

Artificial Intelligence and Student Learning After COVID-19: A Conceptual Review of Transformation, Dependency, and Misuse Patterns.

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ABSTRACT

The COVID-19 pandemic marked an unprecedented turning point in global education, accelerating the shift from traditional classroom learning to technology-driven and AI-assisted academic environments. While this transition expanded access to digital resources and online learning platforms, it simultaneously introduced new patterns of student behavior both productive and problematic. This paper presents a conceptual review of how Artificial Intelligence has progressively integrated into student education, examining developments from the pre-COVID digital era through the post-COVID generative AI period spanning 2000 to 2026.

Drawing upon existing literature across three distinct phases pre-COVID foundational learning (2000–2019), the pandemic-driven digital shift (2020–2021), and the post-COVID AI adoption era (2022–2026) this study synthesizes key findings related to learning transformation, AI-assisted personalization, cognitive dependency, and academic misuse. The review identifies significant benefits of AI integration including improved accessibility, self-paced learning, and personalized academic support. Simultaneously, it highlights critical concerns such as over-reliance on AI-generated content, reduced independent reasoning, and the misuse of AI tools for academic dishonesty.

A conceptual framework is proposed that positions AI as a dual-impact mechanism functioning either as an augmentation tool that enhances student learning or as a dependency driver that undermines intellectual development, depending on the pattern of use and institutional regulation. The study concludes that responsible AI integration in post-COVID education requires structured digital literacy, clear academic policies, and a balanced pedagogical approach that preserves student cognitive engagement.

Keywords: Artificial Intelligence in Education, Post-COVID Learning, Student AI Dependency, Academic Integrity, Generative AI, Digital Transformation, Cognitive Offloading

1. INTRODUCTION

The integration of Artificial Intelligence into education did not begin with the COVID-19 pandemic, but the pandemic undeniably accelerated it. For decades, educational systems worldwide relied predominantly on classroom-based instruction, physical resources, and face-to-face student-teacher interaction. While early digital tools and e-learning platforms began emerging in the 2000s, their adoption remained gradual and largely supplementary to traditional education. Students accessed the internet for research, used basic learning management systems, and engaged with early adaptive software but the core structure of education remained unchanged.

The arrival of COVID-19 in early 2020 disrupted this structure entirely. Overnight, institutions shifted to emergency remote learning, and students across the world were forced to engage with digital platforms as

their primary mode of education [1]. This forced digitization had a profound and lasting effect on student behavior, learning habits, and technological expectations. Internet access, once a convenience, became a necessity. Digital tools, once optional, became the foundation of academic survival.

It is within this post-pandemic landscape that Generative Artificial Intelligence emerged as a transformative force. The release of large language models such as ChatGPT in late 2022 introduced students to AI tools capable of generating explanations, summaries, code, essays, and real-time academic guidance on demand [2]. For many students, particularly those in resource-limited environments, these tools represented an unprecedented democratization of academic support. For others, they introduced a new and troubling shortcut one that bypassed the learning process entirely.

This paper examines AI's evolving role in student education through a pre- and post-COVID lens. It traces how student interaction with technology shifted across three phases: the foundational digital period (2000–2019), the pandemic-driven emergency transition (2020–2021), and the generative AI adoption era (2022–2026). Through a conceptual review of existing literature, the study identifies both the transformative benefits and the emerging concerns associated with AI in student academic life specifically, how the same technology that empowers some students is being misused by others.

2. MOTIVATION FOR RESEARCH

The integration of Artificial Intelligence into student education has undergone a dramatic shift over the past two decades, accelerated most significantly by the disruptions caused by the COVID-19 pandemic. While earlier research documented AI's role as a supplementary instructional tool, the post-COVID landscape presents a fundamentally different reality one where students interact with generative AI systems daily for learning, writing, problem-solving, and unfortunately, academic dishonesty.

Despite growing scholarly attention, most existing research addresses either the technological benefits of AI or the ethical risks in isolation. Limited work provides an integrated perspective that connects the pre-COVID educational baseline, the pandemic-driven digital shift, and the subsequent explosion of student AI adoption into a single coherent analysis. This fragmented discourse leaves educators, institutions, and policymakers without a clear picture of how student behavior and learning patterns have genuinely transformed across these phases.

Furthermore, before to COVID-19, AI in education was largely confined to institutional deployments adaptive learning platforms, automated grading systems, and learning analytics tools adopted by universities rather than by students themselves [3]. The post-COVID period reversed this dynamic. Students now independently access and rely on AI tools such as ChatGPT, often without institutional guidance or structured oversight. This shift from institution-led AI to student-driven AI use represents a critical gap in the literature that has not yet been comprehensively examined.

The consequences of this shift are significant. On one side, students who lacked access to private tutoring or premium academic resources gained unprecedented support through free, on-demand AI tools. On the other, the same accessibility that empowers genuine learners has enabled misuse from AI-assisted assignment completion to examination dishonesty raising urgent concerns about academic integrity and long-term cognitive development [4].

This study is therefore motivated by the need to synthesize existing literature across these three distinct phases, construct a balanced conceptual understanding of AI's dual role in student education, and propose a framework that institutions can use to navigate both the opportunities and risks of AI in the post-COVID academic environment.

3. RESEARCH AIM AND OBJECTIVES

The aim of this study is to conceptually examine how Artificial Intelligence has integrated into student education before and after the COVID-19 pandemic, analyzing both its transformative learning benefits and its emerging misuse concerns from a student perspective.

Specifically, the study seeks to:

- Trace the progression of AI in education from the pre-COVID digital learning era through the post-COVID generative AI period, covering developments from 2000 to 2026
- Synthesize existing literature to evaluate how COVID-19 acted as a catalyst for expanded student access to digital tools and AI-assisted learning
- Analyse the dual impact of AI on student behaviour identifying patterns of productive use such as personalized learning and self-study, alongside harmful patterns including cognitive dependency and academic dishonesty
- Propose a conceptual framework that positions AI as either an augmentation tool or a dependency risk depending on student behaviour, digital literacy, and institutional regulation
- Recommend practical strategies for educational institutions to ensure responsible and educationally beneficial AI integration in post-pandemic student environments

4. LITERATURE REVIEW

4.1 Education Before COVID-19: Traditional Learning and Early Digital Tools (2000–2019)

Prior to the COVID-19 pandemic, education in most parts of the world operated within a predominantly classroom-based structure. While digital technologies were gradually introduced into academic settings from the early 2000s, their adoption remained supplementary rather than central to the learning experience. [5] argued that despite widespread enthusiasm about the transformative potential of digital tools in education, technology integration consistently failed to fundamentally alter core pedagogical practices, with most institutions continuing to rely on face-to-face instruction as the primary mode of learning.

During the 2010–2019 period, AI applications in education began expanding beyond isolated classroom tools into broader institutional systems. Learning analytics, automated assessment, predictive modelling of student performance, and adaptive recommendation engines became increasingly prominent in university environments. A systematic review by [3] examined 146 studies on AI applications in higher education published between 2007 and 2018, finding that while AI demonstrated strong potential for personalization and student profiling, the vast majority of implementations remained at an institutional or administrative level rather than being directly accessed and driven by students themselves. Crucially, the review also identified a significant absence of pedagogical grounding in most AI deployments and called for greater educator involvement in AI-based educational design.

This pre-COVID period therefore established a baseline in which AI in education was largely institution-controlled, narrowly deployed, and disconnected from the daily learning habits of individual students. The student relationship with digital technology was primarily mediated through learning management systems, online research tools, and early e-learning platforms powerful but still limited compared to what would emerge after 2020.

4.2 COVID-19 as a Catalyst: Forced Digitization and Student Adaptation (2020–2021)

The outbreak of COVID-19 in early 2020 represented one of the most disruptive events in the history of modern education. Within weeks, universities and schools across the world were forced to abandon in-person

instruction entirely. [1] documented this transition in depth, analysing how educational institutions particularly in India scrambled to shift from traditional classroom-based learning to emergency online modes with little preparation, limited infrastructure, and significant inequities in student internet access. The study highlighted that while online learning offered certain advantages such as flexibility and continued academic access during lockdown, it simultaneously exposed deep digital divides among student populations, with many learners lacking reliable devices, internet connectivity, or suitable home environments for study.

The speed and scale of this digital transition had lasting consequences for student behaviour and expectations. Students who had previously engaged with technology as a supplementary academic resource were now entirely dependent on it for core learning activities attending lectures, submitting assignments, accessing library resources, and communicating with faculty [1]. This forced immersion accelerated digital literacy across student populations globally and permanently altered how students perceived the relationship between technology and education. The COVID period, while disruptive and unequal in its impact, ultimately lowered psychological and practical barriers to technology adoption among an entire generation of students, creating the conditions for the rapid uptake of AI tools that followed.

4.3 Post-COVID Rise of AI Tools Among Students (2022–2023)

The post-COVID period saw a qualitative shift in how students engaged with technology. The release of ChatGPT in November 2022 marked a turning point that transformed student AI use from passive engagement with institutional platforms to active, self-directed interaction with generative AI systems. [2] were among the first to systematically examine the implications of this shift, documenting how large language models introduced the capacity for AI to not merely support learning but to directly participate in knowledge construction drafting essays, generating explanations, solving problems, and producing academic content on demand.

The pace of adoption was remarkable. [6] conducted a multi-stage case study examining ChatGPT among early adopters in education, analyzing public discourse, user experiences, and ethical concerns across ten educational scenarios. Their findings indicated that while student enthusiasm for AI tools was high and largely positive in initial social media discourse, deeper engagement revealed serious concerns around cheating, privacy, and the accuracy of AI-generated academic content. Significantly, [6] noted that students were adopting AI tools independently, often well ahead of institutional policy responses, creating a governance gap that left both educators and students without clear guidance on responsible use.

[7] offered a broader perspective, examining the opportunities and challenges of large language models in education from both student and teacher viewpoints. Their analysis identified genuine learning benefits including on-demand feedback, personalized explanations, and support for students with learning difficulties while simultaneously highlighting risks such as over-reliance, reduced critical engagement, and copyright and plagiarism concerns arising from AI-generated academic content. Together, these early post-COVID studies established that the student-AI relationship had become direct, personal, and largely ungoverned a fundamentally different dynamic from the institution-mediated AI of the pre-COVID era.

4.4 Benefits of AI in Student Learning: Personalization, Accessibility, and Efficiency (2022–2026)

A significant body of post-COVID research documents the concrete learning benefits that AI tools have delivered to students.[3] earlier identified personalization and adaptive support as the most promising dimensions of AI in education, and subsequent research has confirmed these predictions in the context of generative AI. Students report that AI tools such as ChatGPT provide immediate, personalized explanations that adapt to their level of understanding a capability that traditional static learning materials fundamentally cannot offer.

Educational accessibility represents perhaps the most significant benefit identified in the literature.[4] noted that the free or low-cost availability of generative AI tools has democratized access to academic support that was previously available only to students with financial resources for private tutoring. For students in

developing countries or resource-limited educational environments, AI tools have provided a form of academic equity that institutional systems have historically struggled to deliver.[7] further demonstrated that AI can support students with dyslexia, language learning challenges, and other learning differences by generating simplified explanations, alternative phrasings, and structured guidance tailored to individual needs.

Beyond accessibility, efficiency gains are consistently reported. Students can clarify conceptual doubts instantly, receive structured feedback on draft work, generate study summaries, and practice problem-solving with immediate guidance all without waiting for scheduled office hours or institutional support.[2] acknowledged these efficiency advantages while cautioning that speed of response does not automatically translate into depth of understanding, a distinction that remains central to the ongoing debate about AI's educational value.

4.5 The Dark Side: Academic Misuse, Dependency, and Integrity Concerns (2022–2026)

Alongside documented benefits, post-COVID research has increasingly focused on the risks and misuse patterns associated with student AI adoption.[4] conducted one of the earliest and most widely cited examinations of academic integrity in the ChatGPT era, identifying that AI tools' capacity to generate essays, solve assignments, and produce research summaries at scale posed fundamental challenges to conventional definitions of authorship, originality, and assessment validity. Their study documented institutional difficulty in distinguishing AI-generated work from student-produced work and called for proactive policy responses rather than blanket prohibitions.

Beyond deliberate misuse, researchers have raised concerns about subtler and perhaps more widespread cognitive risks. [7] highlighted the phenomenon of cognitive offloading a pattern in which students increasingly delegate thinking processes to AI systems rather than engaging in independent reasoning. When students routinely request AI-generated explanations instead of working through problems themselves, the development of critical thinking, analytical reasoning, and intellectual resilience may be undermined over time. [6] similarly found that student engagement with AI in educational scenarios frequently prioritized convenience over comprehension, with many users adopting AI outputs without adequate critical evaluation.

The dependency dimension is particularly significant from a post-COVID perspective. Students who were already habituated to heavy digital tool use during the pandemic are potentially more vulnerable to over-reliance on AI assistance.[2] argued that the normalization of AI in academic workflows, without accompanying frameworks for responsible use, risks producing a generation of students skilled at accessing information but less capable of generating original thought. These concerns collectively point to a dual-impact pattern in which the same technology that empowers some students simultaneously diminishes the intellectual development of others the central tension this paper's conceptual framework seeks to address.

5. RESEARCH DESIGN AND METHODOLOGICAL APPROACH

5.1 Research Design

This study adopts a conceptual and descriptive review design. Rather than collecting primary empirical data, the research synthesizes existing scholarly literature to examine how Artificial Intelligence has integrated into student education across the pre-COVID, COVID, and post-COVID periods, and to analyse both the transformative benefits and the emerging misuse concerns associated with this integration. The conceptual review approach is appropriate for this study because the research aim is not to test a hypothesis through experimentation but to build a structured theoretical understanding from existing knowledge identifying patterns, gaps, and relationships across a body of literature spanning over two decades.

This design is consistent with established practices in educational technology research, where conceptual and review-based studies have been used to synthesize rapidly evolving fields and propose frameworks that practitioners and policymakers can apply [8]. The approach allows the study to draw meaningfully on

foundational literature from the pre-2010 period, expansion-phase research from 2010 to 2019, pandemic-period studies from 2020 to 2021, and the most recent post-COVID generative AI literature from 2022 to 2026 providing a longitudinal perspective that purely empirical studies with small samples cannot achieve.

5.2 Literature Selection Criteria

Literature included in this review was selected according to the following criteria:

- Peer-reviewed journal articles published with a verified DOI
- Publications focused on education, educational technology, or AI in academic contexts
- Studies discussing generative AI, ChatGPT, large language models, or digital learning tools
- Research addressing student learning behaviour, cognitive implications, academic integrity, or pedagogical outcomes
- Publications spanning the period 2000 to 2026, with particular emphasis on post-2020 sources
- Priority given to systematic reviews and high-impact publications to ensure academic credibility

Books from established academic publishers were also included where they provided foundational theoretical context unavailable in journal form.

5.3 Databases and Sources

Relevant literature was identified through the following academic databases and platforms:

- Google Scholar
- SpringerLink
- ScienceDirect
- MDPI Open Access Journals
- ERIC (Education Resources Information Centre)
- Wiley Online Library

Search terms used included combinations of: *generative AI in education*, *AI student learning*, *COVID-19 digital education*, *academic integrity ChatGPT*, *cognitive dependency AI*, *post-pandemic learning*, and *AI misuse higher education*.

5.4 Analytical Framework

Selected literature was analysed using a thematic synthesis approach. Studies were grouped into five key thematic categories aligned with the literature review sub-sections:

- Pre-COVID digital education and early AI applications
- COVID-19 as a catalyst for digital and AI adoption
- Post-COVID student AI tool usage patterns
- Benefits of AI in student learning
- Academic misuse, cognitive dependency, and integrity concerns

This thematic organization enabled structured comparison across studies, identification of consistent patterns, and synthesis of conceptual gaps particularly the absence of an integrated framework connecting pre-COVID baselines with post-COVID student AI behaviour.

5.5 Ethical Considerations

As this study is entirely review-based and does not involve human participants, primary data collection, or sensitive personal information, formal ethical approval was not required. All sources cited in this paper are publicly available, peer-reviewed publications. Full attribution is provided for all referenced works in accordance with IEEE citation standards.

6. CONCEPTUAL FRAMEWORK AND ANALYTICAL IMPLEMENTATION

6.1 Overview of the Framework

This study proposes a conceptual framework titled the Student AI Interaction Model: Pre/Post-COVID Dual-Impact Framework. The model explains how the relationship between students and Artificial Intelligence has evolved across three historical phases pre-COVID, COVID transition, and post-COVID and how this evolving relationship produces two distinct and opposite outcomes depending on how students engage with AI tools.

The framework is built around a central argument: AI is not inherently beneficial or harmful to student education. Its impact is determined entirely by the pattern of student interaction, the level of institutional regulation, and the degree of digital literacy a student brings to the engagement. The same tool that helps one student understand a difficult concept independently can simultaneously enable another to bypass the learning process entirely.

The framework positions AI as a dual-impact mechanism operating through two parallel pathways:

- Path A The Augmentation Pathway: AI enhances student learning
- Path B The Dependency Pathway: AI undermines student intellectual development

6.2 Phase Structure of the Framework

The framework is organized across three phases that reflect the historical trajectory examined in the literature review:

Phase 1 Pre-COVID Baseline (2000–2019) During this phase, AI in education was primarily institution-controlled. Students interacted with AI indirectly through learning management systems, adaptive platforms, and automated assessment tools deployed by universities. Student agency over AI use was limited, and the dependency risk was low because access was mediated and structured. The dominant outcome of this phase was supplementary support rather than direct cognitive assistance [3].

Phase 2 COVID Transition (2020–2021) The pandemic forced a rapid and unplanned shift to digital learning environments globally. Students gained direct, independent access to online tools and resources on an unprecedented scale. This phase represents the pivotal transition point the moment when students moved from passive recipients of institutionally-deployed technology to active, self-directed users of digital resources [1]. While generative AI tools were not yet widely available, the behavioural shift toward independent digital tool use was firmly established during this period, creating the conditions for rapid AI adoption in the following phase.

Phase 3 Post-COVID Generative AI Era (2022–2026) The release of generative AI tools such as ChatGPT in late 2022 placed powerful, free, on-demand academic assistance directly in students' hands. Institutional mediation largely disappeared students now interact with AI independently, personally, and constantly, often without guidance or policy frameworks [6]. This phase is where the dual-impact dynamic becomes most visible and consequential, and where the framework's two pathways diverge most sharply.

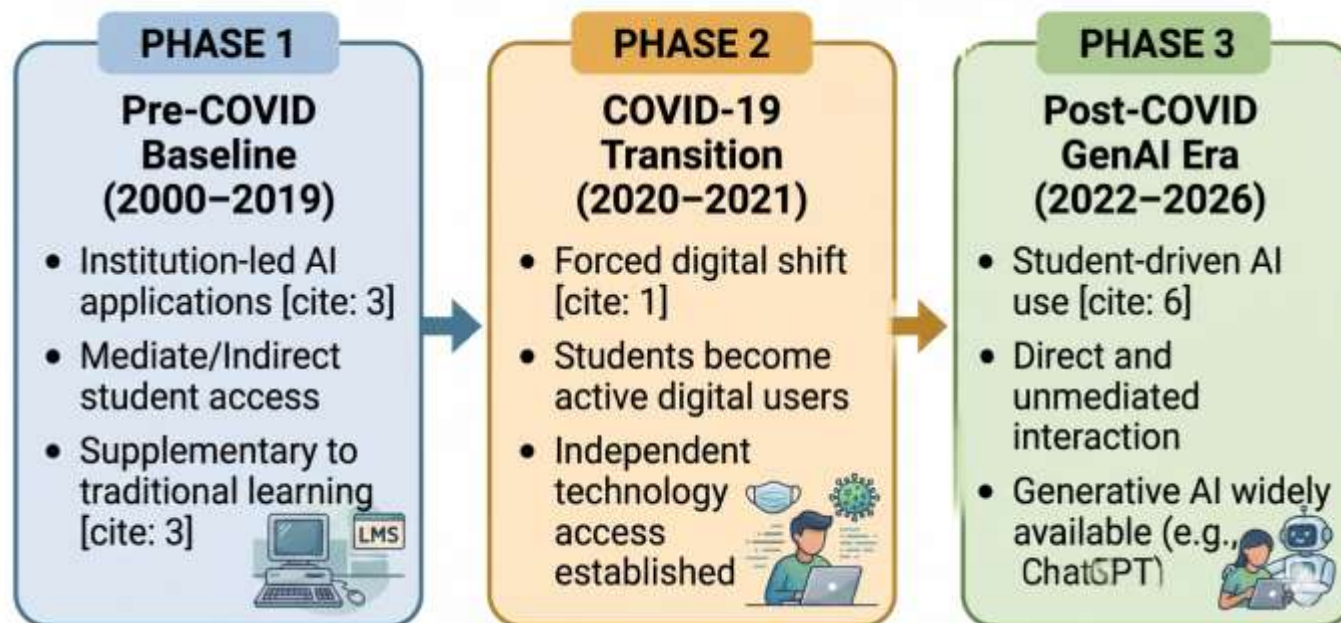


Figure 1: Three-Phase Evolution of Student-AI Interaction (2000-2026)

6.3 The Two Pathways Explained

Path A: Augmentation Pathway

This pathway describes productive student-AI engagement in which AI functions as a learning enhancer rather than a learning replacement. Students on this path use AI to:

- Seek clarification of concepts they have already attempted to understand independently
- Generate alternative explanations when traditional materials are unclear
- Receive immediate feedback on draft work before submitting to instructors
- Access academic support they could not otherwise afford through private tutoring
- Practice problem-solving with AI as a guided assistant rather than an answer provider

The key characteristic of this pathway is active cognitive engagement the student remains the primary thinker, and AI serves as a responsive support tool. Research consistently confirms that this mode of use produces genuine learning improvements, particularly for students from resource-limited backgrounds who gain access to personalized academic support for the first time [4], [7].

Path B: Dependency Pathway

This pathway describes unproductive student-AI engagement in which AI replaces rather than supports independent cognitive effort. Students on this path use AI to:

- Submit AI-generated assignments as their own work
- Avoid engaging with course material by outsourcing comprehension to AI
- Copy AI-produced solutions to assessments without understanding the underlying concepts
- Develop habitual reliance that gradually erodes analytical reasoning and problem-solving capacity

- Exploit AI tools during examinations or timed assessments in violation of academic integrity policies

The key characteristic of this pathway is cognitive offloading the progressive delegation of thinking processes to the AI system, resulting in surface-level engagement and diminished intellectual development over time [2], [9]. This pathway also carries direct ethical consequences, including academic dishonesty, authorship ambiguity, and institutional erosion of assessment validity.

6.4 The Determining Factor: What Decides Which Path a Student Takes?

The framework identifies three variables that determine whether a student follows the Augmentation Pathway or the Dependency Pathway:

Variable 1 Digital Literacy Students with high digital literacy understand the limitations of AI-generated content, critically evaluate outputs before adopting them, and use AI as one source among many rather than the sole authority. Students with low digital literacy are more vulnerable to accepting AI outputs uncritically, increasing dependency risk [8].

Variable 2 Student Motivation and Learning Orientation Students who are intrinsically motivated toward genuine understanding are more likely to use AI productively. Students primarily motivated by grade achievement or assignment completion are more likely to exploit AI as a shortcut, placing them on the Dependency Pathway.

Variable 3 Institutional Regulation and Pedagogical Guidance The presence or absence of clear institutional AI policies, structured pedagogical frameworks, and educator guidance is the most powerful external variable. When institutions define acceptable AI use, redesign assessments to require original thinking, and provide digital literacy training, students are guided toward the Augmentation Pathway. When institutions provide no guidance, the Dependency Pathway becomes the path of least resistance [11].

6.5 Visual Summary of the Framework

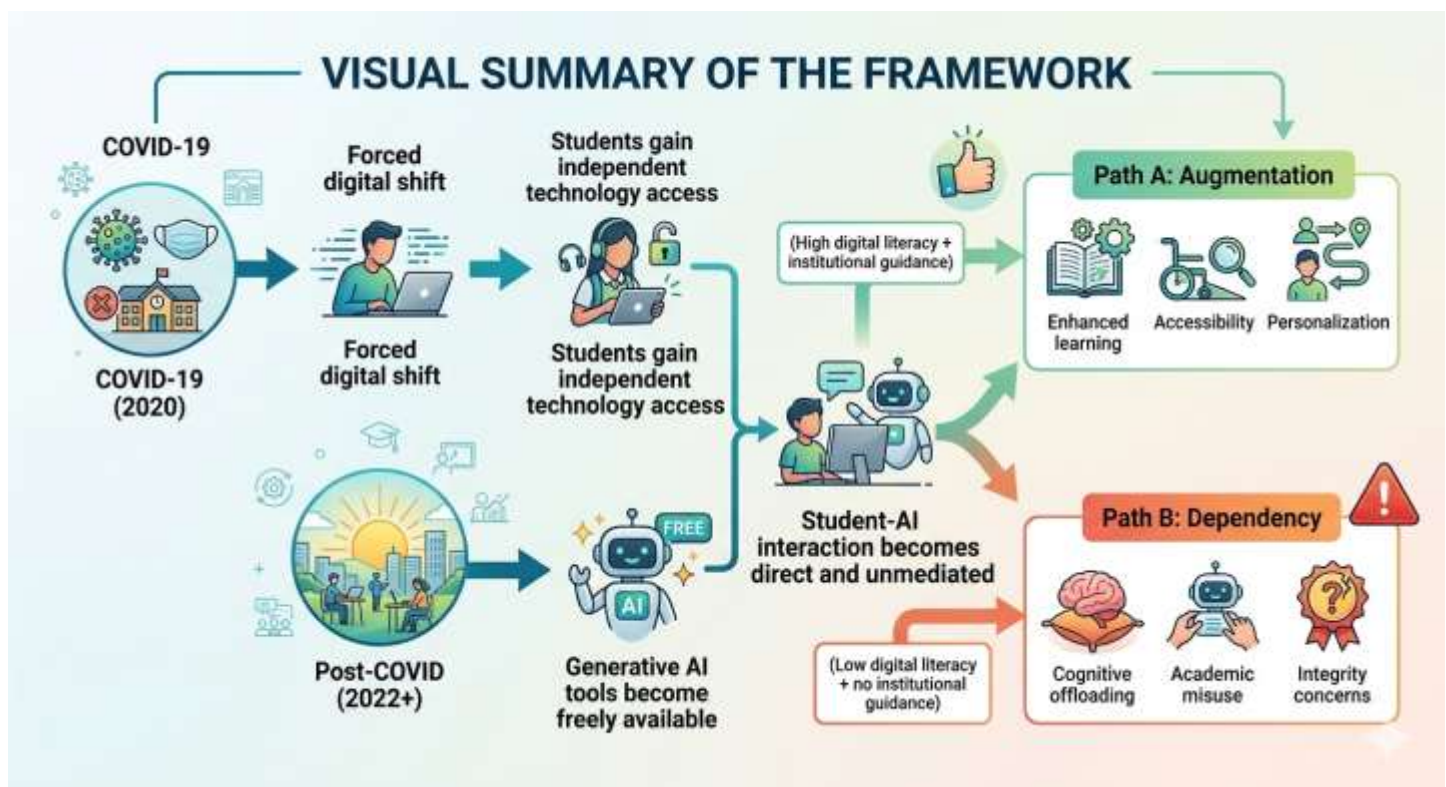


Figure 2: Visual Summary of the Framework

The diagram models how student-AI interaction has become direct and unmediated. The outcome of this interaction diverges along two distinct pathways depending on a student's level of digital literacy and the presence of institutional guidance:

- Path A: Augmentation occurs when high digital literacy is paired with institutional guidance, resulting in productive engagement characterized by enhanced learning, improved accessibility, and personalization.
- Path B: Dependency occurs when low digital literacy is coupled with a lack of institutional guidance, leading to problematic patterns such as cognitive offloading, academic misuse, and integrity concerns.

6.6 Why This Framework Contributes to Existing Literature

Existing research has examined AI benefits and AI risks largely in isolation. What this framework adds is an integrated, historically grounded explanation of why the same technology produces opposite outcomes in different students connecting the COVID turning point, the student behavioural shift it triggered, and the dual-impact dynamic of post-COVID generative AI use into a single coherent model. This addresses the gap identified in the literature review: the absence of a conceptual framework that simultaneously examines educational transformation and cognitive risk within a unified post-COVID analytical lens [8], [10].

7. DISCUSSION

7.1 COVID-19 as the True Turning Point

The findings of this conceptual review support a central argument that runs through all five literature themes: the COVID-19 pandemic was not merely a disruption to education it was the structural turning point that made the current student-AI relationship possible. Prior to 2020, students interacted with AI tools indirectly and institutionally. The pandemic dismantled that mediated structure entirely. As [1] demonstrated, the forced shift to online learning immersed an entire generation of students in direct, unsupported digital engagement almost overnight. Students who had never independently navigated digital academic environments were suddenly required to do so as their primary mode of learning.

This behavioural shift from passive technology recipients to active digital self-managers is what created the conditions for rapid generative AI adoption after 2022. When ChatGPT became publicly available, students were already psychologically and practically primed to adopt it. The COVID period had lowered the barrier, built the habit, and established the expectation that technology could and should serve as an on-demand academic resource. Understanding this sequence is essential: the post-COVID AI adoption explosion did not emerge from nowhere it was the direct behavioural consequence of what COVID forced students to become [11].

7.2 The Digital Divide Did Not Disappear It Transformed

One of the most significant findings emerging from the literature is that COVID did not eliminate educational inequality it transformed it. The pre-COVID digital divide was primarily about access: which students had devices and reliable internet. The post-COVID digital divide is about something more subtle and more consequential: which students have the digital literacy and institutional guidance to use AI productively, and which students are left to use it unsupervised and unguided.

[11] documented how students in developing countries faced severe barriers during the COVID transition unreliable internet, lack of devices, and absence of structured support. These same students, now in the post-COVID era, are arguably more vulnerable to the Dependency Pathway identified in this paper's framework, because they gained technology access without the accompanying critical education on how to use it

responsibly. Meanwhile, students in well-resourced environments with digitally literate educators are more likely to be guided toward the Augmentation Pathway. The framework proposed in this study therefore has particular relevance for educational equity: the benefits of AI will not be evenly distributed unless institutions actively intervene to build digital literacy across all student populations [3].

7.3 The Dual-Impact Pattern Is Consistent Across the Literature

The most striking finding of this review is how consistently the dual-impact pattern appears across completely different research contexts, methodologies, and time periods. Whether examining early AI adoption in universities [3], student reactions to ChatGPT among early adopters [6], academic integrity concerns [4], or the broader cognitive implications of large language model use [7], every study arrives at the same conclusion: AI simultaneously empowers and risks undermining students, and the determining factor is never the technology itself but the conditions surrounding its use.

This consistency across the literature strongly validates the conceptual framework presented in this paper. The Augmentation Pathway and Dependency Pathway are not theoretical abstractions they are documented behavioural realities observed independently by multiple research teams across different countries, disciplines, and institutional settings. What has been missing until now is a framework that connects these independently observed patterns to their historical root: the COVID-driven behavioural shift that put AI tools directly in students' hands without accompanying governance structures [8].

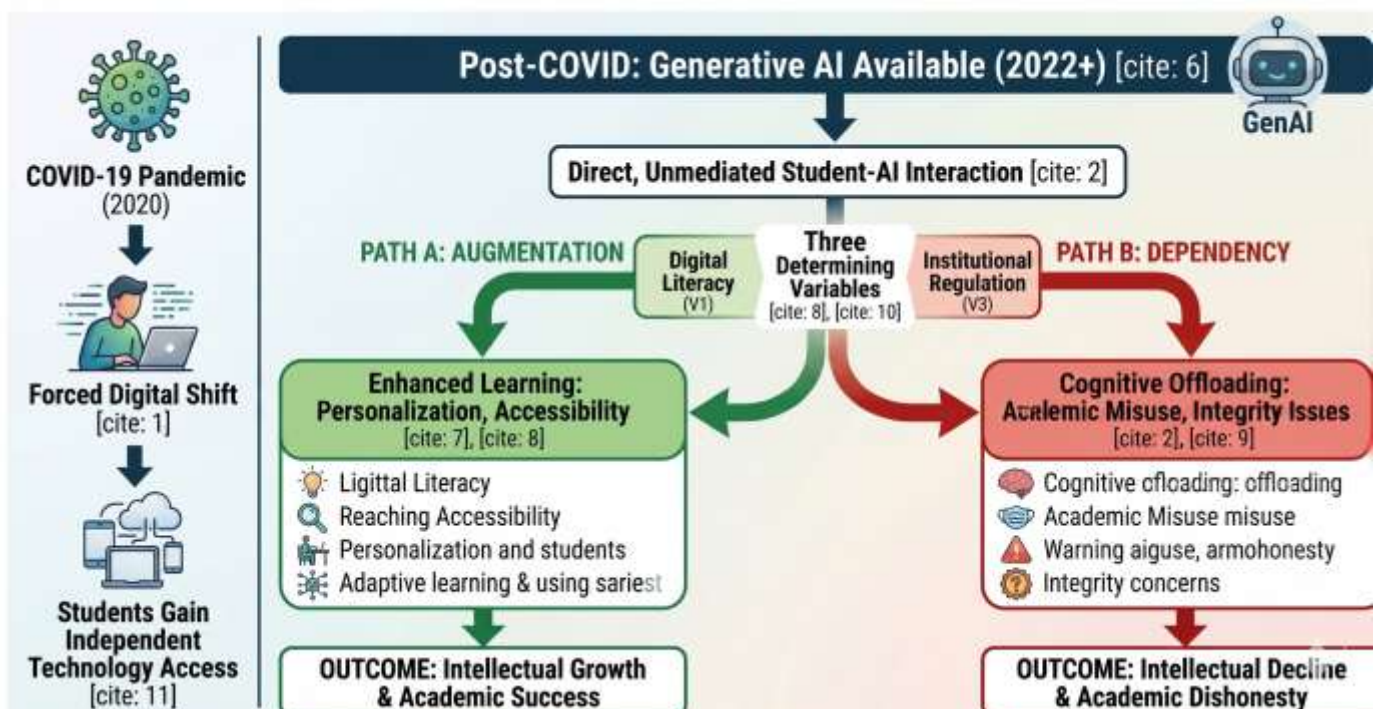


Figure 3: Student-AI Dual-Impact Framework - Augmentation vs. Dependency Pathways.

7.4 Productivity vs. Misuse: A More Nuanced Picture

The discussion of AI misuse in education is often framed in binary terms students either cheat or they do not. The literature reviewed in this paper suggests the reality is considerably more nuanced. [4] found that the most pressing integrity concern is not deliberate, premeditated cheating but rather a grey zone of passive dependency students who use AI not to fabricate entire assignments but to progressively outsource more and

more cognitive effort until the boundary between assistance and replacement becomes blurred even to the student themselves.

This distinction matters enormously for how institutions respond. A blanket ban on AI tools the reflexive institutional response observed in many universities immediately after ChatGPT's release addresses only the most visible end of the Dependency Pathway while doing nothing to address the more widespread pattern of gradual cognitive offloading [2]. Effective institutional responses must instead focus on restructuring how students engage with AI, not on removing the tool entirely. This aligns directly with the framework's identification of institutional regulation as the most powerful variable determining which pathway students follow.

7.5 What the Literature Does Not Yet Fully Address

This review also identifies what remains genuinely unknown and under-researched. The long-term cognitive consequences of sustained AI use particularly for students who began using generative AI tools during their formative academic years have not yet been studied empirically at scale. Current concerns about cognitive offloading and reduced critical thinking are largely theoretical and observational. Longitudinal studies tracking student cognitive development across AI-use intensities do not yet exist at the scale needed to draw firm conclusions [10].

Similarly, the vast majority of existing research focuses on universities in North America, Europe, and East Asia. The experience of students in South Asia, Africa, and Latin America where the intersection of post-COVID digital access expansion and generative AI adoption is happening in particularly resource-constrained contexts remains significantly underrepresented in the literature. This represents both a gap in current knowledge and an important direction for future research, particularly given the relevance of this paper's student-centered perspective to the Indian educational context, where the post-COVID digital shift has been especially dramatic [1].

7.6 The Framework's Practical Implication

The practical implication of this paper's conceptual framework is direct: institutions that wait for students to self-regulate their AI use will produce Dependency Pathway outcomes at scale. The framework makes clear that the determining variables digital literacy, learning motivation, and institutional regulation are all within the capacity of educational institutions to influence. The three-variable model is not merely diagnostic; it is prescriptive. If institutions invest in digital literacy programs, redesign assessments to require genuine critical engagement, and provide clear policy guidance on responsible AI use, the Augmentation Pathway becomes the path of least resistance rather than the exception [8].

8. CONCLUSION

This conceptual review set out to examine how Artificial Intelligence has integrated into student education across the pre-COVID, COVID, and post-COVID periods, and to analyse both the transformative learning benefits and the emerging misuse concerns that have accompanied this integration. Through a synthesis of existing literature spanning 2000 to 2026, the study has arrived at several interconnected conclusions that together paint a coherent picture of where student education stands in relation to AI today.

The first and most fundamental conclusion is that COVID-19 was not simply a crisis that interrupted education it was the structural catalyst that permanently altered the relationship between students and technology. The forced transition to digital learning environments between 2020 and 2021 dismantled the institutional mediation that had previously governed student technology use, placing students in direct, unsupported engagement with digital tools on an unprecedented scale [1]. This behavioural shift from passive technology recipients to active digital self-managers is what made the explosive post-COVID adoption of generative AI tools both inevitable and largely ungoverned.

The second conclusion is that the post-COVID generative AI era has produced a genuinely dual-impact dynamic in student education. The same tools that have democratized access to academic support, enabled personalized learning, and reduced the cost barrier to quality educational assistance have simultaneously enabled cognitive offloading, academic dishonesty, and a gradual erosion of independent reasoning among students who use AI as a replacement rather than a supplement for their own thinking [2], [4], [7]. This dual-impact pattern is not incidental it is structural, and it will persist as long as AI tools remain freely accessible without accompanying institutional guidance.

The third conclusion is that the determining factor in whether AI helps or harms a student is not the technology itself but the conditions surrounding its use. The Student AI Interaction Model proposed in this paper identifies three variables digital literacy, student motivation, and institutional regulation as the primary determinants of whether a student follows the Augmentation Pathway or the Dependency Pathway. Of these three, institutional regulation is the most actionable, because it is the variable most directly within the control of educators and policymakers [8].

The fourth conclusion is that the pre-COVID foundation of AI in education, while limited in scope, established something important: the principle that AI should augment rather than replace human learning. This principle, identified in foundational research well before generative AI existed [3], has become more urgent, not less, in the post-COVID generative AI era. The challenge for higher education institutions is no longer whether to integrate AI but how to structure that integration so that it consistently produces Augmentation Pathway outcomes rather than Dependency Pathway ones.

In summary, AI in student education is neither the transformative revolution its strongest proponents claim nor the academic integrity catastrophe its harshest critics fear. It is a powerful dual-impact tool whose educational value depends entirely on the literacy, motivation, and institutional environment of the student using it. The COVID pandemic accelerated its adoption before those conditions were in place. The task now is to build them.

9. RECOMMENDATIONS

Based on the conceptual framework and synthesized findings of this review, the following recommendations are proposed for higher education institutions, educators, and policymakers navigating the integration of AI in student education:

Develop Clear and Practical AI Usage Policies: Institutions must move beyond vague prohibitions or blanket bans and establish structured, nuanced policies that define what constitutes acceptable AI use across different assessment types and academic contexts. Policies should be developed collaboratively with students and faculty, communicated clearly at the start of each academic year, and reviewed regularly as AI capabilities evolve. The absence of policy, as the literature consistently demonstrates, defaults to the Dependency Pathway [6].

Embed Digital Literacy Training into Curricula **Digital literacy:** It specifically the ability to critically evaluate AI-generated content, understand AI limitations, and use AI as one resource among many rather than a primary authority must become a core academic competency rather than an optional module. Students who enter higher education without this foundation are systematically more vulnerable to cognitive offloading and academic misuse [7].

Redesign Assessments to Require Original Reasoning: The most effective structural response to AI misuse is assessment redesign. Assignments that can be completed by AI standard essays, factual summaries, formulaic problem sets must be progressively replaced by assessments that require personal reflection, contextual analysis, oral defence, and applied problem-solving. When assessment design demands genuine

student reasoning, the incentive to use AI as a replacement rather than a supplement is significantly reduced [10].

Position AI as a Collaborative Tool: It not a Forbidden One Institutions that frame AI purely as a threat to academic integrity miss the more productive opportunity to teach students how to use it responsibly. Structured exercises in which students use AI outputs as starting points for critical analysis identifying errors, challenging assumptions, and refining AI-generated content with their own reasoning build both AI literacy and independent thinking simultaneously [10].

Prioritize Equity in AI Access and Guidance: The post-COVID digital divide has shifted from a question of access to a question of guided use. Institutions serving students from resource-limited or digitally underserved backgrounds must ensure that AI literacy support is actively targeted toward those students rather than assumed. Without deliberate equity-focused intervention, the Augmentation Pathway will remain disproportionately accessible to already-advantaged students [1].

10. FUTURE SCOPE

This study has synthesized existing literature to propose a conceptual framework for understanding AI's dual impact on student education across the pre- and post-COVID periods. Several important directions for future empirical and theoretical research emerge from this analysis:

Longitudinal Studies on Cognitive Development: The most significant gap in current literature is the absence of long-term empirical studies tracking how sustained AI use affects student cognitive development over time. Research that follows student cohorts across multiple academic years comparing analytical reasoning, problem-solving capacity, and independent writing ability between high AI-use and low AI-use groups would provide the empirical grounding that current theoretical concerns about cognitive offloading still lack [2].

Research in South Asian and Developing Country Contexts: The overwhelming majority of existing research on student AI use is conducted in North American, European, and East Asian institutional contexts. The experience of students in India, Pakistan, Bangladesh, and other South Asian countries where the post-COVID digital shift has been particularly dramatic and where institutional AI governance is still largely absent represents a critical and underrepresented research frontier [1], [11].

Empirical Validation of the Proposed Framework: The Student-AI Interaction Model presented in this paper is conceptual. Future research should empirically test its three determining variables digital literacy, student motivation, and institutional regulation through structured surveys, experimental studies, or mixed-methods designs across diverse student populations, to validate and refine the model's predictive accuracy.

AI Policy Effectiveness Studies: As universities worldwide develop and implement AI usage policies, comparative studies examining which policy approaches most effectively guide students toward the Augmentation Pathway and which produce unintended consequences such as increased hidden AI use would provide actionable evidence for institutional policymakers[8].

Discipline-Specific AI Integration Research: Current literature tends to examine AI in education at a general level. Future research should examine how the dual-impact dynamic plays out differently across specific disciplines coding and engineering, creative writing, medical education, law where the appropriate boundaries between AI assistance and independent student work vary significantly by professional and ethical context [8].

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