TechTrends (2020) 64:211–218
https://doi.org/10.1007/s11528-019-00455-6

Flexibility in Formal Workplace Learning: Technology Applications for Engagement through the Lens of Universal Design for Learning

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Published online: 16 December 2019

Abstract
How can technology be used to engage learners for workplace training? This is a question that designers and facilitators of organizational training experiences face in an era when adult learners are increasingly connected to technology devices and mediated experiences to learn. Technology in workplace training affords flexibility and can be used to provide *multiple means* of engaging learners, a centerpiece of the Universal Design for Learning (UDL) framework. UDL has traditionally been used to guide K-12 instructional design, but it is proposed in this article as a relevant lens to aid in engaging learners of supportive technologies in workplace training. Technology trends that impact engagement and learning in the workplace are explored, and technology-supported examples inspired by the UDL engagement principle are provided.

Keywords Universal Design for Learning · Learner engagement · E-learning · Technology

Introduction

Workplace learning experiences are much in demand due in part to evolutions in occupational requirements across many professions (Billett and Choy 2013). For example, mechanical and repetitive processes are increasingly being innovated, and sometimes replaced, by electronic technologies, which has led to need for "greater levels of cognitive skill, flexibility, and autonomy than in traditional employee roles where the production process is fixed and includes limited discretion" (Bresnahan et al. 2002, p. 346). The demand is evident in the top three workplace learning content areas for the past three years reported in the Association of Talent Development's (ATD) *2018 State of the Industry* report – managerial and supervisory, mandatory and compliance, and processes, procedures, and business practices (ATD 2018). Also, training related to interpersonal skills (such as communication and teamwork) has seen a recent rise (placing fourth in content area for 2018), as industries (e.g., auditing; Piper 2017) call attention to the need for employee development in this area (ATD Public Policy Advisory Group 2018).

Jacobs and Park (2009) define *workplace learning* as "the process used by individuals when engaged in training programs, education and development courses, or some type of experiential learning activity for the purpose of acquiring the competence necessary to meet current and future work requirements" (p. 134). According to the ATD report, 67% of formal workplace learning is instructor-led, with about half of that (53%) delivered face-to-face in a traditional classroom and the rest through other formats, including virtual instruction (ATD 2018). Virtual classrooms have the appeal of providing opportunities for learners to interact in real time with an instructor and other learners, while allowing organizations to save travel and classroom costs. Instructor and self-directed e-learning has been increasing, at 33% of training hours overall in 2018 (from 32% in 2017), with the largest increases shown for FIRE (finance, insurance, and real estate) companies (13% increase, from 28% in 2017 to 41% in 2018) and management consulting firms (about 12% increase, from 17% in 2017 to almost 29% in 2018) (ATD 2018). Grouping all technology-based methods together (including e-learning/online, mobile technology, and non-computer technology such as DVD-based training), the 2018 ATD report states that they

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accounted for 43% of learning hours available and 41% of learning hours used.

Despite the proliferation of technology-based learning, organizations often struggle with *how* to best incorporate learning technologies that engage employees in workplace learning experiences (Thomas and Akdere 2013). Through the immersive use of technology in learning settings, instructional designers often work to design experiences that easily and continually engage learners with content that increasingly involves interpersonal skill-building, problem-solving, and decision-making. We position *engagement* as a multidimensional interaction that occurs between a learner's cognitive, affective and behavioral interaction with the content and other learners (Ben-Eliyahu et al. 2018). Instructional technologies can be used to support this engagement in different parts of a training course, such as to introduce concepts, facilitate hands-on practice, and support assessment. For example, Adams (2013) found that in a study of 200 mid-level Canadian bank managers who completed management development courses, the majority indicated that applications of online technologies as part of the course design were a valued part of their learning experience. Online technology applications in this study facilitated pre- and post- class meeting assignments, personalization of learning objectives through team mentoring and job coaching, and action-learning projects, in which employees demonstrated their learning directly to current job-based applications. In another case study of an online leadership class, Deschaine and Whale (2017) found that intentional acts of engagement that included relevant content, participative and collaborative activities, and goal-directed tasks resulted in higher learner course satisfaction and overall effort.

Learner engagement involves a complex interaction among how learners interact with, feel and think about their learning experiences; thus, understanding the varied ways engagement can be stimulated in workplace learning should be of key interest to instructional designers and facilitators who want to maximize learner outcomes. The purpose of this article is to situate instructional design for learner engagement within the Universal Design for Learning framework (CAST 2018) and discuss examples of ways that learning technologies can be used to facilitate flexibility in the area of engagement for formal workplace learning design and delivery. We conclude with specific recommendations for increasing designed flexibility to support learner engagement in training settings.

Universal Design for Learning (UDL)

Analyzing learner backgrounds and needs (i.e., learner analysis) is a foundational step (Wallace 2019) when designing and delivering training in workplace environments. While target learners will likely have some overlapping similarities, it is important to recognize learner variabilities to inform the design of the instruction (Kang et al. 2018). For instance, learners can differ in their learning preferences, levels of experience, language proficiency, and disabilities. Inclusive teaching involves embracing learner differences and viewing these differences "as the source of diversity that can enrich the lives and learning of others"; as such, the curricular design and implementation of the instruction are impacted so that "pedagogy, curricula and assessment are designed and delivered to engage students in learning that is meaningful, relevant and accessible to all" (Hockings 2010, p. 1).

As a design framework to accommodate diverse learner needs, Universal Design for Learning (UDL) is an approach in which designers of instruction proactively differentiate as part of the planning process for an instructional experience, rather than designing for an *average* learner and later having to make accommodations for specific learners who inevitably experience barriers during implementation due to their not fitting that profile. UDL involves building in flexibility into course design in the ways that learners engage, receive content, and express their learning. It is composed of three key principles - *providing multiple means of engagement, providing multiple means of representation*, and *providing multiple means of action and expression* (see Fig. 1).

The UDL framework grew out of Rose and Meyer's (2002) work in K-12 settings, and it has since been applied to adult learning, including chemistry laboratories (Miller and Lang 2016), marketing management courses (Dean et al. 2017), nursing education (Harris 2018), and air traffic controller training (Kang et al. 2018). A recent systematic review of 17 empirical UDL implementation studies at the postsecondary level found that the outcomes of the UDL implementation were effective in 15 of the studies and concluded that "by and large, information from the participants suggests that UDL application was effective for all students sampled, whether they had disabilities or not" (Seok et al. 2018, p. 184). One reason why UDL resonates with educators in many different areas is that it brings attention to the diversity of ways that people learn due to variations in their neuro-physical makeup. This emphasis on *neurodiversity* directs focus towards creating educational experiences that meet the different ways that learners process information. Each UDL principle is connected to a specific neural area and grounds the instructional design with a focal goal, thus allowing for variability in learning presentation.

UDL Engagement Principle

While UDL provides a robust framework for differentiated instruction, we offer a closer inspection of the Engagement principle as relative to workplace learning and specifically where technologies (e.g., eLearning, virtual classrooms, mobile learning) are incorporated. Though UDL can be implemented without the use of technology, learning technologies

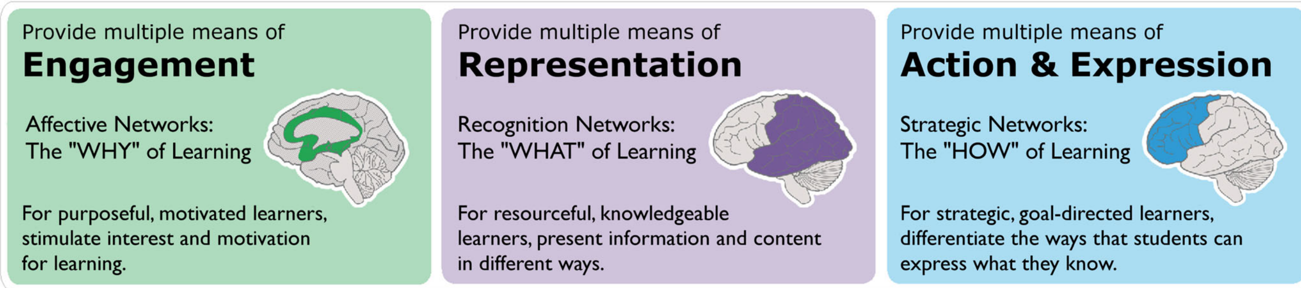

Fig. 1 Universal Design for Learning (UDL) Principles (CAST 2018)

often enable designers and instructors to develop a responsive and interactive learning experience where the learner can interact with the content (Twyman and Heward 2018). Rose and Strangman (2007) describe how digital learning environments offer "choice in appearance, level of support, type of support, method of response, content, speed, and distractors" (p. 388). Technology can therefore expand the options provided for how learners can demonstrate their understandings, which can empower them to be able to choose the supported learning pathway that aligns with their learning preferences and priorities.

The UDL engagement principle presupposes that learners are engaged when they understand the *why* of what they are learning and that will result in increased motivation and purpose in their learning interactions. Krathwohl et al. (1964) describe the affective taxonomy of learning as how learners develop their beliefs and attitudes through receiving, responding, valuing, organizing and characterizing stimuli within a learning context. Neurologically, learner engagement is triggered in the *orbitofrontal cortex* (OFC) of the brain, which is located directly above the eyes within the prefrontal cortex, and it supports associative learning through changes in *outcome expectancies*, neural associations between cues and expected outcomes that integrate memories of related information with emotions and goals (Schoenbaum and Roesch 2005). The OFC is also involved in the regulation of emotions, which are instrumental in learner response, persistence, decision-making, and problem solving (Anderson 2018). In short, learners are able to enact this neural region to adjust their behaviors in accordance with their motivational state and their target goals. Neuroscientists Rudebeck and Rich (2018) offer an explanation for how this impacts learning -

> Learning theory refers to behaviors that are based on the current motivational state of the animal and knowledge of a particular outcome (or goal) that is expected as 'goal directed'. In this case, knowledge of the outcome means its sensory features, motivational value, quantities and so forth. Having this knowledge means that responses are flexible, and can change when circumstances change. This is in contrast to habitual behaviors that are reflexive and not guided by knowledge of the outcome (p. R1085).

Thus, learners may be influenced by their affective perceptions about a target goal, and they are able to consciously make decisions that will enable them to reach it.

The UDL engagement principle (see Fig. 2) includes three corresponding guidelines of providing options for *recruiting interest (RI)*, *sustaining effort and persistence (SEP)*, and *self-regulation (SR)*. (Note: The authors' addition of the acronyms, RI, SEP, and SR, is introduced to support clarity in the remainder of this article.) RI includes supporting learner choice, aligning content relevance and authentic experiences, and minimizing distractions and cognitive overload. The second guideline, sustaining effort and persistence (SEP), focuses on affective strategies that help learners *remain* engaged in the leaning content. It views a learner's persistence as influenced by how well s/he understands and can adjust performance based on feedback. Finally, increasing learner engagement through self-regulation (SR) involves helping learners cope by adjusting their performance and through expanding learner performance outcomes.

UDL Technology Applications

Technology in workplace learning can help facilitate this element of flexibility that can meet diverse learner needs. Sadler-Smith and Smith (2004) characterize *flexible learning* in the workplace as "a means of delivering learning for the acquisition of work-related knowledge and skills, which include the use of instructional technologies" (p. 398). Similar to the overall goal of the UDL framework of cultivating "expert learners who are purposeful and motivated, resourceful and knowledgeable, and strategic and goal-directed" (CAST 2018), Sadler-Smith and Smith's (2004) conception of flexible learning similarly "requires learners to exhibit a degree of autonomy and self-direction in order to engage effectively in a learning process in which the learner and other actors (for example, instructional designers and learning facilitators) may not be physically and/or temporally contiguous" (p. 398).

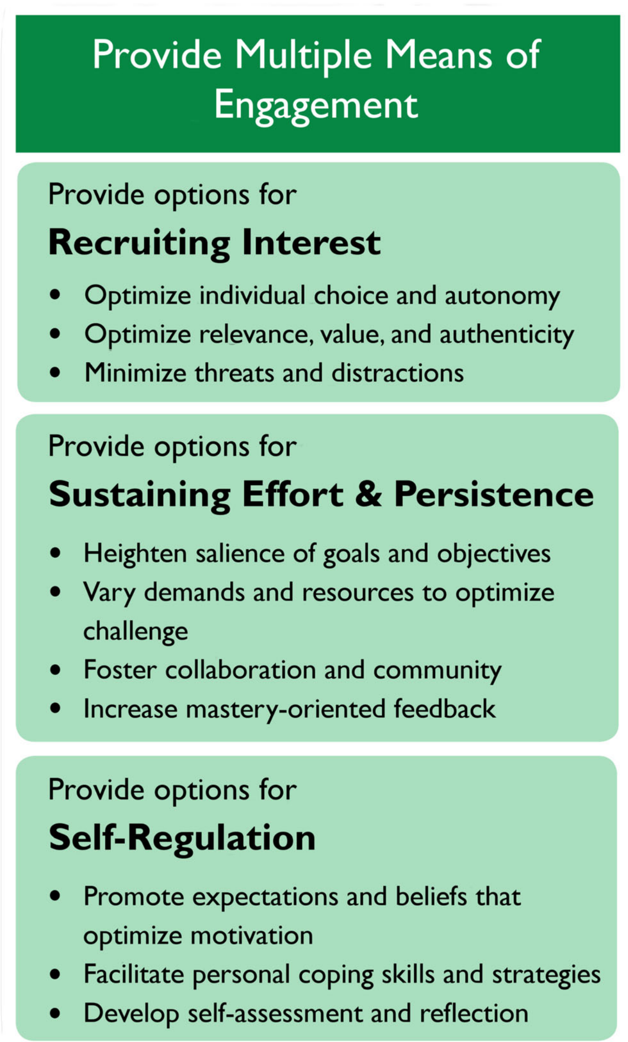

Fig. 2 UDL Engagement Principle and Guidelines (CAST 2018)

Technology used effectively can thus provide flexibility through varied formats and extensions of time and space within and beyond formal classroom instruction. Therefore, this involves selecting appropriate technology tools and applying them in ways that will serve to engage learners and facilitate their learning in the workplace setting. Connecting the array of educational technology possibilities and intentional flexibility can support opportunities for extension and practice of workplace training content in different ways. We offer some workplace learning examples relating to each of the guidelines within the UDL engagement principle.

Recruiting Interest (RI)

Initiating learner interest can be supported through providing choice and enabling learners to personalize aspects of their learning environment (Dickey 2005; Tafarodi et al. 2002). Drawing from an example in multi-player computer game research, psychophysiological responses have been observed related to player ability to represent themselves in the spaces through selection of personalized avatars and points of view (Lim and Reeves 2009). Similarly in an immersive game-based learning experience, providing opportunities for learners to self-select their avatars, scenery, collaborators, and differentiated learning levels (e.g., novice, intermediate, advanced) could stimulate interest and motivation as they are able to represent themselves in the virtual space and advance to more difficult levels based on their prior performance, motivation and learning goals.

Learners can also benefit from an array of advance organizers, such as concept maps and KWL (Know, Want to Learn, Learned) charts (Clapper 2014; Cutrer et al. 2011). Organizational tools such as calendars, visible and audible timers, and trackers can guide learner self-management of their time, pacing, and focused effort on tasks, as Masters et al. (2016) relate within workplace learning of medical and healthcare personnel. Such resources may be embedded into the learning management system (LMS) to support e-learning, but external tools could also be made available, integrated, and supported to encourage learner use. This supportive integration is key, as providing multiple gadgets, functions, information, and resources could be counterproductive through inadvertently inducing technology overload (Yin et al. 2018).

RI also involves fostering relevance of instructional content so that learners recognize how participating in a learning experience connects to their personal goals and interests (Assor et al. 2002). Whether it is having an increased knowledge of current political events to engage in stimulating dinner party conversations or advancing to the next module in the course, a learner must easily and quickly understand the *why* of their learning experience to stimulate their interest and motivation. In a face-to-face session, polling tools such as Plickers (https://www.plickers.com/) can be used by instructors to prompt learner responses to individual application questions, which can then strategically fuel small to large group discussions about varied perspectives and supporting explanations. For e-learning courses, polling tools are often available within web conference platforms, such as Blackboard Collaborate and Adobe Connect, or external tools such as Poll Everywhere (https://www.polleverywhere.com/) can be integrated. Learner interaction in either format can similarly be supported through presentation enhancement tools such as Slido (https://www.sli.do/), Peardeck (https://www.peardeck.com/), and Glisser (https://www.glisser.com/). Learner voice and contributions can also be promoted through the tool AnswerGarden (https://answergarden.ch/), which creates collaborative word clouds from a collection of brief posts (maximum of up to 20 or 40 characters per post) that visually represent themes among participant perspectives on focal topics.

Sustaining Effort and Persistence (SEP)

Learner focus and motivation to persist in a learning experience begins with clearly communicated performance expectations. A variety of learning technologies can be used to clarify performance expectations, manage formative and project-based learning review and feedback, and facilitate microcredentials (Foshay and Hale 2017). Hicks (2018), for example, reported in a study within the technology sector involving over 46,000 employees that an online peer feedback tool significantly increased employee engagement in formal professional development opportunities. The peer feedback tool, called "Real-Time Feedback," was embedded in the learning platform and enabled users to submit and respond to feedback questions (up to 500 characters) within their organization.

Internal threaded discussion boards and commenting features in cloud-based shared drives could also be used similarly. Greater flexibility is supported through varied feedback format options, such as voice comments using the Google Drive add-on Kaizena (https://www.kaizena.com) and the Google Chrome extension Read & Write for Work (https://www.texthelp.com/en-gb/products/read-write/read-write-for-work/) (Keane et al. 2018). A case study of the Transport for London (TfL) organization involved provision of Read & Write to its over 25,000 transportation services employees (McCusker 2013). It was found to be helpful to employees with specific needs such as dyslexia, visual impairments, English language learners as well as most users in the organization broadly for its voice-supports, screen customization, and research support features.

The salience of training goals can be further enhanced when they are aligned with work application expectations. Goals can be cultivated through networked skills profile tools (see Hicks 2018; Siadaty et al. 2012, for examples) that prompt employees to identify their current and desired skills and then guide them to suggested professional development pathways. Consistent with extant research on motivation to transfer training, learners could jointly set training goals in consultation with their managers to support their understanding of connections between training content and workplace applications (Burke and Hutchins 2007; Massenberg et al. 2017). In an e-learning course, learners can be encouraged to establish their learning goals for the online content, which can then direct their attention and focus as they work through embedded quizzes or challenges that provide immediate feedback.

Technology can support the alignment of training goals with work application expectations through the provision of course materials in varied formats, such as text document, graphical, audio, and video. Pairing active learning strategies with technology tools can make learning more visible and foster collaboration. In nurse training, for example, Harris (2018) recommends active learning strategies as a way that nursing faculty can support diverse learners through universal design adjustments. Strategies of *Think-Pair-Share* (in which students *think* about concepts just taught, *pair* with a classmate, and then *share* their thoughts about what they have learned) and *RAP* (which involves *reading* a passage of text, *asking* about the meaning of the main concept and two important details, and *paraphrasing* the passage) could be carried out using a tool like Flipgrid (https://flipgrid.com/), in which learners would record the *share* / *paraphrase* steps of the strategies in brief video postings.

Thomas and Akdere (2013) proposed the term *collaborative media* to characterize the use of social media tools within organizations to support communication and workplace learning. Collaborative media tools such Facebook, Twitter, Microsoft Teams, and GroupMe could be used to provide flexibility and expanded access to course-related discussions and collaborations with other learners (Gronseth and Hebert 2019). It is important to note that developing relationships as part of learning situations involves establishing trust among learners. In virtual learning environments, there are additional challenges related to the distance format, including differences in timings of learners in course activities and absence of physical cues and non-verbals (Short 2014). Providing multiple means of communication can facilitate different options for learners to engage in collaborative learning activities and provide opportunities for trust and relationships to develop. For instance, learners could be prompted to demonstrate a key concept, and the capture and sharing of these demonstrations could be facilitated through threaded video-based discussion. Newman (2019) describes an example of how learners in medical and veterinary courses created videos about kidneys (or "vidneys") in which the learners acted out stages of kidney function in three minute videos. Flipgrid could enhance this activity by enabling co-learners to post reply videos, which would facilitate a social learning aspect. The "vidneys" could even be structured like charades, in which learners post replies about their guesses of the function (or process, concept, idea, etc.) that is being demonstrated. Flipgrid can also support instructor-learner feedback as well, wherein instructors could provide qualitative comments directly to the learner or score a posting using a rubric.

Self-Regulation (SR)

Learners enter learning experiences with different degrees of readiness and motivation and will experience delays and setbacks at different stages. The UDL guideline of providing options for supporting self-regulation addresses this from a curriculum design perspective through guiding learners in goal-setting, enabling them to adjust their learning approaches, as needed, and building in reflective self-assessment opportunities. Designers of training experiences should plan points of self-reflection for learners to visualize their problem-solving processes and self-evaluate their progress towards goals. Features of learning technologies that are particularly supportive in this area include *process displays* that make visible learner thinking as they work through learning activities and solve problems, *process prompts* that question students to explain their thinking before, during, and after they complete learning activities, *process modeling* by experts that illustrate how experts think through and complete target tasks and problems, and *reflective social discourse* that brings in the input of other learners through academic conversation and peer feedback (Lin et al. 1999).

Instructional designers can assist learners to develop self-regulative coping skills by providing ongoing feedback and suggestions to correct performance. Cues, hints, and examples of alternative pathways or decisions can assist learners with expanding their options for action and supporting self-determination. Such information can be provided through augmented reality (AR) platforms, in which learners view and interact with visual overlays over the real-world environment (Sheridan 2019). In AR-infused industrial maintenance and assembly (IMA) training, for example, trainees work on real machines, such as assembling electronic actuators, using their hands, but they wear vibro-tactile bracelets (that provide haptic feedback) and view the machine workspace through tablet computers that superimpose graphical and instructional guidance (Gavish et al. 2011). In a control group comparison study, the AR-infused training group had fewer assembly errors than the control group that viewed the training in video format (Gavish et al. 2015).

Learning technologies can optimize motivation through AR and virtual reality simulations that incorporate adaptive learning experiences, gamification, and retrieval practice opportunities, and some recent examples of this come from the realm of air traffic control (ATC) training. At the National School of Civil Aviation *(Ecole Nationale de l'Aviation Civile [ENAC])* of Toulouse, France, an ATC application presents learners with realistic situations that engage them in the development of their technology skills as they notice and consider contextual elements, such as maps, airplane performance and turning radius, weather, potential intersections of aircraft at the same altitude, and so on (Alvarez et al. 2017). The designers characterize the ATC application as a *serious game*, which combines teaching and learning with playful game elements (Mitgutsch 2011); though in its implementation, some experts chose to refer to it as a *simulation* due to its serious content domain. Another ATC example comes from the University of Oklahoma Aviation Laboratory, which also provides simulation experiences to its air traffic controller (ATC) candidates to support enhanced practice opportunities in different ways (Kang et al. 2018). Students take on the role of a pilot of a plane as part of a classmate's simulation, which provides opportunities for each to enact the associated ATC rules and phraseology. The simulations are also used to guide students to explain their thinking and actions aloud as they work through the scenarios, with instructors pausing to provide just-in-time feedback.

As a key component of building in support for self-regulation, feedback can help learners recognize areas for improvement and then make revisions in their learning pathways accordingly. Developmental feedback, whether by machine learning or by personal feedback, can assist learner's valuing of a learning experience by helping correct for errors and showing progress toward goals. As part of training curricula, rubrics, examples of exemplary work, and other information about learner assessment and feedback techniques can also be provided to communicate expectations and demonstrate how target concepts and skills may be applied in projects (Larbi-Apau and Moseley 2008). Similar to an airplane dashboard that includes an array of fluid and pressure readings that aid pilots in adjusting their flight plans, learners can receive feedback and responsively adjust their goals, learning environment and resources based on a diverse range of indicators.

Recommendations and Future Implications to Practice

By extending UDL to workplace learning, we described the utility of stimulating learner interest and curiosity, sustaining effort, and regulating emotion and behaviors to learning outcomes. We demonstrated the UDL engagement principle by highlighting representative technology applications that can be applied to face-to-face, fully online or hybrid courses. In addition to engaging learning through motivating interest, our examples also demonstrate how technology can help learners transfer their new knowledge and skills outside of the learning environment. For instance, in a survey of workplace training professionals' ($n = 89$) use of Web 2.0 tools to support training transfer (i.e., applying learning from a training session into the workplace), Hester et al. (2016) found the use of online collaborative tools was the preferred medium for helping individuals transfer their learning to the job. The training professionals actively used highly visual modes (such as web or video-conferencing) as well as technologies to obtain virtual feedback from networks (e.g., instant messaging, file-sharing, screencasts) to support learning transfer.

With the evolution to Web 3.0 technologies, training technologies have become even more intuitive in adjusting the learning environment to learner preferences, expanding options for collaborations across platforms especially in utilizing social media, and having learners co-create the content. As a neural-based design framework, UDL can assist instructional designers and facilitators in differentiating instruction that enables learners to self-regulate their learning behaviors while making their progress toward learning goals visible. However, instructional designers and trainers must understand the different ways to engage learners' cognitive, affective and behavioral outcomes through technology. Thus, we propose UDL as a theory-driven design framework for workplace learning and an important professional competency of workplace learning designers and trainers. With learner engagement as a criteria for selecting training technologies, workplace learning can be fluid yet flexible enough to accomplish the target learning goals while also meeting the diverse needs of today's workforce.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent This article does not contain any studies with human participants performed by any of the authors.

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