General Article

Designing Classroom Learning Experiences for Optimal Pedagogical-Technological Integration: Unifying Universal Design for Learning and User Interface/User Experience Principles

Pranita Gopal

Assistant Professor, Central Institute of Educational Technology, NCERT, New Delhi

Email: pranita.gopal@ciet.nic.in

Abstract

This paper focuses on the integration of Universal Design for Learning (UDL) and User Interface/User Experience (UI/UX) principles in education. It outlines strategies for applying these principles in various educational contexts to create inclusive learning environments that cater to diverse student needs. The integration focuses on adaptable content delivery, incorporating interactive learning experiences, and ensuring the accessibility of digital resources. A comprehensive checklist is provided to help educators assess and improve their practices, aiming for a smooth integration of technology that enhances the learning experience. This checklist covers different classroom technology scenarios, including presentations, videos, educational games, and platforms such as DIKSHA. By following these guidelines, educators can effectively blend UDL and UI/UX principles, ensuring that all students benefit from an enriched and supportive educational environment.

Keywords: Universal Design of Learning, User Interface/User Experience (UI/UX), Student engagement, DIKSHA, Cognitive Load

Introduction

In today's rapidly evolving educational landscape, the seamless integration of pedagogy and technology has become paramount. As educators strive to create engaging and effective learning environments, utilizing the synergy between Universal Design for Learning (UDL) and user interface/ user experience (UI/UX) principles is helpful. The collaboration between Universal Design for Learning (UDL) and user interface/user experience (UI/UX) principles can foster student engagement and ensure inclusivity in the learning process. By aligning these approaches, educators can create intuitive interfaces and personalized learning experiences, providing all students with the chance to actively participate in and benefit from the teaching-learning process.

Theoretical Framework

The theoretical framework serves as both the metaphorical and literal cornerstone upon which ideas are framed and postulated (Grant and Osanloo, 2014) The selection of a theoretical framework in a research study often mirrors the researcher's viewpoint regarding the nature of being (ontological) and one's perspective on the theory of knowledge (epistemological)(Heale and Noble, 2019). The subsequent theoretical constructs are pertinent in this context:

Neuroscience for Classroom Practitioners

Educational neuroscience, an emerging field, has gained attention for its potential to inform theory-

backed classroom instruction through insights from neuroscience. The neural network hypothesis of learning and memory, rooted in the work of Canadian Psychologist Donald Hebb, posits a fundamental mechanism for the strengthening or weakening of connections between brain cells over time. This process, termed synaptic plasticity, forms the basis for knowledge formation. Synaptic plasticity forms the foundation for learning, storing memories in and retrieving them from the set of synapses linked to the acquired object, skill, or experience (Kandel, 2009).

The cognitive processes of memory essential for learning are believed to be rooted in the brain's capacity to generate, reinforce, and eliminate connections. Shulman (1987) categorized teachers' knowledge into seven areas: content knowledge, general pedagogical knowledge, pedagogical content knowledge, curricular knowledge, knowledge of students and the teacher's characteristics, knowledge of educational systems and contexts, and knowledge of educational theories and philosophy. The interplay of these various knowledge domains significantly influences the teacher's lesson design process. Content knowledge serves as the foundational understanding of the subject matter, while pedagogical knowledge encompasses general teaching strategies. Pedagogical content knowledge combines these aspects, emphasizing the specific teaching methods relevant to a particular subject. Curricular knowledge directs the alignment of the curriculum with teaching strategies. Understanding students' characteristics aids in tailoring lesson plans to students' learning styles and needs, fostering effective learning experiences.

Teachers mindful of neuroscience while designing lessons witness increased self-efficacy, motivation, and self-responsibility, deemed crucial components of teacher competency (Brick et al., 2021). Elsewhere, Brick et al., 2021 report that teachers who underwent professional development programs in neuroscience were better equipped in recognizing and aiding students with social, emotional, and behavioural issues – aspects essential for creating meaningful learning experiences for students.

Universal Design for Learning

Ron Mace is credited to have coined the term universal design as a way of *"designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability, or status in life"* (Center for Universal Design, 2010). Literature uses universal design of instruction (UDI) and universal instructional design (UID) as other terms to designate frameworks that aim at providing accessibility to learners. Rao et al.,2014 present a descriptive analysis of thirteen research studies from pre-kindergarten through 12th grade and higher education settings, where they explored the application and assessment of Universal Design (UD) in educational contexts. The Center for Applied Special Technology (CAST) delineates nine guidelines and thirty-one specific checkpoints across three principles, illustrating the incorporation of flexible options and learner supports into lesson design and implementation. The three principles are:

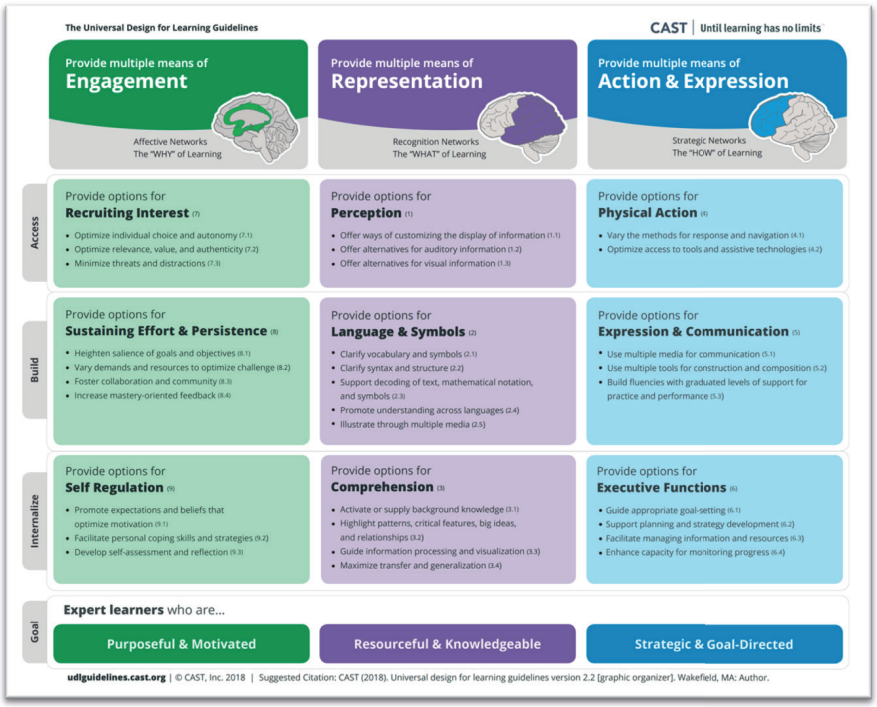
Principle I: Provide multiple means of representation

Principle II: Provide multiple means of action and expression

Principle III: Provide multiple means of engagement

Figure 1 is a graphic representation of the Universal Design for Learning guidelines version 2.2

Figure 1: CAST (2018) Universal Design for Learning Guidelines



Cognitive Load

Cognitive load refers to the mental effort required for learning. Cognitive load research aims to craft instructional techniques that align with the working memory's capacity, fostering optimal learning conditions. Its goal is to develop recommendations conducive to effective learning by adapting to the limitations and capabilities of working memory. Teachers must be mindful of cognitive load as excessive information or complex tasks can overwhelm students, impeding comprehension. Simplifying content, breaking tasks into manageable steps, and employing instructional techniques that reduce cognitive load can enhance learning retention and understanding. Teachers adopting explicit instruction methods can alleviate the cognitive load by presenting information in manageable steps, facilitating better learning retention and understanding. Hattie summarises explicit instruction as an approach in which: The teacher decides the learning intentions and success criteria, makes them transparent to the students, demonstrates them by modelling, evaluates if they understand what they have been told by checking for understanding, and retelling them what they have been told by tying it all together with closure. (Hattie 2009, p. 206). Paas & van Merriënboer (2020) explore how instructional design decisions can effectively manage the learner's working memory resources by considering the attributes of the learning task, the learner, and the learning environment.

UI/UX Principles

The "10 Usability Heuristics for User Interface Design" by Nielsen (2000) are a gold standard in the field of user experience (UX) design due to their universal applicability and ease of use. These heuristics serve as general guidelines that can be applied across a variety of user interfaces, which makes them incredibly versatile. These

heuristics are straightforward and can be quickly leveraged to evaluate and enhance usability, offering a cost-effective way to identify and rectify design issues early in the development process. The principles cover a broad spectrum of design aspects, from error management to aesthetic minimalism, providing a comprehensive toolkit for designers, educators and technology developers. These heuristics are given below:

System Status Visibility: Designs should continuously update users about what's happening through timely and appropriate feedback. This ensures Intuitive navigation and multimedia content and consistent design and clarity.

System-World Realism: The design must use familiar terms and phrases, reducing technical jargon. It should reflect real-world order and conventions. This further ensures clear instructions and immediate feedback are accessible to the user

User Autonomy: Users need clear options to undo actions without going through complex processes, akin to an "emergency exit." This ensures clear navigation and structure of all programs.

Consistency and Norms: The design must ensure consistency in terminology and actions, aligning with the general platform and industry standards. This ensures there is uniformity in design, colour palate and interface.

Error Prevention: The best designs pre-empt issues. It's crucial to either eliminate or check error-prone conditions, offering a verification step before actions are finalized. This ensures immediate feedback is available to the user.

Recognition over Memory: The design should minimize the need for memory recall by making elements and options clearly visible. This ensures the user doesn't always need to decode the symbols and icons used.

Flexible Efficiency: Designs should offer shortcuts that cater to both novice and experienced users, enhancing efficiency for all. This heuristics dictates the need for ensuring clear navigation and bread-crumbs are always available within the environment so as to ensure ease of navigation and accessibility.

Minimalist Aesthetics: Interface design should be simple, only containing necessary information to avoid overwhelming the user. This ensures the design is clutter free and there is little redundancy.

Error Management: Messages should plainly communicate errors and offer constructive recovery steps without technical codes. This ensures the user is engaged within the system.

Documentation Accessibility: While the ideal system is self-explanatory, sometimes supplementary guidance is necessary for user task completion.

Based on these theoretical constructs, the suggestive checklists are designed to integrate the principles of Universal Design for Learning (UDL) and User Interface/User Experience (UI/UX) across various classroom scenarios.

Suggestive Checklist for Integrated UDL and UI/UX Principles across Classroom Technology Scenarios

Effective utilization of Universal Design for Learning (UDL) and User Interface/ User Experience (UI/UX) principles enhances accessibility and cultivates an inclusive learning environment. A structured suggestive checklist assists teachers in seamlessly integrating these principles across diverse classroom scenarios of commonly used technology interventions like presentations, videos from platforms like YouTube, educational games like Kahoot, and

educational apps such as DIKSHA. This adaptable framework empowers educators to skilfully merge technology into teaching practices, addressing varied student needs and optimizing the educational journey. It serves as a flexible guide, enabling teachers to align technology with individual classroom dynamics and student requirements for an enriched learning experience.

Suggestive Checklist - Scenario 1: Using Presentations in the Classroom.

Presentations serve as powerful pedagogical tools, aiding teachers in delivering structured content, visualizing complex concepts, and fostering student engagement. They facilitate interactive learning, stimulate discussions, and cater to diverse learning styles, enhancing comprehension and retention within the classroom setting. They enhance learning by fostering a deeper comprehension of the subject matter while also fuelling student motivation (Lari, 2014). Table 1 presents an Integrated UDL and UI/UX Principles checklist for teachers using presentations in the classroom.

Table-1: Integrated UDL and UI/UX Principles checklist for teachers using presentations in the classroom

Clastsroom Scenario	UDL Principles	Corresponding UI/UX Principles	Checklist for Classroom Practitioners
Teachers use presentations to deliver content in the classroom.	Offer content in diverse formats to cater to varied learners. Remove barriers and ensure equal opportunities for participation. Plan accessible learning experiences that benefit all learners.	Intuitive navigation and multimedia content User-centred design and inclusivity Consistent design and clarity	• Provide information in multiple formats (text, visuals, multimedia). • Ensure the presentation navigation is user-friendly with clear structures (Like demarcation of headings and sub-headings) • Organize content into clear sections for a structured presentation. • Implement easy-to-use navigation tools for seamless movement between slides (Clear next, previous/ back buttons) • Maintain consistent slide layouts for uniformity and easy comprehension (prefer using a consistent theme and design elements) • Include interactive elements for active engagement – like using action buttons and hyperlinks, • Use captivating visuals to reinforce key concepts and sustain attention. • Conduct usability tests to ensure smooth navigation and content comprehension. • Seek feedback from peers or students for continuous improvement. • Regularly assess presentation accessibility to cater to diverse learners.

Clastsroom Scenario	UDL Principles	Corresponding UI/UX Principles	Checklist for Classroom Practitioners
	Provide flexible and diverse learning experiences.	Engagement and interactive design	• Incorporate interactive videos, quizzes, or polls to actively engage students. • Explore different presentation styles (e.g., storytelling, case studies, debates) to cater to diverse learning preferences. • Deliver information using diverse formats (images, infographics, audio clips) to accommodate various learning styles. • Utilize captivating visuals, infographics, and multimedia content to reinforce key concepts and enhance understanding. • Implement adaptable navigation structures to allow students to navigate according to their pace and preferences. • Infuse gamification elements (e.g., challenges, rewards) within the presentation to boost engagement and motivation. • Offer choices within the presentation (e.g., optional activities, branching scenarios) to tailor learning experiences. • Vary the duration of the presentation to accommodate attention spans and learning objectives. • Introduce collaborative activities or group discussions within the presentation to encourage peer learning. • Provide options for students to select learning paths or topics according to their interests or needs. • Include real-life examples or case studies to illustrate practical applications of the content. • Update and refresh presentation content regularly to keep it relevant and current. • Use inclusive language and a conversational tone to ensure the content is relatable and understandable. • Incorporate feedback mechanisms (surveys, discussion forums) for students to share their thoughts or questions. • Provide supplementary resources or further reading materials for students to explore beyond the presentation.

Clastsroom Scenario	UDL Principles	Corresponding UI/UX Principles	Checklist for Classroom Practitioners
	Allow multiple ways for students to demonstrate understanding.	Clear instructions and immediate feedback	• Effective feedback involves targeting specific areas, communicating progress, ensuring timeliness, and allowing students the opportunity to implement received feedback. In a broader context, this encompasses understanding the student's status, evaluating their progress, and determining the subsequent steps forward. Therefore, • Targeting specific areas for feedback. • Communicating progress effectively. • Ensuring timeliness in providing feedback. • Allowing students to practice and implement received feedback. • In a broader context, understanding the student's current status. • Evaluating the student's progress. • Determining the subsequent steps forward.
	Create an adaptable and inclusive learning environment.	Accessibility features and customization	• Maintain the same font type throughout the presentation for readability. • Use different font sizes to emphasize key points while ensuring readability from a distance. • Ensure sufficient contrast between text and background for better visibility. • Avoid overcrowding slides with text; use concise phrases or bullet points. • Use subtle animations sparingly to highlight important content without distraction. • Choose color combinations that are easy on the eyes and aid readability. Some examples of Readable Color Combinations: • Black Text on White Background: • Dark Gray Text on a Light Gray Background – this combination offers a softer contrast, maintaining readability without straining the eyes. • Navy Blue Text on Beige Background: Provides a pleasant contrast while maintaining readability for prolonged viewing. • Organize content using varying font sizes and colors to signify importance and hierarchy. Some ideas include

Clastsroom Scenario	UDL Principles	Correspond-ing UI/UX Principles	Checklist for Classroom Practitioners
			• Title in Bold and Larger Font Size: The main title stands out as the most prominent element, drawing attention. • Subtitles in Slightly Smaller Font: Subtitles or headers are slightly smaller but still larger than the main text, indicating sections or themes. • Bullet Points or Key Information in Bulky Fonts or Colors: Key points or bullet lists in bold or different colors to highlight essential content. • Conduct tests to ensure the presentation is accessible to individuals with visual impairments or disabilities.

Suggestive Checklist - Scenario 2: Using Videos (from YouTube) etc in the classroom

Carmichael, et. al (2018) reveals students' strong inclination towards video-based learning, empowering their independent and flexible educational pursuits. As a result, students actively seek online video content in their courses, indicating a bright and promising future for this instructional format and instilling confidence in educators, librarians, and stakeholders. Table 2 presents an Integrated UDL and UI/UX Principles checklist for teachers using videos in the classroom. This is in continuation of the points mentioned in the previous tables.

Table-2: Integrated UDL and UI/UX Principles checklist for teachers using videos in the classroom

Class Scenario: Using Video Resources (YouTube)	UDL Principles	Corresponding UI/UX Principles	Checklist for Classroom Practitioners
Teachers incorporate YouTube videos for educational purposes.	Offer content in diverse formats to cater to varied learners.	Intuitive navigation and multimedia content	• Ensure the video content has subtitles or transcripts for accessibility. • Enable easy navigation through chapters or timestamps.
	Provide flexible and diverse learning experiences.	Engagement and interactive design	• Use interactive features like quizzes or pause points to reinforce learning. • Offer various video styles (animations, documentaries).

	Allow multiple ways for students to demonstrate understanding.	Clear instructions and immediate feedback	• Provide discussion prompts or reflection tasks after viewing the videos. • Clarify objectives and follow-up activities related to videos.
	Create an adaptable and inclusive learning environment.	Accessibility features and customization	• Ensure videos have proper closed captions and audio descriptions. • Optimize video resolution for diverse device compatibility.
	Remove barriers and ensure equal opportunities for participation.	User-centered design and inclusivity	• Curate a range of videos to address various learning styles and preferences. • Encourage active participation during video sessions.
	Plan accessible learning experiences that benefit all learners.	Consistent design and clarity	• Provide supplementary resources or related materials for deeper understanding. • Maintain consistency in video structure and format.

Suggestive Checklist - Scenario 3: Using Educational Games like Kahoot, Quizzes etc in the classroom

Educational games like Kahoot and quizzes serve as engaging teaching aids, fostering interactive learning experiences. These tools enhance student participation, reinforce key concepts, and provide real-time assessment opportunities for educators. They promote active engagement, stimulate critical thinking, and offer an enjoyable approach to reinforce academic material. Leveraging educational games in classrooms has the potential to reduce distractions, enhancing the quality of both teaching and learning experiences beyond traditional classroom settings (Licorish, 2018).

Research from Forssell, et al. (2023) suggests much like younger demographics, older adults exhibit enthusiasm to participate in educational games, particularly when designed appropriately with tailored features and suitable facilities.

Table 3 presents an Integrated UDL and UI/UX Principles checklist for teachers using online educational games in the classroom. This is in continuation of the points mentioned in the previous tables.

Table-3: Integrated UDL and UI/UX Principles checklist for teachers using online educational games in the classroom

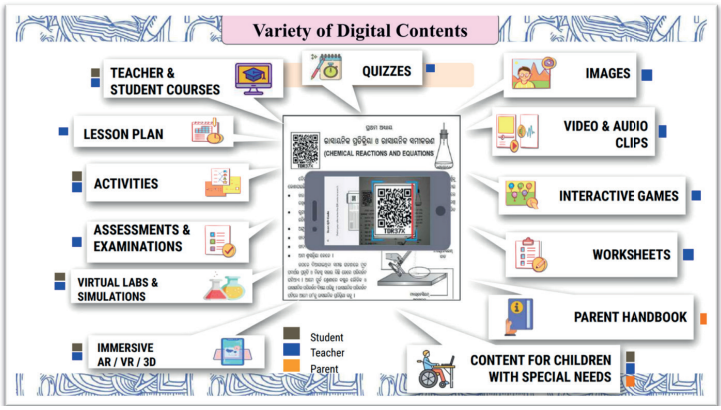
Class Scenario: Playing Online Educational Games (Kahoot, etc.)	UDL Principles	Corresponding UI/UX Principles	Checklist for Classroom Practitioners
Teachers integrate online educational gaming platforms like Kahoot into lessons.	Offer content in diverse formats to cater to varied learners.	Intuitive navigation and interactive design	• Ensure game instructions are clear and accessible to all students. • Allow easy navigation and interaction within the gaming interface.
	Provide flexible and diverse learning experiences.	Engagement and interactive elements	• Include interactive features that engage students actively during gameplay. • Offer various game modes or difficulty levels for learners.
	Allow multiple ways for students to demonstrate understanding.	Immediate feedback and progress tracking	• Provide immediate feedback on answers and track students' progress in the game. • Offer options for students to review their performance.
	Create an adaptable and inclusive learning environment.	Accessibility features and customization	• Ensure gaming platforms are accessible for students with diverse abilities. • Provide audio descriptions or transcripts if necessary.
	Remove barriers and ensure equal opportunities for participation.	User-centered design and inclusivity	• Encourage participation from all students by making games inclusive and fair. • Cater to different learning styles and preferences.
	Plan accessible learning experiences that benefit all learners.	Consistent design and clarity	• Design games with a consistent and user-friendly interface for seamless gameplay. • Offer supplementary materials for post-game review.

Suggestive Checklist- Scenario 4: Using educational platforms like DIKSHA etc, in the classroom

DIKSHA (Digital Infrastructure for Knowledge Sharing) is a digital infrastructure for school education in India, developed by the National Council of Educational Research and Training (NCERT). It's an e-learning platform designed to facilitate teachers' access to quality teaching resources,

aiding in lesson planning and providing interactive content for students. The app offers digital content for K-12 education across various subjects, including textbooks, lesson plans, assessments, and teacher training resources. DIKSHA aims to promote interactive learning and improve the overall quality of education in India by leveraging technology. As an app, DIKSHA not only has static e-learning content but also interactive e-learning content like AR/VR/ Virtual Labs, etc. Figure 2 showcases the varied digital content available in the DIKSHA Platform

Figure-2: DIKSHA (Digital Infrastructure for Knowledge Sharing Infrastructure) – Types of Digital Content



(Accessed from: https://ciet.nic.in/upload/DIKSHA%20Policy%20Perspective%20and%20Scope%20in%20Education.pdf)

The advantage of using platforms is that teachers can direct students to varied levels of content and learning material that are accompanied by exercises and content checklist points. In its present state DIKSHA is yet to help teachers create personalized learning pathways for students, but teachers can direct students to relevant portions of the platform to strengthen classroom experiences. Table 4 presents an Integrated UDL and UI/UX Principles checklist for teachers using educational platforms like DIKSHA in the classroom. This is in continuation of the points mentioned in the previous tables.

Table-4: Integrated UDL and UI/UX Principles checklist for teachers using educational platforms like DIKSHA in the classroom

Class Scenario: Using Educational platforms like (DIKSHA.)	UDL Principles	Corresponding UI/UX Principles	Checklist for Classroom Practitioners
Teachers utilize educational apps for flipped classroom approaches / backward design planning or as a scaffold	Offer content in diverse formats to cater to varied learners.	Intuitive navigation and multimedia content	Ensure app content is available in various formats (text, audio, video) for different learning styles. Enable easy navigation within the app.

	Provide flexible and diverse learning experiences.	Engagement and interactive design	Include interactive features like quizzes or interactive sections for engagement. Offer varied activities to suit different preferences.
	Allow multiple ways for students to demonstrate understanding.	Clear instructions and immediate feedback	Clearly outline tasks and expectations within the app. Provide immediate feedback or progress tracking.
	Create an adaptable and inclusive learning environment.	Accessibility features and customization	Ensure app accessibility for students with different abilities. Provide adjustable settings for personalized use.
	Remove barriers and ensure equal opportunities for participation.	User-centered design and inclusivity	Encourage participation from all students through inclusive app features. Accommodate various learning styles in the app.
	Plan accessible learning experiences that benefit all learners.	Consistent design and clarity	Maintain a consistent interface for easy navigation. Provide supplementary resources within the app.

The presented checklist offers a practical framework, empowering educators to navigate diverse technological scenarios while prioritizing student engagement and inclusivity. As pedagogy continues to evolve alongside technological advancements, the synergy between UDL and UI/UX principles remains instrumental in shaping vibrant, accessible, and personalized learning experiences. By embracing these principles, educators can effectively bridge the gap between theory and practice, ensuring a dynamic and enriched educational journey for all learners.

Reference

Ambrose, Susan A., Michael W. Bridges, Michele DiPietro, Marsha C. Lovett, and Marie K. Norman (2010). "What kinds of practice and feedback enhance learning?" *In How Learning Works: Seven research-based principles for smart teaching* (pp. 121–152). San Francisco, CA: Jossey-Bass.

Benassi, V. A., Overson, C. E., & Hakala, C. M. (2014). *Applying science of learning in education: Infusing psychological science into the curriculum*. Retrieved from the Society for the Teaching of Psychology web site: http://teachpsych.org/ebooks/asle2014/ index.php

Brick, K., Cooper, J. L., Mason, L., Faeflen, S., Monmia, J., and Dubinsky, J. M. (2021a). Tiered neuroscience and mental health professional development in liberia improves teacher self-efficacy, self-responsibility, and motivation. Front. Hum. Neurosci. 15:664730. doi: 10.3389/fnhum.2021.664730

Brick, K., Cooper, J. L., Mason, L., Faeflen, S., Nonmia, J., and Dubinsky, J. M. (2021b). Training-of-trainers neuroscience and mental health teacher education in liberia improves self-reported support for students. Front. Hum. Neurosci. 15:653069. doi: 10.3389/fnhum.2021.653069

Carmichael, et. al (2018) Assessing the Impact of Educational Video on Student Engagement, Critical Thinking and Learning: The Current State of Play. *Sage White Papers*. Accessed from https://us.sagepub.com/sites/default/files/hevideolearning.pdf

CAST (2018). *Universal Design for Learning Guidelines version 2.2*. Retrieved from http://udlguidelines.cast.org

Forssell, et. al (2023) Accessibility of Kahoot! And Quizizz: Utilizing educational games with Elderly Students. C&T '23: Proceedings of the 11th International Conference on Communities and TechnologiesMay 2023Pages 75–84 https://doi.org/10.1145/3593743.3593760

Goodwin, Bryan and Miller, Kirsten (2012). "Good Feedback is Targeted, Specific, Timely". Educational Leadership: Feedback for Learning, Vol. 70, No. 1.

Grant, C. and Osanloo, A. (2014) Understanding, selecting, and integrating a theoretical framework in dissertation research: Developing a 'blueprint' for your "house" January 2015 Administrative Issues *Journal Education Practice and Research* 4(2) DOI:10.5929/2014.4.2.9

Hattie, J. (2009). Visible learning: A synthesis of over 800 meta-ana lyses related to achievement. London: Routledge.

Heale, R., & Noble, H. (2019). Integration of a theoretical framework into your research study. *Evidence Based Nursing*, 22(2), 36–37. https://doi.org/10.1136/ebnurs-2019-10307

Kandel, E. R. (2009). The biology of memory: A forty-year perspective. *The Journal of Neuroscience*, 29(41), 12748–12756. https://doi.org/10.1523/jneurosci.3958-09.2009

Lari, Fateme Samiei. (2014) The Impact of Using PowerPoint Presentations on Students' Learning and Motivation in Secondary Schools, *Procedia - Social and Behavioral Sciences*, Volume 98, Pages 1672-1677, https://doi.org/10.1016/j.sbspro.2014.03.592.

Licorish, S.A., Owen, H.E., Daniel, B. et al. Students' perception of Kahoot!'s influence on teaching and learning. *RPTEL* 13, 9 (2018). https://doi.org/10.1186/s41039-018-0078-8

Nielsen, J., 2020. *Ten usability heuristics for user interface design*. Available from: https://www.nngroup.com/articles/ten-usability-heuristic

Paas, F., & van Merriënboer, J. J. G. (2020). Cognitive-Load Theory: Methods to Manage Working Memory Load in the Learning of Complex Tasks. *Current Directions in Psychological Science*, 29(4), 394-398. https://doi.org/10.1177/0963721420922183

Rao, K., Ok, M. W., & Bryant, B. R. (2014). A Review of Research on Universal Design Educational Models. *Remedial and Special Education*, 35(3), 153-166. https://doi.org/10.1177/0741932513518980

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review,* 57, 1–22.