Intelligence Technologies in Education', *European Journal of Contemporary Education*, 10.2 (2021), 285–96 <<https://doi.org/10.13187/ejced.2021.2.285>>.

shows the availability of needs regarding problems in education, especially access to accurate knowledge, answering exact questions, to AI's ability to create a paper, very easy to use.

**Table 1.** Description of some artificial intelligence in education.

Artificial Intelligence	Description
1 Wolfram Alpha	A computing machine providing knowledge in scientific mathematical calculations and data. The online form of the service offered can answer the given questions factually and calculate the answers in a structured manner.
2 Fireflies	An AI voice assistant that assists in transcribing, summarising, taking notes and getting work done during meetings. This artificial intelligence can record meetings on all leading web conferencing platforms such as Zoom and Google Meet.
3 Hypotenuse	Artificial intelligence writers who can create high-quality, keyword-rich texts that are helpful for blogging, marketing in writing adverts, including the educational aspect of finding initial inspiration when writing topics.
4 Slidesai	An AI platform that can turn text into engaging presentations.
5 Humata	An artificial intelligence tool that has the ability to understand scientific documents more quickly and efficiently.

### Wolfram Alpha AI

Wolfram Alpha is a knowledge computing engine developed by Stephen Wolfram in 2009 that presents a different side to search engines like Google. Wolfram Alpha utilises databases that have been licensed and assessed by experts. The system that runs on this artificial intelligence provides comprehensive lists and tables to give users specific answers to the questions asked. Various questions can be answered by the AI covering various fields of knowledge such as maths, physics, biology, astronomy, geography, music, history, and health. Wolfram Alpha's mission is based on the achievements of science and other knowledge systematics, in providing a single source for every user to get definitive

answers to factual questions<sup>17</sup>. Wolfram Alpha specialises in calculating matrices, algebra, trigonometry, and number theory. This artificial intelligence feature can also display analyses by presenting comparisons of the data obtained.

The features in artificial intelligence offered by Wolfram Alpha certainly open methodological questions about the impact on students if they access freely, or how the role of teachers in dealing with artificial intelligence to be more adaptive to the challenges of an increasingly sophisticated technological culture. Such questions need to get a serious response in the world of education, considering the impact of artificial intelligence also has implications for mentality and character. One way to improve instructors towards AI is to demonstrate effectiveness through robust experimentation, especially the guidance of theories and philosophies and long-established institutions<sup>18</sup>.

Wolfram Alpha's ability to run an operating system is based on Wolfram Natural Language Understanding (NLU), which retrieves data precisely and performs complex calculations through simple natural language<sup>19</sup>. The trillions of knowledge databases that are accurately integrated, and linked to the Wolfram operating language allow AI systems to easily access authoritative data on vast knowledge. The large knowledge base is derived from expert knowledge obtained directly from primary sources and a number of algorithm movements that summarise methods found in almost all fields.

<sup>17</sup> 'About Wolfram | Alpha: Making the World's Knowledge Computable'.

<sup>18</sup> Xieling Chen and others, 'International Forum of Educational Technology & Society', Two Decades of Artificial Intelligence in Education, 25.1 (2022), 28-47.

<sup>19</sup> 'Wolfram Tools for AI: Computational Intelligence Connections', 2023 <<https://www.wolfram.com/resources/tools-for-AIs/#rtapis>>.

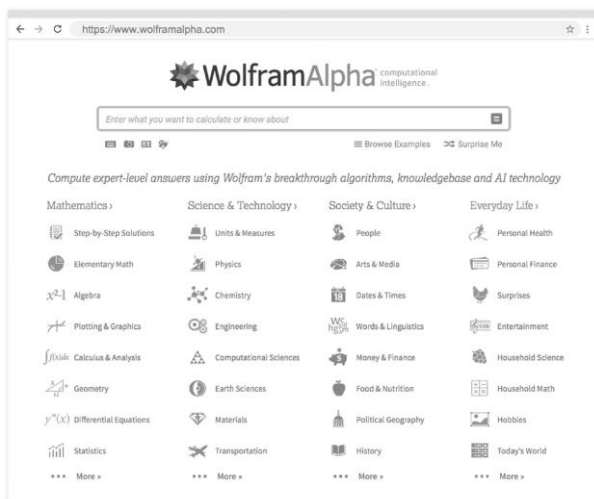


Figure 1. Wolfram Alpha knowledge base coverage.

A large network of algorithms, Wolfram Alpha can work very well in answering every question scientifically. The growth of this artificial intelligence is automatically updated every month and year. Although sometimes there are users asking strange questions, but through the modern neural network owned by Wolfram Alpha, it can answer in depth through the development of automated algorithms that have been evaluated over the years. This has had an impact on the effectiveness of student learning, by adjusting to students' desires and learning abilities.

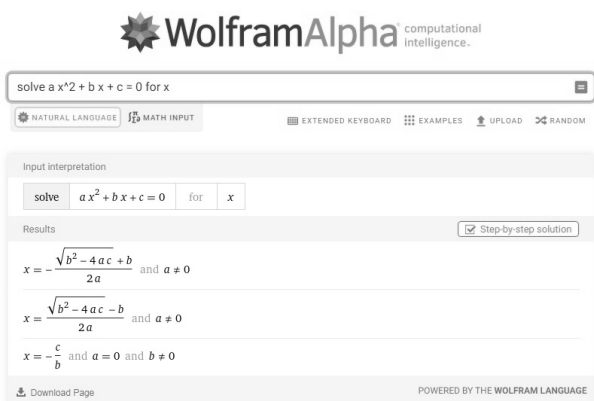


Figure 2. Use of Wolfram Alpha in the exact field

The figure above shows Wolfram Alpha's presentation in explaining a maths problem command, which can be answered with steps that make it easy for users to understand the exact structure of the answer. Although in its work

system Wolfram Alpha uses algorithms and curated data, but on the other hand Wolfram Alpha also incorporates AI components in processing natural language. This artificial intelligence system is very suitable for searching scientific data, through certain computations and answering them with complete information.

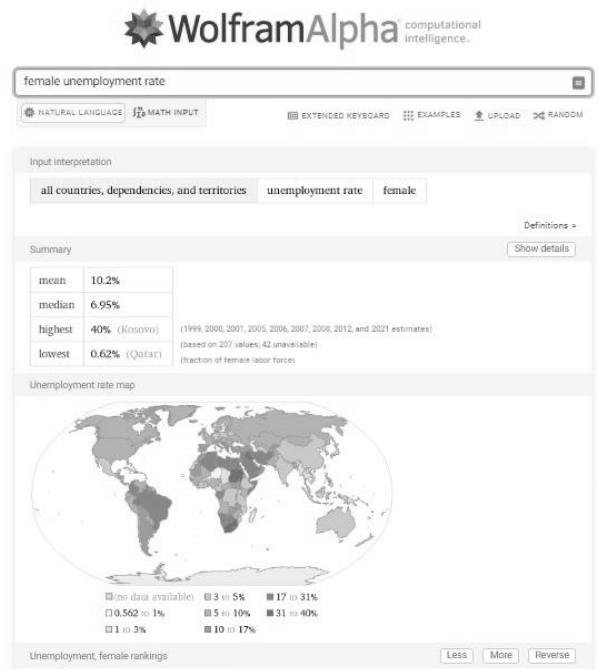


Figure 3. Female unemployment rate data in the world | Wolfram Alpha

While the following data is the unemployment rate of women in the world, presented in full by Wolfram Alpha with tables, geographical areas, including figures obtained from processing trillions of knowledge algorithms spread across the internet. Enabling a visionary view of the world of education through artificial intelligence, while still having wise ethics in its use.

### Ethical Dimensions in Artificial Intelligence

The fast-paced world of technology that enables many human jobs to be done has implications for the mentality of seeing rapid cultural change, including the existence of artificial intelligence. Thus, the best use of AI in education is to increase the capacity of teachers by assisting in the delivery

of more effective learning topics<sup>20</sup>. I argue that artificial intelligence contributes to the flexibility of the learning process between teachers and students. Through the internet and artificial intelligence, students can now access knowledge independently, and have the opportunity to create transdisciplinary knowledge. However, utilisation in AI teaching models requires various development tools and knowledge of statistics.

For example, South Korea used the "National AI Strategy" in 2019 as a plan to develop human resources at the master's and doctoral levels, to expand the AI department. The policy of fostering 10,000 teachers as AI instructors is tailored to the level of education. AI has made the government rethink the purpose of education, restructure educational topics, and innovate new ways of teaching<sup>21</sup>. The existence of artificial intelligence, which demands the transformation of education, ultimately shifts the role of teachers in the framework of learning. There are several aspects that make the role of teachers replaced by artificial intelligence, for example students no longer need to ask for technical knowledge such as mathematics, physics, biology, and chemistry. But the presence of AI is able to fill this aspect with its computational knowledge system, such as Wolfram Alpha which can dialogue with students.

The challenge ahead with the presence of artificial intelligence in education concerns the aspect of assessment. Some literature suggests that teachers have limited capacity and skills to engage in high-quality assessment practices that advance education<sup>22</sup>. In another context, I argue that the use of artificial intelligence can threaten students' creativity and reasoning process. It can be assumed that easy accessibility makes students utilise artificial intelligence for things that can affect their character in the future. For example, in creating fiction and non-fiction papers, students can utilise

AI by simply entering keywords in the manuscript of the work created without going through the process of reflection and reasoning from the author. The logical consequence of modernism ultimately comes with the latent danger of an instant mentality and way of thinking.

Education in reality then, becomes a field that is particularly at risk with the presence of AI because education not only shapes the thoughts and actions of individuals from a young age, but is instrumental in everyone's developmental stage<sup>23</sup>. The notion of inclusive and equal education also needs to be considered, when the learning process has utilised the use of artificial intelligence. It's important to remember that the ultimate AI system still requires human control, and is prone to error<sup>24</sup>. Every user needs to be careful in using the various conveniences of artificial intelligence. The aspect of digital security which has become a global issue, is very possible for cyber criminals to take advantage of the current technology boom era. Literacy about digital security also needs to be understood when using various artificial intelligence tools, including in personal privacy data. Although on the one hand, AI can provide analyses in protecting millions of events to support the work of human security tasks<sup>25</sup>.

However, ethical issues in the use of AI in education need to be taken seriously by stakeholders in view of the rapid development of technology in recent times. Some countries such as France, South Korea, China, and the United States are starting to release national AI strategies, but some developing countries are still far away and limited by structural barriers such as basic technology, and trained human resources<sup>26</sup>. In some of the most recent reports on AI mitigation in

<sup>20</sup> Robert F Murphy, 'Artificial Intelligence Applications to Support K-12 Teachers and Teaching: A Review of Promising Applications, Opportunities, and Challenges. Perspective', *RAND Corporation*, 2019.

<sup>21</sup> Seungsu Paek and Namhyoung Kim, 'Analysis of Worldwide Research Trends on the Impact of Artificial Intelligence in Education', *Sustainability (Switzerland)*, 13.14 (2021) <<https://doi.org/10.3390/su13147941>>.

<sup>22</sup> David Baidoo-Anu and Leticia Owusu Ansah, 'Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning', *SSRN Electronic Journal*, April, 2023 <<https://doi.org/10.2139/ssrn.4337484>>.

<sup>23</sup> Wayne Holmes and Kaška Porayska-Pomsta, *The Ethics of Artificial Intelligence in Education: Practices, Challenges, and Debates*, *The Ethics of Artificial Intelligence in Education: Practices, Challenges, and Debates*, 2022 <<https://doi.org/10.4324/9780429329067>>.

<sup>24</sup> Olaf Zawacki-Richter and others, 'Systematic Review of Research on Artificial Intelligence Applications in Higher Education – Where Are the Educators?', *International Journal of Educational Technology in Higher Education*, 16.1 (2019) <<https://doi.org/10.1186/s41239-019-0171-0>>.

<sup>25</sup> Ramanpreet Kaur, Dušan Gabrijelčič, and Tomaž Klobočar, 'Artificial Intelligence for Cybersecurity: Literature Review and Future Research Directions', *Information Fusion*, 97.January (2023) <<https://doi.org/10.1016/j.inffus.2023.101804>>.

<sup>26</sup> Francesc Pedró, *Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development*, *Unesco*, 2019 <<https://unesdoc.unesco.org/ark:/48223/pf0000366994>>.

2018, there are recommendations for potential AI hazards, calling on researchers and engineers to evaluate security solutions and vulnerabilities in AI use<sup>27</sup>. The future climate of the educational environment with the presence of AI, will certainly change various aspects related to methods, strategies, and curriculum in negotiating technology wisely.

Basically, artificial intelligence is only a useful tool for teachers as a starting point, and then as material for analysis according to learning needs<sup>28</sup>. In my opinion, the development of artificial intelligence in the future will not marginalise the role of teachers in the learning process. This is because, in the classical tradition, there is a saying that 'knowledge is obtained through the heart and example'. Therefore, the strategic role of teachers as bearers of knowledge has sacred emotional forms in the transfer of knowledge. Knowledge is not only limited to the search for truth, but makes humans wiser, characterised by increased spirituality in themselves.

### Conclusions

Artificial intelligence has played an important role in the pinnacle of modern civilisation today. The presence of AI is able to accelerate human work effectively and efficiently. But on the one hand, artificial intelligence also has serious implications in some aspects such as education. One of the artificial intelligence such as Wolfram Alpha has many features with the coverage of the available data knowledge base. A person can ask anything, and easily answered with scientific data through actual explanations. Artificial intelligence ultimately brings latent dangers, if not addressed wisely. Excessive use of AI in the student learning process can threaten students' creativity and reasoning process. Including the issue of digital security which has become a global issue, it is necessary for all elements of education to address

data security in using technology including artificial intelligence. The importance of digital literacy for teachers and students in facing the era of disruption through the swiftness of various new technologies, to always be vigilant, including in terms of privacy data security. The goal of education has always been to emphasise creativity and analytical skills in students. However, AI has the potential to damage students' mentality and character. So the role of the teacher remains primary as a facilitator in learning, by trying to adaptively utilise artificial intelligence wisely in the present and future.

**Conflict of Interest:** The authors declare no conflict of interest.

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<sup>27</sup> Shannon Eggers Char Sample, *Artificial Intelligence for Digital Security and Protections* (Idaho, 2020).

<sup>28</sup> Grant Cooper, 'Examining Science Education in ChatGPT: An Exploratory Study of Generative Artificial Intelligence', *Journal of Science Education and Technology*, 32.3 (2023), 444–52 <<https://doi.org/10.1007/s10956-023-10039-y>>.

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