

A Narrative Review on The Impact of Applied Artificial Intelligence Tools on Higher Secondary Students

Yasmin Abdullahi Mohamud¹, Aini Azeqa Ma'rof^{2,3}, Abdullahi Mohamud Mohamed⁴, Md Uzir Hossain Uzir⁴

¹Odoros Research Center, Tre-piano, Makkah Al-Mukarramah Road, Mogadishu 12311, Somalia, ²Institute for Social Science Studies, Universiti Putra Malaysia, Serdang, 43400, Selangor, Malaysia, ³Faculty of Human Ecology, Universiti Putra Malaysia, Serdang, 43400, Selangor, Malaysia, ⁴Faculty Business administration, University of Somalia, Mogadishu Somalia, ⁵Faculty of Business and Accountancy, Lincoln University College, Selangor, Malaysia

Email: azeqa@upm.edu.my

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Abstract

The education sector is witnessing a surge in the use of applied artificial intelligence (AAI) tools/devices, which offer potential advantages such as personalized learning experiences, increased student engagement, and improved academic performance. However, concerns have been raised about the potential negative impacts of these technologies, including overreliance on the Applied Artificial Intelligence (AAI) tools and devices, decreased social interaction, and less critical thinking skills. Through a comprehensive review of the literature, this review emphasized the benefits and drawbacks of using AAI tools/devices in higher secondary education, providing a comparative view of their effectiveness. In addition, the paper considers the perspectives of educators, students, and parents, and will draw on examples of successful implementation of AAI technology in education. Moreover, the review provides a balanced and informed view of the merits and demerits of using AAI tools/devices for higher secondary students, offering insights into their potential impact on education outcomes and highlighting the need for responsible and ethical deployment.

Keywords: Applied Artificial Intelligence, Higher Secondary Students

Introduction

Applied Artificial Intelligence (AAI) has become increasingly popular in the field of education as it offers immense potential for improving the teaching and learning process (Maseleno et al., 2018). AAI-based tools can be utilized across various domains of education such as personalized learning, immediate feedback, and educational content creation (Davies et al.,

2020; Yu et al., 2017; Pokrivčáková, 2019). By incorporating AAI, teachers can personalize educational content and instruction to cater to the unique needs and preferences of each student. Moreover, AAI can assist teachers in recognizing students' learning gaps and providing timely feedback to help them overcome these obstacles (Farooq et al., 2022). AAI-based tools can also enhance the accuracy and objectivity of student evaluation, enabling teachers to identify areas where students need additional support (Nazaretsky et al., 2022). However, it should be noted that AAI can also act as a potential distraction and negatively affect academic performance, particularly for students who face academic challenges (Reisdorf, 2020).

A study by Jacob and Lefgren (2007) found that students who frequently use technology in their courses earn lower grades than those who use it less frequently. Additionally, AAI tools may hinder social and emotional development by reducing opportunities for interaction with peers and teachers (Luckin et al., 2016). Integrating AAI into education has the potential to revolutionize the sector, and it is essential for educators and policymakers to explore the many ways AAI can be used. However, it is crucial for teachers and administrators to carefully assess the use of AAI tools, so that they do not negatively impact the academic and social development of students.

The purpose of conducting this literature review of Applied Artificial Intelligence (AAI) tools/devices for higher secondary students is to evaluate the effectiveness of various AAI-powered tools and devices in the education sector. By comparing different AAI tools and devices, researchers can identify their respective merits and demerits in terms of their impact on higher secondary students' learning outcomes. This comparative view study can help education, policymakers and educators make informed decisions about the selection and implementation of AAI tools and devices that are most suitable for their specific educational needs. Ultimately, the aim is to ensure that the integration of AAI in the education sector is done in a manner that maximizes its benefits while minimizing its potential drawbacks.

Various AAI tools/devices

Applied Artificial intelligence (AAI) is transforming the field of education by providing students with personalized and adaptive learning experiences. Intelligent tutoring systems (ITS), chatbots, and adaptive learning systems are some of the AI tools and devices that are being used in education to enhance student experience and improve learning outcomes (Alam, 2021; Dimitriadou & Lanitis, 2023).

By using machine learning algorithms like ITS, it can provide students with personalized and adaptive learning experiences (Baker & Inventado, 2014). ITS represent one of the most prominent categories of applied AI in education. These systems leverage AI to provide personalized instruction and feedback to students, effectively serving as a private tutor. ITS adapt to the learning pace and style of individual students, identifying their strengths and weaknesses, and modifying the content accordingly. Examples of ITS include Carnegie Learning's MATHia, which utilizes AI to deliver personalized math instruction, and Squirrel AI, a platform providing customized tutoring for a range of subjects (Woolf, 2009; Zhang, 2019). Chatbots are another AI tool that is gaining popularity in education. These computer programs use natural language processing to interact with students and provide them with assistance on a range of topics, including academic advice and mental health support. By

providing students with quick and easy access to information, chatbots can help improve the student experience (Chen et al., 2023).

Adaptive learning systems are also being used in education to analyze student data and adjust the learning content and pace according to their individual needs. By using AI algorithms, these systems can provide students with personalized feedback and support, allowing them to progress at their own pace (Upadhyay & Khandelwal, 2019). The use of AI tools and devices in education is becoming increasingly prevalent and is expected to continue to grow in the coming years, providing students with new and innovative ways to learn and succeed.

Methodology

In our methodology for conducting a comprehensive narrative review on the impact of applied AI tools/devices on higher secondary students, we implemented a systematic approach to ensure the quality and relevance of the included literature. This began with the careful selection of keywords related to the main concepts of the research topic, including terms such as "Artificial Intelligence", "AI", "Applied AI tools", "Applied AI devices", "Higher Secondary Students", "Education", "Impact", and "Effect". These were used individually and in combination across four databases: Scopus, Google Scholar, IEEE Xplore and ERIC, selected for their extensive coverage of technology and education-related literature.

The literature search spanned from 2007 to 2023, providing a comprehensive overview of the field over the last 16 years. Although the initial search returned approximately 120 articles, refinement was achieved by excluding articles not specific to the use of applied AI tools/devices in higher secondary education. The titles and abstracts of potential articles were reviewed for relevance before moving to full text examination, with additional screening to remove duplicates and non-peer-reviewed or non-English articles.

Following the selection process, 30 articles were selected for a thorough review. Each was analyzed using a data extraction form to consistently collect key details such as author(s), year of publication, study location, type of AI tools/devices studied, methods used, and the sample size and characteristics, along with main findings. This methodical and exhaustive approach helped to draw a comprehensive narrative review of the impact of applied AI tools and devices on higher secondary students, in hopes of providing information on future educational practices and policies.

Positive impact of AAI tools/devices on higher secondary students

The integration of AAI tools into the Higher secondary education curriculum can have a positive effect on students' learning outcomes, including personalized learning, immediate feedback, increased engagement, and accessibility (Davies et al., 2020; Yu et al., 2017; Pokrivčáková, 2019). One of the advantages of AAI tools is the ability to tailor instruction and learning experiences to meet the unique needs, interests, and learning styles of each student (Stranford et al., 2020). Adaptive learning software and strategies such as differentiated instruction can enhance student autonomy and engagement, leading to improved learning outcomes (Pane et al., 2015). Another benefit of AAI tools is the provision of immediate feedback, which allows students to correct mistakes and learn from them in real-time. This approach can help students identify and correct errors before they become ingrained habits, leading to better overall performance (VanLehn, 2011). Moreover, studies have shown that

students who actively engage with AAI tools demonstrate a better understanding of abstract concepts and are more motivated to learn (Wang et al., 2018).

AAI tools also offer accessibility anytime and anywhere, which can support the development of self-directed and independent learning skills. Online resources and mobile devices can provide students with engaging and personalized learning experiences beyond the classroom environment, leading to enhanced learning outcomes (Rivard & Ross, 2021; Gelbrich & Rohlf, 2016). In addition, AAI tools can improve problem-solving, analytical, and critical thinking skills, which are essential for success in the 21st-century workforce. Moreover, these tools can also facilitate teacher assessment and feedback, as well as peer collaboration and communication, leading to social and emotional learning (Fadel et al., 2019). By leveraging these tools effectively, educators can create a more dynamic and effective learning environment that meets the needs of each student.

Negative of AAI tools/device on higher secondary students

AAI tools and devices have become increasingly popular in education, but their use may have negative consequences for higher secondary students. According to a study by the Pew Research Center (Anderson & Jiang, 2018), 60% of teachers believe that digital technologies can distract students more than help them academically. The overreliance on AI tools and devices can lead to a decreased ability to think critically and solve problems independently (Henderson, 2020). Moreover, using AAI tools for higher secondary students reduced social interaction that can result from their use. The Pew Research Center study found that 54% of teens in the United States think that using technology often distracts them from spending time with friends and family (Anderson & Jiang, 2018). The use of AAI tools such as chatbots and virtual assistants can reduce the need for students to seek help from their peers or teachers, limiting their opportunities for social interaction, which is crucial for their social development and overall well-being.

Another concern with using AAI tools and devices in education is privacy and security. The use of AI-powered educational software may require students to share sensitive information, such as personal data or browsing history, potentially putting their privacy at risk (Ching et al., 2018). Additionally, the collection and storage of student data by AAI tools can be vulnerable to cyber-attacks, compromising the security of students' information (Schaub et al., 2018). It is crucial for educators and administrators to consider the privacy and security implications of using AAI tools and devices in the classroom and take appropriate measures to protect students' data and privacy.

Comparison between merits and demerits of AAI usage

The use of AAI tools/devices in higher secondary education has both benefits and drawbacks. On the positive side, AAI technology can provide personalized learning experiences and support for students, as well as automate routine tasks for teachers, allowing them to focus on more complex teaching activities (Gaikwad & Santosh, 2020). Additionally, according to Kshetri, (2018), AAI can help identify students' strengths and weaknesses, allowing teachers to tailor their instruction to better meet their needs. On the negative side, the use of AI may exacerbate issues related to privacy and security, as well as exacerbate existing inequalities if not implemented equitably. Moreover, there is a concern that AI may depersonalize the learning experience and reduce the role of teachers in the classroom (Buery-Joyner et al.,

2019). Therefore, it is important to weigh the benefits against the drawbacks when considering the implementation of AI technology in higher secondary education.

The use of AAI tools and devices can have negative effects on higher secondary students if not used appropriately. To address these negative effects, one potential solution is to incorporate ethical considerations into the design and use of AAI tools and devices. As stated by the OECD (Organization for Economic Cooperation and Development), "embedding ethics into the design, development, and deployment of AAI is essential to ensure that AAI is used for the benefit of individuals and society as a whole" (OECD, 2019). This includes considerations such as transparency, accountability, and fairness in the use of AAI tools and devices in education. Additionally, educators and policymakers should consider providing guidelines and training for the appropriate use of AAI tools and devices to minimize potential negative effects and maximize their potential benefits for students.

The responsible use of AAI in education for higher secondary students has become increasingly important as AAI continues to shape and transform various aspects of modern society. According to a report by UNESCO, AAI has the potential to revolutionize education by enhancing personalized learning experiences, automating administrative tasks, and improving decision-making processes (UNESCO, 2021). However, it is crucial to ensure that AI is used responsibly and ethically in the education sector. This includes ensuring that AI systems are transparent, fair, and unbiased, and that they respect individuals' privacy and data protection rights. By incorporating responsible AI practices into education, students can learn how to use this powerful technology in ways that benefit society while avoiding potential negative consequences.

Preference of AAI selection in education (learning)

While Artificial Intelligence (AI) tools have been increasingly used in education, concerns have been raised about their negative impact on student learning outcomes. Some experts argue that these tools may impede students' natural capacity for critical thinking, creativity, and problem-solving. For instance, a study by Nazari et al (2021), found that when students used an AI-powered writing tool, their writing quality did not improve, and their ability to reflect critically on their writing decreased. However, despite these concerns, many educators and students still find AI tools to be very useful in education. AAI-powered tools can provide learners with access to vast amounts of information that can be used for current and future learning. These tools can also offer personalized learning experiences, helping students to learn at their own pace and level.

Moreover, AAI tools can help to automate repetitive tasks, such as grading and assessment, freeing up educators' time for more meaningful interactions with students. For instance, an AAI-powered chatbot can be used to answer students' questions and provide feedback on their work, allowing teachers to focus on higher-level tasks such as facilitating discussion and critical thinking (Xiao et al., 2020)

Discussion

The integration of AAI tools and devices in higher secondary education has the potential to significantly impact student learning outcomes. AAI-based tools, such as intelligent tutoring systems, chatbots, and adaptive learning systems, offer personalized and adaptive learning

experiences for students (Alam, 2021; Dimitriadou & Lanitis, 2023). One of the positive impacts of AAI tools is their ability to provide personalized learning experiences tailored to the unique needs, interests, and learning styles of each student (Stranford et al., 2020). By analyzing student data, adaptive learning systems can adjust the learning content and pace to match individual needs, enhancing student autonomy and engagement (Pane et al., 2015). This personalized approach allows students to progress at their own pace and improve their learning outcomes (Upadhyay & Khandelwal, 2019).

Immediate feedback is another advantage of AAI tools, enabling students to correct mistakes in real-time and learn from them (VanLehn, 2011). This timely feedback helps students identify and rectify errors before they become ingrained, leading to better overall performance. Moreover, AAI tools promote active engagement, which enhances students' understanding of abstract concepts and motivation to learn (Wang et al., 2018).

AAI tools also offer increased accessibility and flexibility, allowing students to access educational resources anytime and anywhere (Rivard & Ross, 2021). This accessibility promotes self-directed and independent learning skills, as students can engage with personalized learning experiences beyond the traditional classroom environment (Gelbrich & Rohlf, 2016). However, it is essential to consider the potential drawbacks of AAI tools in higher secondary education. Overreliance on technology can lead to distractions and decreased critical thinking and problem-solving abilities (Henderson, 2020). Moreover, the use of AAI tools may reduce social interaction opportunities, limiting students' social development and well-being (Anderson & Jiang, 2018).

Privacy and security concerns are also important considerations. The collection and storage of student data by AAI tools can raise privacy issues and increase the risk of data breaches or cyber-attacks (Ching et al., 2018; Schaub et al., 2018). Protecting students' privacy and ensuring the security of their information should be a priority when implementing AAI tools and devices. In order to mitigate the negative effects of AAI tools and devices, ethical considerations should be incorporated into their design and use. Transparency, accountability, and fairness should guide the implementation of AAI in education (OECD, 2019). Educators and policymakers should provide guidelines and training on the responsible use of AAI tools to minimize potential negative effects and maximize their benefits for students.

Conclusion

AAI tools/devices have become increasingly popular in recent years, including in the education sector for higher secondary students. One of the primary benefits of using AAI tools/devices is that they can enhance the learning experience by providing personalized and interactive content. AI tools/devices can also help students to identify and address their weaknesses and improve their overall academic performance.

However, there are also some potential drawbacks to using AI tools/devices in education. One concern is that students may become overly reliant on technology and fail to develop critical thinking and problem-solving skills. Additionally, some critics argue that the use of AAI tools/devices may lead to a decrease in the quality of education as teachers may rely too heavily on automated systems instead of engaging with their students.

Overall, while there are both benefits and potential drawbacks to the use of AAI tools/devices in education, it is clear that these technologies have the potential to revolutionize the way that students learn and interact with educational content. It is important for educators to carefully consider the pros and cons of using AAI tools/devices and to develop strategies that maximize their benefits while minimizing their potential drawbacks.

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