

The Effects of AI-Based Learning Tools on Students' Learning

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Introduction

The purpose of this stand-alone literature review is to explore how Artificial Intelligence (AI) based learning tools have impacted students' learning and their efficiency in their studying and test preparation. The research includes a synthesis of these AI-based learning tools that help, support, enhance, or benefit all types of learners. The majority (more than 50%) of the peer-reviewed studies are from the past 10 years and focus on higher education; however, K-12 education is also explored. As a result, AI-based learning tools have positive effects or benefit the learner, particularly those who have disabilities (Bressane et al., 2024; Huang et al., 2023; Hart Barnett, 2017; Popenici, S. A. D., & Kerr, S., 2017). Along with digital distractions, note-taking tools, including AI-based applications, are taken into consideration. Limitations and recommendations are stated at the end of this paper. Evidence also suggests the benefits and need for implementing standardized technology policies in the classroom for all types of learners (Flanigan et al., 2023; Parker, 2021). In addition, there is a need for collaboration and communication in AI-based learning tools (Bressane et al., 2024; Liu et al 2021). Concerns regarding ethics, security, and the creation of equitable learning tools are also discussed. Limitations are presented as well as recommendations on how to move forward. Below is a summary of what is addressed:

- The latest in AI technologies such as an AI based app as a learning tool
- Personalize or customizable to all types of learners, especially those with learning disabilities, differences, learning or behavioral challenges.
- Mitigate digital distractions
- Focus on collaboration and communication
- App teaching technologies have a positive effect
- Gaps in designing inclusive and equitable learning opportunities for AI education
- Standardized policies with AI-based tools centered on privacy and data security concerns
- Exploration of ITSs (Intelligent Tutoring Systems)

Effective Use of AI Learning Tools and Learning Disabilities

Mobile learning tools are in a controlled study by Ling et al., (2014). Based on Bloom's taxonomy, through various levels of learning, one group of students who used the mobile learning app performed better on the quiz than the other group that did not use the app (Ling et al., 2014).

Furthermore, students' confidence increased and they believed the app helped them with their learning soon after the experiment was completed (Ling et al., 2014). Although this learning tool is not an AI-based app, the

study shows evidence that mobile learning tools have the potential to play a significant role in education.

According to (Bressane et al., 2024; Huang et al., 2023; Hart Barnett, 2017; Popenici, S. A. D., & Kerr, S., 2017), artificial intelligence (AI) strategies positively affect the learning of students with disabilities. Notetaking applications can be beneficial to students (Suritsky, 1992; Kim et al., 2009). In addition, the AI-enhanced study tools that are personalized lead to positive learning outcomes (Bressane et al., 2024; Huang et al., 2023; Kim et al., (2009); Lin et al., (2023).

The study by Bressane et al. (2024), suggests that students with learning disabilities utilizing AI-induced strategies, with a customized approach that involved quizzes and collaboration, improved their learning outcomes. According to Wei (2022) and Lin et al., (2023), an educational or learning-based application can be customized to teaching methods and approaches or provide assistance or intervention accordingly. Innovative approaches entail AI-enhanced learning tools, personalized for those with disabilities or learning challenges (Bressane et al., 2024; Wei, 2022; Lin et al., 2023).

Digital Distraction, Effective Use of AI Learning Tools & Learning Disabilities

There is a negative impact on learning in the modern classroom environment, particularly with the prevalence of cyberloafing or digital distraction and different types of learners (Parker, 2021). A survey by

Flanigan, Hosek, Frisby, Babchuk, and Ray, (2023), concluded that on average, 94% (n=512) of the student participants always bring their mobile devices, and 30% claim that they “cyberloafed” or used their mobile devices in the classroom for off-task purposes across all their classes. Most participants agree that policies to manage digital distraction should be in place; however, they are not enforced, as 84% of participants reported they are “unlikely” or “very unlikely” to get caught for cyberloafing during class time (Flanigan et al., 2023).

To manage digital distraction or cyberloafing behavior, about 72% of the participants believe active learning experiences in the classroom are either moderately or very effective (Flanigan et al., 2023). In addition, there is evidence that standardized classroom technology policies that are enforced enhance learning (Flanigan et al., 2023; Parker, 2021).

Effects of Note-taking and Learning Disabilities

According to Suritsky, S. K. (1992) and Kim et al., (2009) the majority of students (55%) borrow or share notes. Regarding students with learning disabilities and notetaking, Suritsky, S. K. (1992) suggests that only a few used “comprehensive and effective notetaking techniques,” based on a survey of 31 college students with learning disabilities. Out of 31 students, a few students (23%) request notetaking accommodations, and 55% borrow class notes. Students reported 23 different ways professors could improve lectures. The prevalence of multiple digital devices such as students’ mobile phones, laptops and notebook computers brought into the classroom raises the question of whether or not there is an efficient

use for them as learning tools. Electronic note-taking with devices through Eclass, Enotes, NoteLookm NotePals, Souvenir, and LiveClassroom has been examined and critiqued (Kim et al, 2009). As a result, 59% of the respondents thought bringing a laptop to class was inconvenient; 75% of the respondents preferred hand-writing over typing their notes (Kim et al., 2009). Also mentioned in this study by Kim et al., (2009) was the fact that 68% of the respondents preferred to share their notes and audio was more important than video. What was yet to be explored was how a different type of application could be a better solution for learners (Kim et al., 2009). At the same time, the devices for note-taking purposes may be a distraction and decrease attention (Kim et al., 2009).

In regards to the skill of note-taking, Peverly et al., (2014) suggest positive learning outcomes with handwriting speed, the cognitive processes of language comprehension, and sustained attention with or without the ADHD diagnosis. In other words, efficient notetakers must have the ability to be an attentive, active listener in lecture note-taking and they are more likely to recall the information in their notes than information that was not recorded. However, it is recommended to determine outcome measures other than written recall for future research. As Piolat et al., (2005) argues, students can process rather than take notes that result in a product. Students are pressed for time and make a significant effort to assess, understand, and produce something in written form (Piolat et al., 2005).

Longhand Note-taking Benefits & AI

Significant evidence reveals longhand notetaking resulting in generative notetaking is more beneficial and effective than laptop notetaking as students are transcribing (Allen, LeFebvre, LeFebvre, and Bourhis, 2020; Crumb, Hildebrandt, and & Sutton, 2022; Flanigan, Kiewra, Lu, and Dzhuraev, 2023; Luo et al., 2018). According to Allen, LeFebvre, LeFebvre, and Bourhis, 2020; Flanigan, Kiewra, Lu, and Dzhuraev, 2023; Kim et al., 2009), evidence suggests that students taking notes on their laptops impacts their learning due to digital distraction and multitasking behavior. Students who took their notes in longhand scored higher on tests and received better grades than students who typed their notes or used a laptop for notetaking (Allen, LeFebvre, LeFebvre, and Bourhis, 2020; Flanigan, Kiewra, Lu, and Dzhuraev, 2023). The act of using a laptop migrates student focus away from participation and discussion surrounding the classroom content. Therefore, the learner begins to view classroom activities as something passive, and the discussion background noise is the central focus of what is occurring on the laptop screen. The learner is no longer present and is focused on the screen, not on the professor and the content, “further away cognitively from the instructional experience.” The benefits of learning by taking notes by longhand are: recall, an increase in efficiency, and active learning versus passive learning (Allen, LeFebvre, LeFebvre, and Bourhis, 2020). In another study by Flanigan, Kiewra, Lu, and Dzhuraev, (2023), students who took notes in longhand, with revised notes on a lecture posttest, scored more than half a letter grade better than students who took notes by computer, with revised notes on a lecture posttest. The recommendation is to include revision pauses or in other words, allow pauses during the

lecture so students can make revisions to their notes (Flanigan, Kiewra, Lu, & Dzhuraev, 2023).

AI-based note-taking tools have been proven beneficial (Kim et al., 2009; Saini et al., 2023). As stated by Saini et al., (2023), students receive positive learning outcomes when an AI-based lecture note-taking (LNT) framework, through Google API, is in place. The results of the study favored AI AI-based LNT framework over the manual note-taking method. In addition, the study suggested that the environment such as noise or professors' speech can have an impact on learners' note-taking abilities (Saini et al., 2023). The study also suggested that due to the effectiveness of the artificial intelligence (AI) multilanguage-based LNT framework, the students' learning will be enhanced (Saini et al., 2023). Popenici & Kerr (2017) suggest AI will produce solutions serving students of "all types of abilities with disabilities to a degree that potentially there will no longer be abilities and engage to a certain degree in human-like processes and complex processing tasks that can be employed in teaching and learning." In other words, with AI-based learning tools, disabilities will no longer exist (Popenici & Kerr, 2017).

Intelligent Tutoring Systems (ITSs)

As intelligent tutoring systems (ITSs) continue to increase with more personalization and sophistication, there has been attention to the development of more efficient systems (Lin et al., 2023; Mousavinasab et al., 2021; Verdú et al., 2017). These systems can help determine students' behaviors as well as monitor their learning, such as progress, and include feedback (Lin et al., 2023); (Mousavinasab et al., 2021; Verdú et al., 2017).

The study by Mousavinasab et al., (2021), examines 53 systems; however, the study excluded mobile devices designed for ITSs, and therefore recommendation has been made to focus on the evaluation of mobile device designed for ITS. The NTUITEL program includes an Intelligent Tutoring System and addresses personalized learning for MOOCS (Massive Open Online Courses). Verdú et al., 2017). According to Lin et al., (2023), Intelligent Tutoring Systems (ITSs) are computer-based learning systems that use artificial intelligence (AI) to provide personalized and adaptive instruction for students.

Privacy, Security and Ethical Implications

Privacy, security and ethical implications need more attention due to the utilization of AI- based educational tools in schools (Salas-Pilco & Yang, 2022; Lin et al., 2023). Studies in which Latin American researchers implemented AI-based technologies in the education sector mentioned ethical clearance. As ethics and privacy become a top concern among educators, protocols for personal data protection such as copyright issues must be established (Salas-Pilco & Yang, 2022). The challenges include issues related to privacy and data security, as well as potential biases in algorithms and machine learning models (Lin et al., 2023). A number of studies focus on the explanation of what AI is doing to gain societal acceptance and trust (Lin et al., 2023).

Limitations

Studies are fairly new and are from outside the U.S. with minimal longitudinal research taken into consideration. Students with disabilities account for about 10% of the population; other types of learners that do not qualify for an IEP or 504, such as students with anxieties, learning challenges, student-athletes, and those from diverse backgrounds, may be excluded from this research. For a more equitable learning environment, students showing various characteristics of the populations or demographics should be taken into consideration.

Conclusion and Recommendations

Students prefer personalization AI-based learning tools, specifically note-taking apps designed for all types of learners. Research suggests positive learning outcomes for those who take notes by hand augmented by AI-based learning tools, such as a note-taking application. Embracing these tools and utilizing them in a hybrid manner is the ideal approach instead of using one method over another (Kim et al., 2009). Research suggests that notes can be generated in a manner that would provide students with a complete summary of a class (Flanigan et al., 2023). Based on the book by Lang (2020) *Distracted*, images help attract attention and promote learning. A recommendation would be for an AI-based app to generate lecture notes while also producing visuals for the students, which can also be created for the teachers' presentations. Although a "one-size-fits-all" approach has been proven to not work, standardized policies utilizing AI-based tools enhance the efficiency of learning. Above all, we need to focus on what attracts rather than what

distracts: Attention=achievement. According to Lang (2020), neuroscientist Adam Gazzaly and psychologist Larren Rosen stated that we are “information-seeking creatures.” We actively seek out “novelty” information that is new. “Hooked: How to Build Habit-Forming Products,” indicates educational institutions must embrace societal-oriented, AI-based learning tools, customized for all types of learners. To attract attention and connect with the students, teachers must provide unique yet meaningful information such as storytelling or sharing of personal experiences related to the course material. Learners also are attracted to educators who must be stewards of AI-based technologies by focusing on human needs ethically, safely, and effectively.

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