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Adapting educational practices for Generation Z: integrating metacognitive strategies and artificial intelligence

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The educational landscape is evolving rapidly due to the technological transformations brought by the digital age, necessitating innovative approaches to engage Generation Z learners. This study explores the specific educational needs of Generation Z, defined as individuals born between 1997 and 2012, and examines the role of metacognitive strategies and artificial intelligence (AI) in enhancing their learning experiences. A systematic literature review was conducted using academic databases such as Google Scholar, Scopus, and PsycINFO to identify 121 relevant studies published between 2000 and 2024. The review focused on research articles that addressed motivation, engagement, self-regulation, and cognitive processes in digital learning environments. The results reveal that active learning strategies such as project-based learning and formative assessment significantly enhance engagement and autonomy in Generation Z students. Furthermore, the integration of AI technologies provides personalized learning paths and real-time feedback, supporting self-regulated learning. However, over-reliance on AI poses risks to the development of critical thinking and self-regulatory skills. The study concludes by proposing a balanced approach to AI integration, suggesting that it should complement human guidance to foster holistic student development. Future research should explore the long-term effects of AI on cognitive development and the design of inclusive AI tools that cater to diverse learners.

KEYWORDS

Generation Z, artificial intelligence, metacognition, active learning, self regulation

1 Introduction

The rapid evolution of digital technologies has profoundly reshaped educational practices and redefined the learning experiences of Generation Z, also known as "zoomers." Comprising individuals born between 1997 and 2012 (Dimock, 2019), Generation Z is the first cohort to grow up in a world dominated by smartphones, social media, and ubiquitous access to information. These digital natives have developed distinct cognitive, motivational and behavioral patterns that differ significantly from those of previous generations (Prensky, 2001). As a result, traditional instructional methods often fail to capture their attention and foster meaningful engagement (Twenge, 2017).

Generation Z prefers dynamic and immersive learning experiences. A recent study of Chan and Lee (2023) shows that these young people prefer interactive platforms and online learning tools, seeking personalized, real-time learning opportunities that are absent from conventional methods.

Outside the educational context, social networks play a central role in the lives of Generation Z, influencing their social interactions and the way they construct their identities. Anderson and Jiang (2018) highlights their preference for platforms such as Instagram, TikTok and Snapchat, which offer fast, visual interactions that meet their need for immediate and continuous connection. The adoption of artificial intelligence (AI) by Generation Z presents both opportunities and challenges. According to Gupta et al. (2024), this generation is showing a marked interest in AI, particularly for its educational and professional applications. However, the study also highlights their ethical concerns about privacy and the potential biases of algorithms, a sign of a growing awareness of the social and ethical implications of AI technologies.

The work of Zawacki-Richter et al. (2019) highlighted the impact of AI in higher education, highlighting that the most common technologies include intelligent tutoring systems, learning analytics tools and conversational agents. However, their study reveals a major gap: teachers are often perceived as mere passive recipients, whereas they should play a central role in the adoption and adaptation of these technologies to achieve their pedagogical goals. Research shows that a close partnership between AI and human intervention remains essential, particularly for the development of students' interpersonal and emotional skills.

Similarly, the 2024 systematic review by Ogunleye et al. (2024) highlights significant gaps in the integration of generative AI into educational practice. While some studies focus on the detection of AI-generated texts, there remains an urgent need to better understand how generative AI can be effectively integrated into teaching, educational programmes and assessments. The authors call for interdisciplinary research and close collaboration between researchers, teachers and policy makers to maximize the benefits of AI while minimizing its risks.

This article explores the challenges facing Generation Z and suggests pedagogical strategies that integrate active learning, metacognitive techniques and AI. Based on a systematic review of the literature published between 2000 and 2024, this study focuses on research into motivation, engagement, self-regulation and cognitive processes in digital learning environments. This period covers the emergence of digital technologies and AI in education, coinciding with the rise of Generation Z (Figure 1), allowing us to observe how these tools have transformed learning to meet the specific needs of this generation. By examining the intersection between educational practices and technological innovations, this article offers educators, policy-makers and researchers guidance on how to create effective and inclusive learning environments for Generation Z.

2 Methodology

This study uses a systematic literature review to analyse the educational needs of Generation Z learners and to assess the impact of artificial intelligence (AI) on their learning processes. Its main objective is to synthesize the research focusing on the pedagogical dimensions of AI, in particular the strategies promoting student motivation, engagement and self-regulation.

The methodology of this review follows the guidelines of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Appendix A framework to ensure transparency, completeness and reproducibility. The PRISMA framework (Figure 2), designed to structure and improve the quality of systematic reviews, provides precise guidelines for each stage in the study selection and analysis process. In our study, the PRISMA process involved the following stages: The initial search explored the databases using relevant keywords related to AI, educational practices, and the needs of Generation Z learners. This identified 625 potentially relevant articles. First of all, we used Zotero to check for any duplicates. Articles had to meet strict criteria to be selected, including publication in peer-reviewed journals between 2000 and 2024, the study of Generation Z, and a focus on AI or metacognitive learning approaches. Articles not published in English, gray literature (theses, conference proceedings) and studies focusing exclusively on other generations or on non-educational aspects of AI were excluded (Moher et al., 2009). After a preliminary analysis of abstracts and titles, 355 articles were selected for in-depth evaluation. A PRISMA flow chart (exclusion, inclusion criteria) was used to illustrate the filtering of articles, making visible at each stage the number of articles excluded and the reasons for exclusion, thus reinforcing the transparency of the process. In the end, 121 articles were retained. The final studies were analyzed using a thematic synthesis method, facilitating the identification of recurring trends and gaps in current knowledge. To reduce bias and ensure objectivity, a structured selection grid was developed (Appendix B). It included precise thematic and methodological criteria, enabling the articles selected to be systematically coded. This precise coding process helped to limit subjective interpretations and guarantee the scientific rigor of the review.

To minimize publication bias, the research used multiple databases and variations of key terms related to education, AI, and generation Z. This strategy broadened the scope of analysis, integrating research from diverse cultural and disciplinary perspectives. The systematic and structured methodology, based on the PRISMA framework, makes it possible to synthesize current knowledge on the integration of AI into the education of generation Z and ensures that the results of this study are based on a rigorous and transparent selection of sources, thus providing credible and robust answers to the questions raised by this theme. Next, the entire corpus of 121 articles was analyzed qualitatively and coded with MAXQDA software according to the research questions in three successive analyses: Analysis 1 (generation Z and characteristics), Analysis 2 (generation Z and artificial intelligence). The results were compared by two expert analysts and then summarized into 5 main themes (Analysis 3) in order to present the results (Figure 3).

2.1 Research design and approach

The systematic review involved a qualitative approach, allowing for an in-depth examination of the current literature on educational challenges and technological opportunities for Generation Z.

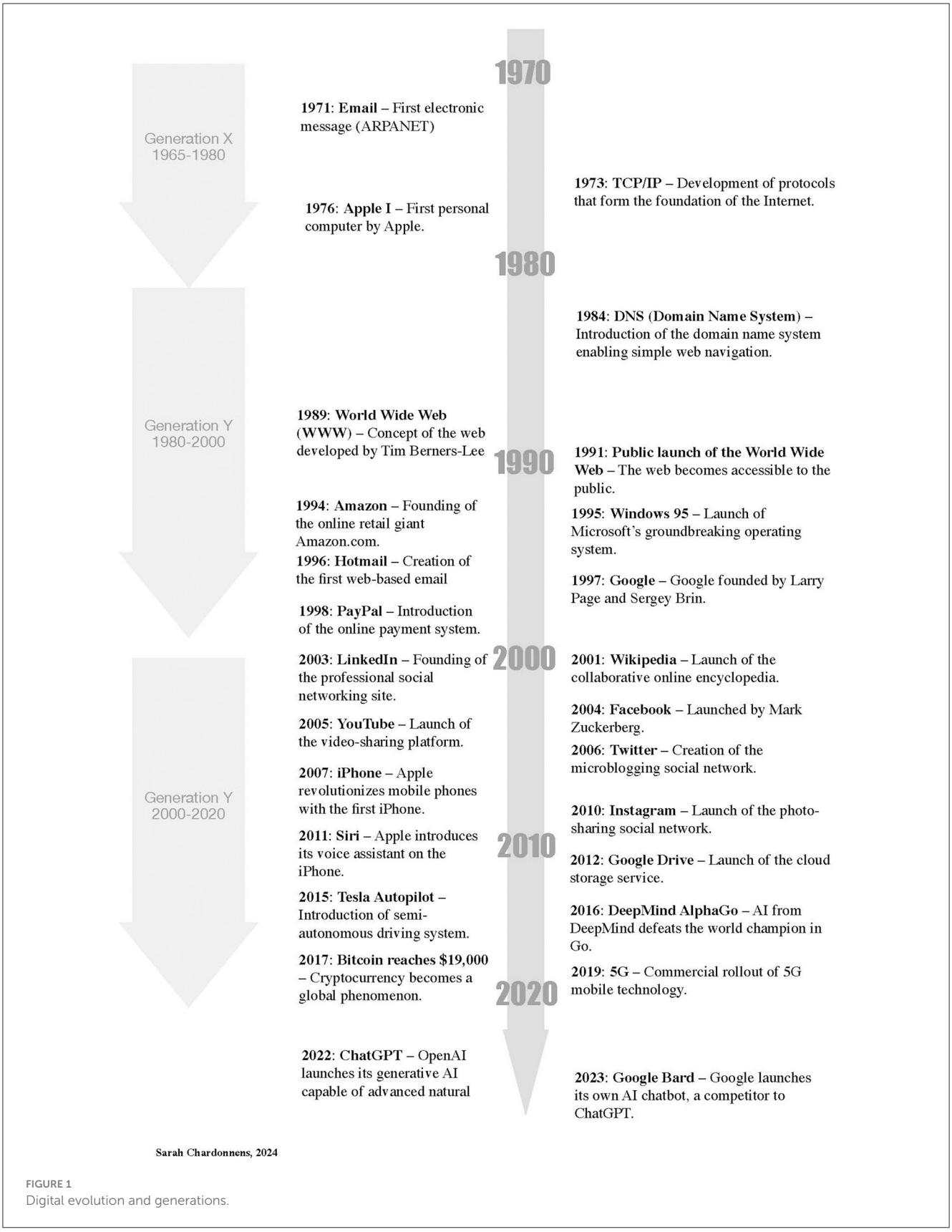

FIGURE 1
Digital evolution and generations.

The review of 121 peer-reviewed articles encompassed a variety of research designs, including empirical studies, theoretical papers, meta-analyses and systematic reviews. By integrating multiple lines of evidence, this study aims to provide a comprehensive understanding of effective educational practices for Generation Z.

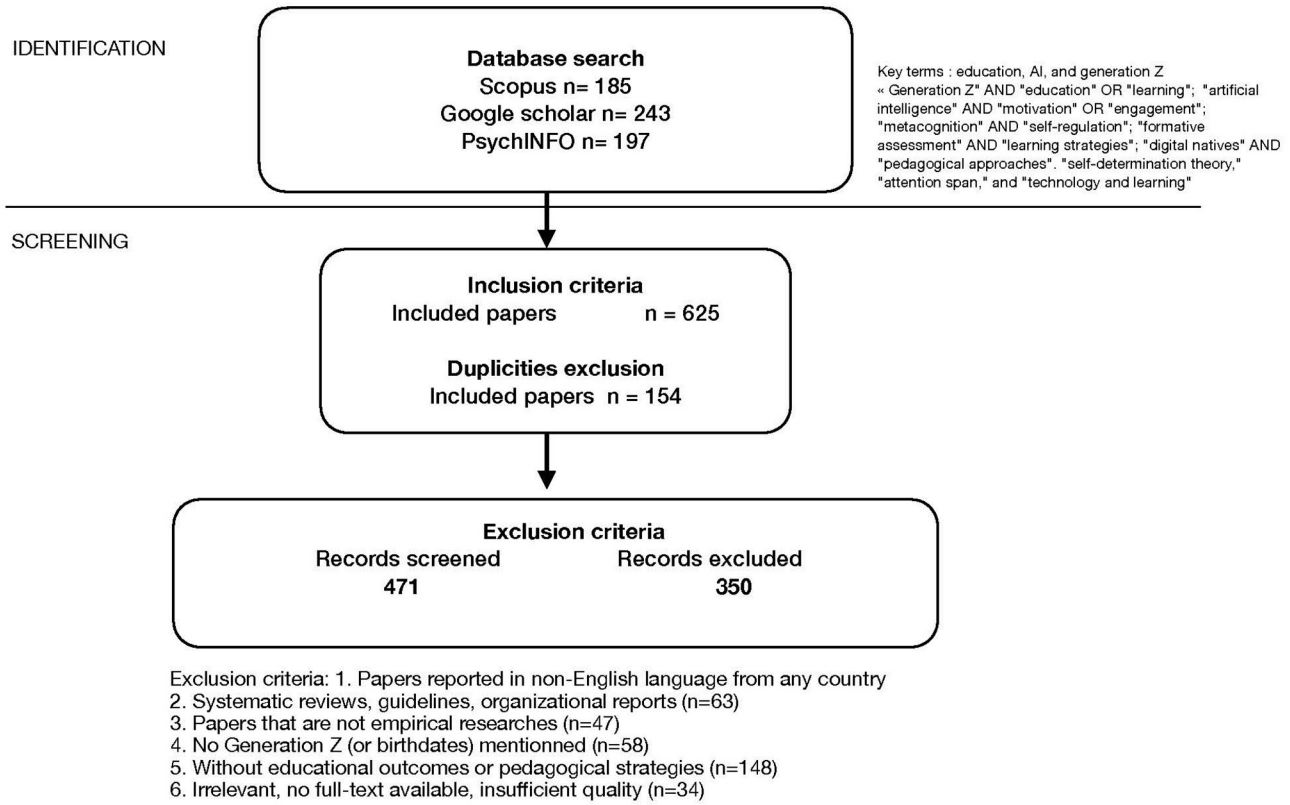

FIGURE 2
PRISMA framework.

2.2 Search strategy

The literature search was conducted using electronic databases, including Google Scholar, Scopus, ERIC (Education Resources Information Center), and PsycINFO. The search focused on peer-reviewed journal articles published between 2000 and 2024 to capture recent research on the integration of AI in education and its effects on Generation Z learners. The following keywords and Boolean operators were used to refine the search: "Generation Z" AND "education" OR "learning"; "artificial intelligence" AND "motivation" OR "engagement"; "metacognition" AND "self-regulation"; "formative assessment" AND "learning strategies"; "digital natives" AND "pedagogical approaches." To broaden the scope, related terms such as "self-determination theory," "attention span," and "technology and learning" were used to include studies that, while not explicitly using the primary keywords, addressed similar themes and constructs.

Specific research questions and sub-questions were formulated as follows:

1. What are the characteristics of Generation Z?
2. What are the learning preferences and behaviors of Generation Z?
3. What role does AI play in the education of Generation Z, and what are the implications for their learning and self-regulation processes (benefits, risks and future strategies to be encouraged)?

2.3 Inclusion and exclusion criteria

Inclusion and exclusion criteria (Figure 2) were carefully defined to ensure the quality and relevance of the studies included in this analysis. These criteria were designed to select research that made a significant contribution to the understanding of educational practices adapted to Generation Z, particularly in digital learning environments enhanced by artificial intelligence (AI) and metacognitive approaches.

Articles had to be published in peer-reviewed journals, guaranteeing scientific rigor and validation by experts (Moher et al., 2009). Work from 2000 to 2024 was favored to capture

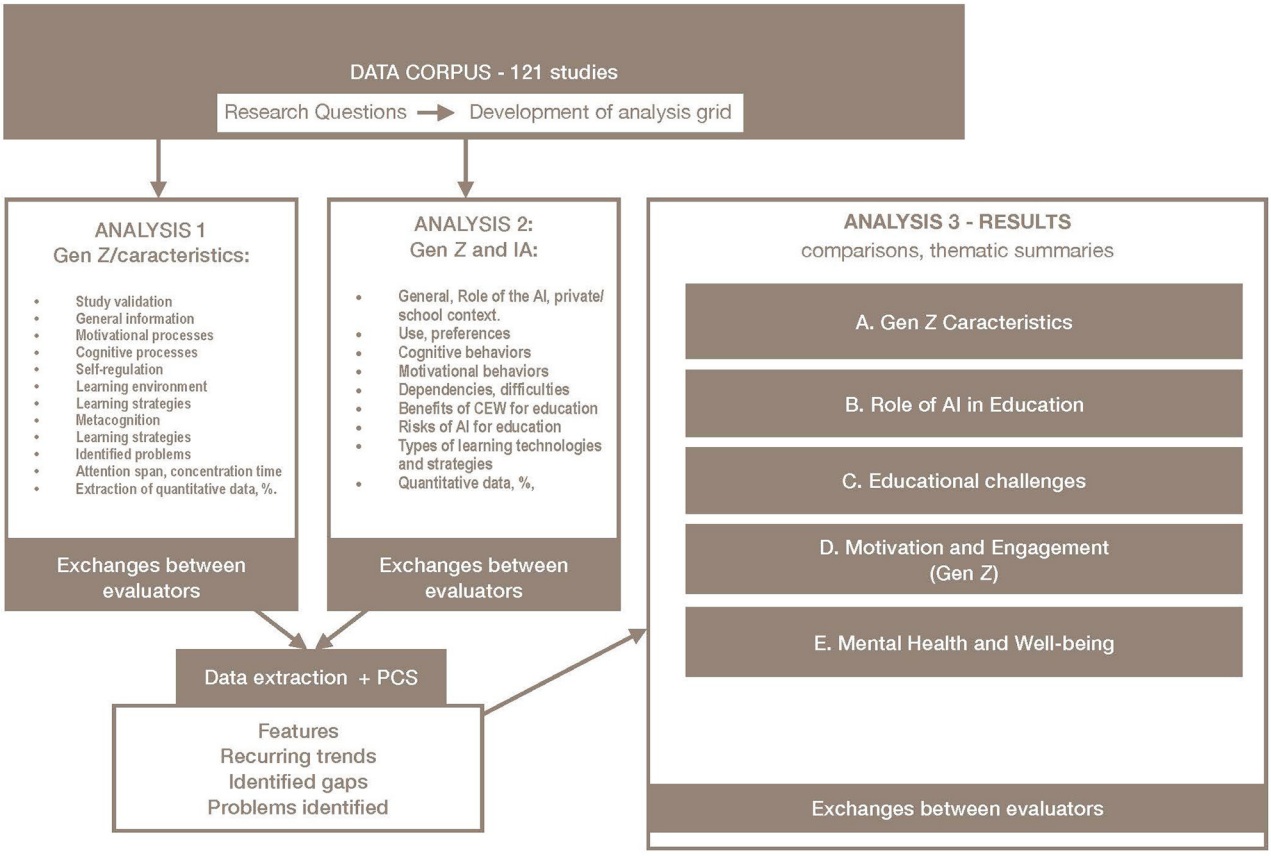

FIGURE 3
Analysis presentation.

recent trends and the impact of emerging technologies, reflecting a period when AI and digital technologies have become increasingly important in education.

Research should focus on Generation Z: studies should specifically address educational practices, cognitive development or the role of technology and AI in the learning of young people aged 11–25, covering middle school, high school and university students. This age limit makes it possible to focus on a cohort that has grown up in a digital environment (Dimock, 2019). In addition, for the sake of thematic relevance, the studies had to explore topics related to digital learning environments, AI, or concepts of motivation, engagement, self-regulation, or metacognition. These topics are directly relevant to modern pedagogical approaches and aligned with the educational needs of generation Z (Schraw and Moshman, 1995). Articles had to include clear methodologies, whether empirical or theoretical, to ensure internal validity and reproducibility of results (Appendix B). Empirical studies had to use robust methods of analysis, such as sufficient sample size and appropriate statistical analysis, allowing for generalizable conclusions (Haddaway et al., 2022). And finally, the last criterion was to retain only meta-analyses, theoretical articles and systematic reviews addressing the educational needs and preferences of Generation Z as these types of studies provide valuable insight and wider perspectives on pedagogical strategies adapted to digital learners.

Exclusion criteria were established to rule out studies that were irrelevant or of insufficient quality. Research on cohorts other than Generation Z, such as Millennials or Generation Alpha, was excluded unless it included a specific comparative perspective. Gray literature, such as unpublished theses, conference proceedings and opinion pieces, and lack of peer review were excluded to ensure academic rigor and scientific validity of the findings (Haddaway et al., 2022). Another exclusion criterion concerned language: studies published in a language other than English were excluded to ensure linguistic consistency and accessibility of the selected research (Moher et al., 2009) and to avoid difficulties and errors in translation. Finally, the focus was limited to technologies without educational implications: studies focusing solely on technology adoption without addressing educational outcomes or pedagogical strategies were excluded. For example, articles examining the use of social media without an explicit link to learning or motivation were not considered.

In summary, the selection and exclusion criteria established in this study made it possible to focus on quality research that was directly applicable to the educational needs and practices of Generation Z. By ensuring thematic relevance, scientific rigor and the inclusion of the most recent work, this review aims to provide an in-depth understanding of educational approaches adapted to young learners in a world increasingly influenced by digital technologies and AI.

2.4 Screening and selection

The screening and selection process was carried out in two distinct stages to ensure the inclusion of highly relevant and methodologically sound studies. The first stage involved the selection of titles and abstracts. All titles and abstracts were carefully screened to exclude studies that did not meet the predefined inclusion criteria. The Zotero management tool was used for document duplication processing to avoid duplicates by comparing metadata. In addition, a manual check was carried out for ambiguous cases, taking into account the authors, title and date of publication. This initial selection was carried out independently by two reviewers in order to minimize bias and improve inter-rater reliability. Any differences between the reviewers were resolved through in-depth discussion and consensus.

The second stage consisted of a complete analysis of the text of the articles that had passed the first selection. Each study was evaluated in depth according to its relevance to the research questions, its methodological rigor and its contribution to understanding the educational needs of Generation Z learners. During the analysis (Figure 3), the researchers grouped similar studies by theme or sub-theme in order to better synthesize the results without redundancy and to compare the results of studies that address the same aspects: learning strategies, engagement/motivation, impacts of AI, mental health and digital wellbeing.

A standardized data extraction template was used to systematically collect key information from each study, including the research objectives, methodology, sample characteristics, main findings and identified limitations. This structured approach ensured that only high quality studies directly relevant to the subject of the research were included in the final analysis.

2.5 Data extraction and synthesis

The data extraction and synthesis process involved a systematic approach to ensure the accurate collection and organization of information from each study. Data extraction was conducted using a predefined template designed to capture essential details, such as the authors and publication year, research aims and objectives, study population and sample characteristics, research design and methodology, key findings and results, implications for educational practice, and limitations of the study.

To enhance the reliability of the extraction process, two researchers worked independently in parallel, using the same template to extract data from each study. After completing the data extraction, the researchers compared their findings, discussed any discrepancies, and reached a consensus on the final extracted data. This collaborative approach minimized the risk of bias and ensured that all relevant information was accurately captured.

Following data extraction, a thematic synthesis was performed to identify recurring patterns and trends in the literature. The identified themes were grouped according to the research questions and further categorized based on the types of pedagogical strategies, cognitive processes, and the role of artificial intelligence (AI) in education. This structured synthesis provided a comprehensive overview of the key findings and facilitated a deeper understanding of the educational needs and preferences of Generation Z learners.

2.6 Quality assessment

The quality assessment and bias analysis were conducted to ensure the robustness and validity of the systematic review. Each study was evaluated using a standardized checklist based on the Critical Appraisal Skills Programme (CASP) (2018) criteria. The checklist covered several key aspects, including the clarity of research aims and objectives, the appropriateness of research design and methodology, the transparency in reporting data collection and analysis procedures, and the consideration of potential biases and confounding variables. Additionally, the relevance and applicability of the findings to educational settings were assessed to determine the studies' contribution to the overall research objectives.

To enhance the reliability of this process, two researchers worked independently in parallel, evaluating each study according to the CASP criteria. After completing their assessments, the researchers compared their evaluations, discussed any discrepancies, and reached a consensus on the final quality ratings. This dual-review approach minimized the risk of individual bias and ensured a thorough examination of each study's methodological quality.

Potential sources of bias, such as publication bias and selective reporting, were considered at multiple stages of the review. A comprehensive bias analysis was conducted, taking into account the methodologies used in each study and their potential impact on the results. By systematically addressing these factors, the review ensured that only high-quality studies with reliable findings were included, thereby strengthening the validity of the overall conclusions.

2.7 Limitations

The methodology used in this review has several limitations that should be acknowledged. Firstly, the search was limited to English-language publications, which may have resulted in the exclusion of relevant studies published in other languages. This language restriction could potentially bias the findings by overlooking diverse perspectives and research outcomes available in non-English sources.

Secondly, the focus on peer-reviewed articles may have excluded emerging findings or innovative approaches that have not yet been published in academic journals. This exclusion could limit the inclusion of recent advancements or preliminary results that have not undergone the formal peer-review process.

Additionally, the selected studies primarily represent educational contexts from Western countries, which may restrict the generalizability of the findings to other cultural or educational settings. The emphasis on Western educational systems might not capture the full spectrum of Generation Z's learning needs and preferences in diverse cultural contexts.

However, in order to mitigate these biases, we note the diversity of databases used, the use of PRISMA methodology (Appendix A),

a critical assessment of the quality of the selected studies (method, sample, potential limitations) as well as a mixed quantitative and qualitative analysis. And finally, the PCS rules were integrated: identified issues, such as different uses of AI, for example, or different educational environments, were categorized and analyzed in sub-codes (within a feature). In order to provide a global representation of the systemic analysis carried out, we used all the codes from the quantitative analysis as well as the data from the qualitative analysis to present a global mapping.

Future research should address these limitations by expanding the scope of the review to include non-English publications and considering gray literature or non-peer-reviewed sources. Moreover, exploring the effects of cultural and contextual factors on the educational needs of Generation Z learners would provide a more comprehensive understanding of their learning experiences and help tailor educational strategies to various global contexts.

3 Results

3.1 Characteristics of Generation Z

Generation Z, defined as individuals born between 1997 and 2012 (Dimock, 2019), has grown up in a world characterized by rapid technological advancements, shaping their learning preferences and cognitive processes (Figure 4). This generation is often referred to as "digital natives" (Prensky, 2001), given their early exposure to digital tools such as smartphones, tablets, and social media platforms. Their familiarity with technology has influenced their learning behaviors, fostering a preference for interactive and personalized educational experiences (Seemiller and Grace, 2019). Research shows that Generation Z learners prefer learning environments that are inclusive, diverse, and emphasize real-world relevance (Dorn et al., 2020).

For example, Anderson and Jiang (2018) conducted a survey with teenagers aged 13–17, revealing that 95% of participants had access to smartphones, and 45% reported being "constantly connected" to online platforms. This constant connectivity allows Generation Z to access information instantly, making them more inclined toward learning experiences that are fast-paced, multimodal, and visually engaging. A study by Seemiller and Grace (2019) found that 74% of Generation Z students considered diversity an essential value in their learning environment, and 68% felt more engaged in courses that included discussions on diverse and inclusive perspectives. These findings indicate that educational institutions need to adapt their teaching strategies to resonate with Generation Z's demand for personalization, inclusivity, and contextual learning.

Moreover, Generation Z's information processing style tends to be non-linear and fragmented. A study by Prensky (2001) observed that Generation Z students spend 35% less time reading content sequentially compared to older generations, opting instead to navigate through content using hyperlinks and non-linear pathways. This preference for condensed and modular information

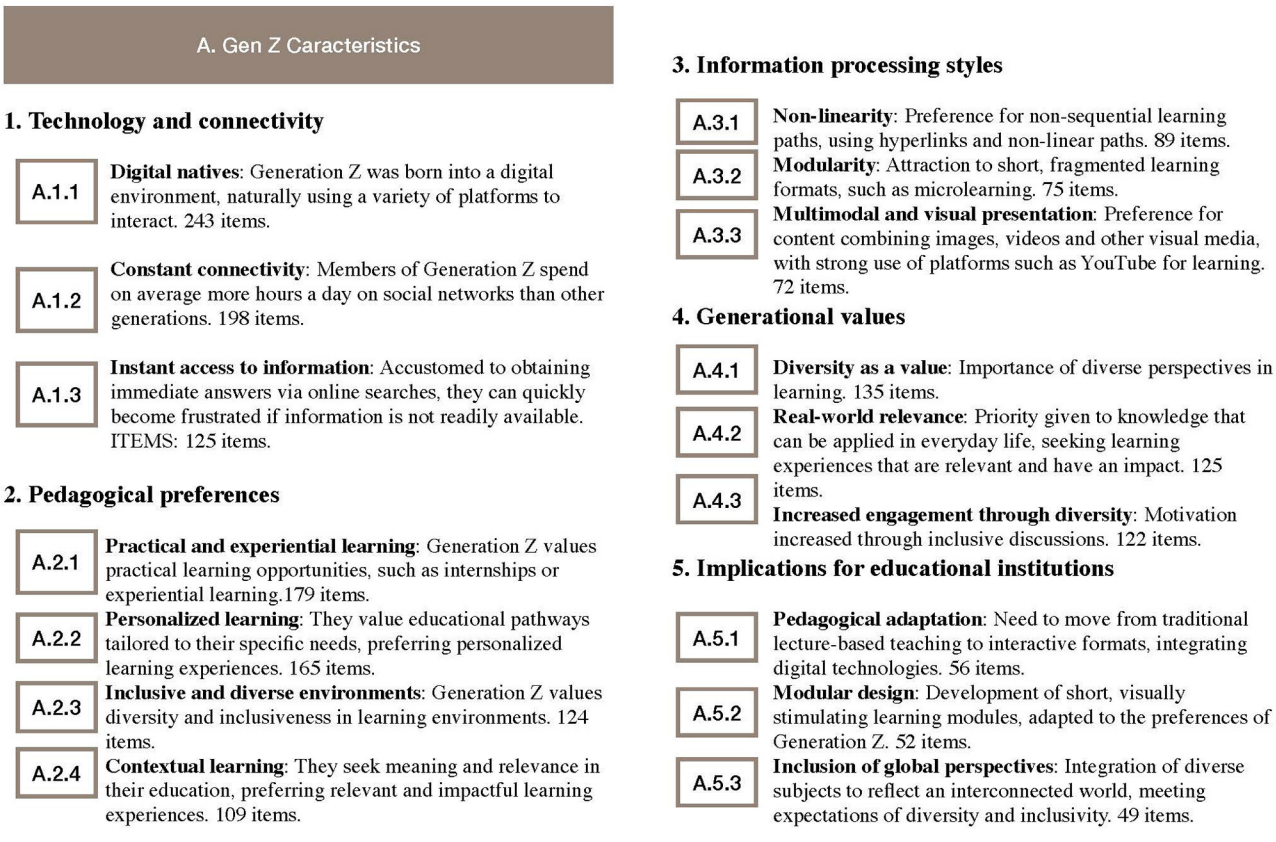

FIGURE 4
Gen Z characteristics.

presentation highlights the need for educators to move away from traditional lecture-based instruction and adopt more interactive and modular learning formats.

3.2 The role of artificial intelligence in education

The integration of artificial intelligence (AI) in education has revolutionized how Generation Z engages with learning content (Figure 5). AI-based systems, such as intelligent tutoring platforms and adaptive learning environments, can analyze students' learning patterns in real-time, providing personalized recommendations and immediate feedback. For instance, Luckin (2017a) conducted a study using an AI-based intelligent tutoring system in a secondary school mathematics class. The system was able to identify students' individual strengths and weaknesses and offer targeted exercises to improve their understanding. Students using the system showed a 15% improvement in their mathematical performance compared to those receiving traditional instruction.

However, despite the potential benefits of AI, its integration into educational practices must be approached cautiously. Carr (2020) examined the impact of AI on students' self-regulatory skills and found that those who relied heavily on AI platforms for learning showed a decline in their ability to plan, monitor, and regulate their learning strategies independently. This finding was corroborated by a study conducted by Schunk and Pajares (2002), which demonstrated that when AI feedback was combined with teacher-led discussions about learning strategies, students developed stronger self-regulation skills and greater autonomy.

The use of AI can also pose ethical concerns, particularly regarding the reinforcement of biases and inequalities in educational outcomes. Binns (2018) highlighted that AI algorithms relying on biased datasets can perpetuate cognitive biases and disproportionately affect students from underrepresented groups. For example, an AI-based grading system used in a university setting was found to provide lower grades to students from specific socio-economic backgrounds due to biased training data. This underlines the need for careful design and implementation of AI tools to ensure that they promote fairness and inclusivity in educational settings.

3.3 Educational challenges: attention span and impact of digital distractions

One of the most significant challenges faced by Generation Z is maintaining focus in an environment saturated with digital distractions (Figure 6). The digital multitasking behaviors common among this generation have been shown to negatively impact attention span and learning outcomes. Ophir et al. (2009) conducted a study on media multitasking and found that students who frequently switched between digital tasks had a 40% higher rate of attentional difficulties compared to those who focused on

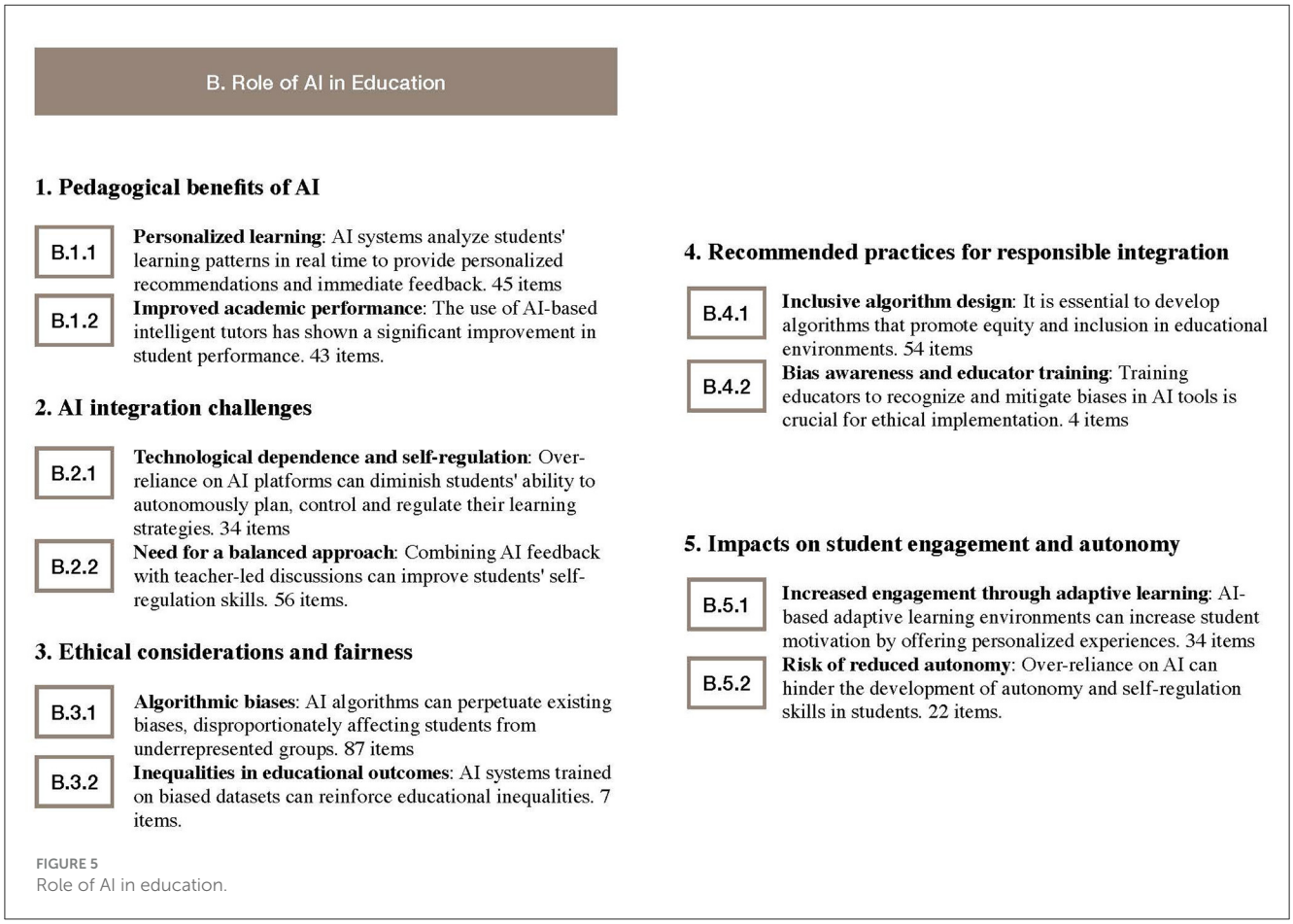

FIGURE 5
Role of AI in education.

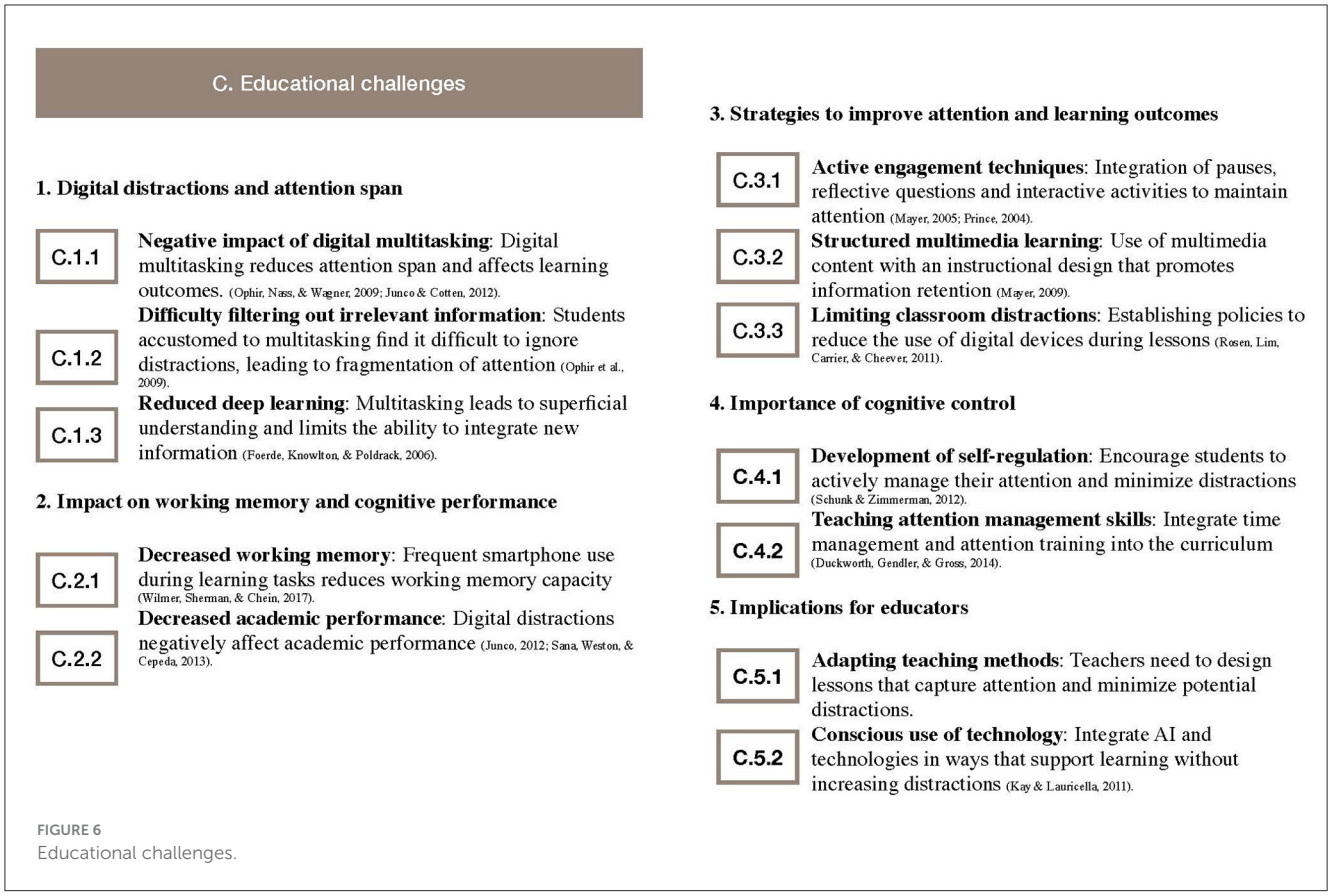

FIGURE 6
Educational challenges.

one task at a time. Participants who engaged in habitual digital multitasking struggled to filter out irrelevant information, leading to fragmented attention and reduced capacity for deep learning.

Further research by Wilmer et al. (2017a,b) explored the impact of digital distractions on working memory. The study revealed that undergraduate students who frequently checked their phones during learning tasks performed 20% worse on memory retention tests compared to those who limited their phone usage. The authors concluded that digital multitasking not only disrupts attention but also impairs the ability to integrate new information, affecting overall cognitive performance.

To address these challenges, educators can implement strategies that promote sustained attention and cognitive control. Mayer (2005) found that using multimedia learning strategies that incorporate pauses, reflective questions, and active engagement techniques resulted in a 30% increase in information retention compared to continuous multimedia content without breaks. These findings suggest that structuring content delivery to include reflective pauses and opportunities for cognitive processing can significantly enhance learning outcomes for Generation Z students.

3.4 Motivation and engagement

Motivation, particularly intrinsic motivation, plays a crucial role in determining academic success for Generation Z learners (Figure 7). Deci and Ryan's (1985) Self-Determination Theory posits that intrinsic motivation is driven by three key factors: autonomy, competence, and relatedness. A study by Deci and Ryan (1985) involving high school students found that when students were given autonomy to choose their research topics, they spent 40% more time on their projects and demonstrated better academic outcomes compared to students with assigned topics. This suggests that allowing students to exercise choice and control over their learning enhances their motivation and engagement.

However, the digital environment can negatively impact motivation by promoting instant gratification and reducing persistence in longer-term academic goals (Twenge, 2017). A 10-year longitudinal study conducted by Twenge (2017) with over 200,000 adolescents in the United States found that students who spent more than 3 h per day on social media platforms were 27% more likely to report symptoms of depression and anxiety compared to those who limited their usage to 1 h daily. A case study within the research described a 16-year-old student who experienced academic disengagement and social withdrawal after constantly comparing her achievements and social status with those of her peers on Instagram.

Educators can counteract these effects by promoting self-regulatory practices and helping students set meaningful learning goals. Bandura and Wessels's (1997) research on self-efficacy showed that students who were guided to set realistic goals and received positive feedback on their progress developed a higher sense of competence and resilience. This, in turn, led to increased academic engagement and perseverance.

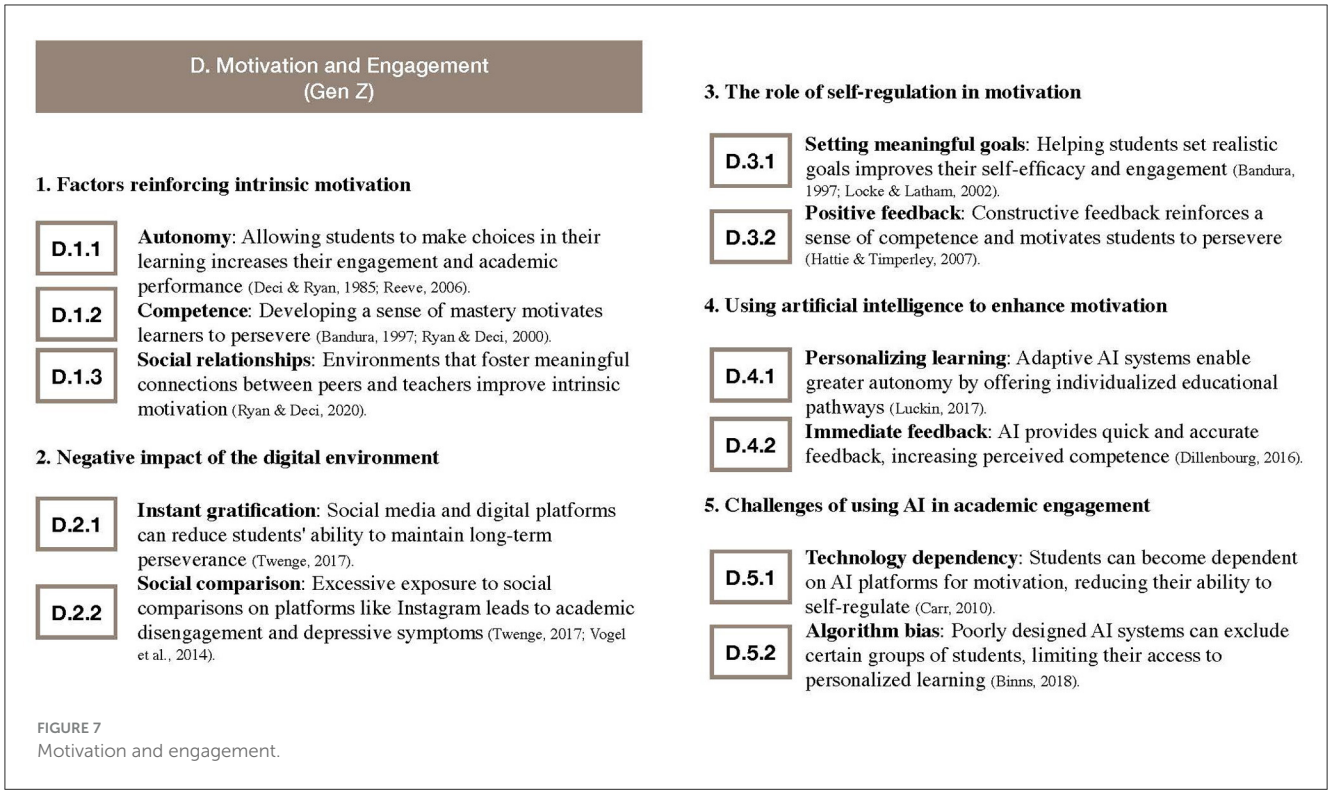

FIGURE 7
Motivation and engagement.

3.5 Mental health and wellbeing

The mental health of Generation Z is a growing concern due to their high levels of digital engagement. Excessive screen time and exposure to social media have been linked to increased levels of anxiety, depression, and lower self-esteem among adolescents (Twenge, 2017). For instance, a study conducted by Twenge (2017) involving over 200,000 teenagers found that those who spent more than 3 h per day on social media were significantly more likely to develop symptoms of depression compared to their peers who spent less time online.

An illustrative example from the study described a 17-year-old student who began to experience social anxiety and academic disengagement after several months of heavy social media use. The student reported feeling overwhelmed by the constant comparison with peers and the pressure to maintain a certain online image. This highlights the need for educators and parents to promote healthy digital consumption habits and encourage students to critically reflect on their digital interactions.

4 Discussion

The results of this study highlight the importance of adopting active, collaborative and metacognitive teaching approaches to meet the unique learning needs of Generation Z. This generation, born in a digital context, is characterized by a preference for dynamic and contextualized learning experiences, in contrast to traditional methods characterized by the linear and passive transmission of information (Prensky, 2001). Faced with these new expectations, educators need to rethink their pedagogical strategies by incorporating elements that encourage student engagement, autonomy and socio-emotional development.

4.1 Active learning and formative assessment: enhancing engagement and autonomy

Project-based learning (PBL) and formative assessment have emerged as powerful strategies for fostering engagement and reinforcing a sense of autonomy among Generation Z students. By offering real-world relevance and opportunities for active participation, project-based learning enables students to apply theoretical knowledge to practical scenarios, fostering deeper understanding and intrinsic motivation (Hattie and Timperley, 2007). For example, in a study of secondary school students in Switzerland, a project on climate change and its impact on local biodiversity resulted in a 35% increase in student engagement compared to traditional lecture-based teaching (Hattie and Timperley, 2007). Incorporating formative assessment further enhances autonomy by providing personalized feedback that helps students identify their strengths and areas for improvement.

In addition, the use of AI-based formative assessments has been shown to improve student learning by providing real-time adaptive feedback. In a high school maths class, students who used an AI-based formative assessment tool saw a 25% increase in their final test scores compared to those who received traditional instruction (Luckin, 2017b). The AI tool provided personalized exercises that adapted to students' learning pace and challenges, reinforcing self-regulation and perseverance. These findings suggest that integrating AI into formative assessment can

create a more responsive learning environment that meets the diverse needs of Generation Z learners.

4.2 Self-regulation and metacognitive strategies: building cognitive and emotional resilience

Integrating self-regulation and metacognitive strategies into the curriculum is particularly important for Generation Z students, who often struggle to manage their own learning due to the ubiquity of digital distractions. Zimmerman (2002) found that when students are trained to set specific learning goals, monitor their progress and reflect on their results, they develop greater perseverance and academic resilience. An illustrative case study was conducted in a secondary school in Sweden where students used digital portfolios to document their learning journey. At the end of the semester, 85% of the students reported greater confidence in their academic abilities and a willingness to engage in more difficult tasks (Zimmerman, 2002).

An effective metacognitive approach is the use of learning logs or reflective journals. Schraw and Moshman (1995) showed that secondary school students who kept a learning diary scored 25% higher on tasks requiring self-assessment and strategy adjustment than their peers who did not use such a diary. This finding suggests that encouraging students to reflect on their learning processes can significantly improve their ability to plan, monitor and evaluate their own progress, monitor and evaluate their own progress. These strategies are essential for building cognitive and emotional resilience, particularly at a time when students are constantly bombarded with digital distractions and information overload.

4.3 Benefits and limitations of AI integration in education

Artificial intelligence offers significant opportunities to personalize education and support self-regulated learning. By identifying the specific needs of each learner and providing tailored recommendations, AI can foster autonomy and improve learning outcomes. It also provides instant feedback, boosting student engagement and motivation. However, over-reliance on these technologies carries risks. For example, Carr (2020) has shown that students who rely heavily on AI to structure their learning can experience a decline in their planning and self-regulation skills. A longitudinal study confirmed that, although these students achieve better results in the short term, they have weaker self-regulation skills in the long term.

There are also concerns about the ethical implications of using AI in education. Binns (2018) points out that, without careful design, AI algorithms can reproduce or accentuate existing biases. For example, an AI-based grading system at one university introduced biases against students from specific socio-economic backgrounds, resulting in unfair assessments for these groups. It is therefore essential to develop fair and inclusive AI systems, so as not to exacerbate inequalities but rather to mitigate them.

Current research, however, has certain methodological limitations. Many studies are based on small samples and are concentrated in Western countries, limiting the generalizability of results. Research in under-represented regions, such as Africa, South Asia and Latin America, would provide a more global view of the impact of AI in education. In addition, the cultural biases inherent in algorithms may limit their relevance to learners from diverse cultural backgrounds. Adapting AI tools to these contexts is therefore crucial.

Finally, the predominance of quantitative approaches in current studies limits our understanding of students' and teachers' experiences with AI. More in-depth qualitative research, such as interviews and case studies, would help to identify the effects of AI on motivation, engagement and perceptions of learning.

4.4 Addressing attention and mental health challenges

The digital environment of Generation Z is characterized by continuous exposure to information and constant digital multitasking, which has a significant impact on attention and cognitive processing. Ophir et al. (2009) found that young people who frequently engage in digital multitasking have a 40% higher rate of attentional difficulties than young people who do not multitask as frequently. This fragmented attention can hinder in-depth learning and reduce students' ability to concentrate on academic tasks over the long term. To mitigate these difficulties, educators can implement digital detox strategies and mindfulness practices. Research by Zeidan et al. (2010) found that mindfulness meditation improved attention span by 30% and reduced anxiety symptoms in adolescents who practiced it regularly. Incorporate short mindfulness sessions.

Exercises at the start of lessons or incorporating reflective pauses during the presentation of content can help students stay focused and reduce their anxiety levels.

The impact of digital media on mental health is another key concern. Research by Twenge (2017) showed that teenagers who spent more than 3 h a day on social media platforms were significantly more likely to develop depressive symptoms compared to those who limited their use. This finding highlights the need for educators and parents to promote healthy digital consumption habits and encourage students to think critically about their digital interactions. Schools can play a proactive role by including digital wellbeing education in the curriculum and facilitating open discussions about the effects of social media.

4.5 Implications for educational policy and practice

The results of this study highlight significant implications for policy makers and education practitioners, particularly with regard to the responsible integration of artificial intelligence (AI) into educational environments. It is crucial that AI is used to complement, not replace, human interaction. Such an approach would allow the benefits of AI to be realized without diminishing the fundamental role of teachers in the cognitive and socio-emotional development of students. Therefore, it is recommended

that policymakers develop guidelines for the use of AI in education to ensure an ethical and balanced application.

In addition, teacher training must evolve to include specific modules on digital wellbeing, self-regulation, and the effective and ethical use of AI in the classroom. Teachers play a key role in supporting students in an increasingly digital world, and they need to be equipped to guide their students in using these technologies in a balanced and informed way.

Educational establishments should also promote the development of socio-emotional skills, which are essential for navigating a complex digital environment. Programmes that foster empathy, resilience and interpersonal skills should be developed alongside academic skills. Future research should explore the effectiveness of different interventions to promote digital wellbeing and examine the impact of varied digital interactions on students' cognitive and emotional development.

Recommendations for the responsible integration of AI in education.

1. Personalization without over-dependence: AI offers opportunities to personalize learning pathways, but it is essential that this personalization does not lead to over-dependence. It is recommended that personalization be limited to areas where the student has specific difficulties, while encouraging self-regulation and independent learning in other areas. Such an approach can support students in their learning without hindering their ability to develop self-regulation skills.

2. Enhancing social-emotional skills: AI can be used to promote the development of social-emotional skills, including collaboration and empathy. By integrating feedback modules based on interaction analysis, AI can offer real-time feedback on communication and cooperation in group activities. This feedback would help students to improve their active listening and teamwork, thus contributing to balanced socio-emotional development.

3. Transparency and explainability of algorithms: To build trust in the use of AI, it is essential that AI-based educational tools are transparent and understandable to teachers and students. The introduction of explainable AI interfaces, which make it possible to visualize and understand the decision-making processes of algorithms, could help users to exercise discernment and critical thinking with regard to these technologies. This transparency would build trust and encourage informed use of AI in the classroom.

4. Prevention of algorithmic bias: AI systems must be designed to minimize potential bias to ensure equity of access and treatment for all students. Algorithms need to be tested in a variety of educational contexts to identify and correct potential biases related to ethnicity, gender or socio-economic status. This would help to create more inclusive educational technologies, promoting the application of AI in a way that is equitable and tailored to the needs of all learners, regardless of their background or context.

These recommendations aim to encourage a balanced and ethical use of AI in education. By promoting policies that frame the use of AI in a transparent and inclusive way, and by supporting teachers in their continuous training, it is possible to take full advantage of technological innovations to enrich the educational experience while preserving the fundamental principles of equity and educational autonomy.

4.6 Future research directions

In order for artificial intelligence (AI) to fully meet contemporary educational needs, in-depth research in specific areas is required:

1. Long-term impact on self-regulatory skills: Although AI promotes individualized learning, it is essential to understand its impact on learner autonomy in the long term. Longitudinal studies could explore how AI influences the development of self-regulation skills and determine whether it supports or, on the contrary, limits students' initiative-taking and ability to manage their own learning autonomously.
2. Mental health and wellbeing of learners: The influence of AI on students' mental health remains an unexplored topic. Research could investigate the effects of AI on student stress, anxiety and wellbeing, particularly in high-pressure, competitive school environments. Understanding how AI can contribute positively or negatively to student wellbeing is crucial to the balanced integration of this technology.
3. Optimizing feedback and formative assessment: AI has the ability to provide real-time feedback, but it is important to identify the types of feedback that are most effective in fostering student motivation and engagement. Research could look at the frequency, format and content of feedback provided by AI, with the aim of determining how these elements can maximize the impact of formative assessment on learning.
4. Adaptability to cultural differences: Researchers need to focus on developing AI algorithms and systems that can adapt to different cultural and educational contexts. The development of multilingual and culturally sensitive tools would ensure a more inclusive and relevant use of AI worldwide, taking into account the cultural nuances that influence learning styles and preferences.

Although this study provides valuable information, several questions require further investigation. Firstly, longitudinal studies are essential to understand the long-term impact of AI on students' cognitive and metacognitive skills. It is also crucial to explore how AI can support students with diverse learning needs, ensuring that technological interventions remain inclusive and equitable for all.

Secondly, there is an urgent need for further research into the relationship between digital consumption and mental health. Although Twenge (2017) has highlighted the negative effects of excessive screen consumption, mental health is not always high on the agenda in studies of AI in education. Future research could examine how different types of digital interactions, such as educational media vs. social media, distinctly influence students' mental health.

Finally, research should focus on developing best practices for balancing the use of technology and the development of social-emotional skills. With the proliferation of digital tools in education, it is essential to ensure that these technologies enhance the holistic development of students, without compromising their interpersonal and socio-emotional skills.

The integration of active learning, metacognitive strategies and artificial intelligence can positively transform the learning

experiences of Generation Z students. However, to avoid over-reliance on technology and to ensure lasting benefits, these approaches need to be implemented thoughtfully. Educators have a key role to play in creating a balance between harnessing technology and promoting fundamental skills such as self-regulation, critical thinking and social-emotional competencies. By adopting a balanced and well-structured approach, learning environments can not only incorporate advanced technological innovations, but also support the overall development of Generation Z learners, preparing them for an increasingly complex and digitalized world.

5 Conclusion

The rapidly changing educational landscape requires a strategic adaptation of pedagogical practices to meet the specific needs of Generation Z, a cohort marked by their familiarity with digital technologies and distinct learning preferences. This study has demonstrated the crucial importance of active learning, metacognitive strategies and the thoughtful integration of artificial intelligence (AI) to engage these digital natives. Generation Z's preference for personalized, inclusive and contextualized learning experiences calls on educators to move beyond traditional methods and implement more dynamic, student-centered approaches.

The results highlight the role of active learning strategies, such as project-based learning and formative assessment, in enhancing student engagement and motivation. By offering opportunities for concrete application and reflection, these methods encourage autonomy and a deeper understanding of academic content. At the same time, AI shows potential for personalizing learning pathways and offering real-time adaptive feedback, helping to support self-regulation and improve academic performance. However, AI should be used as a complementary support tool, as over-reliance could hinder the development of essential skills such as critical thinking and self-regulation.

This study also draws attention to the cognitive and emotional challenges associated with increased digital exposure, such as reduced attention span and vulnerability to mental health problems. To address these challenges, educators are encouraged to incorporate strategies that promote sustained attention, cognitive control and digital wellbeing. Practices such as mindfulness, digital detox and structured moments of reflection could mitigate the negative effects of digital multitasking and information overload. Zawacki-Richter and her colleagues also call for an inclusive, teacher-centered approach, so that AI supports and enriches their role rather than marginalizing it. They also advocate more training for teachers, so that they can integrate these technologies proactively and effectively. In addition, they stress the need for collaborative research between AI experts and educators to develop tools that meet pedagogical needs and support the role of teachers.

Ethical considerations linked to the integration of AI in education are another priority area. AI systems must be designed to ensure equity and inclusion, avoiding reproducing or exacerbating social biases. The implications of AI in areas such as grading, personalized feedback and student tracking need to be scrutinized to protect privacy and ensure fair outcomes.

Despite the promise of these strategies, several gaps in current research require further study. Longitudinal research is essential to assess the impact of AI on long-term cognitive and metacognitive development. In addition, it is crucial to understand how AI can support students' socio-emotional development and to better understand the effects of different digital interactions on mental health and wellbeing.

The implications of this study go beyond the classroom and call for wide-ranging policy initiatives. Policymakers need to establish guidelines for the responsible use of AI in education, while teacher training programmes should include modules on digital literacy, the ethical use of AI and the promotion of digital wellbeing. By equipping teachers with technological skills and an in-depth understanding of the impact of digital environments, education systems can better support generation Z in their learning.

For AI to be implemented equitably and inclusively, policymakers must promote transparency of algorithms, invest in teacher training, ensure equal access to AI technologies, and establish an AI in Education Oversight Board to assess the impact of new tools. These actions will contribute to an adoption of AI that is beneficial and safe for all learners.

In conclusion, adapting educational practices to the needs of Generation Z requires a balanced and integrated approach, combining active learning, metacognitive strategies and responsible use of AI. By adopting educational practices that are both technologically advanced and human-centered, educators, researchers and policy-makers can work together to create learning environments that support students' holistic development. Such an approach will enable Generation Z to thrive in a rapidly changing world, while safeguarding their cognitive, emotional and social wellbeing.

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