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DESIGNING INCLUSIVE AI-SUPPORTED CLASSROOMS: A LONGITUDINAL CASE STUDY OF NEURODIVERSE MIDDLE-SCHOOL LEARNERS

Aarifa Gora

One World International School, Riyadh, Saudi Arabia.

aarifa.gora@globalschools.com

ABSTRACT

This qualitative, longitudinal case study investigates how AI-driven tools can function as cognitive scaffolds for neurodiverse middle-school learners when intentionally aligned with Universal Design for Learning (UDL) principles. Conducted in an international school context, the study follows a cohort of neurodiverse learners across two academic years (2024–2026), including autistic students, learners with ADHD, a student with Irlen Syndrome, and students presenting behavioural challenges. AI-supported feedback and adaptive learning pathways were introduced within digital literacy lessons to support individualized learning processes. Data were collected through teacher reflective journals and student reflection journals across the study period. Thematic analysis, guided by UDL and Cognitive Load Theory, examines how AI-mediated feedback may reduce executive cognitive load, enhance learner autonomy, and support flexible task engagement. The findings inform the development of an Inclusive AI Design Framework that articulates design principles, UDL checkpoints, and ethical considerations for integrating AI within inclusive mainstream classrooms. This framework offers practitioner-oriented guidance for educators and school leaders seeking equitable and pedagogically grounded approaches to AI integration in diverse learning environments.

Keywords: *Inclusive education, Universal Design for Learning, artificial intelligence, neurodiversity, cognitive load, personalized feedback, longitudinal case study.*

INTRODUCTION

The rapid proliferation of artificial intelligence (AI) tools in education promises a new era of individualized support; however, most current implementations remain "tool-centric," prioritizing superficial features such as automated grading or content delivery over deeper pedagogical integration (Sapre et al., 2025). In mainstream middle-school settings, this lack of intentional design often exacerbates barriers for neurodiverse learners, including autistic students and those with ADHD, who are estimated to represent up to 20% of the global student population (Doyle, 2020, as cited in Sapre et al., 2025). These students frequently encounter heightened executive-function overload and reduced engagement when instructional designs fail to explicitly accommodate cognitive and sensory variability (Kohnke & Zaugg, 2025). Without frameworks that proactively address these needs, AI tools risk becoming "one-size-

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fits-all" solutions that ignore sensory sensitivities and cognitive heterogeneity, thereby reinforcing existing educational inequities (Sapre et al., 2025).

While artificial intelligence possesses the capacity to deliver personalized feedback and adaptive learning pathways, its potential to function as a cognitive scaffold supporting executive processes remains underexplored in longitudinal inclusive classroom contexts. Cognitive Load Theory (CLT) suggests that learning is impeded when extraneous load—often generated through poorly designed instructional environments—overwhelms a learner's limited working memory capacity (Gkintoni et al., 2025; Sweller et al., 2023). For neurodiverse learners, these challenges may be further intensified. Students with ADHD or Irlen Syndrome, for example, may experience heightened sensory and cognitive overload when interacting with poorly structured digital interfaces (Kohnke & Zaugg, 2025). Without intentional alignment with inclusive pedagogical frameworks, AI-driven systems may inadvertently increase cognitive demands rather than alleviate them (Gkintoni et al., 2025). Despite these concerns, empirical classroom-based research examining how AI can function as an inclusive cognitive scaffold remains limited.

Despite growing interest in artificial intelligence within education, much of the existing research has focused on higher education environments, large-scale digital platforms, or generalized student populations. Relatively little research has examined how AI-supported learning environments can be intentionally designed to support neurodiverse learners within mainstream middle-school classrooms. In particular, there remains limited longitudinal classroom-based research exploring how AI-mediated feedback and adaptive learning pathways may function as cognitive scaffolds that reduce executive load while promoting learner autonomy and accessibility.

The purpose of this qualitative, longitudinal case study is therefore to develop an Inclusive AI Design Framework that articulates specific design principles and Universal Design for Learning (UDL) checkpoints for integrating AI-mediated feedback and adaptive pathways within inclusive learning environments. Central to this framework is teacher-mediated oversight, or a "human-in-the-loop" approach, which ensures that AI-supported instruction remains guided by professional judgment and responsive to learner variability. By foregrounding this balance between technological support and pedagogical agency, the framework aims to provide a replicable model for inclusive AI integration in mainstream classrooms. In doing so, this study moves beyond dominant narratives that position AI as a replacement for instructional practice and instead conceptualizes AI as a cognitive scaffold that enhances learner-centred choice and promotes equitable access to the curriculum for neurodiverse learners.

Research Questions

1. How can AI-mediated feedback function as a cognitive scaffold for neurodiverse learners in inclusive middle-school classrooms?
2. How do teachers mediate and adapt AI-supported learning pathways to support diverse learner needs?
3. What design principles emerge for integrating AI within inclusive classrooms guided by UDL and Cognitive Load Theory?

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LITERATURE REVIEW

This literature review situates the study at the intersection of inclusive education, Universal Design for Learning (UDL), Cognitive Load Theory (CLT), and AI-mediated supports for neurodiverse learners in mainstream secondary classrooms. As artificial intelligence becomes increasingly integrated into educational environments, questions emerge regarding how these technologies can be implemented in ways that meaningfully support diverse learners rather than reinforcing existing inequities. The literature is therefore organized into four strands: neurodiversity and inclusive schooling, UDL as a framework for learner variability, CLT and executive-function demands, and AI-driven tools as cognitive scaffolds aligned with UDL and CLT.

Neurodiversity and Inclusive Mainstream Classrooms

Neurodiverse learners—including autistic students, students with attention-deficit/hyperactivity disorder (ADHD), students with perceptual processing differences such as Irlen Syndrome, and students with behavioural challenges—are increasingly educated in mainstream classrooms as inclusive education policies expand globally (Doyle, 2020; Fletcher-Watson & Happé, 2021; Pellicano et al., 2022). Inclusive education aims to ensure that all learners can participate meaningfully in classroom environments regardless of cognitive, sensory, or behavioural differences. However, despite policy advancements, neurodiverse learners frequently encounter barriers to participation and learning within mainstream settings (Rose et al., 2022).

These challenges may become particularly pronounced during adolescence, when academic expectations increase and students are expected to manage greater independence in their learning. Tasks requiring sustained reading, planning, and multi-step organization can overwhelm working-memory and self-regulatory capacities for autistic and ADHD learners (Fletcher-Watson & Happé, 2021). Research has also highlighted that executive functioning difficulties—including challenges with planning, working memory, and task initiation—can significantly influence academic participation for neurodiverse students in mainstream classrooms (Tancredi et al., 2025).

Even when schools adopt differentiated instruction at the classroom level, such approaches are often reactive rather than systematically designed to anticipate learner variability. As a result, neurodiverse students may remain dependent on individualized accommodations rather than benefiting from supports embedded within the design of learning environments (Al-Azawei et al., 2016; Rose et al., 2022). Scholars therefore emphasize the need for instructional frameworks that proactively address learner variability rather than responding to learning barriers after they emerge (Pellicano et al., 2022).

Universal Design for Learning and Learner Variability

Universal Design for Learning (UDL) provides a proactive framework for addressing learner variability by embedding flexibility into curriculum design from the outset (CAST, 2024; Rao

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et al., 2021; Rose et al., 2022). Rather than retrofitting supports after learning difficulties arise, UDL emphasizes multiple means of engagement (the "why" of learning), representation (the "what"), and action and expression (the "how"), allowing learners to access and demonstrate knowledge through diverse pathways.

From a neurodiversity perspective, UDL reframes learner differences as expected variability rather than deficits. Multimodal supports—such as visual, auditory, and interactive formats—become integral design features rather than specialized accommodations. For autistic learners, structured routines and predictable formats may support comprehension and engagement, while for students with ADHD, breaking tasks into smaller segments and incorporating interactive media may help sustain attention and persistence (Rao et al., 2021).

Digital learning environments have increasingly been recognized as mechanisms through which UDL principles can be enacted in classroom practice. Technology allows educators to provide multiple representations of content, flexible task pathways, and varied forms of feedback, enabling learners to select formats that align with their preferences and needs (Rose et al., 2022). However, researchers note that translating UDL principles into everyday classroom practice remains challenging, particularly in secondary classrooms where academic expectations and time constraints are significant (Bunbury, 2020).

Cognitive Load Theory and Executive-Function Demands

Cognitive Load Theory (CLT) provides a complementary perspective for understanding why instructional environments may pose particular challenges for neurodiverse learners. CLT distinguishes between intrinsic load (the inherent complexity of the material), extraneous load (avoidable demands created by instructional design), and germane load (cognitive effort devoted to meaningful learning processes) (Paas & van Merriënboer, 2020; Sweller et al., 2023).

When instructional materials impose excessive extraneous load, learners' limited working-memory resources may become overwhelmed, reducing their ability to process and retain new information. For autistic and ADHD learners, executive-function challenges—including difficulties with planning, organization, and sustained attention—can magnify the effects of extraneous load (Tancredi et al., 2025).

In conventional classroom tasks, students are often required to interpret lengthy instructions, manage multiple steps simultaneously, and monitor their own progress. Such demands can exceed working-memory capacity, particularly when instructions are ambiguous or poorly structured (Sweller et al., 2023).

Integrating UDL with CLT suggests a design goal of minimizing extraneous load while supporting germane cognitive processing through explicit scaffolds for planning, monitoring, and strategy use. Within this integrated framework, digital tools may help externalize cognitive processes by organizing information, segmenting tasks, and providing prompts that guide learner decision-making (Paas & van Merriënboer, 2020).

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Artificial Intelligence as Cognitive Scaffolding in Inclusive Classrooms

Recent advances in artificial intelligence have generated significant interest in the potential of AI-driven learning environments to support adaptive and personalized learning experiences. AI systems are increasingly capable of generating real-time feedback, recommending adaptive learning pathways, and presenting multimodal explanations tailored to individual learner needs (Chen et al., 2020; Holmes et al., 2022; Luckin et al., 2022).

When intentionally integrated within instructional design, such tools may function as cognitive scaffolds that support executive processes for learners. AI-mediated prompts, structured feedback, and visual organizers can help students externalize planning and monitoring tasks, thereby reducing executive overload and allowing learners to focus more effectively on conceptual understanding (Holmes et al., 2022).

In inclusive classrooms, these features may be particularly beneficial for neurodiverse learners by providing structured guidance, immediate feedback, and opportunities for self-paced engagement. Research on AI-supported writing tools suggests that adaptive prompts and feedback mechanisms may enhance learner autonomy and support differentiated learning pathways when guided by effective instructional design (Kohnke & Moorhouse, 2021).

However, scholars caution that many implementations of AI in education remain tool-centric, emphasizing algorithmic capabilities rather than alignment with pedagogical frameworks (Kasneci et al., 2023). Without intentional alignment with inclusive design principles, AI systems may inadvertently increase extraneous cognitive load through complex interfaces, excessive prompts, or ambiguous feedback (Holmes et al., 2022).

Maintaining a human-in-the-loop approach—where teachers mediate and contextualize AI-generated feedback—remains critical to ensuring that AI-supported instruction remains pedagogically meaningful and responsive to learner needs (Holmes et al., 2022).

Gaps in the Literature

Across these strands of scholarship, several gaps emerge. First, although Universal Design for Learning and Cognitive Load Theory provide powerful frameworks for inclusive instructional design, relatively little empirical research has examined how artificial intelligence can operationalize these frameworks within mainstream secondary classrooms that include neurodiverse learners.

Second, much of the literature on AI in education emphasizes technological performance and personalization algorithms rather than the lived learning experiences of students with autism, ADHD, perceptual processing differences, or behavioural challenges (Zawacki-Richter et al., 2019; Holmes et al., 2022).

Finally, the relational and pedagogical dimensions of AI integration—including teacher mediation, student autonomy, and perceptions of fairness—remain underexplored. Understanding how AI can support learner agency while maintaining ethical and inclusive classroom practices is therefore an important area for further investigation.

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Transition to the Present Study

Addressing these gaps requires classroom-based research that examines how AI tools interact with instructional practices, learner variability, and teacher mediation within authentic learning environments. Longitudinal qualitative research can provide valuable insight into how AI-supported instructional strategies evolve over time and how students engage with these technologies within everyday classroom activities.

Building on these theoretical and empirical insights, the present study investigates how AI-mediated feedback and adaptive learning pathways can support neurodiverse learners within an inclusive middle-school English classroom over a two-year period. By examining teacher and student reflections through the combined lenses of Universal Design for Learning and Cognitive Load Theory, the study contributes an empirically grounded account of how AI can be designed and orchestrated as a cognitive scaffold in inclusive classrooms. The study ultimately proposes an Inclusive AI Design Framework intended to guide educators in integrating AI-supported tools within inclusive instructional environments.

METHODOLOGY

Research Design

This study adopts a qualitative longitudinal case study design to examine how artificial intelligence (AI) can function as a cognitive scaffold for neurodiverse learners within an inclusive middle-school English classroom. Qualitative case study approaches are particularly suited to exploring complex educational phenomena within real-world contexts, allowing researchers to capture detailed insights into instructional practices, learner experiences, and classroom dynamics (Merriam & Tisdell, 2021; Yin, 2023).

A longitudinal design was selected to observe how AI-supported instructional practices evolved over time and how students interacted with these supports across two academic years. This approach enabled the study to examine patterns in student engagement, teacher mediation, and the development of AI-supported scaffolding strategies within authentic classroom conditions. The overall instructional design and data collection process implemented in the study is illustrated in Figure 1.

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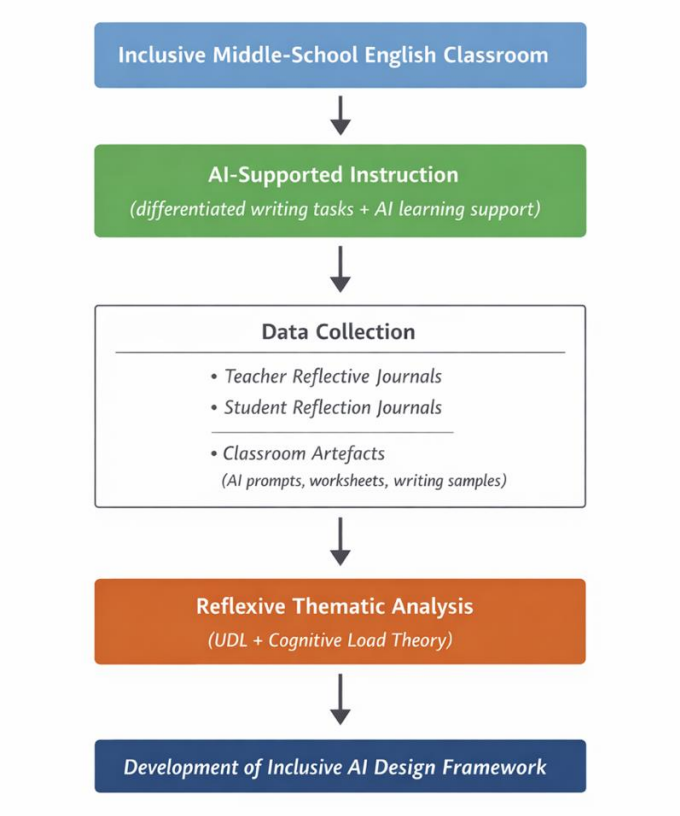

Figure 1: AI-Supported Instructional Design and Data Collection Process

Research Context

The study was conducted in an international secondary school in Riyadh, Saudi Arabia, within a Grade 7 English classroom consisting of 25 students aged 12–13 years. The classroom followed a literacy-focused curriculum emphasizing reading comprehension, structured writing tasks, speech preparation, and paragraph development.

The research took place over two academic years (August 2024 – May 2026), spanning approximately 20 months of classroom instruction. English lessons occurred four times per week, with each lesson lasting 45 minutes. AI-supported instructional strategies were integrated primarily during writing units, including activities such as speech writing, paragraph development, and argumentative writing tasks.

Within this classroom context, artificial intelligence tools were introduced as instructional supports to assist both teachers and students during writing and language learning activities. The integration of AI was guided by principles of Universal Design for Learning (UDL), which emphasize providing multiple means of engagement, representation, and action and expression to accommodate learner variability (CAST, 2024; Rao et al., 2021).

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Participants

Participants consisted of 25 students enrolled in a Grade 7 inclusive English classroom. The class included a diverse cohort reflecting the inclusive learning structure of the school.

Within the class:

- 2 students were formally identified as autistic
- 3 students had ADHD diagnoses
- 1 student had Irlen Syndrome
- several students presented behavioural or executive-function challenges documented through school learning support records

Both neurodiverse and neurotypical students participated in the same instructional activities examined in this study. Including the entire classroom allowed the research to capture how AI-supported instruction functioned within an authentic inclusive learning environment rather than isolating specific learner groups.

To protect student privacy, all identifying information was removed and pseudonyms were used when referring to individual students within journal excerpts.

Instructional Intervention

Artificial intelligence tools were integrated into classroom instruction in two primary ways: teacher-mediated differentiation and student-supported writing processes.

First, the teacher used AI-assisted tools to generate differentiated learning materials aligned with classroom writing tasks. These materials were produced using large language model tools available through the Google Workspace AI environment (Google Gemini / Google Gems).

Although all students worked toward the same English learning objective, the structure and complexity of worksheets varied according to learner needs. Some materials included:

- scaffolded prompts
- simplified instructions
- visual organizers
- chunked writing tasks
- step-by-step planning supports

These differentiated materials were designed to reduce extraneous cognitive load and support executive functioning during writing tasks, consistent with principles of Universal Design for Learning and Cognitive Load Theory (Sweller et al., 2023).

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For example, the teacher used prompts such as:

> *"Generate a Grade 7 paragraph writing worksheet about environmental responsibility. Provide three versions: (1) scaffolded version with step-by-step prompts, (2) visual organizer version with idea mapping, and (3) standard paragraph structure for independent writers."*

All AI-generated materials were reviewed and adapted by the teacher before use in class, reflecting a human-in-the-loop approach in which AI-generated outputs were mediated through professional pedagogical judgment (Holmes et al., 2022).

Second, students were permitted to use AI tools as learning supports during writing and speech preparation activities. During these activities, students used AI to:

- brainstorm ideas for writing tasks
- organize arguments and paragraph structure
- receive grammar suggestions
- refine written responses

Examples of student prompts included:

> *"Help me brainstorm three ideas for a speech about protecting the environment."*

> *"Can you help me improve the grammar and structure of this paragraph, without out changing my idea?"*

These AI-supported prompts were intended to support the writing process rather than replace student thinking, and teacher guidance emphasized evaluating AI suggestions critically. The process used to generate differentiated writing materials and guide student interaction with AI tools is illustrated in Figure 2.

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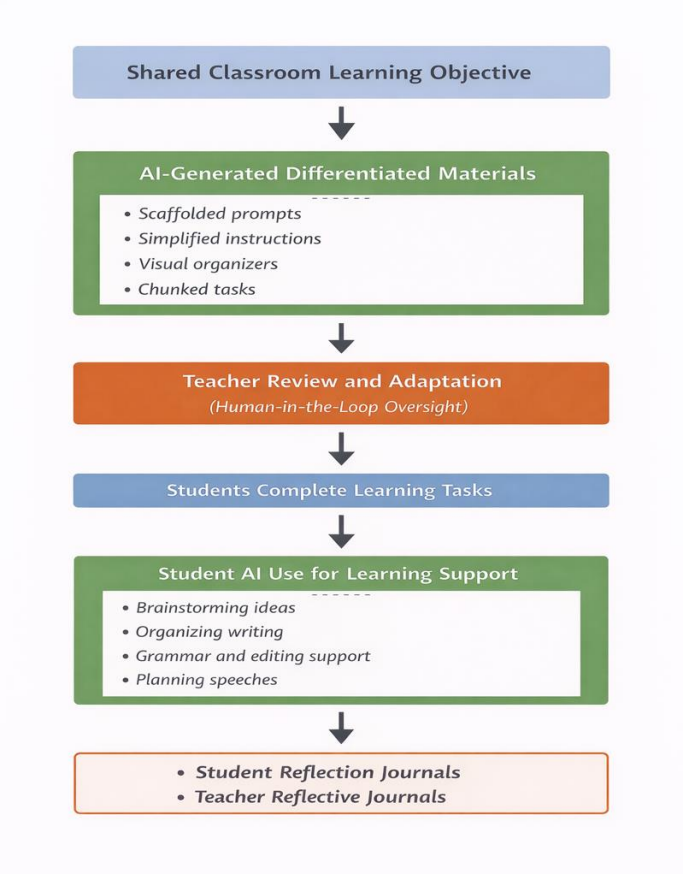

Figure 2: AI-Supported Differentiated Instruction Process

Data Collection

Two primary sources of qualitative data were collected throughout the study.

Teacher reflective journals documented instructional decisions, classroom observations, and reflections on how AI-supported activities influenced learner engagement, task completion, and participation. These journals were completed weekly during writing units, resulting in approximately 60 teacher journal entries across the study period.

Student reflection journals were also collected to capture learners' perspectives on their experiences using AI tools during writing activities. Students were invited to reflect on task difficulty, their interaction with AI prompts and how AI feedback influenced their writing process.

Student reflections were collected at the end of selected writing lessons, generating approximately 180 student journal responses across the two-year study period.

In addition to journals, classroom artefacts such as AI-generated worksheets, writing prompts, and anonymized student writing samples were reviewed to provide contextual insight into how AI-supported instructional strategies were implemented in practice.

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Data Analysis

Data were analysed using reflexive thematic analysis, a qualitative method for identifying patterns and themes across textual data (Braun & Clarke, 2021). Coding followed Braun and Clarke's six-phase approach, including familiarization with the data, initial coding, theme development, theme review, theme definition, and final reporting.

The analysis was guided by the theoretical lenses of Universal Design for Learning (UDL) and Cognitive Load Theory (CLT).

Initial coding focused on identifying instances where AI-mediated supports functioned as instructional scaffolds. Codes were developed to capture patterns related to:

- scaffolded feedback
- adaptive task pathways
- executive-function support
- learner autonomy
- cognitive load management

Through iterative coding and analytic mamboing, these codes were grouped into broader themes that reflected how AI tools interacted with inclusive instructional practices within the classroom.

To enhance trustworthiness, the analysis process included reflective memo writing and iterative refinement of codes throughout the study. These procedures align with qualitative research practices emphasizing transparency and reflexivity in classroom-based research (Merriam & Tisdell, 2021).

Ethical Considerations

Ethical procedures were implemented to protect student privacy and ensure responsible research practices. Participation in reflection activities was voluntary, and all collected data were anonymized prior to analysis. No identifying information about individual students is included in the study.

The research adhered to ethical guidelines for classroom-based research involving minors, including parental awareness of classroom activities involving digital learning tools and the use of anonymized data for research purposes.

FINDINGS

The thematic analysis of teacher reflective journals and student reflection journals revealed four interrelated themes illustrating how AI-supported instructional practices functioned as cognitive scaffolds within an inclusive middle-school English classroom. These themes highlight how AI-mediated feedback supported learner autonomy, enabled flexible task design,

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reduced cognitive load, and influenced students' social-emotional engagement with writing tasks.

Theme 1: AI-Mediated Feedback as a Scaffold for Learner Autonomy

One prominent finding across both teacher and student reflections was the role of AI-generated feedback in supporting students' ability to independently manage aspects of the writing process. Students frequently reported using AI-generated suggestions to plan revisions, refine ideas, and improve sentence structure before seeking teacher assistance.

A student reflected in their journal:

> *"The AI helped me see how to fix my paragraph when I didn't know what to change."*

Another student described how AI suggestions supported the early stages of writing:

> *"When I didn't know how to start my speech, the AI gave me ideas and I could choose the one I liked."*

Teacher reflective journals similarly documented a gradual shift from teacher-directed instruction toward more student-initiated problem solving. In one journal entry, the teacher noted:

> *"Several students began revising their work using AI suggestions before asking for help. This reduced the number of direct prompts needed and allowed students to take greater ownership of the writing process."*

These observations suggest that AI-mediated feedback functioned as an external cognitive scaffold, supporting students' ability to monitor and revise their work more independently.

Theme 2: Adaptive Pathways Enable Flexible Task Design

A second theme involved the ways in which AI-supported differentiation enabled more flexible task pathways within the classroom. Although all students worked toward the same writing objectives, AI-generated worksheets allowed tasks to be presented at varying levels of scaffolding and complexity.

Students selected visual organizers that supported idea generation, while others chose scaffolded prompts that structured the writing process into smaller steps. One student explained this choice in their reflection journal:

> *"I used the organizer worksheet because it helped me see my ideas before writing the paragraph."*

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Another student commented on the usefulness of simplified prompts:

"The steps helped me know what to write next instead of feeling stuck."

Teacher reflections also indicated that these differentiated materials supported inclusive participation within the classroom. One journal entry noted:

> *"Students with different learning needs were able to approach the same writing task using different supports, which helped maintain shared learning goals while accommodating individual needs."*

These findings suggest that AI-supported differentiation enabled multiple pathways for completing the same academic task, aligning with UDL principles that emphasize flexible approaches to learning.

Theme 3: Managing Cognitive Load and Reducing Executive Overload

A third theme related to the role of AI-supported tools in helping students manage executive-function demands associated with writing tasks. AI-generated scaffolds—including checklists, structured prompts, and step-by-step instructions—helped students externalize aspects of planning and organization that might otherwise overwhelm working memory.

Students frequently described how these supports helped them maintain focus during writing activities. One student wrote:

"The checklist helped me remember what to do next so I didn't get confused."

Another student reflected:

"Breaking the task into steps made the writing easier."

Teacher journal entries also noted observable changes in classroom behavior during scaffolded activities. In one reflection, the teacher recorded:

> *"Students who typically struggled to start writing were able to begin more quickly when the task was broken into smaller steps."*

However, teacher reflections also noted occasional over-reliance on AI-generated prompts, prompting the teacher to gradually reduce scaffolding in later lessons in order to encourage independent writing strategies.

Theme 4: Social-Emotional Dimensions of AI Use

The final theme highlighted the social-emotional dimensions of AI-supported learning. Several students reported increased engagement and confidence when AI tools were available to support writing tasks.

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One student wrote:

"It felt easier to try writing because the AI could help if I got stuck."

Another student commented on the perceived fairness of the classroom environment:

"Everyone had the same tools to help them, so it felt fair."

Teacher reflections similarly suggested that students were more willing to attempt challenging writing tasks when AI-supported scaffolds were available. One journal entry noted:

> *"Students appeared more confident in attempting longer writing tasks when they knew that support tools were available."*

Some students initially expressed uncertainty about whether AI-generated suggestions were always correct, but these concerns diminished as classroom discussions emphasized critical evaluation and student choice when using AI feedback.

Synthesis of Findings

Taken together, these findings suggest that AI-supported instructional practices can function as cognitive and organizational scaffolds within inclusive classroom environments when mediated through intentional pedagogical design. Across themes, AI-supported tools appeared to assist students in managing executive-function demands, organizing writing tasks, and engaging more confidently with academic challenges.

Building on these themes, the study proposes an Inclusive AI Design Framework that synthesizes key principles for integrating AI-supported feedback and adaptive learning pathways within neurodiverse classrooms.

The relationship between Universal Design for Learning principles, AI-supported differentiation, and learner autonomy is illustrated in Figure 3.

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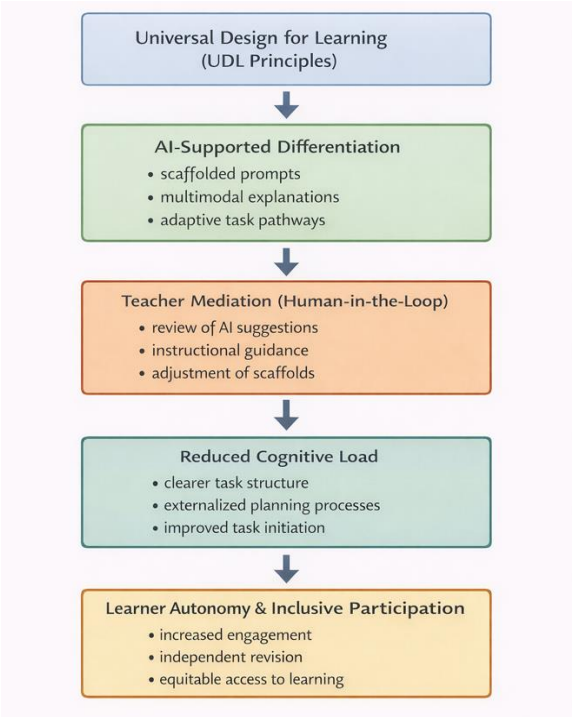

Figure 3: Inclusive AI Design Framework

Note: The framework illustrates how Universal Design for Learning principles guide AI-supported differentiation, mediated through teacher oversight, to reduce cognitive load and promote learner autonomy and inclusive participation.

DISCUSSION

The findings of this study suggest that AI-supported instructional practices can function as meaningful cognitive scaffolds within inclusive classroom environments when mediated through intentional pedagogical design. Across the themes identified in this study, AI tools supported learner autonomy, enabled differentiated task pathways, reduced cognitive load during writing tasks, and influenced students' perceptions of engagement and participation. These findings reinforce emerging perspectives that the educational value of artificial intelligence lies not simply in automation or personalization features, but in how such tools are intentionally integrated into pedagogical practice (Holmes et al., 2022; Zawacki-Richter et al., 2021).

One key finding was the role of AI-mediated feedback as a scaffold for learner autonomy, particularly within writing tasks. Students frequently used AI-generated suggestions to brainstorm ideas, organize arguments, and revise grammatical structures. Teacher reflections indicated that students increasingly initiated revisions independently rather than relying solely on teacher prompts. These observations suggest that AI tools can support the externalization of cognitive processes involved in writing, allowing learners to manage planning and revision more independently. Similar findings have been reported in recent research on AI-supported writing environments, where adaptive prompts and feedback mechanisms were shown to

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promote learner agency and iterative revision practices (Kohnke & Moorhouse, 2021; Holmes et al., 2022).

The findings also align with principles of Universal Design for Learning (UDL), which emphasize designing flexible learning environments that anticipate learner variability rather than responding to it retrospectively. Through AI-generated differentiated worksheets, students engaged with the same learning objectives while receiving varying levels of scaffolding and representation. Some learners benefited from simplified instructions, while others used visual organizers or structured prompts to guide their responses. These practices reflect UDL's emphasis on providing multiple means of engagement, representation, and action and expression, enabling learners to access and demonstrate knowledge through varied pathways (CAST, 2024; Rao et al., 2021). Within inclusive classrooms, such flexibility is particularly important for neurodiverse learners, whose cognitive and sensory needs may differ significantly across learning contexts.

The results further highlight the relevance of Cognitive Load Theory (CLT) in understanding how AI-supported tools may influence learning processes. Writing tasks often require learners to manage several cognitive demands simultaneously, including idea generation, organization, grammar monitoring, and revision. For neurodiverse learners, these demands can create significant executive-function challenges. In this study, AI-generated supports such as step-by-step prompts, checklists, and structured outlines appeared to reduce extraneous cognitive load by externalizing aspects of task organization. By simplifying planning processes and breaking complex tasks into smaller components, AI-supported scaffolds allowed students to allocate greater cognitive resources to composing and refining their responses. These findings are consistent with research suggesting that structured scaffolding and explicit instructional supports can reduce extraneous cognitive load and improve learning outcomes (Sweller et al., 2023; Paas & van Merriënboer, 2020).

At the same time, the findings emphasize the importance of teacher mediation within AI-supported learning environments. Teacher reflective journals indicated that AI tools were most effective when implemented through a "human-in-the-loop" approach, where educators reviewed AI-generated materials, guided students' interactions with AI prompts, and gradually reduced scaffolding as learners gained confidence. This oversight ensured that AI-supported instruction remained aligned with curricular goals and responsive to individual learner needs. Current scholarship similarly stresses that AI should function as a support for instructional design rather than a replacement for professional pedagogical judgment (Holmes et al., 2022; Zawacki-Richter et al., 2021).

Building on these findings, the Inclusive AI Design Framework proposed in this study illustrates how AI-supported differentiation, teacher mediation, and cognitive load management can interact to support inclusive learning environments. Within this framework, AI is conceptualized not as a substitute for teaching but as a cognitive scaffold that extends inclusive pedagogical practices when aligned with UDL principles and guided by teacher expertise. By positioning AI within a broader ecosystem of inclusive instructional design, the framework provides a conceptual model for integrating emerging technologies in ways that prioritize accessibility, learner autonomy, and equitable participation.

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Taken together, these findings suggest that the effectiveness of AI in inclusive education depends less on the sophistication of the technology itself and more on how it is embedded within thoughtful pedagogical structures. When AI tools are aligned with inclusive design frameworks and mediated through professional teaching practice, they may offer meaningful opportunities to reduce cognitive barriers and support neurodiverse learners' participation in mainstream classroom environments.

LIMITATIONS AND FUTURE RESEARCH

While this study provides insight into the integration of AI-supported instructional practices in an inclusive middle-school English classroom, several limitations should be acknowledged. First, the research was conducted within a single classroom cohort in one international school, which may limit the generalizability of the findings to other educational contexts. Classroom culture, teacher practices, and access to technological resources may influence how AI-supported instruction is implemented and experienced by students. Second, the study employed a qualitative case study design that relied primarily on teacher reflective journals, student reflection journals, and classroom artefacts. While these sources provided rich insights into classroom experiences, they reflect subjective interpretations of learning processes.

Additionally, the researcher's dual role as teacher and researcher may introduce interpretive bias despite efforts toward reflexivity. Future research could expand this work through multi-site case studies, incorporate additional data sources such as classroom observations, and examine the longer-term impact of AI scaffolding and gradual "fading" strategies on learner autonomy and self-regulation (Holmes et al., 2022).

IMPLICATIONS FOR PRACTICE

The findings of this study offer several implications for educators, developers, and educational policy contexts seeking to integrate AI tools within inclusive classrooms. For practitioners, AI-supported instruction may be most effective when implemented through a cyclical process that includes diagnosing learner needs, configuring AI-supported tasks aligned with Universal Design for Learning (UDL) checkpoints, monitoring student engagement, and adjusting scaffolds accordingly. In English classrooms, AI-generated prompts, structured outlines, and differentiated worksheets can help students manage complex writing tasks while maintaining shared learning objectives. For developers, AI platforms should enable granular customization of feedback frequency, modality, and difficulty levels while providing transparent analytics that allow teachers to review and guide AI-supported learning processes. Co-design approaches involving educators and neurodiverse learners may further improve accessibility and reduce bias in AI systems. At the policy level, educational institutions should consider embedding inclusive AI guidelines within existing inclusive education frameworks, emphasizing ethical use, data privacy, and equitable access to AI-supported learning environments (CAST, 2024; Holmes et al., 2022).

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CONCLUSION

This study examined how AI-supported instructional practices can function as cognitive scaffolds within an inclusive middle-school English classroom when aligned with Universal Design for Learning and informed by Cognitive Load Theory. The findings indicate that AI tools can support learner autonomy, reduce cognitive barriers associated with writing tasks, and enable differentiated pathways that respond to learner variability. Importantly, the study highlights that the effectiveness of AI in inclusive classrooms depends not on the technology itself but on how it is integrated within intentional pedagogical design. When mediated through teacher oversight and aligned with inclusive instructional frameworks, AI-supported tools can extend existing teaching practices by providing flexible supports that enhance accessibility and engagement. The Inclusive AI Design Framework proposed in this study offers a practitioner-informed model for integrating AI-supported feedback and adaptive learning pathways within mainstream classrooms. Ultimately, AI should not replace teachers; rather, when thoughtfully implemented, it can support educators in creating more responsive and equitable learning environments for neurodiverse learners.

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