

# Universal design for learning and artificial intelligence in the digital era: Fostering inclusion and autonomous learning

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## ABSTRACT

In the digital era, the convergence of universal design for learning (UDL) principles and artificial intelligence (AI) stands as a transformative force shaping education. This article explores their intersection, emphasizing their combined impact on fostering inclusion and autonomous learning through the lens of UDL's multiple means of representation, engagement, and expression. UDL, committed to inclusivity by providing various ways for students to access, engage with, and demonstrate understanding of content, synergizes with AI's transformative capabilities. The article presents three practical applications illustrating how the integration of UDL and AI, employing multiple means, enhances autonomous learning, eliminates barriers, and cultivates inclusive educational spaces. This collaboration not only addresses immediate challenges but also serves as a catalyst for systemic change, paving the way for a more just and equitable educational landscape in the digital era. Continuous reflection, ethical considerations, and purposeful integration of UDL principles and AI are essential for refining these approaches and ensuring a responsive educational system that promotes inclusion and autonomy.

**Keywords:** universal design for learning, artificial intelligence, autonomous learning, inclusion

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## INTRODUCTION

Education in all its various aspects is experiencing a growing influence from the digital world, where technology is progressively employed to impart education, knowledge, and skills through novel and innovative approaches (Grand-Clement, 2017). Thus, in this rapidly evolving landscape of education, the digital era has covered a profound transformation, redefining the ways in which teaching and learning is approached. As traditional educational paradigms give way to innovative technologies, the empowerment of students through inclusive scenarios and autonomous learning should be taking relevance nowadays.

On the one hand, in many different educational scenarios, inclusive education stands as a fundamental aspect reflecting imperative values for the society. It encompasses a system of education that incorporates and embraces all students, providing a supportive environment for them to learn regardless of their identity, abilities, or specific needs. The aim is to ensure that no one is excluded from the educational process, and every child, including those with disabilities, has the right to access inclusive education (UNICEF, 2017).

Moreover, independence is becoming increasingly significant for developing a capacity of individuals to assume their own learning. Different findings highlight students' attempts to autonomously navigate their learning path. These new trends empower students to

participate actively and assume leadership responsibilities, nurturing a feeling of ownership over their educational pursuits (Farikah et al., 2023).

When it comes to updating educational practices, digital technologies have played a crucial role. They have facilitated various teaching methodologies and boosted computer proficiency among both educators and learners, resulting in more interactive, adaptable, and inventive classroom experiences (Pratiwi & Waluyo, 2023). It is a fact that the combination of digital tools and educational methodologies not only enhances the accessibility of knowledge but also opens a way for promoting a learner-centric approach. In this sense, this new era presents important challenges that demand innovative ideas.

A recent protagonist of this technological revolution is placed by artificial intelligence (AI), a powerful tool that has been increasingly revolutionizing the way teaching and learning is approached. Taking into consideration these advancements, the concept of universal design for learning (UDL) has to emerge as a guiding principle, advocating for inclusivity and autonomous learning in education. McMahon and Walker (2019) address the importance of leveraging emerging technologies to design an inclusive educational future through UDL. They emphasize on the need not to fear new technologies but to explore how they can benefit inclusive education. Integrating technology with familiar educational practices, adapting technology to pedagogical

needs, and applying UDL approach are key aspects to create accessible and equitable educational environments.

Achieving inclusivity is essential not only for its intrinsic worth but also as an avenue to promote autonomous learning. UDL and AI altogether play a role in providing fair access to educational opportunities by accommodating the requirements of various student populations. By adopting AI and thoughtfully incorporating it with a UDL perspective, educators can guarantee that their learning environments are not only more inclusive but also well-prepared to address the varied requirements of every student. This preparation ultimately equips students for success in a world, where technology and AI will continue to hold substantial importance (Wolf, 2023).

This convergence between UDL and AI not only enhances the personalization of learning experiences but also addresses disparities presented within every educational system, fostering an environment, where individuals of varied backgrounds, abilities, and learning styles can actively participate and thrive. In this sense, UDL principles, when combined with AI, enhance accessibility by addressing barriers to learning. This ensures that digital content is not only personalized but also accessible to individuals with diverse needs, promoting an inclusive learning environment, where everyone can participate and succeed.

This integration becomes a comprehensive approach to addressing the challenges and opportunities of the digital era fostering autonomous learning and creating inclusive learning environments. To cultivate learner autonomy, students are not merely given free will to choose their activities. On the contrary, fostering learner autonomy involves creating a sense of ownership in regarding their learning, imparting the necessary learning strategies for effective learning, and offering opportunities for them to make choices and decisions about their own educational journey (Intraboonsom et al., 2020).

Likewise, to establish inclusive education, educators must recognize the impact of technology, pedagogy, and content in either reinforcing or combating inequity. It is crucial for teachers to understand how to attain inclusive education in a learning setting, harnessing the inclusive learning opportunities that technology offers while mitigating any potential drawbacks associated with its use (Slotman et al., 2023).

This article aims to serve as a comprehensive guide for educators seeking to harness the full potential of the digital era by integrating UDL and AI in learning environments. Through the presentation of three practical applications, this paper seeks to establish a clear methodology for creating a pertinent relationship between UDL and AI. By delving into the practical implementation of this combination, educators can gain insights into the dynamic ways these approaches can collaborate to foster more inclusive learning environments and promote autonomous learning. The provided practical applications outline a coherent methodology, offering a step-by-step guide to help educators navigate the complexities of combining UDL and AI, ultimately contributing to the creation of educational spaces that are accessible, equitable, and tailored to the diverse needs of learners in the digital era.

## DESIGN FOR LEARNING: AN IMPACT ON EDUCATION

UDL is a framework designed to enhance and optimize the educational process for all individuals, utilizing scientific insights into

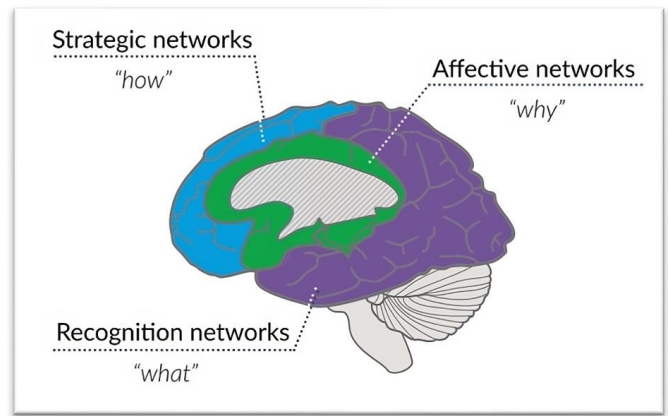


Figure 1. UDL & learning brain (CAST, 2018)

the principles of human learning (CAST, 2024). The fundamental concept of UDL involves creating instructional materials, methods, and assessments that are not only accessible but also effective for a broad spectrum of learners, encompassing different abilities, learning styles, and backgrounds.

According to Rao (2020), the essence of UDL lies in the concept of learner variability, which acknowledges the diversity in individuals' abilities, needs, strengths, and preferences. It emphasizes that these learner characteristics are dynamic and not fixed; they can evolve and fluctuate based on the context and surroundings. When educators incorporate the consideration of learner variability into their instructional design, they can provide flexibility, offer choices, and integrate instructional supports that prove beneficial for a wide range of learners. This approach ensures that the educational environment is adaptable to the evolving and diverse needs of individuals.

UDL framework is grounded in three key principles that instruct educators to devise multiple means of engaging students, representing content, and encouraging student expression. The means associated with UDL correspond to a neurological organization illustrated in Figure 1.

In general, sensory information entering the brain, such as visual and auditory stimuli, is initially received in the posterior regions, including the occipital and temporal lobes (recognition networks). This information is then processed and conveyed for meaning at the central part of the brain (affective networks), and finally, organized in the frontal lobes for response or action (strategic networks). Although the processing may not strictly follow a linear progression, conceptualizing these three broad learning networks can be beneficial when designing learning experiences (CAST, 2018). Also, through the application of these principles, educators create adaptable instructional experiences that encompass various options to cater to the diverse needs of learners.

Yet, it is important to remark that these guidelines must heavily be influenced by students' contributions and input. While many students may not be familiar with the term UDL, their primary concern lies in ensuring that their learning environment caters effectively to both their own needs and those of their peers. They prioritize practices that are effective, flexible, and diverse in teaching and learning methods, as well as a system that guarantees progress and maintains quality standards. UDL enables students to actively engage in their studies, be well-prepared, and conscientiously contribute to their learning experience (Universal Design License to Learn, 2016).

As a consequence, UDL aims to establish a versatile learning setting that eliminates obstacles to learning and advocates for inclusivity. By acknowledging and catering to the varied needs of learners, UDL seeks to guarantee an equal opportunity for everyone to access, engage in, and gain from education. This strategy proves especially beneficial in addressing the diverse learning preferences and capabilities of students, cultivating a more inclusive and supportive educational experience. Achieving autonomous learning within UDL involves strategies such as personalized learning plans, choice and flexibility, technology integration, goal setting, skill development for self-advocacy, inclusive learning materials, collaborative communities, and continuous feedback. This approach empowers students to take control of their education, fostering a mindset of continuous learning and adaptability for the challenges of the digital era.

Taking into consideration the previous framework of UDL, the promotion of inclusion and autonomous learning becomes an imperative process within educational environments. By considering the networks, teachers can plan for personalized learning opportunities tailored to individual needs, and also foster students to gain their own autonomy through the educational journey. The integration of technology, such as AI, enhances accessibility and facilitates personalized learning experiences, enabling students to engage with diverse methodologies based on their needs.

Overall, UDL principles and AI play a crucial role in supporting inclusion and autonomous learning allowing teachers and students to create collaborative communities to expand spaces for peer support and collaboration, enhancing the learning experience. In this sense, educators along with students can create dynamic and inclusive learning environments that empower the learning process and help each individual to become autonomous learners.

### Multiple Means of Representation

Multiple means of representation is a fundamental principle of UDL, designed to make learning accessible to all students. It addresses recognition networks and the “WHAT” aspect of learning. Learners vary in how they perceive and understand presented information. There is no single method of representation that suits all learners optimally; offering diverse options for representation is crucial (CAST, 2024). This principle recognizes the diverse ways individuals perceive and comprehend information, emphasizing the provision of multiple avenues for presenting content. The goal is to ensure that learning materials can be accessed and understood by learners with varying abilities, backgrounds, and preferences.

Basically, multiple means of representation in UDL is about acknowledging and embracing diversity in how learners process and understand information. It aims to create a learning environment, where students can access, comprehend, and engage with the content in ways that align with their individual strengths and preferences. By incorporating flexibility in the presentation of information, educators can better support the varied needs of their students, ultimately fostering a more inclusive, effective and personalized learning experience.

### Multiple Means of Engagement

Multiple means of engagement is a core principle within UDL framework, aimed at making education more accessible to a diverse range of learners. It involves affective networks and the “WHY” aspect of learning. Emotions are a pivotal component of the learning process,

and there are substantial differences among learners in how they can be motivated or engaged in learning (CAST, 2024). As a consequence, this principle underscores the importance of providing multiple pathways for learners to engage with and participate in the learning process. Instead of a one-size-fits-all approach, it acknowledges and embraces the varied interests, motivations, and preferences of individual students.

Within the context of UDL, the principle of multiple means of engagement encourages educators to offer various options for students to connect with the learning content. This involves recognizing that students have different interests, levels of motivation, and ways of engaging with material. By incorporating a variety of activities, projects, and interactive elements, educators can create an environment that caters to diverse interests, keeping students engaged and invested in their learning.

The principle also emphasizes the importance of providing choices in how students demonstrate their understanding of the material. This allows learners to express their comprehension in ways that align with their strengths and preferences, fostering a sense of autonomy and ownership over their learning process.

In summary, multiple means of engagement in UDL is about creating an inclusive and flexible learning environment that acknowledges and accommodates the diverse motivations and interests of students. By offering multiple avenues for engagement and providing choices in how students demonstrate their understanding, educators can enhance the overall learning experience and promote a more customized education, where each individual can become protagonist of its own learning process.

### Multiple Means of Expression

Multiple means of expression is a foundational principle within UDL framework, designed to address the diverse ways in which students can demonstrate their understanding and knowledge. It involves the strategic networks and the “HOW” aspect of learning. There are variations among learners in how they navigate a learning environment and articulate their understanding of the content (CAST, 2024). This principle recognizes that individuals have varied strengths, preferences, and modes of communication, and it emphasizes providing multiple options for learners to express themselves.

Within the context of UDL, multiple means of expression encourages educators to offer diverse methods for students to showcase their learning. This involves recognizing that individuals may have different preferences and abilities when it comes to communication and expression. By allowing students to choose from various assessment options, such as written assignments, oral presentations, or project-based assessments, educators accommodate a range of learning styles and provide opportunities for each student to demonstrate their understanding in a way that aligns with their strengths.

Additionally, the principle supports the integration of technology and tools that facilitate alternative means of expression. This might include speech-to-text applications, multimedia creation tools, or collaborative platforms, allowing students to leverage their strengths and preferences in demonstrating what they have learned.

In essence, multiple means of expression in UDL is about fostering an inclusive environment, where students can express their understanding through methods that best suit their individual abilities and preferences. By providing diverse avenues for expression,

educators enhance the accessibility of assessments, promote student autonomy, and ensure that each learner has the opportunity to demonstrate their knowledge in a way that reflects their unique strengths.

## ARTIFICIAL INTELLIGENCE: A TRANSFORMATION IN EDUCATION

AI is a field within computer science that strives to develop machines and systems with the capability to perform tasks typically associated with human intelligence. AI seeks to empower computers to generate human-like tasks based on data, emphasizing the need to scrutinize results for accuracy and reliability in a manner akin to evaluating traditional human-generated conclusions (Wayne Resa, 2018). These tasks range from learning and problem-solving to understanding natural language and visual perception. AI systems are expected to evolve, enhance, and polish their performance progressively, emulating as close as possible the capacity of human intelligence to create knowledge from experiences.

In terms of education, the development of AI has started a fresh era of potential and advancements. The incorporation of AI into educational environments seeks to cater to specific learning requirements and cultivate adaptive, customized learning experiences. The potential of AI lies in revolutionizing the education sector by elevating learning experiences, aiding educators, and furnishing students with personalized learning opportunities. Personalized learning, facilitated by AI-powered systems, entails the analysis of students' learning styles, strengths, and weaknesses. This analysis is used to craft customized methodologies and recommend resources that cater to individual learning needs (Bojorquez & Martínez, 2023).

This way, AI contributes significantly to fostering autonomous learning within a flexible and inclusive educational environment. By having suitable usage of AI, students can access, or even create, personalized learning experiences tailored to their individual needs and preferences. Adaptive algorithms analyze data on students' performance, learning styles, and progress to dynamically adjust content and assessments, ensuring a customized learning journey. AI's ability to provide real-time feedback facilitates continuous improvement, empowering learners to self-regulate and take ownership of their educational progress.

Additionally, AI-managed platforms offer diverse modalities for presenting information, accommodating varied learning preferences and abilities. Through the integration with educational technology, AI creates an inclusive environment by removing barriers to learning, promoting accessibility, and catering to diverse needs. Overall, AI enhances the autonomy of learners, fosters inclusivity, and contributes to the creation of a dynamic and responsive educational ecosystem.

The rise of AI in education signifies a fundamental change, presenting unparalleled chances to improve individual learning experiences. Yet, like any technological progress, ethical concerns, such as the dehumanization of the educational process, concerns about data privacy, algorithmic bias, equity in technology access, and potential social and cultural impacts (Soledispa et al., 2024), and the necessity for human supervision are critical elements to manage. Finding an equilibrium between leveraging AI's potential and addressing ethical considerations ensures that education retains its focus on humanity,

enhanced by intelligent technologies. Hence, Riki (2023) and Soledispa et al. (2024) state that these debates underscore the significance of creating and deploying AI in education that is ethical, inclusive, collaborative and responsible. An effective AI education should integrate the support of technology with the essential role of teachers, ensuring it benefits all students without widening the access gap or diminishing the human aspect of the learning process.

## UNIVERSAL DESIGN FOR LEARNING & ARTIFICIAL INTELLIGENCE: A PARTNERSHIP IN EDUCATION

The collaboration between UDL and AI sets the stage for self-directed learning, a concept in harmony with the digital era's transition towards autonomous learning. By embracing UDL principles, educators create a dynamic educational environment that systematically shuts down barriers to learning, ensuring accessibility for all students.

Autonomous learning is seen not just as a method of teaching and learning, but also as a pathway to grasp the essence of learning itself. It encompasses content acquisition, activity selection, online engagement, and the utilization of digital tools. Research has shown that these technological resources have incentivized learners to take charge of their learning, with guidance from educators to navigate through different materials and provide support to foster motivation (Pratiwi & Waluyo, 2023). As a result, UDL's commitment to providing multiple means fits to implementing diverse methodologies effectively, fostering inclusivity in content delivery. With its adaptive features, AI enables self-directed learning by providing customized resources, feedback, and assistance to learners. In an inclusive setting, autonomous learning goes beyond obstacles, empowering students to partake in self-directed education without constraints.

In addition, UDL and AI, when integrated altogether, have the potential to transform educational systems into inclusive environments that foster autonomous learning, ultimately contributing to the cause of social justice. The connection of these two powerful forces has the capacity to disrupt educational norms, challenge systemic inequities, and set a new standard for educational practices in the digital era.

## UNIVERSAL DESIGN FOR LEARNING & ARTIFICIAL INTELLIGENCE: PRACTICAL APPLICATIONS

UDL and AI can work together to create a more accessible, inclusive, and socially just educational environment. UDL is an educational framework that aims to provide all students with equal opportunities for learning, regardless of their abilities, backgrounds, or learning preferences.

The connection AI-ULD is responsive and flexible, adjusting in real-time to cater to the evolving needs of individual learners. This quality is particularly valuable for learners with disabilities or specific learning needs (Digital Learning Institute, 2023). AI tools enable educators to create personalized content addressing specific learning needs and lowering the challenges of time constraints in finding or generating appropriate instructional material. Simultaneously, students can use AI tools to access or create content that aligns with their individual learning preferences. This dual functionality of AI tools helps

**Table 1.** Multiple means of representation

Objective	Methodology	AI tools
To enhance understanding of a historical event through multiple means of representation.	1. Select a historical event relevant to your curriculum.	
	2. Utilize AI tools to generate diverse representations of the event, such as converting a written account of the event into an audio file using text-to-speech technology; creating visual representations like infographics or timelines, to complement the text-based information; incorporating closed captions or subtitles in videos related to the event to support students with hearing impairments or language differences.	<a href="https://piktochart.com/generative-ai/editor/">https://piktochart.com/generative-ai/editor/</a>
	3. Present the various representations to the students, allowing them to choose the format that best suits their learning style.	<a href="https://www.naturalreaders.com/online/">https://www.naturalreaders.com/online/</a>
	4. Facilitate a class discussion to explore how different representations enhance understanding for various learners. Encourage students to share their preferences and experiences.	<a href="https://wave.video/">https://wave.video/</a>
	5. Assign a project where students create their own representation of the historical event, using any format they find most effective.	

minimize barriers in terms of resource availability and time, promoting a more inclusive educational environment. By integrating AI into the instructional process, and implementing UDL principles, teachers can foster an atmosphere, where diverse learning styles are accommodated, and students are empowered to engage in autonomous learning experiences.

The constant application of UDL principles has great importance in creating inclusive educational spaces and fostering autonomous learning. Through this implementation, educators get to cover the diverse needs of students, recognizing that a one-size-fits-all approach may not be suitable for effective learning. AI tools play a pivotal role in this task, serving not only as valuable resources for teachers but also as empowering tools for students. The following segment explores the practical applications and effective approaches to integrating UDL and AI within educational environments, offering valuable insights and recommendations for educators dedicated to advancing inclusive education in today's digital era.

### Practical Application 1: Multiple Means of Representation

This practical application aims to elucidate the seamless integration of multiple means of representation from UDL with the transformative capabilities of AI. By exploring this synergy, teachers and students gain insights into how diverse learning styles and preferences can be effectively addressed through AI-driven personalized learning experiences. The application showcases how AI can dynamically adapt content presentation to cater to individual needs, offering varied modalities such as text-to-speech, visual representations, and interactive simulations.

**Table 1** provides a comprehensive overview of the learning session, encompassing both the objectives and the didactic methodology employed. In the second phase of this practical application, the promotion of multiple means of representation involves utilizing the capabilities of AI tools to diversify how the event is presented. This includes employing the Natural Reader AI tool to leverage text-to-speech technology, converting a written account of the event into an audio file. This alternative modality caters to learners who benefit from auditory information. Moreover, visual representation is enriched by using the Piktochart AI tool to create infographics or timelines, catering specifically to students who excel in visual learning. Additionally, closed captions or subtitles in videos related to the event, facilitated by the Wave.video AI tool, serve as a supportive measure for students with hearing impairments or language differences, ensuring enhanced accessibility and comprehension.

While the practical application concentrates specifically on point 2 within **Table 1**, emphasizing the integration of multiple means of representation with AI, it is crucial to recognize that optimal results in fostering autonomous learning hinge on addressing the entire didactic sequence. The complete integration of UDL principles and AI should extend across all aspects outlined in **Table 1**, ensuring a cohesive and inclusive approach that caters to diverse learning styles, preferences, and abilities. Acknowledging the interconnectedness of the didactic elements is essential to creating a holistic and effective learning experience for both educators and students.

The incorporation of multiple means of representation presented in this exercise ensures that students with diverse learning styles and abilities can engage with the content in ways that suit their needs, promoting a more inclusive and accessible learning environment. As Edyburn (2005) states, even if UDL principles are incorporated into particular products or utilized to create specific adjustments and adaptations, they always prove how versatile technologies (such as AI) can facilitate student learning in manners that engage and captivate them.

By illuminating the practical implementation of UDL principles enhanced by AI, this application contributes to a more accessible, personalized, and equitable educational experience for all. This not only fosters inclusivity in the learning process but also empowers teachers with innovative tools to engage students effectively.

### Practical Application 2: Multiple Means of Expression

This practical application endeavors to elucidate the implementation of multiple means of expression from UDL through the integration of AI. This application aims to provide insights for both teachers and students on how diverse methods of expression can be facilitated. Demonstrating the practical aspects of using AI tools to offer varied assessment options, including written, oral, or project-based assessments, the application emphasizes the flexibility and inclusivity achieved through this collaborative approach.

**Table 2** provides a comprehensive overview of the learning session, including both the objectives and the didactic methodology. The didactic sequence outlined in **Table 2** is carefully crafted to foster inclusion and autonomous learning, but it is essential to note that the practical application concentrates specifically on point 3 within **Table 2**. This highlights the use of AI tools for personalized assessment methods. Utilizing the TinyWow AI tool, students can generate compelling stories from simple prompts, enhancing their understanding of historical events, for instance.

**Table 2.** Multiple means of expression

Objective	Methodology	AI tools
To utilize AI to offer diverse methods for students to express what they have learned.	1. Choose a specific unit or topic from your curriculum for this exercise.	
	2. Introduce students to AI-assisted assessment tools that support various means of expression (voice typing, speech recognition software, or text prediction tools).	
	3. Provide a demonstration of the AI features, showing students how to use voice typing, speech recognition, or text creation tools within the chosen platform. Ensure students are comfortable with the technology.	
	4. Assign a project related to the chosen unit or topic. The project should allow for various expressions of knowledge, such as a written essay, an oral presentation, a multimedia project, etc.	<a href="https://tinywow.com/">https://tinywow.com/</a> <a href="https://www.recraft.ai/">https://www.recraft.ai/</a>
	5. Encourage students to personalize their assessments based on their strengths and interests (podcast, video, etc.).	
	6. Foster collaboration by allowing students to work with peers who have chosen different means of expression.	
	7. Facilitate a class discussion where students reflect on their learning experiences and the effectiveness of different means of expression.	
	8. Celebrate the diversity of expressions in the classroom.	

**Table 3.** Multiple means of engagement

Objective	Methodology	AI tools
To implement AI-powered personalized engagement strategies to enhance student motivation and inclusivity.	1. Introduce the concept of AI-powered personalization to the students. Explain that the goal is to make learning more engaging by tailoring content to their individual interests, abilities, and learning pace.	
	2. Conduct a survey or class discussion to gather information about each student's interests, hobbies, & preferred learning styles. Use this information as a basis for personalization.	
	3. Utilize the gathered information to create personalized learning activities. Implement adaptive assessments using the chosen AI platform. These assessments should adjust difficulty levels based on individual performance, providing a tailored learning experience for each student.	<a href="https://beta.character.ai/">https://beta.character.ai/</a> <a href="https://www.magicschool.ai/">https://www.magicschool.ai/</a>
	4. Emphasize that the AI-powered platform allows for self-paced learning. Students can progress through the material at a pace that suits their individual needs, promoting a more inclusive and accommodating environment.	
	5. Conduct periodic reflections with students to discuss their learning experiences with the personalized approach.	

Furthermore, the tool allows students to seek explanations in a manner suitable for a five-year-old, facilitating comprehension. Additionally, the Recraft AI tool enables students to swiftly discover various styles for illustrating content, injecting versatility and dynamism into content delivery that resonates with different learning styles. This approach not only fosters creativity but also ensures a more engaging and varied learning experience, aligning with the principles of UDL and harnessing the capabilities of AI to cater to individual preferences and abilities.

Nevertheless, to achieve optimal results in fostering inclusion and autonomous learning, it is imperative to address the entire didactic sequence, ensuring a holistic and cohesive approach that caters to diverse learning styles, preferences, and abilities. The interconnectedness of the didactic elements is crucial for creating a learning experience that maximizes inclusion and autonomy for all participants.

In essence, this principle and the previous practical application illustrate the importance of acknowledging that each student will utilize information differently from their peers. Consequently, teachers should offer flexibility in the tools that are used and the products that are obtained. It is then crucial to recognize that the teacher's active role as a provider of adaptable educational experiences relies on the array of options available nowadays (Sánchez, 2023). By embracing this principle and encouraging students to create their own means of

expression, educators empower learners to become autonomous and actively involved in the learning process, fostering a dynamic and inclusive educational environment.

### Practical Application 3: Multiple Means of Engagement

This practical application represents an innovative model that integrates multiple means of engagement with AI tools. In this methodology, AI tools are strategically employed to diversify learning pathways, offering adaptability to individual learning styles. Interactive virtual environments, real world connections and simulations cater to diverse interests, encouraging hands-on exploration and understanding.

**Table 3** delineates the didactic methodology geared towards achieving the overarching objective of implementing AI-powered personalized engagement strategies to enhance student motivation and inclusivity. Special attention is directed towards point 3, emphasizing the utilization of gathered information to create personalized learning activities. Within this context, the implementation of AI tools plays a pivotal role in promoting multiple means of engagement. One illustrative example is the incorporation of Character.ai, which invites students to engage in conversations with recognized characters. This not only injects an element of novelty and interest but also fosters a sense of engagement by making the learning process more interactive and relatable.

Also, the utilization of MagicSchool AI tools stands out as an exemplification. Among its different capabilities, this tool enables students to establish meaningful connections between specific topics and real-world, updated contexts. By bridging the gap between theoretical knowledge and practical application, MagicSchool not only enhances engagement but also encourages students to perceive the relevance and applicability of their learning. It is imperative to note that the efficacy of AI tools in promoting autonomous learning, as part of UDL principles, is contingent upon the comprehensive implementation of the entire didactic path, not solely restricted to point 3. Each step in the methodology contributes synergistically to fostering a learning environment that is not only engaging but also empowers students to take ownership of their educational journey.

To accomplish the objective of cultivating students as proficient learners, the initial phase involves ensuring their motivation, enthusiasm, engagement, and intrinsic interest in their learning journey. In this regard, fostering student autonomy necessitates granting them options in how they pursue learning objectives and offering the requisite assistance and tools to facilitate their progress (Sánchez, 2023). Thus, the utilization of previous applications and AI tools serves as a model for students to create personalized products related to given subjects, thereby engaging them deeply in the learning process and fostering their development as motivated and self-regulated learners.

## CONCLUSIONS

In conclusion, the intersection of UDL and AI represents a powerful benefit in the evolution of education, offering a transformative approach to inclusivity. The development of AI has prompted educators from diverse backgrounds to engage in reflection, explore various perspectives, assess the impact on teaching and learning, and share both concerns and aspirations. A consensus among many educators is the necessity to reevaluate teaching and learning approaches, and there is a collective call to embrace AI, with the integration of UDL and culturally responsive pedagogies seen not as an option but as an imperative (Saleh, 2023).

The sense of autonomy is regarded as a crucial skill for encouraging learning processes, specifically through the utilization of technologies, to stimulate independent learning. This facilitates not only the inclusion of students in general but also the integration of others with disabilities into the educational process (Massola, 2023). Consequently, holding the principles of UDL empowers educators to establish learning environments that meet the varied needs of students, cultivating a setting characterized by fairness and accessibility. The integration of AI offers personalized learning experiences, diverse content suggestions, and tools designed to counteract biases, ultimately playing an important vital role in creating a more equitable educational landscape.

Inclusive methodologies, particularly when potentialized by UDL principles and AI tools, significantly foster autonomous learning. UDL, with its emphasis on providing multiple means of representation, engagement, and expression, ensures that learners can access content in diverse ways, promoting autonomy in how they perceive and interact with information. The integration of AI tools further enhances this by offering personalized learning experiences according to individual needs, allowing students to engage with content at their own pace and style. The adaptability of AI tools, coupled with UDL, accommodates

diverse learning preferences, ensuring that every student, regardless of their abilities or requirements, can actively participate in and benefit from the learning process. The combination of inclusive methodologies, this partnership creates an environment, where learners and teachers have the flexibility, resources, and support needed to navigate their educational journey autonomously.

Yet, while navigating the collaboration between UDL and AI, it is crucial to take into consideration the ethical considerations associated with the responsible utilization of technology in education. Maintaining a balance between innovation and ethical implementation is essential to maximize the advantages of these technologies without perpetuating inequalities. In this sense, possessing access to digital tools does not guarantee that students will utilize the diverse features effectively, or that they will be used effectively for learning. It is crucial to assess how technology aligns with the goals of lessons and the learning objectives for students. Integration of digital tools into the learning environment should be purposeful, aiming to support individual students and enhance learning for the entire student body (Rao, 2020). Thereby, continuous reflection, adaptation, and collaboration among educators and students will be essential to refine and improve these approaches, fostering pertinent results.

The practical applications act as a starting point for comprehending the possibilities within the collaboration between UDL and AI. By paying attention to these applications, educators and students can collaboratively contribute to shaping a future, where education is inclusive, accessible, and in harmony with the ideals of social justice. With such integration and continuous improvement, there can be a potential to redefine educational standards, minimize inequities, and lead the path toward a more equitable educational experience for all learners in the digital era.

In essence, the combination of UDL and AI serves not only to narrow educational disparities but also to ignite transformative change within the education system. Emphasizing inclusivity and autonomous learning, these methodologies not only embrace the immediate needs of diverse student groups but also establish the foundation of equality, and this should be accomplished by working together, educators and students. In the end, rethinking education demands fresh perspectives on teaching and learning settings to effectively address the unprecedented challenges of the present era. Educators and students must possess the skills and adaptive expertise to collaboratively create and navigate intricate adaptive environments (Lewis & Trépanier-Bisson, 2022).

The goal of ensuring equal opportunities for every student leads to a sense of empowerment and autonomous learning. Through this pedagogical proposal, the collaboration between UDL and AI not only represents technological advancement but also stands as an opportunity to accomplish a more inclusive and self-directed educational environment.

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