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Generative AI in Inclusive Classrooms: Enhancing Social Interactions, Personalised Learning, and Metacognitive Skills

Abstract: In this study, the researcher conducted a systematic literature review to investigate the pioneering potential of generative artificial intelligence (GAI) tools and technologies to cater to diverse learning needs in inclusive classrooms. The research was based on social constructivist, human–machine learning collaborative learning, and metacognitive theories and was designed to address three major concerns: the social hindrances faced by students with diverse learning needs during collaborative tasks in inclusive classrooms, the inability of students with learning difficulties' to participate equally when using GAI tools, and the potential implications of GAI tools for students struggling with metacognitive skill development. The investigation was based on a thematic analysis of 20 scholarly research articles drawn from Scopus, Web of Science, and Google Scholar following PRISMA. Commonalities in the data were identified using colour coding techniques. The results revealed that GAI tools improve communication skills by breaking down cultural and linguistic barriers, which gives neurodivergent learners equitable opportunities to participate in peer interactions. GAI tools can increase reflective thinking, encourage creative problem-solving, and aid in developing structured and planned groups within a stipulated time. GAI tools effectively reduce cognitive load, improve focus, facilitate goal-driven learning, and provide personalised assistance through adaptive scaffolding that addresses learners' multimodal needs. These tools help in deskilling by providing scaffolding and fostering gradually increasing independence. Further research can be conducted to explore the long-term impact of GAI on students and open up new possibilities for addressing the limitations of current GAI technology in inclusive pedagogy.

Keywords: inclusive classrooms, students with diverse learning needs, GAI tools, students with learning disabilities, metacognitive skills

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Scientific article

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Introduction

Generative artificial intelligence (GAI) is artificial intelligence (AI) that uses generative models to generate images, videos, texts, or other data. Banh and Strobel (2023) highlighted that its fusion of data-driven creativity and AI can redefine the boundaries of innovation and transform the digital landscape of the future. The rapid advances of technological domain have transformed the educational arena, offering innovative ways to enhance learning experiences and student engagement. The potential for GAI to enhance social interaction, personalised education, and collaborative learning is immense and is revolutionising classrooms (AlAli & Wardat, 2024), but there is still a need to explore its metacognitive skill development benefits for learners with diverse needs. The current study elucidated the role of GAI and associated tools in providing personal scaffolding for students with learning disabilities in overcoming critical challenges in inclusive education. Barriers such as linguistic diversity, cultural variations, and students' unique needs often hinder learning in inclusive classrooms (Evans et al., 2021). Moreover, these challenges can be aggravated by communication difficulties, metacognitive skill differences, and collaboration. In such cases, traditional teaching approaches may fail to adequately address individual learners' needs, which can create gaps in access to equitable education. GAI tools are promising solutions for use in education; however, inclusive classrooms can raise questions concerning the support they can give for fostering metacognitive skill development and social connections and addressing the needs of students with learning difficulties. A lack of deeper understanding in the application of GAI in education field can negatively affect educators. Consequently, they may struggle to implement this technology without fully comprehending ways to use it for equitable and inclusive education. Therefore, in this study, the researcher conducted a systematic literature review to investigate the pioneering potential of generative GAI tools and technologies to cater to diverse learners in inclusive classrooms.

Literature Review

GAI in Education

GAI tools based on machine learning (ML) algorithms and natural language processing (NLP) are increasingly used in educational contexts. These tools assist in creating content and provide personalised learning routes for learners, enabling interactive learning experiences to be tailored to their unique needs. Lo et al. (2024) explained that GAI is capable of facilitating the automation of repetitive tasks, which enhances performance and creativity while supporting differentiated instruction. For example, AI-driven chatbots provide instant feedback to learners, and the use of predictive analytics can assist in identifying gaps in learning. Darwish et al. (2024) also claimed that GAI tools are capable of reducing cognitive load and providing scaffolding to support learners at various levels. These studies have highlighted the ability of GAI tools to overcome barriers to learning in inclusive classrooms via multimodal approaches. Thus, it enhances learners' accessibility in diverse educational settings. Hence, the use of GAI tools in education may be favourable for educational institutions. Holmes and Tuomi (2022) also highlighted that AI-assisted tutoring systems and AI-assisted simulations or apps can support AI-driven education for learners, assisting students in gaining familiarity with tech-driven workspaces and entering competitive fields after the completion of their education.

Application of GAI in Inclusive Classrooms

The goal of inclusive classrooms is to accommodate students with different abilities and backgrounds and to promote equitable education in the classroom (Ali et al., 2024). In such classrooms, learners' diverse needs are acknowledged, and well-tailored strategies are incorporated to support learners with different cultural backgrounds, including those with learning difficulties or who are experiencing social challenges. In this context, Sandhu et al. (2024) showed that GAI tools can make education inclusive via personalising support and by improving learners' active participation, boosting communication, collaboration, and social interaction in inclusive settings. GAI tools, such as multilingual chatbots and real-time translation software (for example, Google Translate and Microsoft Translator), help bridge language gaps among students. Trajkovski and Braun (2023) pointed out that GAI tools are beneficial in providing adaptive, context-rich instructions for students in inclusive classrooms, improving the chances of equitable access to educational resources. Overall, GAI tools are revolutionising learners' learning experiences by catering to their learning needs at the individual level. Bahroun et al. (2023) also pointed out that there is an increasing demand for GAI tools to incorporate inclusive and culturally sensitive content to boost their academic and sociocultural acceptance across diverse cultures. This would enable GAI tools to address disparities in learners' access to quality education in inclusive settings

by providing culture-specific content. However, care should be taken to develop content that fosters an inclusive educational landscape but does not resonate with learners' needs. It is important to ensure that the content developed not only promotes inclusivity but also meaningfully aligns with the diverse needs and experiences of learners.

Students with Social and Learning Difficulties

Traditional educational environments tend to impose unique challenges on students with various social and learning disabilities, but the development and evolution of GAI tools has opened up the possibility of personalised learning experiences to help them cope with these challenges. Hellesnes et al. (2024), based on an investigative study, stated that real-time feedback, visual aids, and simplified instructions have reduced cognitive stress for autistic students and students with learning difficulties. This implies that GAI has the potential to promote inclusivity to ensure the equal contribution and progress of students with various learning profiles in inclusive classrooms during structured tasks and group assignments that require interaction with peers. Supporting this assertion, Layachi and Pitchford (2024) claimed that the personalised learning experiences afforded by GAI tools enhance the academic and social skills of students with difficulties. These studies have shown that the use of GAI tools in inclusive education has promoted adaptive learning for students with social and learning difficulties.

Theoretical Framework

The researcher based the theoretical framework for this study on three integral theories—metacognitive theory, human–machine collaborative theory, and social constructivist theory—which are described in the following sections.

Metacognitive Theory

The concept of self-regulated learning in inclusive classrooms emerged from metacognitive theory, which developmental psychologist John Flavell claimed allows individuals to comprehend, interpret, regulate, and then reflect on their self-learning and perceptions (Temple et al., 2023). Metacognitive theory encompasses two primary components: metacognitive knowledge and metacognitive regulation. The former refers to self-awareness as a learner and the learner's own cognitive processes, while the latter allows learners to actively evaluate cognitive challenges during problem-solving (Teng, 2022). Thus, learning about oneself as a learner, and effectively planning and monitoring progress in learning related to self-regulated learning strategies, are integral aspects of metacognition. Metacognitive theory focuses on the need for learners to reflect upon their own cognitive

activities, such as planning, monitoring, and reviewing their study strategies to attain set objectives. Such reflective awareness allows learners to control their own learning efficiently and to make informed judgements when solving problems. GAI tool can reinforce metacognitive development by providing instant feedback, adaptive scaffolding, and reflective questions. These attributes motivate learners, particularly those with varied learning difficulties, to actively engage in evaluating progress, refining learning strategies, and gaining greater control of their learning processes.

Human–Machine Learning Collaborative Theory

Shared learning processes are facilitated by a mutually beneficial relationship between AI systems and human cognition based on human–machine learning collaborative theory, which holds that AI tools complement humans and vice versa, mostly by exploiting the different strengths of each (Geng & Varshney, 2022). With the help of technologically advanced features, such as pattern recognition, computational excellence, and personalised learning insights, AI helps humans gain a better understanding of contextual matters by training the human brain, with the help of machines, to think critically and develop creativity. For instance, human–machine learning collaborative theory supports adaptive learning systems that can provide customised recommendations based on the concepts of co-learning and by analysing users' behaviours (Alix et al., 2021). This aligns with Vygotsky's zone of proximal development (ZPD) concept, which "what a child can do on his or her own and what the child can do with help from someone more capable" (Xi & Lantolf, 2021). Thus, recent advances in adaptive tutoring systems and GAI, such as ChatGPT, foster exploration, help students gain constructive knowledge, and act as collaborative agents.

Social Constructivist Theory

Vygotsky pioneered social constructivist theory to highlight the importance of the cultural aspects of learning and the role played by social interactions in learning (Tasos, 2024). This theory supports learners' shared experiences during collaborative tasks and facilitates the co-construction of knowledge in social contexts (Tasos, 2024). GAI can be aligned with the needs of learners who struggle with participation and thereafter support the completion of peer-based tasks in inclusive classrooms. For instance, students with different cultural backgrounds may find it difficult to process instructions and develop relatedness and a sense of belonging, especially in inclusive classrooms, where they may find their social communication hindered (Tavares, 2024), hampering their productivity, learning, development, and progress. In such cases, AI (GAI) tools, such as multilingual chatbots and real-time translators, can facilitate communication among students with varied sociocultural and linguistic backgrounds. GAI tools promote equitable

participation, fostering the shared understanding and co-construction of knowledge through immersive experiences and encouraging learners to engage in group activities that impart mutual respect and empathy.

Conceptual Framework

This section outlines concepts that forms the foundation for the current study. Regarding the integration and implementation of GAI tools in inclusive educational settings, the researcher selected the social constructivist, metacognitive skill development, and human–machine learning collaboration theories as independent variables for the investigation, and selected communication skills, reflective thinking, personalised learning, inclusion, and cognitive load appeared as the dependent variables.

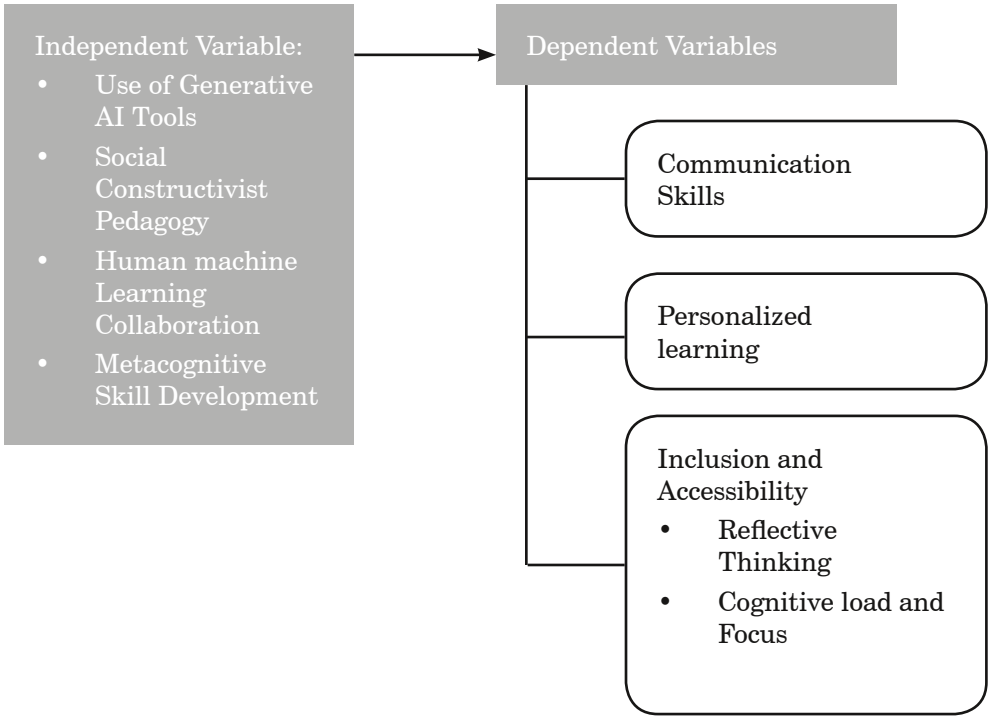

Figure 1: Flowchart for the Conceptual Framework

Research Objectives

The following research objectives underpinning the systematic literature review:

- RO1: Explore the influence of generative AI (GAI) tools on social interactions and collaborative learning in inclusive classrooms.
- RO2: Analyse how GAI tools address the specific needs of students with learning difficulties by providing scaffolding for personalised learning experiences.
- RO3: Investigate the implications of GAI tools for developing the metacognitive skills of students with diverse learning difficulties for inclusive classroom..

Research Questions

The researcher formulated three precise research questions (RQ) to address the learning objectives, as follows:

- RQ1: How are social interactions and collaborative learning influenced by GAI tools in inclusive classrooms?
- RQ2: In what ways do GAI tools address the specific needs of students with learning difficulties by providing scaffolding for personalised learning experiences?
- RQ3: What are the implications of GAI tools for students with diverse learning needs struggling with metacognitive skill development?

Significance of the Study

This study significantly contributes to the existing body of research on GAI tools for extensive use in inclusive classrooms. First, it should help break down the linguistic and cultural barriers that hinder equal participation in group activities to promote collaborative and social learning. Second, based on the key concepts of self-regulation, cognitive development, emotional regulation, and task management, it highlights how GAI tools can provide personalised learning assistance to students challenged with learning difficulties. Finally, it paves the way for all categories of learners to meet their learning goals and sets milestones for policymakers and educators to work collaboratively with technologists to develop practical solutions..

Methodology

The researcher conducted a systematic literature review to gain greater clarity regarding and in-depth insights potential use of GAI in education outcomes

(Maxwell, 2021). The researcher scrutinised secondary data, including academic journals, research articles, published records, and some grey literature, to synthesise and analyse the data further to identify research gaps and suggest future research directions.

Research Design

Through the previously mentioned analyses, the researcher drew data from selected studies regarding the experiences and practices of key stakeholders to underpin findings regarding the effectiveness of GAI tools in improving the metacognitive skills of learners with diverse learning needs. According to Braun and Clarke (2019), thematic analysis is generally appropriate for identifying, reporting, and analysing common themes within qualitative data. Thus, in this study, the researcher employed it to analyse the data in light of the broader RQs to fulfil the ROs rather than to give an overall idea of the relevance of contextual issues. The thematic analysis allowed the researcher to become familiar with the data and to review, define, and name themes to produce a final report. This approach was chosen because it was highly flexible, adaptable to a range of qualitative data, and would permit the researcher to assess the impact of GAI tools.

Inclusion and Exclusion Criteria

To be considered relevant for the review, studies had to meet the following inclusion criteria: 1) published in 2014–2023, 2) considering students and teachers, 3) full text available, 4) published in English, 5) addressing the role of GAI in improving the metacognitive skills of students with learning difficulties, and 6) including analyses of GAI tools and their applications. The researcher excluded studies with the following characteristics: 1) not published in 2014–2023; 2) considering only students below 5 years of age, 3) only the abstract available, 4) published in a language other than English, and 5) validity of the data not established.

Search Strategy

The researcher conducted a comprehensive screening of academic databases to conduct the systematic review. Since it is crucial to use two or more databases to avoid the bias resulting from a single database (Kraus et al., 2022), the researcher searched three databases—Scopus, Web of Science, and Google Scholar—thoroughly to retrieve relevant studies. To yield impactful citations and further analyse relevant data, researchers should use keyword searches, facilitated by machine learning and text-mining procedures, for each database (Kraus et al., 2022). Therefore, the researcher conducted an extensive search to identify relevant articles in the selected electronic databases using the following combination of search

terms and their derivatives: ('GAI tools' OR 'GAI applications') AND (students with learning difficulties' OR 'students with social difficulties' OR 'students with diverse learning needs) AND ('inclusive classrooms' OR 'special education').

Selection Criteria

Following the initial search, the researcher screened as many relevant studies as possible to address the RQs. The databases were searched from 2014-2024. The category was limited the language was selected as English. The researcher screened 50 publications, of which only 20 were selected based on the inclusion criteria, following the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (Figure 1). After removing duplicates and redundant articles, the researcher reviewed the remaining citations and selected those deemed suitable for inclusion. Only full-text publications were included, while those available only as abstracts were excluded.

Data Extraction and Analysis

The researcher read the full texts of the 20 publications that had been selected from the databases and examined them to identify the sample sizes, research designs, findings, and implications, recording and tabulating the data for further analysis. The researcher thematically analysed the qualitative data to detect common emerging themes and similarities. According to Kraus et al. (2022), scholars who intend to conduct thematic analysis from a qualitative point of view should organise information into themes on a subjective basis. After the data had been recorded in tabular form, the researcher inserted a separate column for data extraction and colour-coded the commonalities among emerging themes to further analyse the data and establish findings. The researcher also used the PRISMA guidelines and the Critical Appraisal Skills Programme (CASP) checklist to evaluate the quality and credibility of the included studies (Costa et al., 2024). An in-depth analysis of GAI tools revealed valuable insights into how these tools support the development of social and metacognitive skills in students with diverse learning needs.

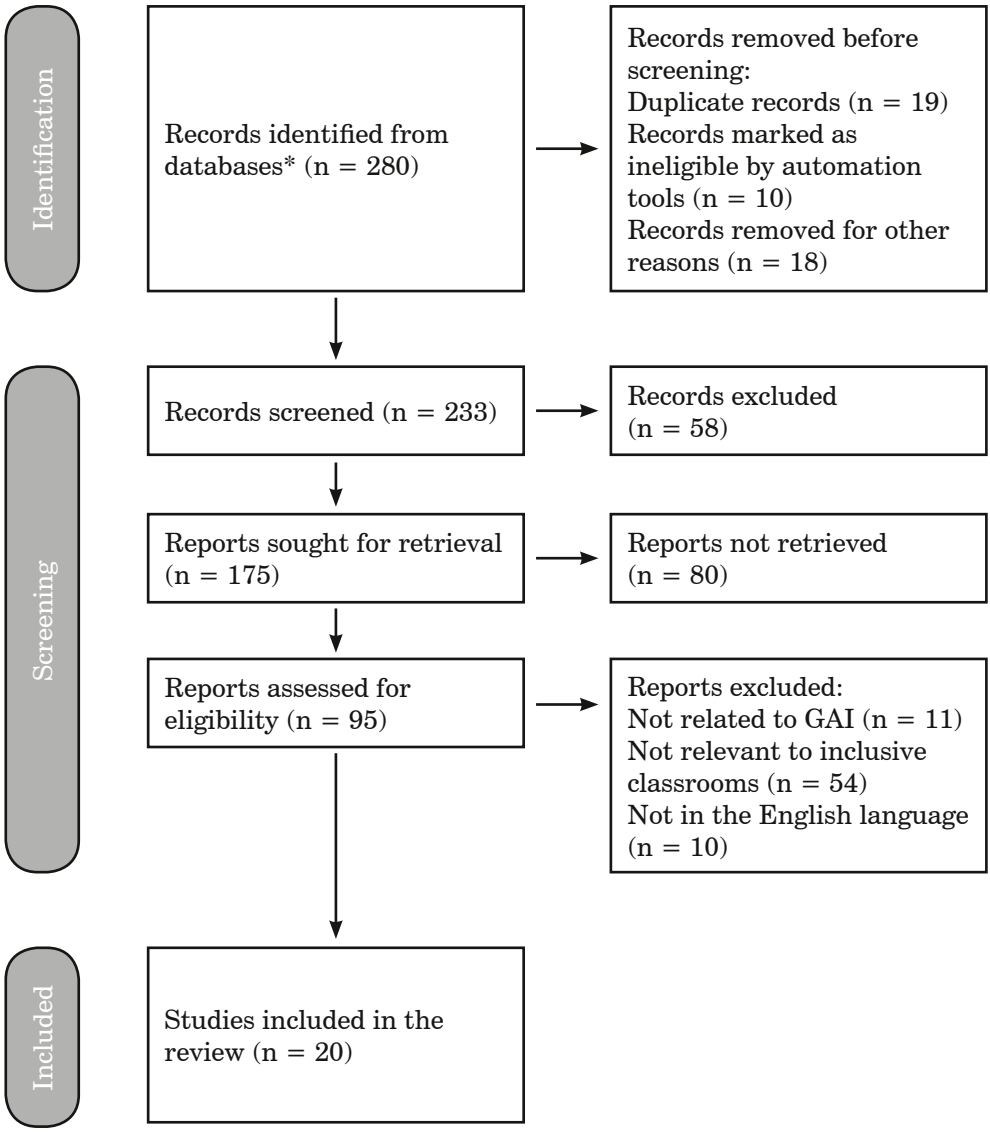

Figure 2: PRISMA Flowchart for the Selection of Articles

Results

Three broad themes emerged from the data analysis: 1) collaborative learning and social interaction, 2) use of GAI tools to address the specific needs of students with learning difficulties, and 3) implications of GAI tools for students

with diverse learning needs struggling with metacognitive skill development, as shown in Table 1.

Synthesis of Findings

The three distinct themes identified in this systematic literature review spanned studies regarding the impact of GAI tools in education. Of the 20 included studies, 3 followed a qualitative research design (Behboudi et al., 2024; Chigora 2024; Pierrès et al., 2024) to explore different dimensions of the impact of GAI tools on personalised learning. Another three studies were based on quantitative research designs (Avcı, 2024; Liang et al., 2023; Zeng & Sun, 2024) and emphasised the ways in which GAI tools can enhance learners' creativity and self-esteem, suggesting broad implications for leveraging this technology to facilitate the self-regulated learning of students with learning difficulties. Of the 20 studies, 2 (Chen et al., 2024; Tai & Chen, 2024) employed mixed-methods approaches to analyse the quantitative and qualitative aspects of GAI tools, including multimodal learning approaches and peer tutoring systems. In seven studies, the researchers conducted systematic reviews to interpret and analyse the various dimensions of GAI tools in inclusive learning settings and collaborative learning while exploring their implications for students with learning difficulties (Iannone & Giansanti, 2023; Kumar et al., 2023; Liu et al., 2023; Mittal et al., 2024; Ortega-Ochoa et al., 2024; Payne & Swanson, 2024; Xian et al., 2024). One study (Huang, 2024) was an experimental study conducted to provide an in-depth understanding of and enriched qualitative data regarding the real-life application of GAI tools for enhancing learners' motivation and performance. Additionally, 3 of the 20 considered a broad range of GAI tools and their ability to mitigate metacognitive difficulties across diverse learning profiles studies (Kar et al., 2023; Mittal et al., 2024; Sandhu et al., 2024).

Theme 1: Collaborative Learning and Social Interaction

Social interactions and collaborative learning are vital in inclusive classrooms. Peer collaboration is an integral factor that supports collaborative tasks and facilitates communication (Behboudi et al., 2024; Sandhu et al., 2024). GAI tools make this easier by acting as supplementary rather than problem-solving tools to support collaborative projects. Pedagogical strategies that integrate GAI tools in inclusive classrooms should emphasise group assignments that allow students to critically evaluate AI-formulated solutions by seeking peer feedback (Iannone & Giansanti, 2023; Tai & Chen, 2024). Students with learning difficulties face issues with phonology, pronunciation, and vocabulary, which negatively affect their self-esteem while communicating with peers and may discourage them from engaging in collaborative tasks. Hence, students' learning difficulties often overlap

with social difficulties in inclusive classrooms. GAI tools can foster seamless social interactions through rigorous feedback and active interactions via AI chatbots (Khadpe et al., 2022). However, constant monitoring is required to avoid students' overreliance on GAI tools, which may prevent them from interacting with human peers (Pescapè, 2024). Therefore, social dynamics in inclusive classrooms should be balanced against the assistance provided by communicative GAI tools, aligning with social constructivist theory.

Theme 2: Using GAI Tools to Address the Specific Needs of Students with Learning Difficulties

GAI tools with collaborative features can be customised and blended with diverse learning techniques to provide tailored solutions and feedback and aid in problem-solving by reducing the cognitive load on students with learning difficulties. However, the features required to serve individual needs are often ignored, which can be attributed to oversimplified learning profiles. However, this risk does not undermine the inclusive features of GAI tools, as it allows flexible their adaptation to diverse learning profiles (Payne & Swanson, 2024; Pierrès et al., 2024). For students with learning difficulties in inclusive classrooms, the professional development of teachers is a priority to ensure that diverse learning needs are accurately interpreted and the use of GAI tools is adapted accordingly to provide homogenous support while ensuring the collective and individual progress of students (Chen et al., 2024; Kar et al., 2023; Liu et al., 2023; Zeng & Sun, 2024). This theme aligns with human–machine learning collaborative theory, which deals with the symbiosis between AI systems and human cognition.

Theme 3: Implications of GAI Tools for Students with Diverse Learning Needs Struggling with Metacognitive Skill Development

GAI tools can provide effective scaffolding information to enhance self-regulated learning and self-awareness during the learning process. However, challenges may arise for students in inclusive classrooms, especially for students with learning difficulties, such as autism, Attention-Deficit/Hyperactivity Disorder (ADHD, and dyslexia (Chigora, 2024; Huang, 2024; Liang et al., 2023; Ortega-Ochoa et al., 2024). These students tend to develop dependence on GAI tools for learning assistance and thus lose the capacity for interpretation and self-analysis. Educators should give explicit instructions that inform students about the monitoring, planning, and evaluation of learning in inclusive classrooms. GAI tools must be integrated with feedback loops and goal-setting programs to target metacognitive difficulties and develop interventions for students with learning difficulties in inclusive educational settings (Avcı, 2024; Kumar et al., 2023; Mittal et al., 2024; Xian et al., 2024). Overall, equitable access to educational GAI tools helps in

catering to individual needs and ensuring consistency in extending the benefits of this modern technology to enhance metacognitive skills.

Discussion

Social Interactions and Collaborative Learning Influenced by GAI Tools in Inclusive Classrooms

Inclusive classrooms have been infiltrated by GAI tools that enhance social interaction and foster collaborative learning in education, helping to establish equity in learning domains, promote teamwork, and facilitate peer learning. GAI tools promote adaptable communication and, thereby, linguistic and cultural inclusivity. They can help break down language barriers and encourage students from diverse linguistic cultures to participate in group tasks and communicate in multiple languages. For instance, communication regarding group projects can be facilitated by real-time language translation AI tools, such as Microsoft Translator and Google Translate. These tools can be integrated with augmentative and alternative communication (AAC), which allows students with communication difficulties to freely express their beliefs in group activities. This facility was highlighted by Sandhu et al. (2024), who stated that GAI tools facilitate effective communication in inclusive environment irrespective of students' mother tongues. Communication is made easier by text-to-speech conversion applications, such as Proloquo2Go and Cboard, which can be used to promote communication among nonverbal learners. The applications that support such collaborative skills are scaffolded by multilingual chatbots and translation systems. It aligns with Vygotsky's perception of social constructivism whereby peers or tools mediate learning (Triantafyllou, 2022). Thus, collective knowledge building is based on constructivist learning, which requires the removal of linguistic barriers and the fostering of shared understanding.

Additionally, Behboudi et al. (2024) pointed out that GAI tools promote data-driven activities, helping to create balanced communities that enhance the strengths of each participant based on individual profiles. Thus, GAI tools can effectively support collaborative activities that stimulate students' reflective thinking about socioenvironmental concerns. This aligns with the co-construction of knowledge highlighted in social constructivism, which prioritises group learning as a significant facilitator of reflection. GAI tools support reflection by enabling students with communication challenges to engage more deeply in critical thinking and dialogue, while also affirming the value of their unique perspectives. This promotes inclusivity within learning groups that comprise culturally and socially diverse students. For example, AI-driven platforms, such as Replika, promote real-time conversations that help overcome autistic learners' social anxiety. GAI tools can thus help break down hierarchies in social systems and foster equitable access to resources and facilities, which can democratise group activities.

The concept of shared learning experiences has been emphasised as a major function of GAI tools that enhances peer tutoring. The constructivist framework holds that peers should work collaboratively to scaffold knowledge within ZPDs, which is the basis for GAI chatbots, such as CoolE Bot, as described by Tai and Chen (2024). According to Tai and Chen (2024), human-like conversational features have proven effective in supporting English as a Foreign Language (EFL) learners' individual and paired interactions and mutual growth, helping them navigate intermediary and advanced communications. Thus, they create a safe space that enhances students' social competence and speaking skills, implying improved social engagement for students with learning difficulties, such as autistic learners. In this context, Assistive technologies (ATs) can be integrated with GAI to create role-playing scenarios and simulated interactions that help learners develop real-life communication skills. The importance of social interactions is particularly highlighted in social constructivist theory, especially for students who struggle with typical social cues and suffer from developmental difficulties. One way of improving the quality of inclusive discussion and collaboration in virtual teams is to flag inappropriate behaviour and guide conversations. GAI tools act as moderators for facilitating this, which creates conditions that help diverse learners feel safe and empowered (Khadpe et al., 2022). This matches the constructivist principle of establishing effective communication as a basic pillar for collaborative learning. This implies that the co-construction of knowledge in virtual environments powered by GAI tools can indirectly promote equal participation by making GAI tools applicable and suggesting areas for significant improvement. For instance, GAI systems such as Padlet help students share constructive feedback from peer groups and extract learning experiences from collaborative reflection boards. This allows cross-cultural adaptability and fosters empathy and understanding in perceptions of multicultural content. Pescapè (2024) highlighted that GAI tools create immersive experiences that allow fellow learners to experience certain scenarios from others' perspectives. Meaningful learning, which perpetuates mutual respect in inclusive classrooms, is embedded in social constructivist theory.

Ways of Scaffolding Personalised Learning Experiences for Students' Specific Needs

GAI tools offer flexible, personalised approaches to learning, rather than providing rigid curricula. Learning support is basically provided on demand, which is a perfect example of GAI tools, such as ChatGPT. ChatGPT simplifies complex tasks by breaking them down into manageable steps, which are useful for editing content, drafting essays, and generating the delineated steps for solving tasks (Pierrès et al., 2024). These tools effectively simplify solutions for students in real time, especially those who require special attention due to their learning difficulties, such as ADHD, autism, or dyslexia. This concept of GAI aligns with human–machine learning collaborative theory, which highlights the technical abilities of

machines to simplify difficult cognitive activities. For instance, GAI tools can analyse the difficulty of tasks by assessing data related to students' performance (Liu et al., 2023), implying that students with learning difficulties, such as dyslexia, can be given adaptable tasks to help them respond to real-life situations, providing that the tasks are neither oversimplified nor overly complex, such that engagement is not hampered. Thus, students with dyslexia can regulate the pace of their learning by using GAI tools to improve human competence. For students with learning difficulties, these tools can ensure equitable access to learning opportunities.

Different modes of content delivery have proven to be beneficial for students with learning difficulties. This learning with GAI involves presenting information via various sensory channels. For instance, visual programming tools, such as MindScratch, allow the integration of kinaesthetic, auditory, and visual elements to induce creative thoughts and enhance comprehensive capacities (Chen et al., 2024). Multimodal teaching has been proven to increase the interest of students affected by attention deficit disorders by providing a diverse range of customised, learner-centric specificities. This aligns with the human–machine learning collaborative theory, which holds that alternative pathways should be provided to support diverse human cognitive abilities. This can be done by 'complementing' textual knowledge and integrating visual cues and auditory components into GAI tools to improve the retention of informative data while imposing a minimum cognitive load. This can create opportunities for the exploration of creative ideas to ensure in-depth engagement with learning materials.

GAI tools are effective mechanisms for helping students with learning difficulties manage the development of executive functions, primarily by providing sensory reminder tools, such as alarms and timers, and planning aids, such as checklists and calendars, to assist them in optimising tasks and managing time. This aligns with human–machine collaboration theory, which asserts that machines are major scaffolding tools for empowering human minds to excel in their domains of expertise. This implies that students with autism who face communication issues can benefit from independent learning processes aided by GAI tools foster essential life skills. Structured learning pathways allow students, particularly those with autism, to draw calmness from predictable routines. Zeng and Sun (2024) found that this improved anxiety and engagement in students with learning difficulties. This aligns with human–machine learning collaborative theory, which emphasises that machines provide reliable timetables that enable anxious students to thrive in stressful settings. Task scaffolding is another important aspect of personalised learning experiences. GAI tools incorporating NLP help in processing and decoding complicated textual material by simplifying, paraphrasing, and summarising it (Kar et al., 2023). This increases the accessibility of curriculum-aligned materials, making them simpler and more readable and helping students focus on solving higher-order thinking tasks rather than wasting time analysing lower-order processing assignments.

Implications of GAI Tools for Students with Diverse Learning Abilities

Metacognitive abilities comprise various components, an important one of which is creative problem-solving. Mittal et al. (2024) highlighted the ability of GAI tools to enhance metacognitive skills by simulating real-time scenarios to promote creative problem-solving. Subsequently, it would enable learners to evaluate and adapt variable metacognitive strategies based on their learning outcomes. Fostering reflective practices is another vital component of the development of metacognitive skills. In the case of personalised learning experiences, metacognitive skills reduce cognitive stress by requiring learners to engage deeply with learning materials. Such skills can be enhanced by GAI co-regulative learning (GAI-CRL) tools that foster motivation, self-efficacy, and creativity. On the same note, independence and deskilling are foundational skills that need to be cultured to promote independent learning. Avci (2024) stated that students need to acquire foundational skills before they can become active and independent learners, and automated scaffolding can facilitate this, which helps students with ADHD and autism who lack confidence assert their knowledge. Meanwhile, self-efficacy and cognitive engagement act as mediators in the relationships between learning achievements and student–GAI interactions. GAI tools can foster these skills by providing immediate feedback that enhances engagement and motivation, as well as tailored guidance and opportunities to yield success. GAI tools can provide proper frameworks for the articulation and prioritisation of learning objectives. Inaccuracies in GAI feedback and limited personalisation may hinder the achievement of goal for some learners (Ortega-Ochoa et al., 2024). However, GAI tools can achieve simplification, assist with time management, and reduce the cognitive load by incorporating automated routines, providing focus, and reducing anxiety, especially for students with learning difficulties such as dyslexia or ADHD. The performance of these students can be greatly improved by assisting with the self-monitoring, planning, and evaluation of tasks. For instance, Mittal et al. (2024) stated that the capacity for self-regulation can be enhanced by customising GAI-mediated personalised strategies for students with learning difficulties that not only enhance performance but also suggest planned lesson curricula.

Conclusion

The recent emergence of GAI tools has fostered collaborative learning, personalised assistance, and social interactions in inclusive classrooms among students with diverse learning needs. The researcher based this study on metacognitive, social constructivist, and human–machine learning collaborative theories to investigate personalised learning experiences scaffolded by GAI tools to enhance self-regulation, goal setting, and the development of social skills to promote participation in group activities of individuals with disabilities. The research showed that the effectiveness of GAI integration in inclusive classrooms is limited by inaccurate feedback, repetitive content, a lack of appropriate prompts, and inadequate

personalisation. However, despite these limitations, GAI tools are transformative tools that offer empowerment and adaptability to students with ADHD, autism, and dyslexia in inclusive classrooms.

Limitations

The findings of this study are restricted to only a few specific tools and do not provide generalised information for all demographic groups that participate in inclusive classrooms. Moreover, the researcher did not consider students' over-reliance on GAI tools. Neither was the reduction in interaction with peers and teachers was considered. The findings are limited to a small number of students with communication and learning difficulties, which causes lack of generalizability. Additionally, the research did not uncover studies on under-resourced learning environments and socioeconomic groups, which indicates the limited reach of the evolving GAI technology.

Future Research Directions

In the future, the long-term impact of GAI tools on the cognitive and social development of students in inclusive classrooms can be studied. The suitability of these tools for specific learning needs will also be further investigated by considering insights from psychology, AI development, and education. A detailed investigation should be conducted to determine the adaptability of GAI tools in diverse linguistic environments. Furthermore, research should be conducted to compare the effectiveness of different GAI tools for different difficulties for possible mitigation strategies addressing the potential bias and scalability of these tools.

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GENERATIVNA UMETNA INTELIGENCA V INKLUZIVNIH RAZREDIH: SPODBUJANJE SOCIALNE INTERAKCIJE, PERSONALIZIRANEGA UČENJA IN METAKOGNITIVNIH SPRETNOSTI

Povzetek: Namen te študije je proučiti pionirski potencial orodij in tehnologij generativne umetne inteligence (GUI) v inkluzivnih razredih z raznolikimi učenci. Raziskava temelji na teorijah socialnega konstruktivizma, teoriji sodelovanja med človekom in strojem ter metakognitivni teoriji in obravnava tri glavna vprašanja: socialne ovire med sodelovalnimi nalogami, s katerimi se soočajo učenci v inkluzivnih razredih, nezmožnost učencev z učnimi težavami, da bi enakovredno sodelovali pri uporabi orodij GUI, in potencialne posledice uporabe orodij GUI za učence z raznolikimi učnimi potrebami, ki imajo težave z razvojem metakognitivnih spretnosti. Raziskava je bila izvedena s tematsko analizo 20 znanstvenih člankov iz uglednih podatkovnih zbirk. Ugotovljene skupne značilnosti vzorca so označene z uporabo tehnik barvnega kodiranja. Rezultati kažejo, da orodja GUI izboljšujejo komunikacijske spretnosti, saj odpravljajo kulturne in jezikovne ovire, kar nevrodivergentnim učencem nudi boljše možnosti za interakcijo z vrstniki. Orodja GUI lahko izboljšajo refleksivno mišljenje, spodbujajo ustvarjalno reševanje problemov ter pomagajo pri strukturiranih in načrtovanih časovno omejenih skupinskih dejavnostih. Orodja GUI učinkovito zmanjšujejo kognitivno obremenitev in s tem izboljšujejo osredotočenost, omogočajo ciljno usmerjeno učenje in zagotavljajo prilagojeno pomoč, ki upošteva učenčeve večplastne potrebe. Ta orodja pomagajo premostiti pomanjkanje spretnosti in omogočajo postopno samostojnost. V nadaljevanju se raziskava osredotoča na dolgoročne učinke in najnovejše možnosti za odpravljanje omejitev trenutne tehnologije GUI v inkluzivni pedagogiki.

Ključne besede: inkluzivni razredi, učenci z različnimi učnimi potrebami, orodja GUI, učenci z učnimi težavami, metakognitivne spretnosti

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