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Artificial Intelligence and Brain Rot: Implications for Students' Cognitive Development and Character Education

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ABSTRACT

The rapid integration of Artificial Intelligence (AI) into education has transformed students' learning patterns, offering both cognitive opportunities and psychological challenges. This study explores the implications of AI on the phenomenon of brain rot a term referring to cognitive stagnation, reduced attention span, and diminished motivation caused by overexposure to shallow digital stimuli. Using a literature-based qualitative method, data were gathered from relevant academic sources, books, and online reports to analyze the dual impact of AI on students' cognitive and motivational domains. The findings reveal that, while AI fosters personalized learning and enhances self-efficacy through adaptive systems and data-driven feedback, it simultaneously risks promoting intellectual passivity when students excessively rely on generative AI for instant answers. Such overdependence weakens analytical, evaluative, and creative abilities core components of higher-order thinking thereby accelerating symptoms of brain rot. The study further highlights that digital environments saturated with short-form content amplify these risks, conditioning students to seek immediate gratification and undermining their capacity for deep learning. However, when employed reflectively, AI can serve as a metacognitive scaffold that promotes inquiry, reflection, and sustained engagement. To mitigate the negative implications, the research emphasizes the necessity of integrating digital literacy, ethical awareness, and self-regulation into educational frameworks. In conclusion, AI should be positioned not as a cognitive substitute but as a supportive partner in learning one that enhances critical thinking and preserves intellectual vitality in the digital age.

Introduction

The rapid advancement of digital technology in the 21st century has profoundly reshaped human cognition, learning habits, and behavioral patterns. Among the most transformative innovations is Artificial Intelligence (AI), a field of computer science that seeks to emulate human cognitive processes such as learning, reasoning, and problem-solving. Over the last decade, AI has permeated almost every aspect of modern life from healthcare and communication to education and creative industries bringing both significant opportunities and complex challenges. In education, AI has been widely recognized for its potential to revolutionize pedagogical methods through intelligent tutoring systems, automated feedback mechanisms, and adaptive learning environments. These innovations promise to enhance students' learning motivation, promote personalized education, and develop higher-order thinking skills. However, alongside these benefits, a growing body of research warns of unintended psychological and cognitive side effects that may accompany the increasing dependence on AI, particularly the phenomenon popularly known as "brain rot" (Malec, 2024).

The term *brain rot* refers to a state of mental stagnation, reduced attention span, and diminished cognitive function resulting from prolonged exposure to shallow, fast-paced, and instantly gratifying digital content. Although originally used in popular discourse, the concept has drawn increasing academic interest due to its implications for learning and critical thinking. The digital environment, characterized by algorithmic feeds and information overload, conditions the brain to favor immediate stimuli over sustained focus and deep comprehension. Carr (2010) earlier described this shift as the erosion of deep reading and reflective thought, as the internet rewires neural pathways toward superficial information processing (Carr, 2010). Within this context, the emergence of AI tools such as generative text models, chatbots, and automated essay writers has introduced new dynamics that intensify both the advantages and the risks of digital learning. On one side, AI can act as a powerful cognitive aid, but on the other, it may reinforce mental shortcuts and passive thinking habits that align with the symptoms of brain rot.

In educational settings, the use of AI is growing rapidly. According to Massaty, et.al (2025), AI-driven systems have demonstrated strong potential to improve computational thinking and self-efficacy among students (Massaty et al., 2025). Through data-driven personalization, these systems adjust content difficulty and feedback to suit individual learning needs, which can stimulate metacognitive engagement and intrinsic motivation. Similarly, adaptive AI tutors can assist teachers in identifying students' weaknesses and designing more effective interventions. This suggests that, when used constructively, AI has the capacity to counteract cognitive decline by fostering sustained engagement and critical reasoning. However, despite these benefits, educational researchers have also expressed growing concern about the misuse of AI, particularly when students employ it as a substitute for thinking rather than as a tool for enhancement.

Evidence suggests that overreliance on AI-generated answers can negatively impact students' ability to analyze, synthesize, and evaluate information three essential components of higher-order thinking. Wecks et al. (2024) found that students who frequently used generative AI tools to complete academic tasks displayed weaker

performance in understanding and memory retention compared to those who engaged in manual problem-solving (Wecks et al., 2024). The findings indicate that AI dependency may foster intellectual passivity, as students skip the cognitive effort required to process and integrate information deeply. This phenomenon closely parallels the mechanisms of brain rot: the substitution of deep, effortful cognition with instant gratification and surface-level engagement. Over time, this can erode the brain's capacity for sustained attention, reflective reasoning, and creative thought skills essential for academic success and lifelong learning.

The interaction between AI and brain rot must also be viewed through the lens of digital culture. Today's students, often referred to as digital natives, inhabit a media ecosystem saturated with short-form videos, algorithmic feeds, and gamified content designed to capture and hold attention. This constant exposure to rapid information cycles has been linked to attention fragmentation and cognitive overload. Studies from Universitas Muhammadiyah Surakarta (UMS, 2024) reported that students accustomed to consuming fast, entertainment-based content exhibit lower motivation for academic activities that require concentration and patience(Universitas Muhammadiyah Surakarta, 2024). When these habits intersect with AI technologies that provide immediate solutions, the risk of brain rot intensifies. The student's cognitive system becomes conditioned to expect quick results, reducing tolerance for delayed rewards and complex thinking processes.

Moreover, the psychological implications of brain rot extend beyond individual cognition. Continuous dependence on AI systems and digital media can reshape students' emotional and motivational frameworks. Instant access to answers can diminish the sense of achievement that typically accompanies effortful learning. This not only weakens resilience but also undermines the development of self-efficacy a crucial psychological factor determining academic persistence and problem-solving confidence. As students outsource cognitive labor to AI, they may experience what scholars term "cognitive offloading," a process where memory and analytical functions are externalized to technology. While such offloading can optimize efficiency in the short term, it risks impairing long-term intellectual autonomy if not balanced by critical reflection and active engagement.

The paradox, therefore, lies in the dual role of AI as both a cognitive enhancer and a cognitive inhibitor. When used thoughtfully, AI can expand human intelligence by providing scaffolds for learning, supporting reflection, and facilitating creativity. Yet, when used uncritically, it may cultivate the very habits of mind that define brain rot impatience, superficiality, and intellectual complacency. Krsmanović and Deek (2025) emphasized that the educational value of AI depends not merely on algorithmic sophistication but on pedagogical intent and student awareness (Krsmanović & Deek, 2025).

They argue that effective AI integration requires a framework that promotes active inquiry rather than passive consumption. For instance, using AI to generate reflective prompts, support peer review, or simulate problem-based learning scenarios can transform the technology into a cognitive partner rather than a substitute for human reasoning. From a socio-educational perspective, the implications are significant. The phenomenon of brain rot, if left unchecked, could undermine the intellectual foundations of future generations. As education systems increasingly adopt AI-based platforms, there is a pressing need to balance innovation with cognitive preservation. Policies should emphasize digital literacy, ethical awareness, and mental well-being alongside technological proficiency. Students must be taught not only how to use AI tools but also how to question them developing discernment in evaluating AI outputs and recognizing when reliance becomes detrimental. Likewise, teachers and institutions must be equipped to design curricula that integrate AI responsibly, ensuring that its use stimulates critical engagement rather than replaces it. In light of these considerations, the present study seeks to explore the impact of Artificial

Intelligence on the phenomenon of brain rot among students, focusing on the cognitive, motivational, and educational dimensions of this relationship. It aims to analyze how AI influences thinking patterns, learning behaviors, and attention management, while also identifying strategies to mitigate potential negative effects. This research contributes to ongoing discourse on digital cognition and educational transformation by highlighting the need for ethical, reflective, and balanced AI implementation.

Method

This research is a literature study, with data collection carried out through the examination of books, articles, and other sources relevant to the topic under discussion. Once the data were collected, the researcher conducted a selection process to identify materials that were most relevant to the study. The selected data were then analyzed using content analysis techniques, followed by the final step of drawing conclusions.

Results and Discussion

a. Artificial Intelligence Phenomenon

The emergence of artificial intelligence (AI) has revolutionized various aspects of human life and has had a tangible impact on everyday activities across multiple domains (Çalışkan et al., 2022). **D**awaesar (2013) remarked that "Our devices matter to us as much as food and shelter. Technology has altered the flow of time. The overall time that we have for our narrative, our life span, has been increasing, but the smallest measure, the moment, has shrunk" (Alfeir, 2024). Along with advancements in digital data collection, machine learning, and computational technologies, AI has now penetrated fields that were once considered the exclusive domain of human intelligence (Çalışkan et al., 2022). One prominent example is its role as a driving force in transforming educational paradigms, fundamentally reforming the processes of teaching and learning (Zhang et al., 2025).

Artificial Intelligence (AI) can be defined as a technology that emulates human thinking and decision-making processes, characterized by cognitive abilities such as learning, memory, and reasoning. AI also refers to an engineered form of human intelligence capable of learning, perceiving, and adaptively processing information **(Albasalah et al., 2022)**. This technology is regarded as a strategic revolution for the future by the Chinese government as well as many other nations and serves as a foundational element in the formulation of development strategies aimed at fostering inclusive national progress in anticipation of an AI-driven social landscape **(Albasalah et al., 2022)**. Furthermore, the emergence of conversational AI systems such as ChatGPT (OpenAI), Bard (Google), and Bing (Microsoft) has made the ongoing AI revolution increasingly evident **(Portocarrero Ramos et al., 2025)**.

The presence of artificial intelligence (AI) has produced a wide range of impacts, both positive and negative, across various sectors. A study revealed that learners who utilized ChatGPT as an aid in problem-solving experienced greater learning retention, enhanced mastery of new skills, and improved critical thinking abilities in evaluating their learning outcomes, particularly within the context of programming education. Furthermore, graduates with a high level of proficiency in various AI tools tend to achieve more optimal job placements and exhibit stronger alignment between their professional roles and areas of expertise **(Portocarrero Ramos et al., 2025)**. On the other hand, the use of AI also requires careful consideration of ethical, privacy, and accountability aspects to ensure that the technology is applied responsibly (Çalışkan et al., 2022). In the fields of robotics and security, for instance, machines have been developed with the capability to take human lives without direct operator control (Burton & Soare, 2019). Such risks may escalate alongside the convergence of innovations in chemical design and AI-driven robotics, as

highlighted by the public announcement of Autonomous Weapon Systems (AWS) as the third revolution in warfare (Reports from the American Association for the Advancement of Science Meeting, Washington DC, 2019).

b. The Phenomenon Of Brain Rot in The Digital Era

The phenomenon of brain rot in the digital era describes a decline in cognitive abilities and mental health caused by excessive consumption of meaningless or low-quality content (Malec, 2024). Carr introduced the concept of brain rot as a negative consequence of excessive internet use, which alters the way the human brain processes information (Carr, 2010). According to Carr, the ease of accessing information encourages the brain to operate on a superficial level. This leads to a habit of quickly switching from one piece of information to another without achieving deep understanding (Carr, 2010). Carr highlights the phenomenon of information overload, where individuals receive an overwhelming amount of information without adequate time to process or evaluate it, thereby reducing their ability to think critically and analytically (Carr, 2010). This habit fosters an instant and shallow mindset , making it challenging for the brain to tackle problems that require deep thought and problem-solving (Wecks et al., 2024) (Universitas Muhammadiyah Surakarta, 2024)Krsmanović & Deek, 2025).

Several symptoms are commonly observed in digital users experiencing brain rot (Çalışkan et al., 2022). The first is a decline in cognitive abilities (Connell et.al, 2022), where users struggle with concentration (Portocarrero Ramos et al., 2025)(Hassan et.al, 2021) experience memory deterioration (Schnell et.al, 2021), and find it difficult to process new information (Portocarrero Ramos et al., 2025). The second symptom is decreased productivity (Dogaru et al., 2025), marked by challenges in completing tasks and an increase in procrastination (Sirois, 2023). The third symptom is a sense of lethargy and lack of motivation (Enoka et.al, 2021), as users feel trapped by boredom and a lack of energy (Murphy et.al, 2023). Fourth, users may experience sleep disturbances, leading to poor sleep quality (Maestro-Gonzalez et.al, 2021). Carr outlines several indicators of brain rot. The first is a decline in deep reading ability. Brain rot conditions the brain to favor fast and superficial reading over deep reading, impairing the ability to understand complex information. The second indicator is the fragmentation of attention due to the habit of multitasking, which makes it difficult for the brain to focus on a single task for an extended period (Carr, 2010).

The third is memory impairment, where the brain becomes less effective at transferring information from short-term to long-term memory due to overreliance on search engines and digital devices (Hassan et.al, 2021). The fourth is a loss of capacity for deep thinking, as the brain becomes accustomed to shallow information consumption, diminishing the ability to reflect deeply and think creatively (George et.al, 2023). The fifth indicator is the addiction to digital stimulation (Ding et.al, 2023). The internet is designed to provide constant stimulation, making digital users struggle to feel satisfied without distractions from their devices (Mosolov & Yaltonskaya, 2022). The impacts of brain rot on digital users can be significant. First, it increases the risk of depression and anxiety, as exposure to negative online content heightens emotional distress (Grumi et.al, 2021). Second, it leads to a decline in quality of life, including reduced satisfaction in work or studies (Enoka et.al, 2021). Third, it disrupts social relationships by diminishing face-to-face communication skills (Stevic, 2021). Addressing these challenges is essential for fostering healthier cognitive and emotional habits in the digital era (Rahmatullah et.al, 2022).

c. The Implications of Artificial Intelligence on the Phenomenon of Brain Rot Among Students

In the digital era, the term *brain rot* has emerged to describe a form of mental stagnation caused by excessive exposure to fast, shallow, and repetitive online content. Among

students, this phenomenon manifests as a decline in critical thinking, shortened attention span, and reduced motivation for academic effort. It has become a growing concern in educational and psychological studies, as technology reshapes not only how students learn but also how their brains process information. With the widespread integration of Artificial Intelligence (AI) into educational contexts, understanding how AI influences this phenomenon is crucial. AI can serve as both a tool for cognitive enhancement and a trigger for cognitive decay depending on how it is used (Malec, 2024).

AI's potential to enhance learning lies in its adaptive and personalized capabilities. When implemented effectively, AI can support the development of higher-order thinking skills through personalized learning paths and data-driven feedback. For instance, studies have shown that AI-powered platforms such as adaptive tutors and virtual learning assistants can foster computational thinking and self-efficacy among students by offering dynamic challenges that match their cognitive levels (Massaty et al., 2025). This suggests that, when used consciously and critically, AI could help mitigate aspects of brain rot by promoting problem-solving, reflection, and engagement key antidotes to the passive consumption patterns driving cognitive decline.

However, these benefits can quickly turn into cognitive risks if students become overly reliant on AI for thinking and decision-making. When learners consistently depend on generative AI to produce essays, summarize texts, or solve problems, they bypass essential mental processes such as analysis, synthesis, and evaluation. Wecks et al. (2024) found that excessive reliance on AI tools correlated with lower academic performance and a weakened ability to recall and apply learned knowledge (Wecks et al., 2024). This overdependence fosters intellectual laziness a key symptom of brain rot where students prefer immediate results over the effortful thinking that leads to genuine understanding. In this way, AI may unintentionally reinforce the same instant-gratification dynamics that make social media addictive and mentally numbing.

Cognitive science research has long established that deep learning requires desirable difficulty effortful engagement that strengthens neural connections. Yet AI tools designed for convenience may strip away this difficulty by providing instant answers and polished outputs. Similar to how social media platforms serve short, dopamine-rewarding content that erodes focus, AI applications risk turning learning into a process of passive consumption rather than active exploration. As Malec (2024) explained, brain rot arises from the "continuous outsourcing of attention," where the mind adapts to seek quick stimulation instead of sustained concentration. In educational settings, this outsourcing is mirrored when students delegate thinking to AI rather than engaging in intellectual struggle (Malec, 2024).

The relationship between AI use and cognitive stagnation is also influenced by digital consumption habits. Students immersed in short-form video culture already face difficulty sustaining attention, and the availability of AI tools that instantly complete cognitive tasks amplifies this trend. Research at Universitas Muhammadiyah Surakarta (UMS, 2025) found that prolonged exposure to fast-paced digital content lowers motivation for analytical or creative academic work (Universitas Muhammadiyah Surakarta, 2024). In this context, AI functions as another agent of convenience it offers intellectual shortcuts that feel productive but often bypass deep learning. Over time, this reinforces the very patterns that constitute brain rot: fragmented attention, superficial understanding, and diminished persistence.

Despite these risks, AI can also be strategically used to counteract brain rot if its role is reframed from substitution to scaffolding. Instead of generating answers, AI can be integrated as a metacognitive tool that prompts students to reflect, question, and refine their reasoning. For example, teachers can use AI to create Socratic dialogues or adaptive feedback systems that challenge students' assumptions, requiring them to explain, justify,

or critique AI-generated responses. Studies have shown that AI-supported reflection tasks promote higher cognitive engagement than traditional methods because they place the learner in an active role (Krsmanović & Deek, 2025).
In such frameworks, AI acts as a cognitive sparring partner rather than a replacement thinker, strengthening students' ability to sustain focus and deepen understanding. Moreover, addressing the brain rot phenomenon through AI requires cultivating digital literacy and self-regulation. Students must be taught to approach AI critically recognizing when it supports learning and when it undermines it. As UMS (2024) emphasizes in its report *Waspada Gejala Brain Rot*, awareness is the first step toward prevention: students need guidance in balancing online activity, managing screen time, and developing offline habits such as reading and reflective journaling (Universitas Muhammadiyah Surakarta, 2024). These practices reinforce neural circuits for sustained attention and reduce the passive consumption patterns associated with brain rot. Schools can integrate digital wellbeing modules alongside AI literacy training, ensuring that students use AI as a cognitive enhancer rather than a cognitive crutch.

The broader implication of AI in this context extends beyond individual cognition to the social and educational structures shaping student behavior. When institutions prioritize efficiency and automation over reflection and discourse, they inadvertently create an environment where brain rot can flourish. As Wecks et al. (2024) noted, the educational value of AI depends less on the sophistication of the algorithms and more on the intentionality of its use (Wecks et al., 2024). AI should not replace teachers or diminish human effort but rather augment it by supporting deeper inquiry and personal growth. Effective AI integration thus requires a balance between human judgment and technological assistance a balance that sustains cognitive vitality.

Finally, the ethical dimension of AI and brain rot cannot be ignored. The same systems that make AI convenient also incentivize speed and volume over quality and depth. Students, educators, and developers share responsibility in resisting this drift toward intellectual automation. Ethical AI design should prioritize cognitive development, curiosity, and attention rather than productivity metrics alone. Educators, meanwhile, must encourage students to use AI reflectively to ask better questions rather than seek faster answers. The goal should not merely be technological proficiency but intellectual resilience. In this light, the struggle against brain rot becomes a struggle for the preservation of human depth in an age of artificial convenience.

Conclusion

This study highlights that AI has a dual influence on the phenomenon of brain rot among students. On one hand, AI offers transformative potential to enhance learning through adaptive systems that stimulate critical thinking, reflection, and metacognitive engagement. On the other hand, excessive reliance on AI for instant solutions and cognitive shortcuts can accelerate symptoms of brain rot, including reduced concentration, weakened memory, and superficial understanding. The findings indicate that the key determinant lies not in the technology itself but in how it is utilized AI should serve as a cognitive scaffold rather than a substitute for human reasoning. Therefore, developing digital literacy, self-regulation, and ethical awareness in AI usage is essential to prevent cognitive stagnation and to ensure that technological progress strengthens, rather than diminishes, students' intellectual vitality and capacity for deep learning.

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