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About the Journal

During the past 50 years, journals in the field of instructional design have been responsive to the changing needs of both scholars and to a lesser degree, the practitioner. We have seen an evolution of AVCR to ECTJ, the emergence of JID, and finally the merging of ECTJ and JID to form ETR&D. ETR&D is a widely recognized, scholarly journal in our field that maintains rigorous standards for publications.

During the past 50 years, we have also witnessed a change in the field due in part to the success of instructional design in business and other nonschool environments. The number of instructional designers working outside the university has dramatically increased. Of particular importance is the rise in the number of instructional designers with doctorates who consider themselves practitioners, but not necessarily scholars. This growing group of designers might be best described as reflective practitioners who can make a significant contribution to the knowledge of our field.

This growth and success in the application of instructional design has also changed the field. From the early days of the field until the mid-1980’s, the theory and practice of instructional design was almost exclusively influenced by the academic community. With the growth of instructional designers, the theory and practice of the field is now defined by both academics and practitioners. There is a need for greater communication between the scholars and the practitioners in a scholarly journal that will support innovation and growth of our knowledge base.

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Goals

The purpose of this journal is to bridge the gap between theory and practice by providing reflective practitioners a means for publishing articles related to the field. The journal establishes and maintains a scholarly standard with the appropriate rigor for articles based on design and development projects. Articles include evaluation reports (summative and formative), lessons learned, design and development approaches, as well as applied research. The articles are based on design and development projects as opposed to pure research projects and focus on lessons learned and how to improve the instructional design process. Rigor is established through articles grounded in research and theory.

A secondary goal of this journal is to encourage and nurture the development of the reflective practitioner in the field of instructional design. This journal encourages the practitioner as well as collaborations between academics and practitioners as a means of disseminating and developing new ideas in instructional design. The resulting articles inform both the study and practice of instructional design.

Philosophy

This journal will provide a peer-reviewed format for the publication of scholarly articles in the field of applied instructional design. The journal recognizes the role of the practitioner in the work environment and realizes that outside constraints may limit the data collection and analysis process in applied settings. The limitations of real-world instructional design of the practitioner can still provide valuable knowledge for the field.

Sponsoring Organization

JAID is a publication of the Association for Educational Communications and Technology (AECT).

JAID is an online open-access journal and is offered without cost to users.

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About AECT

The Association for Educational Communications and Technology (AECT) is a professional association of instructional designers, educators and professionals who provide leadership and advise policy makers in order to sustain a continuous effort to enrich teaching and learning. Seizing opportunities to raise awareness and leverage technology, our members may be found around the world in colleges and universities, in the Armed Forces and industry, in museums, libraries, and hospitals, and in the many places where educational change is underway. Our research and scholarly activity contribute to the knowledge base in the field of Learning. We are on the cutting edge of new developments and innovations in research and application.

AECT is the premier organization for those actively involved in the design of instruction and a systematic approach to learning. We provide an international forum for the exchange and dissemination of ideas for our members and for target audiences. We are the national and international voice for improvement of instruction and the most recognized association of information concerning a wide range of instructional and educational technology. We have 24 state and six International Affiliates all passionate about finding better ways to help people learn.

Since 1923, AECT has been the professional home for this field of interest and has continuously maintained a central position in the field, promoting high standards, in both scholarship and practice with nine Divisions and a Graduate Student Assembly that represent the breadth and depth of the field. Other journals sponsored by AECT include Educational Technology Research and Development and TechTrends.

The Journal of Applied Instructional Design (JAID) is a refereed online journal designed for the publication of scholarly articles in the field of applied Instructional Design. The purpose of JAID is to provide the reflective ID scholar-practitioners and researchers a means for publishing articles on the nature and practice of ID that will support the innovation and growth of our knowledge base. The journal is for practitioners, instructors, students, and researchers of instructional design.

Call for Submissions

JAID is for reflective scholar-practitioners, who through documentation of their practice in ID, make significant contributions to the knowledge of our field. Authors are invited to submit articles documenting new or revised approaches to ID; the processes of ID including in-depth documentation of analysis, design, and development, implementation and evaluation; design-based research; as well as applied research. Articles must be based on instructional design projects as opposed to pure research projects and focus on documented processes, lessons learned, and how to improve the overall process of ID. Articles must be grounded in research and theory connecting the intellectual foundations of the ID field and how these foundations shape its practice.

The journal will establish and maintain a scholarly standard with the appropriate rigor for articles based on design and development projects. A secondary goal of this journal is to encourage and nurture the development of the reflective practitioner in the field of ID. This journal encourages the practitioner as well as collaborations between academics and practitioners as a means of disseminating and developing new ideas in ID. The resulting articles should inform both the study and practice of ID.

Submit an Article

Article Types

JAID currently accepts submissions of three article types.

Instructional Design Practice

This is an applied journal serving a practicing community. Our focus is on what practitioners are doing in authentic contexts and their observed results. These articles cover topics of broad concern to instructional design.
practitioners. The articles should represent issues of practical importance to working designers.

**Research Studies on Applied Instructional Design**

JAID is interested in publishing empirical studies exploring the application of instructional design principles in applied settings. Quantitative and qualitative studies are welcome.

**Instructional Design/Performance Design Position Papers**

JAID also accepts position papers that attempt to bridge theory and practice. Examples may include conceptual frameworks and new ideas facing the instructional design community. The paper must also provide enough information to allow the replication of the innovation or continuation of the research in other settings. Position papers must be based in the context of a theoretical framework. Efficacy data is strongly preferred, but not always required, contingent upon the potential generalizability or value of the innovation.

**Submission Guidelines**

The journal will focus on in-depth applications of the ID process and publish a variety of articles including case studies of the ID process; application articles that go beyond a mere how-to approach that provide implementation insights, guidance and evaluation of a process; evaluation articles that focus on the viability of a product or process; applied research resulting from evaluation of materials, studies of project implementation, articles on ways to improve the ID process from the perspective of the practitioner, and short essays that provide a scholarly debate of relevant issues related to the application of ID and relevant book reviews. When applicable, articles should include supplementary materials including examples of ID products, evaluation instruments, media files, and design artifacts.

The articles in the journal will be from the perspective of the scholar-practitioner rather than from the researcher. However, the manuscripts must demonstrate scholarly rigor appropriate to applied manuscripts.

Articles, including tables or figures, must follow APA 6th edition formatting and be submitted in a word or doc format using at least 12-point New Times Roman font. Each article must have an abstract (75-100 words) and a list of keywords. While there is some flexibility in the length of an article, 2,000 to 4,000 words is a best-guess estimate. If in doubt, contact the editor prior to submitting the article. Identifying information must only be located on the cover page including contact information for the first author.

You may contact the editors via email, if you have further questions.

[Contact the Editor]
Applying UDL to Online Active Learning

Instructional Designer Perceptions

Sandra A. Rogers & Susie L. Gronseth

In online environments, active learning techniques can facilitate varied ways that learners engage and enact skill development, understanding, and connections across concepts. The Universal Design for Learning (UDL) framework supports providing options and design flexibility. Using a multi-site, mixed method case study design, this exploratory study investigated how 23 instructional designers at three large, urban, US public higher education institutions view alignment between UDL and active learning approaches in online course design. Techniques, strategies, tools, enablers, and challenges of these practices are highlighted. Study data collected included survey responses and focus group sessions. Emergent themes of belongingness, social learning space, structuredness, and universality are discussed.

Introduction

Instructional design for online formats has been shifting pedagogically from expository to active and interactive approaches, fueled by constructivist practices and aided by newer technologies (Means et al., 2013; Rudestam & Schoenholtz-Read, 2010). Expository and active learning approaches are presented as two sides of a dichotomy, with the traditional expository approach involving content delivery through lecture or instructor-directed means, and active learning constructively engaging learners to explore, connect, and apply focal concepts and skills through exercises, discussions, and projects. By adding a collaborative dimension, it becomes interactive.

Despite wide support for active-learning practices, there have been mixed empirical findings regarding the effectiveness of active-learning experiences contrasted with expository experiences (e.g., Andrews et al., 2011; Prince, 2004). This could be due to the importance of context regarding the scaling up of educational interventions in online learning (Kizilcec et al., 2020) and the lack of expertise in the science of online learning and skillful development of planned interactions. For example, Andrews et al. (2011) reported on the inability of regular science instructors to replicate the successful active-learning studies of science education researchers. Instructional designers (IDs) thus play a crucial role in providing guidance and support for effective course design and teaching (Kumar & Ritzhaupt, 2017).

Just as learners vary in learning abilities, experiences, and other dimensions in face-to-face instructional settings, learner variability is also observed in online instructional settings (Black et al., 2015). The flexibility that online learning affords can facilitate increased educational access in support of a diverse array of student needs, including remote instruction during a crisis (Dickinson & Gronseth, 2020). Such potential for designed flexibility in online courses (e.g., time, location, pace) aligns with the Universal Design for Learning (UDL) framework through the provision of multiple ways that content is represented, students engage in a course, and learning is expressed (Meyer et al., 2014).

Supporting learner diversity as part of strategic course design upfront not only supports learners with disabilities (Black et al., 2015), but is also considered a best practice for learners in general (Gronseth, 2018). Sufficiently structured, action-oriented learning activities contrast with loosely-designed, passive-oriented activities. Further, there is evidence that active learning reduces failure rates for unprepared students because they have the potential to build student learning skills as part of the activity design (Freeman et al., 2011; Styers et al., 2018; Theobald et al., 2020).

Related Literature

Universal Design for Learning

UDL is a front-loaded curricular design approach, which conveys the considerable time and forethought that designers invest in planning for flexible and varied means of learning. Applying UDL involves designing engaging opportunities that support students’ accessing, building, and internalizing of target content. Planning active learning activities through a UDL lens can involve expansion in the areas of engagement (the why for learning), representation (the what that is being learned), and action and expression (the how of the learning process; CAST, 2018). The why aspect is associated with the affective domain of learning (Bloom et al., 1956; i.e., attitudes, emotions, feelings), aiming to capture and sustain students’ interest and persistence to reach their learning goals. The what aspect refers to the information processing of content for the cognitive domain of learning (i.e., knowledge, comprehension, application) to facilitate perception and comprehension. The how of learning addresses affective, cognitive, and psychomotor domains.
The relevance of UDL in present instructional design practices garner attention for recognizing and planning intentionally for variations in learner characteristics and needs and cultivating the development of learners’ self-regulation skills through strategic course structures and facilitation strategies. For example, the UDL principle of providing multiple means of action and expression expands ways learners can practice and demonstrate progress toward target course objectives to have options for how they might utilize and show what they are learning regarding a target learning goal or objective. In this way, learners seem to appreciate having voice and choice, contributing to increase in enjoyment and proficiency (Goldowsky & Coyne, 2016).

Active Learning

Educational reform efforts promoting active learning include Dewey’s (1938) experiential learning, Johnson and Johnson’s (1999) cooperative learning, and inverted learning commonly known as a flipped classroom (Lage et al., 2000; Mazur, 1997). General interest in active learning has continued to rise over the past decade (as indicated in the Google Trends analysis shown in Figure 2). Active learning triggers cognitive functioning (Freeman et al., 2014; Harris & Bacon, 2019) and enhances or refocuses student attention. Student mental models are called upon and shaped directly in the learning process through student-centered interactive instructional activities. This contrasts with passive learning, which tends to occur indirectly with limited student interaction and is often characterized as teacher-centered replication. Active learning opportunities allow learners to self-direct and utilize supportive resources as they develop their mental models for concepts. Active learning can be individual or group based and may involve a range of complexities in setup and engagement. Clear activity guidelines are highly recommended to ensure effective interactions within an online course experience (Quality Matters, 2018).

Planned Interactions

Within the UDL principle of providing multiple means of engagement, planning for collaboration and community is a key component (See checkpoint 8.2; CAST, 2018). Some IDs use the community of inquiry (COI) framework (Garrison et al., 2000) to promote cognitively challenging learning through planned interactions (e.g., student-student, student-content, student-teacher/practitioner). For an online COI, learner and instructor presence in the areas of social, cognitive, and teaching are essential to the communication loop and should be based on course design that includes engaging events, exploration of mental model versus the shared world, integration of ideas, and resolution through consensus building (Garrison et al., 2000). Active learning tasks combined with planned interactions serve as mechanisms for a COI. Empirically, social presence either has a causal or correlational relationship to achievement, and teaching presence correlates with cognitive presence (Arbaugh, 2019). COI aligns with UDL guidelines to provide options for comprehension, communication, and executive functions (CAST, 2018).
Role of Instructional Designers

Bain (2020) described the following challenges facing IDs in higher education: collaboration with faculty, research-based best practices, competing standards, quality and uniqueness, feedback-loop design, and performance-focused outcomes. Our study focused on the broader challenges of collaboration with various stakeholders in course design specifically in designing active learning within the UDL framework. Miller and Metz (2014) reported instructors’ perceived barriers to active learning as insufficient class time, lack of time to develop material, and comfort with traditional lectures. Generally, instructional design degree programs prepare IDs to address such challenges with coursework on educational psychology, needs assessments, organizational behavior, educational research, evaluation, and instructional design theory and best practices. Additionally, IDs come from various fields of study and have prior work experiences to incorporate into how they approach their ID roles.

The present study was conducted during the COVID-19 pandemic in 2020, in which institutions of higher education across the US transitioned instructional activities to online delivery, dramatically expanding online instruction. IDs were in a crucial position of supporting faculty to re-envision course activities for the synchronous and asynchronous online formats and equipping them with the needed pedagogical and technical skills. IDs in the development and support of online courses take on many roles beyond design such as faculty training, project management, and project evaluation (Kumar & Ritzhaupt, 2017). In this way, they often work with varied members of the campus community, as they “…primarily serve faculty in their roles, but also perceive students as their final audience” (Kumar & Ritzhaupt, 2017, p. 371).

Method

Using a multi-site, mixed method case study design, this exploratory study investigated how IDs view the alignment between UDL and active learning approaches in online course design, highlighting techniques, strategies, and tools used, perceived enablers of these practices, and challenges faced. Four research questions were addressed:

1. How do IDs perceive connections between UDL and active learning approaches in online course designs?
2. How do IDs apply UDL to active learning approaches in their online course designs?
3. What do IDs perceive as enablers to the application of UDL to active learning approaches in their online course designs?
4. How do IDs address barriers to the application of UDL to active approaches in their online course designs?

Participants

IDs (N = 48) at three large, urban, public, Carnegie Research I-classified institutions in the US were identified as potential participants in the study, with 26 meeting the criteria of being involved in course design and having been in their position at least six months. Of those, 23 (88% response rate) participated in this study, with 17 identifying as female and six as male. Participants were overall highly educated with the following degrees: 17% bachelor, 61% master, and 22% doctorate. Participants reported varied formal education-related training, with about 25% having completed Quality Matters™ training, and others having certifications in learning management system course review, user experience design, and various areas of expertise (e.g., counseling, human resources, library and information sciences). Participants were overall experienced instructional designers, with about 70% having been in their position six years or more (See Figure 3). Participants designed curriculum and supported instruction in an array of subject matter areas (e.g., architecture, arts, business) and workforce development.

Figure 3

Participant Years of Experience as an Instructional Designer

Instruments

The researchers developed a survey instrument, Universal Design for Learning-Online Active Learning (UDL-OAL), for gathering ID experiences and perceptions regarding the utilization of approaches in online synchronous and asynchronous course design. The UDL-OAL (See Appendix A) consists of a demographic section (four closed-response and one open-response items), an active learning section (five closed-response and three open-response items), and a UDL section (two closed-response and two open-ended items). The survey was reviewed by an external ID expert and revised based on recommendations that surfaced through this expert review. The researchers also developed a semi-structured focus group (FG) session protocol, consisting of nine main
items and follow-up questions (See Appendix B). Four of the items incorporated initial FG participant polling and then provided opportunities for further elaboration on observed themes.

**Data Collection Procedures**

Approved participants were sent the consent information and the UDL-OAL survey via Qualtrics XM™ online survey software. Respondents were then invited to participate in a virtual FG session with other IDs across the three sites, of which 13 elected to participate. One FG session consisted of seven participants, and the remaining six were in a second session. The sessions were hosted in Microsoft Teams, recorded, and transcribed. During the sessions, aggregated survey data were presented and discussed using real-time voice discussion, chat, and Google Forms polls. Participants rank ordered emerging findings by importance and elaborated on open-ended question prompts. Study recruitment, data collection, and management procedures were approved by the second author’s Institutional Review Board.

**Data Analysis**

Descriptive statistics were computed for the closed-response survey items. Responses to the open-ended items and virtual FG recording notes and transcriptions were dual coded by both authors (who have practical ID experience and advanced research degrees), and emerging themes were identified and discussed. Initial findings from the survey data were shared with FGs as a reference point for discussion to gather further explanatory data to strengthen the interpretations, employing the emic approach (i.e., illuminating the voices/perspectives of participants). Initial in vivo coding was used to determine emergent themes through interim data analysis via a secondary focused coding on related language (Glaser, 1978). We used reflexivity to entertain potential personal biases. Key informants from each site were consulted to review and confirm themes. We conducted mixed methods that pragmatically considered the means of data collection and analysis that included participants’ voices, addressed researchers’ bias, and considered member checking (Johnson & Christensen, 2014).

**Findings**

**RQ1: How Do IDs Perceive Connections Between UDL and Active Learning in Online Course Designs?**

Most participants expressed confidence in their facility with designing accessible courses and learning materials, with over 80% fairly to completely confident. The main ways that they reported learning about accessible educational practices were reading on their own, learning from colleagues, participating in workshops, and watching videos. Accessibility was viewed by many as core to UDL. For example, one participant defined UDL as, “an expansion of the concept of accessibility, where courses are designed with all users considered, not just those with a registered disability.” IDs expressed how UDL supports expanded online access to learning and plans for barriers that students are likely to experience. Some of their characterizations of UDL included the following:

- “Designing to the Margins. Designing Courses That Are Inherently Accessible and Culturally Responsive.”
- “…Improving Learning Experiences by Reducing Obstacles and Eliminating “Othering” of Non-Traditional Students.”
- “Designing Courses with the End User at the Forefront, Creating Online Spaces That Emphasize Aesthetic Consistency and Foster Opportunities for All Learning Types and Abilities to Participate in the Learning Experience.”

Participants mentioned how UDL centers student needs and engagement, which is a key component of active learning. UDL and active learning approaches support each other. In fact, one designer said, “we cannot do active learning without UDL.” They viewed the overlap between UDL and active learning in online course designs as dependent in part on the technology, as accessibility challenges can inhibit broad student participation. Another designer said, “since both UDL and active learning support designing student-centered, and more interactive course content and activities, I think the application of the dual framework would be an effective strategy to promote and improve course design.” Other shared attributes, in vivo, of this dual framework included equity, choice, inclusivity, participatory, personalized, responsive, and varied modalities.

**RQ2: How Do IDs Apply UDL to Active Learning Approaches in Their Online Course Designs?**

Centering students in the learning process emerged as a theme for IDs’ application of UDL to active learning approaches in their online course designs. Upon viewing this visual from the survey data, one designer expanded upon their view of UDL application:

By selecting the appropriate active learning tools, techniques, and strategies, the instructor will engage students in a participatory learning environment. When...
When surveyed about active learning in synchronous sessions specifically, IDs reported commonly using techniques of breakout groups, polls, “popcorn” share (posing a question and then gathering ideas from everyone), and question-and-answer review. Within breakout group structures, IDs discussed activities of small group case study discussions, PBL, student-led reading discussions, think-pair-share, and other types of projects that position students as teachers. Tools utilized to support these activities include discussion, polling, and collaborative desktop publishing. During an FG session, one ID mentioned using the virtual backgrounds feature to support the simulated experience as part of synchronous role play conversations. Of note, graphic organizers and social media were not popular tools for synchronous formats.

We cut out a lot of the ‘lecture-ette’ pieces and built a lot of micro-learning for- you’ve got to look at this beforehand, because when we’re together, we’re going to be engaging in talking with one another and making this a social learning space and time for reflection and ask me anything and debrief and skills practice, polls, Mentimeter, working on different visualizations together and making posters in an electronic fashion... It’s forcing adults, at least in our space, to engage in ways that they might have just been able to be quiet in the classroom.... So, creating that space for the different types of learners and communicators to come through and share their perspective in the wisdom in the room.

Another designer described how some of the lecture alternative techniques serve dual purposes for both creating spaces for learner engagement but also supporting accessibility and multiple means of representation of content in the course:
We bundle all of our transcripts, all of our slide-based lectures and transcripts every week, into a weekly reader, along with the required articles. And, while that did initially begin as an accessibility approach, we find that in terms of reaching a broad spectrum of learner needs, having all of the content in the course in about three different formats means that if people need something to read while they’re commuting, if people need or if people are out in the field and have very limited Internet, that there’s a lot of different ways that people have needs for different formats.

Figure 5
Instructional Alternatives to Live Classroom Lectures

RQ3: What Do IDs Perceive as Enablers to the Application of UDL to Active Learning Approaches in Their Online Course Designs?

Regarding characteristics that contribute to the use of active learning techniques in their online course designs, all participants indicated an “Innovative Instructor” as being key. Other leading contributors to active learning from the survey data included funding incentives for active learning, ample time, ample technology resources, experienced instructors, accessibility support, and support of teaching assistants (See Figure 6). In discussing instructor innovativeness in the FGs, one designer elaborated on their perspective regarding the relationship between instructor prior experience and their willingness to innovate their teaching with active learning techniques alongside the support of an ID:

I think it’s all about having the time to work on their course, and I find that “experienced” can be bad if they’re like really experienced in that they’ve been teaching a lecture: traditional lecture format for a long time, then it can be hard to shift versus somebody who might be a new instructor teaching the course for the very first time. They’re kind of a blank slate and open to do whatever. And then I think the training, like if they have somebody like an instructional designer, giving them ideas and showing them examples that can really go a long way versus somebody being expected to do it on their own and not quite knowing what to do or what to try or what tool might work best or that sort of thing.

Figure 6
Average Rating of Enablers to the Application of UDL to Active Learning in Online Course Design

Additional enablers noted in the follow-up open-ended survey response included student buy-in, user-friendly technology, and “success stories.” One respondent suggested the utility of “dissemination of current examples in use: case studies of tool-in-use for instructors to observe and consider.” Application of active learning techniques is also supported when there is a “...shared vision and direction between subject matter expert and course designer.” For leadership and IDs, they felt it was important to have “... a disciplined background: education, training, and experience. If you do not have those, the results will be middling and mostly miss the mark.”

RQ4: How Do IDs Address Barriers to the Application of UDL to Active Learning Approaches in Their Online Course Designs?

IDs’ perceived lack of time and instructors overwhelmed by their course preparation workload emerge as the greatest challenges to the implementation of active
learning techniques in online course designs (See Figure 7). Other leading barriers from the survey data included accessibility concerns, resistance by instructors, unmanageability in large classes, lack of support staff, and lack of training. Respondents also noted some additional limiters to active learning implementation in the open-ended survey item, including poorly designed technology tools, slow Internet speeds, and the need to constantly update curriculum based on innovations and other changes.

Challenges related to the present COVID-19 pandemic were also expressed. One participant described feeling compelled to develop “easy-to-execute course designs” in seeing how overwhelmed faculty and students seemed during this challenging time. They remarked, “In general, professors and students have a hard time focusing on academics given our circumstances making it difficult for me as an ID to incorporate effective techniques that require more preparation.” Another ID expressed the pandemic’s impact on their role as, “This context [pandemic, wildfires, and witnessing how these catastrophes are aggravating racial injustices] is definitely limiting my ability to incorporate innovative learning techniques into course design.”

In the FGs and survey, IDs expressed barriers and possible solutions regarding leadership, institutionalized policies, and pedagogy, such as the following remarks:

- “…time-based and achievement/grading-oriented system of higher education, rather than a competency-based model.”
- “…understanding the pedagogy and the best practices that drives the design decision is not prioritized.”
- “When there is a dearth of knowledge in leadership, then intentional and principled instructional design will not be considered.”
- “An individual may be very invested in and successful at implementing active learning and others in the department could view their teaching practices negatively, which impacts their motivation to continue to do active learning or do it more visibly.”

While many of these barriers may be beyond the control of the ID, some conceded that resolutions might be reached through training and non-training solutions.

Emergent Themes

The data were dual coded for themes by the authors, and then codes were synthesized into four main emerging themes. The themes and sample quotations from the data that corresponded to each theme were shared with four key informants from across the three universities. The key informants confirmed that the emerging themes seemed reasonable and accurate. The four main emerging themes, with in vivo codes, and quoted examples provided in parenthesis are as follows:

1. **belongingness** (i.e., autonomy, enhance community building, inclusion, journal clubs, student lounge);
2. **social learning space** (i.e., authentic learning experiences, bounce ideas first, group teach, interviews, microlearning, peer moderation, popcorn share, student-centeredness);
3. **structuredness** (i.e., guided exercises, just-in time video, polls for pre-work, predetermined criteria, strategic design of UDL); and
4. **universality** (i.e., adaptive learning, bundled transcripts, share notes with students in slides, strategically designed for the margins).

In sum, the designers sought to foster a student presence in the social learning space, and they did so through certain structures (planned interactions) in coordination with universal access. They saw UDL and active learning both as having student-centeredness at their core.

Discussion

This study highlights ID perspectives on the application of UDL and active learning in online course designs, as well as facilitation and hindrances encountered. Our goals were to contextualize their processes, innovations, and concerns. Overall, participants were highly educated, trained, and experienced in creating accessible online courses. The importance of UDL and its correlation to online active learning was evident in their contributions to this study, given the multiplicity of crises faced in their respective locations.

The emergent themes parallel Palmer and colleagues’ (2003) principles for universal instructional design (UID).
and the foundations of the UDL framework (CAST, 2018). Table 1 presents a comparison of the key themes alongside dimensions of UID and UDL. Belongingness and social learning space primarily address UDL’s affective networks and corresponding principle of providing multiple means of engagement, while structuredness and universality may be associated with all three principles.

Table 1

Comparison of Emergent Themes with UID and UDL

<table>
<thead>
<tr>
<th>Key themes</th>
<th>UID (Palmer &amp; Caputo, 2003)</th>
<th>UDL (CAST, 2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belongingness</td>
<td>Accommodating learning spaces</td>
<td>Optimize individual choice &amp; autonomy (7.1), minimize threats &amp; distractions (7.3), facilitate personal coping skills &amp; strategies (8.2), and activate...background knowledge (3.1), as means of engagement and representation.</td>
</tr>
<tr>
<td>Social learning space</td>
<td>Supportive learning environment</td>
<td>Foster collaboration &amp; community (8.3), as a means of engagement.</td>
</tr>
<tr>
<td>Structuredness</td>
<td>Consistency, explicitness, minimization of effort</td>
<td>All the principles</td>
</tr>
<tr>
<td>Universality</td>
<td>Accessibility, flexibility</td>
<td>All the principles</td>
</tr>
</tbody>
</table>

Application of Instructional Strategies

In Table 2, a summary of the online active learning-oriented instructional strategies used by participants is categorized by the typology of Ragan et al. (2008) with implications for practical application. In this typology, interactive tasks that involve collaborative tools and student groupings are characterized as activity-centered lessons. Content-centered lessons contain passive tasks wherein students mainly interact with the content, with the exception being class discussions of the content. Experience-centered activities incorporate hands-on approaches to developing artifacts or serving/co-working with others. Learner-centered activities offer learners opportunities to enact self-directedness regarding their pursuit of knowledge, including metacognitive actions for self-regulated learning. There are affordances and constraints for each of these activity classifications, as are noted in the table, though these may vary depending on any given learning task or content focus.

Table 2

<table>
<thead>
<tr>
<th>Types</th>
<th>Strategies mentioned</th>
<th>Implications for online course design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity-centered</td>
<td>Case studies, debates, games, group projects, roleplay, students crowd-source information/resources using criteria</td>
<td>Affordances include ease of setup in web conferencing breakout rooms, virtual backgrounds, Internet search engines, and collaborative publishing tools. Barriers include large class size, non-innovative instructors, and setup for games.</td>
</tr>
<tr>
<td>Content-centered</td>
<td>Discussions, presentations, writing activities</td>
<td>Affordances include familiarity of tasks and ease of management. Barriers include large class sizes for discussions and presentations.</td>
</tr>
<tr>
<td>Experience-centered</td>
<td>None provided</td>
<td>Constraints are inhibiting IDs from considering these.</td>
</tr>
<tr>
<td>Learner-centered</td>
<td>Polls/Quizzes, peer feedback</td>
<td>Affordances for polls include just-in-time feedback, the opportunity to share and discuss students’ input, and feasibility in large classes. Barriers include non-innovative instructors.</td>
</tr>
</tbody>
</table>

In applying the variety of instructional strategies, we recommend that learner preferences be supported through multimodal opportunities for learning. For example, alternatives to live virtual lectures are important because of the brain’s inability to pay attention, process, and store lengthy amounts of information (Baddeley et al., 1974; Bruning et al., 2011; Miller, 1956; Sweller et al., 1998). Further guidance, exemplars, and training are needed for designers and instructors regarding experience-centered instructional strategies to overcome present constraints for this modality. Experience-centered techniques in the online environment offer great potential for online licensure/professional courses such as teacher education, nursing, health sciences, and instructional design.

Enablers and Barriers

In collaboration with experienced innovative instructors, IDs felt they could successfully design active online courses as per the UDL framework, if given sufficient...
resources (e.g., time, funding, technology) and accessibility support. According to the Association for Talent Development’s categorization of root causes (Wilmore, 2004), the barriers expressed in this study fall into the performance improvement factors of information, knowledge/skills, resources, and structure/process. Instructors’ lack of time to develop active learning material has been identified in prior research, including Miller and Metz (2014). Challenges faced by IDs collaborating with instructors have also been identified in prior research such as Bain (2020), though the barriers of instructors’ lack of innovation or online teaching experience were not mentioned.

In remote teaching situations prompted by various crises, instructors (regardless of experience) may be called upon to teach online. Emergency remote teaching online may be different than traditionally designed online coursework, wherein specific criteria and guidelines may be more thoroughly incorporated (Hodges et al., 2020). More investigations are needed to decipher the complexities of collaborating with instructors ranging in experience and openness to innovation to provide online accessible education irrespective of the situation.

**Study Limitations**

This study was exploratory, and as such, limited in scope. Findings represent the perspectives of the participant sample and are not intended to be generalized. Further iterations of the UDL-OAL instrument could be expanded to include the additional suggested contributions from participants in this pilot study. Further, the study is situated within the context of challenges related to the COVID-19 pandemic, which involves a large-scale application of online learning at present in US higher education institutions to mitigate viral spread. The pressures to reinvent approaches to deliver content in this remote format have necessitated a rapid redesign of coursework and other learning experiences. Future research could address this gap by exploring success case scenarios particular to the barriers identified in this study. Additionally, scholarly inquiry into the collaborative aspects of ID in coordination with instructor openness to innovation may yield valuable insights into the expanded application of active-learning techniques to support varied learner needs.

**Conclusion**

With the input from IDs, we explored approaches to designing online active learning techniques from a UDL stance. The ideas and concerns raised can be used to inform our practice and the stakeholders involved in instructional design in higher education. We hope that our case study is replicated through both innovative and necessary modifications to other contexts (e.g., rural, private, international) and that the study instruments will be utilized and expanded. We are thankful to our participants who most enthusiastically shared their compassion for making online education accessible to all.

**References**

[https://edtechbooks.org/-hGHhi](https://edtechbooks.org/-hGHhi)


[https://edtechbooks.org/-JzBq](https://edtechbooks.org/-JzBq)


[https://edtechbooks.org/-ukL](https://edtechbooks.org/-ukL)


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Cavanagh, A. J., Chen, X., Bathgate, M., Frederick, J.,


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**Appendix A**

**Universal Design for Learning - Online Active Learning (UDL-OAL) Survey**

**Demographics Section**

1. What is your gender?
   1. Female
   2. Male
   3. Non-binary
   4. Prefer not to disclose

2. How long have you been an instructional designer?
   1. 6 months-2 years
   2. 3-5 years
   3. 6-8 years
   4. 9-11 years
   5. 12+ years

3. What is your highest level of education?
   1. Associate’s degree
   2. Bachelor’s degree
   3. Graduate certificate
   4. Master’s degree
   5. Doctoral degree

4. To gain a sense of the range of study participant...
experiences, describe any formal training you have completed related to instructional design.

[free text]

5. What content area(s) do you tend to support or design for? Check all that apply.
   1. Architecture
   2. Arts
   3. Business
   4. Education
   5. Engineering
   6. Health Sciences
   7. Hotel, Restaurant Management, Hospitality
   8. Languages
   9. Law
   10. Liberal Arts
   11. Library and Information Sciences
   12. Mathematics
   13. Natural Sciences
   14. Social Sciences
   15. Social Work
   16. Technology (e.g., computer information systems, construction management)
   17. Other [Free text]

Active Learning Section

The next section of questions related to active learning techniques. Active learning engages students directly in the learning process through instructional activities with differing degrees of interaction that are student-centered. This is contrasted with passive learning, which tends to occur indirectly and without interaction.

1. How often do you incorporate the following active learning techniques in online course designs?

<table>
<thead>
<tr>
<th>Cognitive learning activities (e.g., brainstorming, concept mapping, graphic organizers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use regularly</td>
</tr>
<tr>
<td>Discussion-based (e.g., think-pair-share, threaded discussions, synchronous breakout groups)</td>
</tr>
<tr>
<td>Presentations / Jigsaw activities</td>
</tr>
<tr>
<td>Debate</td>
</tr>
<tr>
<td>Case studies</td>
</tr>
<tr>
<td>Writing activities (e.g., one-minute papers, journaling/blogging/podcasting, student publishing, end of a unit reflections)</td>
</tr>
<tr>
<td>Annotations</td>
</tr>
<tr>
<td>Photo walk (i.e., taking and sharing pictures of key concepts, topics, etc.)</td>
</tr>
<tr>
<td>Group projects/ problem-based learning</td>
</tr>
<tr>
<td>Peer-feedback</td>
</tr>
<tr>
<td>Games</td>
</tr>
<tr>
<td>Quiz/poll questions</td>
</tr>
<tr>
<td>Immersive activities (e.g., simulations, role play, Virtual Reality, Augmented Reality)</td>
</tr>
</tbody>
</table>

1. Describe any other active learning techniques that you typically incorporate into your online course designs. [Free text]

1. Describe your favorite techniques to incorporate active learning in synchronous learning sessions. [Free text]

1. Which of the following alternatives to live virtual classroom lectures do you design/recommend? Check all that apply.

- Pre-recorded narrated presentation/screencast
- Written lecture
- Podcast
- Virtual tour (e.g., museum, SecondLife, Google Earth TourBuilder)
- Digital storytelling
- Inquiry-based activity (e.g., series of tasks, scavenger hunt)
- Community-based activity (e.g., attending local civic leader presentation)
- Gaming
- Simulation
- Guest speaker/expert interview
- Other ____________________________
1. What tools do you typically incorporate into the design of synchronous session activities for teaching assistants or instructors? Check all that apply.

- Web-conferencing tool (e.g., Microsoft Teams, Zoom, WebEx, Adobe Connect, Big Blue Button)
- Collaborative desktop publishing tools (e.g., Google Suite, Microsoft Office 365, Dropbox)
- Polling tools (e.g., Poll Everywhere, Mentimeter, Google Forms, Microsoft Form)
- Quizzing tools (e.g., Kahoot, Quizizz, Quizlet)
- Graphic organizer tools (e.g., Coggle, Lucidchart, Popplet, Google Drawing)
- Social media (e.g., Twitter, Facebook, Snapchat)
- Other [Free text]

1. To what extent do you think each of the following limit use of active learning techniques in online course designs at your University?

<table>
<thead>
<tr>
<th>Resistance by instructors</th>
<th>Very limiting</th>
<th>Moderately limiting</th>
<th>Not at all limiting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance by instructors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance by students</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance by administration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructors overwhelmed by course preparations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unmanageable in large class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of access to technology resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of support staff (e.g., teaching assistants, graders, course administrators)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility concerns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of time</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Describe any other barriers not in the list above that you see as limiting your use of active learning techniques in online course designs at your University. [Free text]

**Udl Section**

1. To what extent do you feel confident in your knowledge about designing accessible courses and learning materials?

<table>
<thead>
<tr>
<th>Completely confident</th>
<th>Fairly confident</th>
<th>Somewhat confident</th>
<th>Slightly confident</th>
<th>Not confident at all</th>
</tr>
</thead>
</table>

1. How have you learned about accessible educational practices? Check all that apply.

- Workshop
- Course
- Reading on my own
- Watching videos
- Meeting one-on-one with a mentor/expert
- Professional learning network
- Learning from my colleagues
- Other [free text]

1. What does Universal Design for Learning (UDL) mean to you? [free text]

How do you think Universal Design for Learning applies to active learning? [free text]
Appendix B

Semi-Structured Focus Group Protocol

1. Describe some ways that you promote using active learning techniques in synchronous sessions for courses or learning experiences that you design or support.

2. [Show survey data word cloud of active learning techniques.] In the poll, select what you think are the top three most important active learning techniques that you tend to promote for use in synchronous sessions.
   1. Why do these techniques seem to be most favored?
   2. Do you have an example related to one of these techniques that you’d want to share?

3. [Show survey data bar graph of alternatives to live virtual classroom lectures.] In the poll, select what you think are the top three most important alternatives to live lecture format that you tend to promote in your designs and instructional support.
   1. Why do these alternatives seem to be most favored?
   2. Do you have an example related to one of these alternatives that you’d want to share?

4. [Show survey data bar graph of active learning techniques that designers knew about but tended to not incorporate in their designs.] Tell us more on why designers tend not to use these in course designs.

5. [Show survey data word cloud of active learning and UDL overlap.] Tell us more about your thoughts on how you see Universal Design for Learning and active learning techniques overlap.

6. Tell us more about how you strategically design from the outset for diverse learners in online learning environments.
   1. Can you share any examples of ways that you have done this in your designs?

7. [Show survey data bar graph of alternatives to live virtual classroom lectures.] In the poll, select what you think are the top three most important active learning alternatives that you tend to promote in your designs and instructional support.
   1. Why do these techniques seem to be most favored?
   2. Do you have an example related to one of these techniques that you’d want to share?

8. [Show survey data bar graph of enhancers that enable active learning techniques in online course designs.] In the poll, select what you think are the three greatest enhancers.
   1. How do you enhance applications of UDL in active online learning activities?
   2. Could you share some examples?

9. Any final thoughts that you would like to share?
Designing Together From Moment to Movement

A Faculty Framework for Access Online

Ann Gagné & Adriana Grimaldi

This paper will explore the role of collaboration to explain how a pedagogical reading group supported faculty and staff at an institution in Canada in the development of self-awareness and application of Universal Design for Learning (UDL) principles. Within this social learning framework, a community of individuals, an educational developer, and members of the pedagogical reading group, were able to articulate and disseminate a process where learning together, as an experience of small meaningful moments, led to the possibility of larger wholesale movements as institutional change.

Introduction

Faculty and educational development are very much premised on the ability to build strong connections to instructor groups and being able to reinforce the importance of having evidence-based approaches to pedagogy regardless of the way the content is delivered. The ability to build connections is often difficult, and before the pandemic, part of connection building was linked to an awareness of the role and scope of educational developers (ED) and instructional designers (ID). As Tom Warhover (2020) states “we need to get the word out that what [IDs] do matters” (p.61). The work of faculty development and the role of teaching and learning centres is always somewhat in flux, and very much about meeting colleagues where they are in terms of their needs, their background, and their gaps. Ultimately, those who work in faculty development and the role of teaching and learning centres is always somewhat in flux, and very much about meeting colleagues where they are in terms of their needs, their background, and their gaps. Ultimately, those who work in faculty development are invested in creating moments of connection that lead to larger movement towards, ideally, equitable and inclusive pedagogy and rewarding teaching and learning experiences for all. This type of engagement addresses a common barrier to evidence-based pedagogical change - the prevalence of individual or pocket efforts in driving change - rather than a more wholesale movement on behalf of a majority of the faculty members (Tagg, 2012 as cited in Brownell& Tanner 2012). Studies discuss the tensions between faculty and ID/ED dynamics, the Intentional Futures (2016) report states “the number one obstacle that instructional designers face is a lack of faculty buy-in” (p.15). Thus, ID/EDs are always looking for ways to gain buy-in, and “humanize our work as instructional designers” (Grabau, 2020, p.41) to make ID’s work and resources accessible to instructors from many different backgrounds, and increase the possibility of faculty buy-in.

Whether explicitly framed in such a way or not, Universal Design for Learning (UDL) principles underpin the work of faculty development and support a humanizing approach to ED/ID work. As outlined in Richardson et al. (2018), important elements to the ED/faculty relationship are building trust and remaining flexible. UDL fundamentally supports flexibility as seen in the guidelines outlined by the Center for Applied Special Technology (CAST). The nine evidence-based UDL guidelines are divided into three categories of multiple means of engagement, representation, and action and expression. For the purposes of this article, we will be focusing on guidelines 7 (recruiting interest), 8 (sustaining effort & persistence), and 9 (self-regulation) as they are the most directly connected to reading group practice as instructor professional development (CAST, 2018).

UDL theory and practice is also framed around intentionality, which informs each professional development opportunity provided, or resource created and shared by an ED/ID, as ED/IDs support instructors where they are. It also engages faculty, regardless of their status within the institution. Anything that is provided should be open and created to have something that will be of use for tenure-track professors (at any stage of their career from assistant to full professor), teaching-stream professors, adjunct faculty, post-doctoral fellows, and graduate-student course instructors.

This intervention will highlight the use of a pedagogical reading group (PRGs) as a low-stakes activity to build community on a campus with many departments and stakeholders and to engage in the important work of exploring pedagogical theories and framing of praxis. It helped the individual participants pivot immediately to a remote learning environment (Meaningful Moments 1 and 2), and the ED design support programs at an institutional level (Meaningful Moments 3, 4, and 5). Bond and Blevins (2019) situate reading groups (book group discussions) within the larger social-learning framework of professional development, specifically belonging to the category of learning communities (LCs). PRGs embody one of the key change strategies of LCs (as identified by Bond and Blevins 2019) namely the opportunity to listen to various perspectives and envision alternative teaching models. In addition, pedagogical reading groups (PRGs) address UDL checkpoint 8.3
“foster collaboration and community” (CAST, 2018). They also help open conversations and reflections on UDL checkpoints 8.1 “heighten salience of goals and objectives” and UDL checkpoint 9.3 “develop self-assessment and reflection” (CAST, 2018). PRGs help model the kinds of UDL structures that participants could incorporate in courses, whether the book being read together is about UDL or not. However, if the book is about UDL, as was the case with our reading group in January of 2020, and a global pandemic or educational crisis ensues, PRGs represent a meta-modelling framework for creating moments that lead to more in-depth reflections and holistic ideology that potentially spark movements.

Unsurprisingly, faculty educational development leads to positive impacts in the classroom. Wheeler and Bach (2020) assert courses taught by instructors who participate in ED programs “had significantly more learning-focused syllabi and active learning than courses taught by non-engaged instructors” (Wheeler & Bach, 2020, p.1). The professional development (PD) investigated in this study were, relatively, time-intensive: “a week-long course design institute (35 hours) with subsequent participation in a learning community (16 hours for the new faculty learning community and 14 hours for the STEM learning community)” (Wheeler & Bach, 2020, p.3). These are impressive findings, that are a direct result of a well-designed and committed approach to faculty development in which all the stakeholders came together with the specific goal of improving the student-learning experience. This is the kind of holistic approach that we would all like to strive for, but that is not always possible. In the absence of this type of time and resource commitment, we do not have to give up on high-impact ID/ED. One of the prized elements of the new faculty learning community in Wheeler and Bach’s 2020 study was its ability to “engage participants in a cycle of deliberate experiment, analysis of, and reflection on their experience” (Wheeler and Bach, 2020, p.3). This commitment to an iterative, intentional process to pedagogy can also be articulated and strategize in a less formalized manner. As such, we want to provide a “start here” mandate, one that employs UDI’s plus-one, as seen in Tobin and Behling’s (2018) and other’s work, an approach that privileges the implementation of low-stakes activities (in terms of time and flexibility) that yield high-impact results such as community creation and support. As such, PRGs can be also be employed by EDs and IDs as a scaffolded activity that introduces a pedagogical teaching topic which is then continued as a more time- and resource-intensive activity as the ones outlined above in Wheeler and Bach’s (2020) study. This would effectively reverse the procedure of Wheeler and Bach’s study in which the participants are required to enrol in a LC after the workshop and instead places the PRG as a foundational activity.

With the opportunity to read a text together and actively share in the learning process of its contents, faculty are able to experience a microcosm of the learning experience they wish to cultivate in their own classes. Participating in a PRG gives participants instant advantage by locating them in the learners’ space. This article uses a narrative framework that models the reflection and discussion that is part of reading groups and social learning practices. It echoes what Jay Dolmage (2015) suggests in his work on UDL, that the “way to start this essay, then, would be to suggest that you not read it as an essay at all.”

Teaching and Learning Collaboration

PRGs offered every semester are just one of the offerings supported by the Teaching and Learning Collaboration (TLC), which includes workshops, webinars, and teaching and learning grants. The TLC has been in existence in its present form since 2015. Funded and supported by the Vice-Dean, Teaching and Learning, the TLC programming and resources are administered and co-facilitated between the Associate Dean, Undergraduate and EDs. Pre-COVID, teaching and learning exchange lunches were also held where instructors met over lunch to discuss strategies and challenges in their teaching and courses.

Meaningful Moment 1: Pedagogical Reading Group

What are some of the barriers to creating a group of instructors who will meet several times over the course of the semester to discuss a book together? When you want a group to be inclusive of participants at different stages in their career, one of the biggest barriers is timing and schedules. Finding a time that is convenient to meet is one of the EDs’ main goals in administering PRGs, and a reason for offering two groups a term to fit different schedules and interests. Instructors self-select which book they would be interested in reading, which models a UDL framework of choice, from a curated list of books created by the ED that supports inclusive teaching and learning.

As stated previously, the PRG addresses primarily collaboration and community building which are strong aspects of a UDL framework, but also an important part of seeing peers in different disciplines or different points of their career. These reading groups have increasingly become a common feature of many centres for teaching and learning, and are often cited as a “less formal, faculty-centered professional development experience to promote best practices of teaching and learning” (Ramlo & McConnell, 2008, p.25). As part of the learning community to which it belongs, PRGs are indeed “a true
gestalt [in which] the whole is greater than the sum of its parts” as it promotes collaboration in an environment that is usually siloed in its respective disciplines (Sicat et al., 2014, p.5). PRGs directly address many of the CAST guidelines and support key knowledge that successfully builds rapport such as the knowledges outlined by West et al. (2017) namely “knowledge of others, knowledge of self, knowledge of relational tools, knowledge of process, knowledge of teaching and learning” (p.49). Like the goals of the TLC in general, a PRG brings a community of like-minded individuals together in one space at a specific time creating an opportunity for the first meaningful moment. It is an example of Richardson et al.’s (2019) suggestion that “encouragement from the administration are also important factors in establishing instructional designer-faculty collaborative relationships” (p.864). Therefore, acquiring financial and administrative backing for such an initiative is important to community building.

The PRG started in mid-January reading Thomas J. Tobin and Kirsten T. Behling’s (2018) Reach Everyone, Teach Everyone: Universal Design for Learning in Higher Education. We met every other week for an hour and had a specific reading schedule, usually two chapters every two weeks. This schedule was set to make the reading manageable but also so that the group could wrap up by the end of the semester (the end of March). The book was part of a curated list of accessible books that all faculty could easily engage with. The group consisted of five members: one was a teaching-stream faculty member, three were part-time lecturers, and one was a graduate student finishing their doctoral dissertation.

Acknowledging the barriers of time and schedules, a conscious effort was made to grant complete autonomy in terms of how the group members chose to interact with the text. The goal was to familiarize oneself with the content of the two chapters assigned for each meeting, and be prepared to discuss as a group. However, there were no restrictions on procedure to give choice and opportunity for all participants. Some annotated the hardcopy provided, others made separate notes, and some made no notes. Participation in the group was not prescriptive. Some chose more active and verbal contributions preferring to brainstorm out loud, while others opted to listen and observe the unfolding conversations and offer their opinions only when they felt they were fully-formed. Still others chose to take screenshots with their phones of any resources that came up in our discussion in order to refer to it later. In doing so, the need for any specific accommodations was removed, the negative emotional valence generally associated with it (Tobin & Behling, 2018, p.3).

Regardless of the methods chosen by the participants, the outcome was the same each and every meeting: content of the chapters was thoroughly discussed, examples of how to apply the content to their own teaching practices were exchanged and refined based on the suggestions and contributions of the group, and ideas were put forth as to how whole-scaled improvements could lead to systemic institutional changes that would benefit a larger group.

In the relatively short period of 60 minutes, we were able to consolidate our thoughts and collaborate on the real-world applications to implement in our own pedagogy and respective units and departments. These pedagogical changes were supported under the leadership of the group facilitator, the ED, who was able to provide instant feedback and supplement gaps in resources arising from conversation. We learned to privilege the quality of our engagement and not the quantity and how this approach could best serve our students by acknowledging this could only be accomplished through a commitment of intentionality in our pedagogical practices. Commitment to intentionality is mirrored in the very structure of Tobin and Behling’s (2018) book. Among the many “aha moments” for our group, was the realization that accessibility was provided by modelling the UDL practices advocated by offering a layered approach to content through narrative examples, theoretical applications, discussions, summaries, and checklists. We experienced for ourselves how effective this approach and subsequent practices could be. Unknowingly, the goals of our PRG had aligned with the goals of Tobin and Behling’s (2018) book, namely to reframe UDL so as to move the conversation beyond disability services. Tobin and Behling (2018) provide practical examples of how to implement UDL in individual course design and as well as at an institutional level beyond mere compliance with accessibility laws (Tobin & Behling, 2018). Moreover, it allowed participants to acknowledge the changing nature of the student population and employ UDL as an effective strategy to continue to serve it effectively and equitably.

At the same time the very nature and structure of the PRG allows for reassessment of the “form and distribution of power in such collaborations” (Richardson et al., 2019) and opening of more possibilities for collaboration and trust in the future.

**Meaningful Moment 2: Pedagogical Reading Group, The End**

The second-last meeting of the PRG coincided with the last week’s campus providing in-person instruction. We quickly moved from being in the same space as our students and colleagues to remote environments with Zoom meetings and poorly-defined boundaries. Just as quickly, we began to plan for our new pedagogical reality and the principles of UDL presented themselves as effective and viable solutions. As most (if not all) of us had no experience with teaching in any other modality, essentially cut off from our students, immediate anxiety stemmed from the question of how to engage students...
The PRG resulted ultimately in the creation of on-the-ground UDL advocates for the larger teaching and learning community. In the current pandemic context and different modalities of teaching and learning, we had five practitioners plus the ED to give guidance and inspire more micro-meaningful moments in remote teaching.

**Meaningful Moment 3: Pandemic and the Need for Emergency Training Support**

Ending the semester with remote exams and final assessments meant that instructors had about three weeks to pivot their summative assessments online. From an ED position, this meant quickly assessing the overarching needs of instructors in a holistic way and creating training support to model UDL principles reflecting choice and different ways for faculty not used to online pedagogy. There was never a doubt that UDL had to be a foundational piece to the design and the delivery of this support, as supported by the work of Baldaris Navarro et al. (2016) The discussions and work completed as part of the PRG framed the transitional professional development offerings. This training was designed using feedback from the stakeholders directly engaged with this support including the instructors’ instructor-gained feedback from students.

The modality in and of itself was a very obvious barrier to address. Instructors and students alike did not necessarily have the technology or the Internet access to engage with materials synchronously. Another barrier is meeting people where they are and ensuring that no one is lost in the transition, especially if they have technology, information, or knowledge gaps that mean they cannot access resources.

The approach taken by the TLC was to offer a series of four webinars on foundational online pedagogy concepts: Analyze, Design, Develop, Implement, Evaluate [ADDIE], learning outcomes and assessment alignment review, inclusive assessment design and academic integrity online, and syllabus review clinic for those teaching in the summer term. We also provided two webinars for teaching assistants. One focused on cultivating community and communication strategies and the other focused on providing feedback online. These were training pieces that were needed in that moment and had to necessarily have different ways for faculty, instructors, and teaching assistants to engage with them. Each of these webinars were offered synchronously, and were also recorded to be viewed asynchronously by those who could not make the time or would like to review the concepts. The slide deck for each webinar was emailed to the participants and was also made available in the institutional LMS with the recording for those who were engaging asynchronously.
The inclusive assessment design workshop introduced UDL and experienced some resistance against UDL fundamentals and associated pedagogical rigour, which is common (UDL on Campus by CAST, 2020; Novak, 2019). Often with the mention of multimodality, the cognitive barrier to address, with those who are engaging in the training, is the belief that multimodality means avoiding critical writing skills. One of the goals of the subsequent workshops, throughout the summer, was to demonstrate how UDL is in fact a movement towards an equitable and rigorous curriculum, one that is aligned with outcomes and features many ways to attain those outcomes. Pliner and Johnson’s (2004) work has demonstrated how rigorous is an integral part of universal instructional design, and yet there are still doubts that a pedagogy of choice could be a rigorous pedagogy.

This is where having conversations with students in terms of what they need, prefer, and engage with is an important part of supporting UDL in pedagogy and assessments. As Womack (2017) states “even though learning requires that material be accessible to students, educators often assume that making material accessible to disabled students threatens academic rigor” (p.497) and it is often this assumption that accessibility advisors and inclusive pedagogy proponents have to engage with daily. As Womack (2017) continues “inclusion and rigor are only incompatible opposites when rigor is defined as exclusion and inflexibility. When rigor is defined as difficulty, they are complementary values” (p.497) and thus, the pivot to a remote teaching environment offered an opportunity to redefine concepts and move mindsets.

UDL’s exploration of the how of learning became particularly critical in late March and early April as we collectively shifted our attention to assessments. How do we evaluate our students without the assistance of our usual tools, namely, invigilated final exams? Preoccupation with academic integrity became a serious stumbling block for many faculty and the potentially short-sighted solution of remote proctoring resulted in undue anxiety for faculty and students alike. The problem was not one of academic integrity, but the narrow definition of academically-rigorous assessments. As Tobin and Behling (2018) outline, most of us see the wisdom in providing multiple ways of delivering information, and motivating our students, but that wisdom is generally not extended to assessments, citing concerns of dilution of rigour and a reluctance to complicate the grading process (p.178-179). The discussions from the PRG allowed for an accessible way into many of these questions. The pandemic prompted many to ponder if the invigilated final exam provides the only means of demonstrating knowledge. In UDL terms, all were questioning whether our assessments have construct relevance, whereby “constructs are the knowledge, skills or abilities being measured by an assessment” (Tobin & Behling, 2018, p.25).

Construct relevance ensures we are evaluating a student’s grasp of the content of the learning, not the format of the evaluation. The example provided by Tobin and Behling (2018) outlines the issues with evaluating math competencies solely through word problems as “[l]earners who have difficulty with reading may miss certain items even though they may have a good grasp of the underlying math concepts” (p.25). Just as we did when shifting teaching modalities, we needed to start with well-defined learning objectives that include criteria for measurement and evaluation of proficiency. For example, in one of the author’s literature courses this past term, this was accomplished by rethinking the assessment plans to better operate within the testing structures afforded by the Canvas Learning Management System. As well as reconfiguring questions to align with higher levels of Bloom’s Taxonomy, namely, analyzing, evaluating, and creating (Anderson, Krathwohl, & Bloom, 2001). Lower-level recall items were eliminated and short- and long-answer questions were prioritized that asked students to reflect upon and apply the core concepts covered in class. This assessment redesign eliminated the need for any virtual proctoring service and proved to be successful in minimizing the opportunities for cheating in a remote environment. It is possible to pursue format-agnostic assessments that are academically rigorous, if supported by construct relevance and well-defined objectives (Harrison, 2006).

Meaningful Moment 4: Accessibility Audits and Course Design

One of the concepts that the TLC programming hoped to embed with instructors is using aspects of critical pedagogy, specifically, reflection practices, as part of course design and review. The Teaching Assistants’ Training Program (TATP) on the main campus of our institution already had a well-developed “access check” framework as part of their training. Informed by the social model of disability, the access checks are meant to be reflective spaces where learners can identify access barriers to learning and share these barriers in a comfortable manner with the instructor. The access checks model is very much about acknowledging accommodation needs, which is a good start to promoting discussions about access and inclusion but within a UDL framework. Access checks needed to go a step further as we move away from contingency planning to needing solutions for a permanently-altered educational environment. We needed to ask more longitudinal questions and shift to the affective brain network that probes the why of learning and how to motivate learners. UDL offers a solution by finding ways to connect with student interests through multiple means of engaging with course material (Tobin and Behling, 2018).
The TLC started using the terminology, accessibility audit, in relation to accessible course review and design. We promoted the access-checks model in our webinars and started each with first, a land acknowledgement of the Indigenous land that our institution is on, and then, an access check for all webinar and workshop participants. Building on this access-check framework, an accessibility audit encourages educators to look at the many types of barriers that could be found in a course. These accessibility audits work for both face-to-face course delivery but also for remote and online course delivery. Supported by a self-paced, asynchronous, eight module mini-training resource, built on the Articulate Rise platform, faculty were encouraged to conduct an inclusion audit of their course design for the fall semester. These modules covered topics such as physical barriers [important for face-to-face delivery], technological barriers [important for remote delivery], and racial, cultural, age, gender expression, family, and class barriers that can be seen in any delivery mode. The purpose of these modules was also to introduce UDL principles as a way to approach inclusive design to reduce these barriers in course design and delivery. It also referenced Tobin and Behling’s (2018) book. These modules were meant to make auditing courses for accessibility as one of the many meaningful moments that faculty would experience in the course design and delivery process. It was again another instance of micro affecting the macro, for each barrier, however large or small, that was addressed in a course, which meant a more inclusive, ethical, and rewarding learning experience for everyone.

**Meaningful Moment 5: Collaborative Opportunities in Instructor Summer Camp**

The accessibility audit modules were introduced as part of a four-day summer camp for instructors that was offered in July and again in August to assist in design of fall remote courses. This summer camp was built on UDL principles where instructors had a choice in terms of when to attend and how to engage with content because there were synchronous and asynchronous elements to the camp. The camp was also built to model the remote learning experience so instructors who have not taken an online course or experienced one previously could explore the environment in a safe and meaningful way, surrounded by a community of peers. The synchronous elements were given within a two hour block each day for four days. Throughout the synchronous block breaks were also enforced, again to model the kind of inclusive and accessible pedagogy that would support learners in a remote environment as indicated by evidence-based research.

The schedule was created in such a way to “provide options for recruiting interest” (CAST, 2018, Guideline 7), as well as “foster collaboration and community” (CAST, 2018, Guideline 8.3) through breakout groups, discussion posts, practice exercises, and reflection opportunities. Multi-modal aspects (CAST, 2018, Guideline 5) were promoted throughout summer camp, but especially in relation to visual syllabi and using icons for signposting throughout the course materials and the LMS, a practice that the camp facilitators modelled in the Canvas course shell for summer camp. This strategy had widespread appeal.

For faculty who had participated in previous professional development webinars offered since March, it was an opportunity to consolidate that information and translate it into a viable pedagogical plan. For those who had not, the summaries, checklists, and other summative materials provided helped to forge a pedagogical plan and to benefit from some of the early expertise of their colleagues. The key was the collaborative, inclusive environment created by the Camp options. For as Richardson et al. (2019) state “collaborations between faculty and instructional designers are key to developing positive learning experiences for students” (p.872). The feedback that the TLC received from summer camp demonstrates that the experience was filled with meaningful moments for the participants. Many developed new skills from the experience and a new awareness of engagement opportunities and techniques built on UDL principles, largely because they had been modelled in the delivery of that material.

**Conclusion**

What makes this moment so particularly important for UDL is the near-universal loss of the face-to-face teaching delivery mode, where physical proximity is now a barrier common to everyone. We are working, in unison, to ensure an equitable online environment for all, in the wake of this loss, and it has brought to the forefront the issues of accessibility and comprehensive inclusion opportunities. We are cognizant of the inherent injustice that issues of accessibility and the accommodations that those in the disability community have been asking for years and have become a more focal reality in the face of a pandemic. We hope that this new-found empathy helps to harness this moment in time into a more momentous and sustained movement for access and inclusion.

There were many meaningful moments in the transition to remote teaching and learning, and these meaningful moments have a powerful radiating framework that support UDL adoption and practice institutionally. From the smallest micro moment of a focused on a UDL text to the macro implementation of a summer camp with participation of over 300 faculty, instructors, and staff from over three campuses institutionally and more than a dozen departments. There was a marked institutional
shift seen in the discussion of how UDL as a theory could work in practice with concepts of rigour and academic integrity at the heart of the discussion. This experience has demonstrated how moments can create movements and UDL has given us an opportunity to do so in the wake of immense pedagogical shifts.

References


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Walking the UDL Walk

Designing an Online Course About UDL

Anya S. Evmenova

Incorporating UDL principles allows faculty to create engaging and accessible online courses for diverse learners in higher education. This article demonstrates a systematic and iterative development and testing of a course about UDL designed with UDL principles in mind. Mixed methods data sources and analyses were used to explore (1) understanding, (2) use, and (3) perceptions of UDL by 132 graduate students across five semesters. In-service educators recognized the specific UDL guidelines and checkpoints built into the course and found first-hand experiences inspiring to implement UDL in their own teaching/service environments. Specific suggestions for universally-designed course elements are shared and discussed.

Introduction

In recent years, the population of learners enrolled in higher education institutions has grown more and more diverse. According to the Integrated Postsecondary Education Data System (2020), the numbers of first-generation, culturally diverse, international, students with various abilities and needs, adult learners, and career switchers keep steadily increasing. In turn, the format of courses in higher education is changing as well. The percentage of students enrolled in online synchronous or asynchronous courses ranges between 30 and 70% for different types of institutions (National Center for Education Statistics, 2018). In fact, adult learners returning to school after an absence, transfer students, first-generation students, and students with disabilities are among the most common groups in online programs (Duffin, 2020). Thoughtful instructional design is even more important for online courses than face-to-face counterparts. Design plays an integral role in the ability of learners to actively engage and successfully complete online coursework.

Universal Design for Learning (UDL) framework effectively addresses learner variability in various educational environments including online courses. UDL originated from the concept of Universal Design (UD) in architecture (Meyer et al., 2014). While UD aims to design products and environments usable by all people without the need for any modification, UDL aims to proactively design learning experiences accessible to all learners. UDL is rooted in the cognitive, neurological, and learning sciences (Meyer et al., 2014). It is based on the three principles of (1) multiple means of engagement, offering options to motivate learners; (2) multiple means of representation, presenting content in different ways; and (3) multiple means of action and expression, allowing options in how learners demonstrate what they know (Rose & Meyer, 2002). While other frameworks exist that support core principles of UD in higher education including Universal Instructional Design (UID; Silver et al., 1998) and Universal Design for Instruction (UDI; Burgstahler, 2015), UDL allows for more flexibility in the instructional design and ways to incorporate physical access, cognitive access, as well as foster meaningful learner engagement especially in online environments regardless of learners’ abilities, needs, interests, and preferences (Evmenova, 2018; Kumar & Wideman, 2014; Rao & Meo, 2016). Flexibility is guided by nine UDL guidelines and 31 checkpoints across three UDL principles (CAST, 2020).

UDL Design Process

Intentional and proactive design is critical in the UDL framework (Hollingshead, 2018). In order to guide educators in applying UDL to various learning environments, the UDL planning process has been suggested (Rao & Meo, 2016). The process walks educators through planning a lesson proactively incorporating UDL principles into instruction. After unwrapping desired learning outcomes and chunking course content into logical modules, UDL strategies are applied to goals, assessments, methods, and materials. There is no prescriptive way of how specific UDL guidelines and checkpoints can be applied, but the focus is on addressing learner variability and existing barriers through providing flexibility and options in engagement, representation, and action/expressions. The UDL planning process also incorporates systematic implementation and revisions. After the initial design, it involves teaching and reflecting on what has worked and what needs to be changed to further reduce barriers (Rao & Meo, 2016). This iterative process allows educators to explore ways to support the diversity of “students with atypical backgrounds in the dominant language, cognitive strategies, culture, or history of the average classroom, who, therefore, face barriers in accessing information when presented in a manner that assumes a common background among all students” (Rose et al., 2006; p. 3).
UDL in Higher Education

Elements of different UD frameworks have been effectively used while designing courses in higher education (Rao et al., 2015). Through carefully crafted testing, research shows UDL in higher education supports students with disabilities (Catalano, 2014), supports English as a second language speakers (Ragpot, 2011), and establishes inclusive environments for all learners (Rao et al., 2014; Rao & Tanners, 2011; Scott & Temple, 2017). Collectively, these studies offer evidence that both faculty and students demonstrate positive attitudes towards UDL and exhibit positive changes in student engagement. In fact, students’ positive perceptions of instruction have shown to be significantly higher in cases when instructors received UDL training compared to those who did not (Davies et al., 2013). Strategies such as providing instructional videos and outlines of lectures as well as offering materials in multiple formats were identified by students as having a significant impact on their educational experiences. However, in addition to what is taught during professional development, it is also important to consider how it is taught (Borup & Evmenova, 2019). Modeling best practices has shown promise as an effective strategy to develop pre-service and in-service teacher skills (Moore & Bell, 2019). The intent of these demonstrations is to foster the transfer of desired methods and behaviors into future and current teachers’ own classrooms. Providing scaffolded authentic experiences and serving as role model for learners is one of the key qualities of effective teacher educators (Tondeur et al., 2012).

Modeling UDL in Online Courses

Some research has focused specifically on modeling UDL in online environments to encourage the adoption of inclusive educational practices (Ashman, 2010; Ye, 2014). In some studies, UDL modeling took place while teaching students about the concept of UDL (Engleman & Schmidt, 2007; Evmenova, 2018; Streagle & Wood, 2015). Experiencing UDL first-hand has resulted in pre-service and in-service teachers’ willingness to transfer its flexibility into their own teaching environments. Despite promising evidence, faculty members are still slow to adopt this framework. UDL awareness and time to meaningfully incorporate the strategies are cited as barriers to UDL implementation (Kumar & Wideman, 2014; Ye, 2014).

The purpose of this study was to explore the importance of modeling the principles while introducing UDL to in-service educators. Specific research questions asked: (1) How do in-service educators interact with UDL components in the course about UDL; (2) What UDL guidelines and checkpoints do in-service educators recognize in an online asynchronous course; and (3) What are in-service educators’ perceptions about the importance of incorporating UDL principles into a learning environment?

Method

In order to answer the research questions, a mixed methods triangulation design was used (Creswell, et al., 2003). Both quantitative and qualitative data were collected and analyzed simultaneously to evaluate students’ use, understanding, and perceptions of UDL. Different data sources complemented each other and allowed for deeper exploration.

Course Context

In order to introduce in-service educators to UDL, an online graduate course was developed following the UDL planning process. The course was delivered primarily in an asynchronous online format; however, optional synchronous interactions were also built-in. The course was logically divided into eight learning modules with weekly readings, activities, formative and summative assessments. The module topics included: (1) Foundations and principles of UDL; (2) UDL standards and guidelines for research and practice; (3) Multiple means of representation; (4) Multiple means of action and expression; (5) Multiple means of engagement; (6) UDL in higher and online education; (7) UDL and student progress monitoring; (8) Designing UDL curriculum. The main course goals focused on understanding the foundations of UDL and applying UDL principles to various environments. Students enrolled in this course were primarily part-time graduate students working full time as educators including general and special education teachers, related service providers in K-12 and higher education settings. Table 1 outlines how multiple means of engagement, representation, action/expression were incorporated into the course in order to motivate and support this diverse group of learners. The numbers in parentheses refer to those specific UDL guidelines aligned with the described strategies (explanation of UDL guidelines can be found at http://udlguidelines.cast.org).

Table 1

UDL Principles Embedded into an Online Course
### UDL Course Elements

<table>
<thead>
<tr>
<th>Multiple Means of Engagement</th>
<th>Course Elements</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>• Course modules consistently organized (7)</td>
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<td></td>
<td>• Syllabus and Online Expectations Letter outlining requirements and expectations (7; 9).</td>
</tr>
<tr>
<td></td>
<td>• Students personalizing their learning by choosing the focus of major assignments and ways to submit those (e.g., choosing an article to review for UDL Research Review assignment; choosing what resources to collect for UDL Resource Notebook assignment; choosing a lesson to observe and analyze for the UDL Instructional Plan assignment; 7)</td>
</tr>
<tr>
<td></td>
<td>• Instructor available via email, FAQ blog, and synchronous virtual hours (7)</td>
</tr>
<tr>
<td></td>
<td>• Self-monitoring checklist to check off the completed work in each module (8)</td>
</tr>
<tr>
<td></td>
<td>• All major assignments broken into manageable chunks with flexible deadlines (8)</td>
</tr>
<tr>
<td></td>
<td>• Mastery-oriented text/video feedback from the instructor and peers enabling revisions (8)</td>
</tr>
<tr>
<td></td>
<td>• Choice to complete some activities individually or in small groups (8)</td>
</tr>
<tr>
<td></td>
<td>• Discussions both class-wide and small groups organized by learners’ areas of interest (8)</td>
</tr>
<tr>
<td></td>
<td>• Optional readings and UDL videos allowing to choose relevant materials (8)</td>
</tr>
<tr>
<td></td>
<td>• Video/text-based overview highlighting objectives and actions in each module (9)</td>
</tr>
<tr>
<td></td>
<td>• Rubrics, outlines, and exemplars of projects, frequent reminders (9)</td>
</tr>
<tr>
<td></td>
<td>• Making connections between content and personal experiences in reflections (9)</td>
</tr>
<tr>
<td></td>
<td>• Ungraded self-assessments encouraging students to apply the UDL planning process (9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiple Means of Representation</th>
<th>Course Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• All course materials accessible (1)</td>
</tr>
<tr>
<td></td>
<td>• Course readings offered in both printable and digital formats (when possible; 1)</td>
</tr>
<tr>
<td></td>
<td>• Each module lecture offered in four different formats: narrated video, regular PowerPoint for note taking, audio MP3, and transcript of the narration (1)</td>
</tr>
<tr>
<td></td>
<td>• Free text-to-speech tools demonstrated and explored to access course materials (2)</td>
</tr>
<tr>
<td></td>
<td>• Captions interviews with experts providing different perspectives (2)</td>
</tr>
<tr>
<td></td>
<td>• Infographics used to introduce key terms for the module (2; 3)</td>
</tr>
<tr>
<td></td>
<td>• Interactive learning environments allowing students to click on hotspots on the image of a classroom to see how a specific principle can be represented (3)</td>
</tr>
<tr>
<td></td>
<td>• Optional websites, podcasts, and videos allowing students to personalize their learning (3)</td>
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</tbody>
</table>

<table>
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<tr>
<th>Multiple Means of Action/Expression</th>
<th>Course Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Activities and discussions submitted in traditional (text) and alternative formats (video, interactive presentation, infographic, Padlet, graphic organizer, etc.; 4; 5)</td>
</tr>
<tr>
<td></td>
<td>• Instructor-created wiki sharing an abundance of tools organized by UDL principles (4)</td>
</tr>
<tr>
<td></td>
<td>• Students choosing to explore and apply those or other tools in their activities (5)</td>
</tr>
<tr>
<td></td>
<td>• Executive functions supported through semi-weekly announcements and strategically placed “Stop &amp; Think” reflection questions embedded in the modules (6)</td>
</tr>
<tr>
<td></td>
<td>• Self-monitoring checklists helping students stay on track (6)</td>
</tr>
</tbody>
</table>

### Participants

Data were collected from five sections of this graduate UDL course offered over five Spring semesters (2016-2020). During those semesters, 150 students across two different universities enrolled in the course. Students from one university were enrolled in Master’s programs in learning technology, while students from another university were in the assistive technology (AT) certificate/master’s degree program. Participants in this study included 132 students who actively participated in the course activities submitting work on time. Of those, 77.3% were female and 22.7% were male. All the participants had experience working with individuals with disabilities ranging from 1 to 26 years ($M = 8.68; SD = 6.17$). Across semesters, five students identified disabilities documented through the Office of Disability Services (two persons with visual impairment; two persons with learning disability; one person with hearing impairment). All participants had taken at least one online course before. Additional demographics are presented in Table 2.

### Table 2

#### Study Participants’ Demographics

<table>
<thead>
<tr>
<th>Occupation: All Participants (n = 132)</th>
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</thead>
<tbody>
<tr>
<td>General education teachers</td>
</tr>
<tr>
<td>Language arts</td>
</tr>
<tr>
<td>Math</td>
</tr>
<tr>
<td>Science</td>
</tr>
<tr>
<td>Social studies</td>
</tr>
<tr>
<td>Language/ESL</td>
</tr>
<tr>
<td>Specials (music, art, PE)</td>
</tr>
<tr>
<td>All subjects in elementary grades</td>
</tr>
<tr>
<td>Special education teachers</td>
</tr>
<tr>
<td>Other educators (AT specialists, SLPs, OTs, principals, librarians, behavior technicians, adult services)</td>
</tr>
<tr>
<td>Full-time students</td>
</tr>
</tbody>
</table>

### Grade Levels: In-service Educators (excluding full-time students; n = 123)

<table>
<thead>
<tr>
<th>Grade Levels: In-service Educators (excluding full-time students; n = 123)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
</tr>
<tr>
<td>Middle</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Mixed (secondary middle/high; K-12; K-8, 3-8, etc.)</td>
</tr>
<tr>
<td>Other (related services, adult services, higher education)</td>
</tr>
</tbody>
</table>

*Note. ESL = English as a Second Language; PE = Physical Education; SLPs = Speech-Language Pathologists; OTs = Occupational Therapists*
Data Sources

Three different data sources were used to answer the research questions in this study.

UDL Use

Students’ engagement with various course components was determined by reviewing the usage analytics in the learning management system. Number of downloads for different lecture formats (available in every module) and the number of time students reviewed embedded self-assessments (available in Modules 3, 4, 5, and 6) was examined by running content usage reports for 132 participating students. In addition, the number of times the selected activities (UDL Research Review, UDL Resource Notebook, UDL Tools) were submitted in alternative formats was manually counted. These data were collected at the end of each course section.

UDL in Our Course Reflections

In Module 6 students were asked to analyze how the specific UDL guidelines and checkpoints were incorporated into the course. This activity was graded anonymously to encourage constructive feedback. Students were asked to respond to the following prompts:

1. Please review the course and reflect on which UDL guidelines and checkpoints are embedded in it.
2. Please propose additional UDL strategies that would remove additional barriers and enhance the learning opportunities for online learners taking this course.

Students were asked to both fill out the table with nine cells representing nine UDL guidelines (quantitative data) and provide descriptive explanations of how each guideline/checkpoint has been addressed (qualitative data). Specifically, if a student correctly identified a UDL guideline present in the course, it was counted as one entry. The total number of entries for each of the nine UDL guidelines was calculated across the participants. In addition, the descriptive explanations of how each guideline was addressed were coded to align with specific UDL checkpoints.

Final Questionnaire

The final course questionnaire was adapted by the instructor from the Web-based Learning Environment Instrument (WEBLEI; Chang & Fisher, 2003) and validated in previous semesters (Evmenova, 2018). The purpose of this questionnaire was to measure students’ satisfaction and use of various course features including UDL components. Four scales: access, interaction, response, and results were represented by 27 items. Among those, 20 items used a 5-point scale from “never” to “always” or from “strongly disagree” to “strongly agree.” Of those, a subset of 11 items reflecting the design principles were used for the data analysis in this study. Nine items evaluating the instructor’s actions (e.g., timeliness of feedback) were omitted. Seven additional items were open-ended and asked students about their previous online learning experiences, reasons for why students chose to complete module activities in traditional and alternative ways, specific activities in the course, suggestions for changes, and students’ understanding of UDL at the end of the course. The questionnaire was created using the Survey tool in the learning management system and was completed anonymously in Module 8. A majority of participants (93%) provided answers to the final questionnaire.

Reliability and Trustworthiness

Both quantitative and qualitative data were used to verify the findings in this study. Results have been corroborated by multiple data sources as well as triangulated across different educators and different sections of the course. In addition, the UDL in Our Course reflections have been scored and analyzed by two independent reviewers: the official course instructor and the adjunct instructor teaching additional sections of this course. The submissions were reviewed both for accuracy (e.g., examples from the course were representative of corresponding UDL guideline/checkpoint) and qualitatively analyzed to determine overarching themes representing each UDL guideline/checkpoint. The inter-rater agreement between the two reviewers was 99%.

Results

Frequencies and descriptive statistics were used to analyze content usage in the learning management system (RQ1), specific UDL guidelines recognized by the participants in the course (RQ2) and the Likert-scale items on the final questionnaire (RQ3). In addition, the UDL in Our Course reflections and open-ended items on the final questionnaire were analyzed using the qualitative thematic analysis (Guest et al., 2011). The thematic analysis involved reading and re-reading the entries in order to examine data for patterns. These patterns were compared across educators to develop categories. The categories then merged into overarching themes in response to specific research questions.

UDL Use

Quantitative Results

Participants accessed module lectures in all four formats. Specifically, across all modules and course sections, narrated video was accessed by 81% of students, regular
PowerPoint for note taking by 98%, audio MP3 by 32%, and transcript of the narration by 52% of students. Since students could use more than one format for each lecture, the total exceeds 100% and demonstrates that multiple formats of the same lecture were often used. The analysis of students’ use of ungraded self-assessment showed that 76% of students reviewed it in Module 3; 76% in Module 4; 65% in Module 5, and 71% in Module 6.

In terms of how selected activities were submitted, students preferred alternative formats in some cases and more traditional formats in others. For example, students were asked to create UDL Resource Notebooks compiling and analyzing UDL resources in their areas of interest. Figure 1 demonstrates the different formats students choose their UDL Resource Notebook assignment. In the UDL Tools activity, students analyzed how UDL was represented in a program/app of their choice and also chose different formats to submit their work (Figure 2). In turn, the UDL Research Review was submitted in paper-based format (90%); interactive presentation (9%); and video (1%).

Figure 1
UDL Resource Notebook Assignment Completed in Different Formats

Figure 2
UDL Tools Activity Completed in Different Formats

Note: “Other” category included brochures, magazine covers, and Popplet graphic organizers.

Qualitative Results

In addition to the quantitative data, students had two open-ended questions on the final questionnaire asking them to reflect on the reasons why they had chosen to complete activities in traditional (e.g., written text-based responses) and alternative ways (e.g., posters, videos). Qualitative analysis of students’ responses resulted in three overarching themes: (1) time to learn new programs; (2) levels of comfort, and (3) showcasing someone’s abilities. While some students chose traditional ways because they had limited time to learn new programs, others appreciated an opportunity to take the time and explore options. Similarly, while some students referred to “force of the habit,” others enjoyed being challenged to think outside of their comfort level and experience what their own learners might experience. Finally, while some students found it easier to clearly articulate and organize their thoughts in writing, others found writing to be confusing and tried new ways to present their ideas to demonstrate learning. As one student noted “Honestly, it made me think harder and work with the material more to find clear, concise ways to convey my thoughts.” One additional reason unique to traditional formats was based on some students not being able to download unknown programs on their school-owned devices.

UDL in Our Course Reflections

Quantitative Results

The quantitative analysis of the UDL in Our Course reflections showed that all students were able to accurately identify the UDL principles built-into the course. The percentages of students who recognized specific UDL guidelines were as indicated in Table 3.

Table 3
UDL Guidelines Recognized by Students in an Online Course

<table>
<thead>
<tr>
<th>UDL Guidelines</th>
<th>Percentage of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>UDL Guideline 1. Provide options for perception</td>
<td>97%</td>
</tr>
<tr>
<td>UDL Guideline 2. Provide options for language &amp; symbols</td>
<td>74.2%</td>
</tr>
<tr>
<td>UDL Guideline 3. Provide options for comprehension</td>
<td>94.7%</td>
</tr>
<tr>
<td>UDL Guideline 4. Provide options of physical action</td>
<td>67.4%</td>
</tr>
<tr>
<td>UDL Guideline 5. Provide options for expression &amp; communication</td>
<td>98.5%</td>
</tr>
<tr>
<td>UDL Guideline 6. Provide options for executive functions</td>
<td>90.2%</td>
</tr>
<tr>
<td>UDL Guideline 7. Provide options for recruiting interests</td>
<td>96.2%</td>
</tr>
<tr>
<td>UDL Guideline 8. Provide options for sustaining effort &amp; persistence</td>
<td>88.6%</td>
</tr>
<tr>
<td>UDL Guideline 9. Provide options for self-regulation</td>
<td>74.2%</td>
</tr>
</tbody>
</table>

Qualitative Results: Specific UDL Checkpoints Recognized by Students

In addition to quantitative analysis, students’ reflections on strategies incorporated into the course were analyzed using thematic analysis. Table 4 presents specific UDL checkpoints students recognized in the online course organized by nine UDL guidelines (explanation of UDL guidelines and checkpoints can be found at http://udlguidelines.cast.org).

Table 4

Specific UDL Checkpoints Embedded into the Course and Recognized by the Students

<table>
<thead>
<tr>
<th>Provide Multiple Means of Engagement</th>
<th>Provide Multiple Means of Representation</th>
<th>Provide Multiple Means of Action/Expression</th>
</tr>
</thead>
</table>
| 7: Provide options for recruiting interest  
  • Choices in assignments focus; multiple media options; flexible deadlines (7.1)  
  • Personalize content and activities; UDL implementation videos; small groups organized by roles/grades (7.2)  
  • Many ways to contact instructor; sense of community; expectations letter (7.3) | 1: Provide options for perception  
  • Use print/online version of textbook and other readings allowing adjusting font size, contrast, speed, etc. (1.1)  
  • Lectures with captions and transcript; text-based module overviews (1.2)  
  • Lectures with narration; video-based module overviews (1.3) | 4: Provide options for physical action  
  • Varying methods for participating in discussions and submitting assignments (text, audio, video, etc.) (4.1)  
  • Access to text-to-speech programs(s); accessible documents & materials; UDL Wiki with links to UDL/AT tools (4.2) |
| 8: Provide options for sustaining effort and persistence  
  • “Are You on Track?” checklist in each module; assignments in chunks (8.1)  
  • Mandatory & optional activities with varying degrees of difficulty (8.2)  
  • Class-wide, small group discussions; options for group work (8.3)  
  • Mastery-oriented text & audio feedback; rubrics; peer feedback (8.4) | 2: Provide options for language, mathematical, expressions, and symbols  
  • Definitions of key terms; links to external websites w/examples (2.1)  
  • Clear expectations in multiple formats for each module (2.2)  
  • Using text-to-speech program(s) to access required readings (2.3)  
  • Content in text, podcasts, videos, infographics, interactive maps (2.5) | 5: Provide options for expression and communication  
  • Use different ways to communicate: blogs, discussions, emails, etc. (5.1)  
  • Complete work via multiple tools: Word, Prezi, Pictochart, video, LiveBinders, Padlet, graphic organizers, etc. (5.2)  
  • Large assignments broken into chunks, submitted for feedback (not graded); modules building on each other (5.3) |
| 9: Provide options for self-regulation  
  • Reflection blog throughout the course; syllabus & online expectations letter; semi-weekly reminders; rubrics, outlines, etc. (9.1)  
  • Flexible deadlines; grading based on effort; virtual office hours; optional informal synchronous meetings (9.2)  
  • Ungraded self-assessments on the UDL design process (9.3) | 3: Provide options for comprehension  
  • Links to optional resources; reflecting on personal experiences (3.1)  
  • Infographics; module outlines; concepts revisited multiple times (3.2)  
  • Interactive maps demonstrating UDL checkpoints in a classroom; step-by-step instructions; screenshots (3.3.)  
  • UDL implementation videos; “Are You on Track?” checklists (3.4) | 6: Provide options for executive functions  
  • Semi-weekly announcements; learning objectives listed; module overviews (6.1)  
  • Table outlining all module activities; Stop & Think prompts in lectures; submitting drafts for feedback (6.2)  
  • Sample papers, projects, outlines; UDL wiki organized by UDL principles (6.3)  
  • Downloadable “Are You on Track?” checklist in each module (6.4) |
Qualitative Results: Additional UDL Strategies

The thematic analysis of the additional suggestions for UDL strategies that could further remove barriers and enhance students’ learning resulted in following overarching suggestions:

1. Provide options for perception – review accessibility options on various devices
2. Provide options for language & symbols – create UDL glossary of terms and definitions to access throughout the semester; demo a translation tool for other languages
3. Provide options for comprehension – make explicit connections to activities
4. Provide options of physical action – offer opportunities to access materials using AT
5. Provide options for expression & communication – offer low-tech options
6. Provide options for executive functions – allow students to reflect on personal goals
7. Provide options for recruiting interests – set up chats with UDL implementers
8. Provide options for sustaining effort & persistence – have more collaborative projects
9. Provide options for self-regulation – allow students to set up personal goals

Final Questionnaire

Overall, a majority of students reported being more confident in their understanding of UDL after taking the course ($M = 4.88; SD = .35$) and planning to incorporate UDL strategies in their environment ($M = 4.84; SD = .39$). Table 5 presents the results of the Likert-scale items on the final questionnaire representing three UDL principles.

Table 5

<table>
<thead>
<tr>
<th>Multiple Means of Engagement</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q4: The expectations of activities and assignments were clearly stated.</td>
<td>4.88</td>
<td>(.35)</td>
</tr>
<tr>
<td>Q13: The feedback from the instructor was helpful and sufficient.</td>
<td>4.85</td>
<td>(.51)</td>
</tr>
<tr>
<td>Q16: Instructor actions/course activities (e.g., reflection blogs) reinforced the development of a sense of community among course participants.</td>
<td>4.05</td>
<td>(.87)</td>
</tr>
</tbody>
</table>

Multiple Means of Representation

Q6: Presentations were helpful in summarizing the essential information from the assigned readings and other assignments. | 4.83 | (.42) |
Q8: There is a value in having course materials available in multiple formats. | 4.90 | (.43) |
Q22: I see the value in video introductions/overviews for each module. | 4.76 | (.58) |

Multiple Means of Action Expression

Q7: The activities throughout the semester helped me learn and prepare for the final project. | 4.77 | (.44) |
Q21: Even if I didn't have time to choose alternative formats for the module activities, having options throughout the semester provided nice examples of how to incorporate UDL strategies into my own learning environment. | 4.76 | (.61) |
Q3: The structure of each class module was clear and kept me focused on what was to be learned. | 4.80 | (.49) |

Note. Standard deviations are presented in parentheses.

As indicated in Table 5, students were satisfied with the UDL principles embedded into this online course. Clear organization of the course, instructor feedback, presentations in multiple formats, video overviews, ability to submit work in alternative formats were rated highly by the participants. A single item scored low and referred to building a sense of community among students. Even though there were multiple opportunities to interact with peers asynchronously, many participants still wanted more synchronous interactions with the instructor and peers.

Discussion

This study aimed to demonstrate how important it is to walk the UDL walk by modelling the principles to create both an inclusive learning environment and encourage deeper understanding of UDL among in-service educators. Participants in this study actively used the ungraded self-assessments (multiple means of engagement), different lecture formats (multiple means of representation), and opportunities to submit activities in alternative ways (multiple means of action expression).
The fact that some students downloaded multiple formats of the same lecture illustrated that those could be used for different purposes. As one student noted on the final questionnaire “I really liked the presentations in multiple formats. Sometimes I wanted to read it, and sometimes I watched the videos and printed the slides to take notes.” Thus, alternative formats support accessibility for students with certain needs (e.g., captions/transcripts for a student with hearing impairment) as well as benefit students in different life circumstances (e.g., inability to watch a video on a train). This finding is also corroborated by previous research on strategies identified by students as having the most significant impact on their learning (e.g., presenting materials in multiple formats, providing an outline for note taking; Davies et al., 2013).

The fact that most students preferred a more traditional written format for the UDL Research Review and more creative ways to showcase UDL Tools supports the premise that assignments with goals and objectives drive the format and not the other way around. Some novices might assume that UDL is about completing the work in innovative ways only. However, if a traditional written response helps a learner generate more ideas and organize their thoughts, then the format should be available for the learner. The use of technological advances is not the focus of UDL. Allowing learners to demonstrate knowledge in formats that work the best for them is the focus of UDL. Responses from the participants on why they chose or did not choose to use alternative formats corroborate the need for many different options (including more traditional approaches) allowing diverse learners to choose how to show what they know.

While it is possible to implement UDL without it, technology makes it easier to build in multiple means of engagement, representation, and action/communication, especially in online environments (Evmenova, 2018). However, it is important to remember that low-tech choices should also be offered and modeled. As one student pointed out “I would have liked more opportunities to create low-tech products (e.g., a hand-painted poster). These options weren’t explicitly ruled out but were also not given as examples and could have led to some fun and unique final projects.” Indeed, reflecting on the course design, it becomes apparent that constraints still existed even though alternative formats for submission were always an option. In order to provide structure and sufficient supports in an asynchronous learning environment, suggested formats with accompanying tutorials were offered in each module. For example, students were asked to complete the UDL Research Review as a paper (following an outline) or as an interactive presentation (following a tutorial and an exemplar). While students were always encouraged to explore any other ways, only one student took the initiative to create a video critiquing an article. In the next iteration of the course, an improved solution might be to create a choice board or a menu of options for the whole semester rather than prescribing options for each individual activity. This could increase the number of assignments submitted in alternative format. An important consideration would be to create a set of clear expectations for each possible format or directions that can work across formats.

**UDL Understanding & Attitudes**

Modeling has enabled a deeper understanding of UDL principles at the level of specific UDL guidelines and checkpoints. Participants in this study were able to accurately and systematically identify the built-in UDL guidelines and checkpoints. More than 90% of students recognized guidelines 1 (provide options for perception), 3 (provide options for comprehension), 5 (provide options for expression and communication), 6 (provide options for executive functions), and 7 (provide options for recruiting interest). Other guidelines were either not explicitly addressed in the course (2 provide options for language and symbols and 4 provide options for physical action) or were affected by personal preferences (8 provide options for sustaining effort and persistence). For example, even though most course materials were available in accessible digital format, which would allow users to use translation or AT tools, those checkpoints were not directly modeled in the course. In turn, while participants from one university had been going through their program as a cohort and were able to easily identify partners for optional group work, participants from the second university were eager to see more structured collaborative projects. Future iterations of the course should consider additional ways to support a sense of community among all learners, including offering synchronous chats.

In addition, students provided other valuable suggestions for further course development. While some ideas have already been incorporated in the next iteration of the course (e.g., creating a glossary of terms to be used across the semester) and other suggestions require additional efforts to implement (e.g., setting up chats with UDL implementers in different environments), all suggestions focus on further removing barriers and reaching more learners (e.g., someone who is not an inservice educator). More importantly, modeling throughout the semester increases students’ confidence in understanding UDL. It allows teachers and related service providers to feel inspired to use UDL in their own settings. The advantages of experiencing UDL practice first-hand may counterbalance the time and effort it takes to develop (Engleman & Schmidt, 2007; Evmenova, 2018; Streagle & Wood, 2015). As one student noted on the
Too often in education we are told how to teach, but the modeling that accompanies that teaching is often vastly different from what we are expected to do. I really appreciated all of the time and effort put into this course and the materials, so that I could not only learn about UDL classrooms, but also experience one as I learned about it.

Similar to previous research, students' perceptions of UDL were very positive (Ashman, 2010; Rao et al., 2015; Ye, 2014). The analysis of the final questionnaire showed high ratings for all course components that represented the three UDL principles. As was noted by Catalano (2014), strategies that support specific learning needs might be linked to the instructional design decisions that benefit all students. While UDL originated in special education, it has since expanded to become a recognized framework for designing high-quality, engaging online learning environments (Evmenova, 2018; Hollingshead, 2018; Rao et al., 2015). As a result, faculty should be encouraged to explore and incorporate UDL in the instructional design of their courses.

Limitations and Future Research

While participating in-service teachers showed an improved understanding of UDL and attitudes towards it, the biggest limitation of this study is the inability to observe educators implementing UDL in their own classrooms. Future research should expand the measures of knowledge and perceptions to explore the actual transfer of those skills to authentic instructional settings. It is important to examine how in-service teachers apply what they learned in the course in making their instruction more inclusive and accessible for all learners.


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Exploring the Impact of Universal Design for Learning Supports in an Online Higher Education Course

Christina Levicky-Townley, Michele Garabedian Stork, Jingshun Zhang, & Elizabeth Weatherford

The significant increase in online learning, particularly in higher education, has raised questions about the methods instructional designers (IDs) consider to maximize learners’ cognitive functioning and abilities. The literature suggests that Universal Design for Learning (UDL) offers students enhanced opportunities for engagement, expression, and academic performance. However, there is limited research measuring student perceptions on learning following the integration of UDL practices and subsequent course delivery modifications. This article discusses the integration of specific checkpoints within the three domains identified by the UDL framework. The exploratory case study identifies supports perceived to be instrumental in building students’ capacity towards self-regulation, comprehension, and executive functions in an online learning environment.

Introduction

Online learning is growing more rapidly than any other innovation in higher education today (Duesbery et al., 2015). For students who are suitably skilled in reading and possess the necessary organizational abilities, these courses present the opportunity for students to study at their convenience. However, online courses have traditionally relied on asynchronous, text-heavy use of online readings, discussions, written assignments, and tests or quizzes, which are often problematic for students with learning differences (Andrews et al., 2015; Hollins & Foley, 2013).

As online learning platforms increase in popularity, the student population in higher education is becoming increasingly diverse. For example, there is a growing number of students reporting disabilities in addition to the rising number of students enrolling with minority, part-time, and non-traditional student statuses (Roberts et al., 2011). Therefore, the importance of proactive instructional design to reduce barriers, rather than incorporating accommodations after the fact, may be worth exploring (Hollins & Foley, 2013; Kumar & Wideman, 2014; McGuire & Scott, 2006).

To address barriers to student learning, researchers applied the principles of Universal Design from the world of architecture and developed Universal Design for Instruction (UDI), Universal Instructional Design (UID), and Universal Design for Learning (UDL) (Roberts et al., 2011). UDI was derived from the seven principles of Universal Design with the addition of two education-specific principles, “a community of learners,” and “instructional climate.” The focus of UDI is instructional and classroom environment and design. Thus, UID is used synonymously with UDL. In contrast, UDL was developed to address the variability between learners using principles based in neuroscience to alleviate barriers to learning (Meyer et al., 2014).

Literature Review

UDL

UDL was inspired by advances in cognitive neuroscience research, and its framework integrates “what we know about the learning brain” and “inform[s] the design of environments that support all learners” (Center for Applied Special Technology (CAST), 2018b). Tobin (2014) suggests the tenets of UDL are not exclusively for students with disabilities; thus, UDL gives all students equal opportunities to learn and offers online course designers with an effective means to enhance connections with all students. Therefore, the more education professionals and learners understand about the complexities, neuroscience, and predictable variability in learning, the more proficient they will be to advance toward expert learner status (CAST, 2018b; Martinez, 2010).

The Center for Applied Special Technology (CAST) (2018b) describes the UDL Guidelines as a tool, based on scientific insights into how humans learn, for implementing the UDL framework. Thus, the guidelines are designed to be used by educators, researchers, curriculum developers, and anyone interested in optimizing teaching and learning for all people. The UDL Guidelines offer a set of concrete suggestions outlining multiple means of engagement, representation, and expression with the ultimate goal of cultivating expert learners who are (a) purposeful and motivated, (b)
resourceful and knowledgeable, and (c) strategic and goal directed (CAST, 2018b).

**Attention**

The UDL framework acknowledges the diversity of learning and the value of empowering learners to focus on areas of challenge to drive their own learning experiences (CAST, 2018a). Thus, researchers have become increasingly interested in the phenomenon of attention (Kirk et al., 2017; Ratey, 2001; Sarter et al., 2006). Seminal author William James (1890) described attention as “withdrawal from some things in order to deal effectively with others” and implied focalization and concentration of consciousness are the essence of attention (p. 404). According to Ratey (2001), attention is more than observing incoming stimuli; it involves a number of processes including (a) filtering out perceptions, (b) balancing multiple perceptions, and (c) attaching emotional importance to these perceptions. Similarly, from a neural perspective, Penner (1984) describes attention as receptive and cognitive processes that bring awareness to stimuli entering consciousness. Therefore, when attention is insufficient or inappropriate, learning is negatively affected (Eastwood et al., 2012).

Attention drives learning, and when learners are paying attention to something else and are not paying attention to what is being taught, there is little chance they will learn (Wolfe, 2001). Online learning formats present an opportunity for students to identify and improve their attentional resources. For example, in a recent study by Kirk et al. (2017), data revealed intensive computerized attention training resulted in modestly improving certain untrained skills in children with intellectual and developmental disabilities. Similarly, understanding how attention impacts learning outcomes may be beneficial for online course designers to consider if they wish to strengthen online learners’ cognitive skills and abilities.

**Memory**

Memory is essential to learning and provides the foundation for higher order thinking when existing knowledge scaffolds the integration and interpretation of new events (Preston & Eichenbaum, 2013). Thus, researchers in the areas of psychology and neuroscience have provided a rich body of literature on the various forms of memory and their development (Atkinson & Shiffrin, 1968; Paivio & Lambert, 1981). Schooling may have a profound influence on memory development, and learning environments can be viewed as vessels for providing students with opportunities to become more proficient in strategically structuring their remembering and learning (McCandliss, 2010).

Computers are similar to the human brain, and the most obvious similarity is memory (Martinez, 2010). Just as a computer’s memory is vital to its functionality and power, according to Martinez, a human’s memory is just as essential for maximizing learning and proficiency. Cowan (2009) describes three types of memory: (a) long-term memory, (b) short-term memory, and (c) working memory. Although confusion is common between the three types of memory, a study by Nemati (2009) reveals that teaching through memory strategies is effective, and knowledge about the brain gives educators insight to methods and designs conducive to the “mental labor” of the three types of memory (p. 21).

**Multitasking and Engagement**

As students process information from educational materials and digital media, they are increasingly interrupted by their surroundings and competing media (Liu & Gu, 2020). Moreover, as opportunities for online learning continue to expand, research has demonstrated that college students are commonly involved in multiple online activities when they are engaged with the Internet (Moreno et al., 2012). Therefore, the increasing prevalence of media multitasking has raised concerns among educators, and research supports that multitasking during educational activities negatively affects academic performance and learning (van der Schuur et al., 2015). Multitasking is commonly understood as synchronously engaging in two or more things or performing multiple tasks sequentially and in rapid succession (Burak, 2012). Similarly, media multitasking is typically defined as dual tasking or task switching in learning contexts (Wood & Zivcakova, 2015). According to Lepp et al. (2019), multitasking in online and face-to-face courses differs; therefore, online course designers may require different pedagogical methods to effectively minimize multitasking behaviors. For example, Miller (2014) describes the popularity of asynchronous online models which allow students flexibility to finish coursework. However, online learners also experience factors that have the potential to impact learning and student engagement such as (a) technical issues, (b) environmental distractions, and (c) social distance from instructors and peers. Therefore, pedagogical strategies for maximizing student engagement in an online environment requires forethought and savvy design choices.

Researchers have raised questions about the quality of online education in providing students with rich and engaging learning experiences (Chen et al., 2008). In a recent study conducted by Bagriacik and Banyard (2020), literature reveals engagement has been shown to be supported or related to various variables including: (a) self-efficacy, (b) self-determined learning, (c) affect sensitive intelligent systems, (d) self-regulated learning, and (e) problem-based learning.
Overview of Conceptual Framework

According to Miles and Huberman (1994), the conceptual framework provides the researcher with the opportunity to gather constructs into themes or categories. For the purpose of this exploratory case study, the conceptual framework was developed from a review of the literature, professional experiences, and generalizations from empirical data (Baxter & Jack, 2008). The major constructs were organized in Figure 1.

Figure 1
Conceptual Framework

Note. The conceptual framework was adapted from CAST's (2018). *Universal Design for Learning Guidelines Version 2.2*.

The UDL framework is a set of guidelines organized into three domains. Each domain offers checkpoints for creating expert learners who internalize self-regulation, comprehension, and executive function. It is a framework for teaching and learning that offers guidelines for designing instruction that addresses known learner variability and removes learning barriers. UDL provides a framework for course design that will increase access, participation, and success for all learners. The Higher Education Opportunity Act of 2008 defines and endorses UDL implementation for postsecondary instruction (Meyer et al., 2013; Novak & Thibodeau, 2016).

The checkpoints identified by the UDL framework for the engagement, representation, and action and expression domains contributed to the conceptual framework for this research project. Attention, memory, and multitasking activities were selected because these areas of cognition aligned well with the guidelines on which the UDL framework was developed (Miller et al., 2020; Miller, 2014).

Checkpoints for self-regulation are guidelines for the affective network of the learning brain, within the engagement domain of the UDL framework. These checkpoints include offering students opportunities that promote expectations and beliefs that optimize motivation and facilitating students’ personal coping skills and strategies. These checkpoints were selected for this project because they address the power of learner variability on attention and engagement. For example, Miller (2014) describes that “in face-to-face teaching, you can ensure that some bare minimum of time is devoted to classwork (by policing attendance),” and classes can be scheduled “when students are likely to be fresh (i.e., not in the middle of the night). Neither of these basic strategies for ensuring maximal engagement is easy to do online” (p. 40). Because engagement is so essential to learning, these checkpoints offer online instructional designers (IDs) guidance focused on the real goal of education—developing learner expertise. Learners who are able to self-regulate their attention and memory can set difficult goals for themselves and sustain their efforts to achieve, even when conditions for engagement vary (Meyer et al., 2014; Pintrich, & Schunk, 1996).

Checkpoints for comprehension are guidelines for the recognition network of the learning brain, within the representation domain of the UDL framework. These checkpoints include activating student background knowledge. This checkpoint was selected for this project because it offers a research-based scaffolding technique that addresses learner variability. Learners differ greatly in their ability to construct meaning based on their prior knowledge and experiences. There are also barriers for learners who have the necessary background knowledge but might not know it is relevant. The importance of attention, memory, and multitasking to learning is more likely to be important to students when the information is significant to them.

Checkpoints for executive function are guidelines for the strategic network of the learning brain within the action and expression domain of the UDL framework. These checkpoints include helping students choose appropriate goal setting, supporting students’ planning and strategy development, and facilitating students managing information and resources. Thus, this checkpoint was selected for this project because it is critically important for students and IDs to understand that executive functions have very limited capacity due to working memory limitations. If working memory is not constructed as relevant within a learning activity, students have to understand how to keep information organized in a way that works for them. Learners also have to develop the skill of effective goal setting. Once a goal is set, effective learners plan a strategy, including the tools they will use,
individual learning activities designed to elicit complete brief online survey responses following university courses. Study participants were asked to were enrolled in six separate undergraduate level students (undergraduate students and 53 male undergraduate United States. The participants included 121 female students attending a public university in the southeastern Data were collected from a convenience sample of 169 Method The following central questions directed this qualitative education course. Research Questions The purpose of this study was to explore how students perceive the use of specific learning activities on attention, memory, and multitasking to help them develop as “expert learners” who are, each in his or her own way, resourceful and knowledgeable, strategic and goal-directed, purposeful and motivated. This research also sought to identify lessons that can be learned by IDs who would like to implement UDL supports in an online higher education course. Purpose The purpose of this study was to explore how students perceive the use of specific learning activities on attention, memory, and multitasking to help them develop as “expert learners” who are, each in his or her own way, resourceful and knowledgeable, strategic and goal-directed, purposeful and motivated. This research also sought to identify lessons that can be learned by IDs who would like to implement UDL supports in an online higher education course. The checkpoints within the three domains defined by the UDL framework were the basis for using the data collection instruments and collecting data to examine and identify the elements that contribute to students’ perceptions of using specific learning activities on attention, memory, and multitasking to develop as expert learners. After data collection, the UDL framework also served as the basis for data analysis. This framework added structure to data collection and coding during data analysis but did not restrain the nature of qualitative research. In summary, the UDL framework is what provided the constructs for the conceptual framework guiding this research. \section*{Research Questions} The following central questions directed this qualitative case study research: \begin{enumerate} \item How do students perceive the use of specific learning activities on attention, memory, and multitasking to help them develop as “expert learners” who are, each in his or her own way, resourceful and knowledgeable, strategic and goal-directed, purposeful and motivated? \item What lessons can be learned by IDs who would like to implement UDL supports in an online higher education course to support student success? \end{enumerate} \section*{Method} Data were collected from a convenience sample of 169 students attending a public university in the southeastern United States. The participants included 121 female undergraduate students and 53 male undergraduate students (N = 6 unreported gender). The participants were enrolled in six separate undergraduate level university courses. Study participants were asked to complete brief online survey responses following individual learning activities designed to elicit perceptions about attention, memory, and multitasking. Responses were analyzed and interpreted using the suggested steps for conducting qualitative data analysis and interpretation (Creswell & Guetterman, 2019). The data analysis conducted for this qualitative case study exploring how students perceive the use of specific learning activities on attention, memory, and multitasking was performed using qualitative case study methods for its data collection and analysis (Yin, 2011). Data collected from the online learning activities were analyzed in a three-step qualitative analysis procedure. The steps are as follows: 1. Open coding of responses and reflections of each online activity creating labels in conceptual chunks, 2. Grouping open codes into categories for preliminary axial coding; and 3. Comparing the open and axial codes to arrive at composite themes. Through each phase of the study, the researchers met to check for potential bias and to build objectivity to the study (Creswell & Guetterman, 2019). Stake (1995) suggests “there are multiple perspectives or views of the case that need to be represented, but there is no way to establish, beyond contention, the best view” (p. 108). Thus, case study design methods were the most adequate tools to realize both the practical and theoretical aims and to ensure the credibility of the data and findings of the research. The researchers received permission to conduct the study from the institution’s Institutional Review Board (IRB), and the study participants were asked to sign a consent and were informed that their participation in this study was voluntary. The participants were also advised that they could withdraw from the study at any time and that their responses would remain confidential. The learning activities, called “Attention Matters!,” designed by Miller et al. (2020) to address growing concerns about distraction and learning, were integrated into the Canvas learning management system throughout weekly course modules. The activities were organized into three separate units. The units, titled respectively, are as follows: \begin{itemize} \item “What do you know about attention?” \item “What happens when you overload attention?” \item “What’s your plan?” \end{itemize} Each of the three units was designed to have similar structure and sequence of learning materials and a discussion. The first two content units included a short description of the unit’s content, followed by between one and two demonstrations and/or videos, a one-page explanation of the phenomena that were shown in the demonstrations and videos, and a discussion forum. The module design emphasized interactive demonstrations or multimedia (e.g., engaging short video clips), instead of more traditional materials such as slide decks or assigned readings. The discussion prompts emphasized personalization, encouraging students to talk about...
whether the activities could apply to their own experiences. The third unit asked students to describe what they would do in the future to better manage attention, memory, and multitasking in situations that require executive functioning skills, such as when they were tempted to text during class. Figure 2 shows the structure of the “Attention Matters!” student activities in the “Modules” page of the Canvas course.

Figure 2

“Attention Matters!” Student Activities in Canvas

Note. The Attention Matters! modules and activities in Canvas were adapted from Miller, M. (2014).

The “What do you know about attention?” unit included activities to demonstrate phenomena related to attention and distractions. These activities integrated change blindness and the Stroop effect (1935). Change blindness is a phenomenon that involves changes in visual scenes that take place across some type of interruption such as a brief flicker of a gray field across the scene (Miller et al., 2020). Miller suggests that change blindness is an attentional phenomenon that is unlikely to occur when it is known what the scene is about or what important action is taking place. Change blindness was used to start the discussion about the limitations of attention and how information can be difficult to discern when it is focused elsewhere. This activity used a 2 minute and 43 second YouTube video, “Colour Changing Card Trick” (Quirkology, 2012), which uses misdirection and cuts to distract viewers from major changes taking place in the scene, and then replays the video with the changes pointed out. This unit also included an activity to demonstrate the complexity of distractions, using the Stroop effect (Stroop, 1935). Participants were asked to name the color of a series of words, printed in different colors, which conflict with the color names spelled out by the word (e.g., the word “blue” is printed in red ink, the word “yellow” printed in purple ink, and so forth).

The “What happens when you overload attention?” unit included an activity to demonstrate phenomena related to memory. The activity was adapted from Nickerson and Adam’s (1979) coin drawing task that illustrates memory for details of highly familiar objects can be strikingly inaccurate. Students were asked to draw a one-cent coin on paper and then check it for inaccuracies. They also had the option to upload a photo of their drawings to the discussion forum.

Lastly, the third unit “What’s your plan?” unit included a discussion asking students to share their plans for managing attention, memory, and distractions to help them be more successful with their own learning.

Overall, this case study addresses the three UDL framework domains relevant to building learners’ self-regulation, comprehension, and executive function in an online higher education course. Six checkpoints within these three domains contributed to the conceptual framework used as a foundation to facilitate reliability of this research.

Results

A qualitative analysis of the data revealed four central themes related to integrating UDL supports into an online higher education course: supported students’ attention; helped eliminate distraction roadblocks; provided relevance to learning; changed students’ beliefs about attention, memory, and multitasking. These four themes emerged from the qualitative data analysis and represent the major ideas in the database. They are infused throughout the three domains and corresponding checkpoints used as the framework for this research. These four themes were intertwined throughout the domains. Table 1 provides an overview of the findings by theme within the UDL framework domains and related checkpoints.

Table 1

Overview of Findings by Theme within the UDL Domains and Related Checkpoints
<table>
<thead>
<tr>
<th>Theme</th>
<th>Engagement Domain</th>
<th>Representation Domain</th>
<th>Action &amp; Expression Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self-regulation checkpoints:</td>
<td>Comprehension checkpoints:</td>
<td>Executive function checkpoints:</td>
</tr>
<tr>
<td></td>
<td>Promote students’ expectations and beliefs that optimize motivation</td>
<td>Activate student background knowledge</td>
<td>Guide appropriate goal setting</td>
</tr>
<tr>
<td></td>
<td>Facilitate students’ personal coping skills and strategies</td>
<td></td>
<td>Support students’ planning and strategy development</td>
</tr>
<tr>
<td></td>
<td>“We are better able to pay attention when we are told and are aware of what we are looking for and what we should be focusing on.”</td>
<td>“Distractions cause confusion and loss of focus which results in more time necessary to complete tasks.”</td>
<td>Facilitate students management of information and resources</td>
</tr>
<tr>
<td></td>
<td>“I have limited my own potential.”</td>
<td>“We focus on what we find important.”</td>
<td>In order to manage distractions I think [I] need to know what [my] main distractions are and create a manageable plan.”</td>
</tr>
<tr>
<td></td>
<td>“I do not pay attention to small details.”</td>
<td>“It is challenging/difficult to pay attention (focus)to more than one thing at a time.”</td>
<td>“I’m definitely going to be doing things a lot differently in all of my classes.”</td>
</tr>
<tr>
<td></td>
<td>“…I want to change, I want to do things differently…”</td>
<td>“I am now aware of how my attention can affect not only myself, but also the people around me.”</td>
<td>“Overall, the Attention Matters module has been one of the most impactful lessons I have ever learned from.”</td>
</tr>
</tbody>
</table>

Attention drives learning, and the concept of attention skill gathering is important for students’ academic success and social relations (Yildirim Doğru, 2015). In the current study, students indicate “managing distractions during work, school, and meetings is beneficial to truly pay attention in those settings.” Similarly, a study by Cheong et al. (2016) investigated instructor concerns about how to fulfill pedagogical goals and communicate their authority in the classroom amongst mounting digital distractions. Thus, providing opportunities that raise students’ awareness that attention is adversely affected by distractions in the classroom, and as study participants remarked, “affects not only myself, but also the people around me” is valuable information for improving student engagement, improving students’ social relations (i.e., expressed care and concern for others around them), and improving expert learning. Students perceived the learning activities “showed [them] how paying attention makes a difference”.

When planning for instruction, educators must have an awareness of their students’ interests, their preferences, their strengths and challenges, and their readiness to learn (Kieran & Anderson, 2019). This case study indicated that the checkpoints within the three domains defined by the UDL framework contributed to changing students’ perceptions of memory, attention, and multitasking as they develop as expert learners. Also, participants of this study expressed an interest in managing distractions during classes and study time by, for example, “turning my phone off” or “putting away my Apple watch” to maximize in and out of class engagement and productivity. Thus, intertwining modules into an online platform curriculum that explicitly focuses on individual student barriers to learning, and having conversations about strategies for eliminating these barriers, may support students’ readiness to learn in both online and traditional classrooms.

Supporting educators’ understanding of how teaching models and learning designs must be reconfigured to meet the needs of 21st century learners is needed to support student success (Awadhiya & Miglani, 2016). This study changed the learning design of six university courses by introducing various online modules into the curriculum, and the results revealed a change in students’ beliefs about attention, memory, and multitasking. For example, one student explained the following:

When I first started this class, I sometimes texted while I was going through the assignments, but not anymore. By completing the activities in [“Attention Matters!”] I learned just how distracting cell phones can be in class and when trying to pay attention in general. Furthermore, I think that turning off my phone before class will improve my academic performance in general.

Another student described, “[a]t the beginning of the [“Attention Matters!”] my answers were far from correct. Before reviewing the module, I never truly realized how important it is for students to pay attention in the classroom.” After the study, participating students indicated that their “communication with other people has increased,” and they have “noticeably found [themselves] understanding so much more in class because the professor has [their] full attention.”
Therefore, the online modules equipped students, in a practical way, to address their counterproductive beliefs related to attention, memory, and multitasking.

This study revealed that students perceived that the use of specific learning activities on attention, memory, and multitasking helped “change [their] view[s]” and develop an awareness of their ability to “take different actions” to develop as “expert learners” who are, each in his or her own way, resourceful and knowledgeable, strategic and goal-directed, purposeful and motivated.

Discussion

As the impact of the use of ubiquitous technologies like smartphones, laptops, and tablets remains widely unknown, and despite the spirited conversations of the drawbacks digital and media multitasking, multitasking with devices remains a common practice amongst 21st century learners (Miller et al., 2020). The results of the current study indicate that integrating the UDL framework into an online higher education course supported students’ attention, helped eliminate distraction roadblocks, provided relevance to learning, and changed students’ beliefs about attention, memory, and multitasking.

Chief academic officers consistently rate online education learning outcomes “as good as or better” than the learning outcomes for face-to-face instruction. However, a consistent minority continue to consider online education as inferior with one of the outcome barriers reported by faculty as “the need for more discipline on the part of online students” (Allen & Seaman, 2013, p. 6). Therefore, IDs who explore the lessons learned through the implementation of UDL in an online higher education course, presents opportunities to support students’ “discipline” and students’ success. For example, several participants in this study expressed awareness that they “need to pay close attention” and “need to manage distractions,” and they also perceived “managing distractions is a very important life skill” and that “everyone’s distractions are different so [everyone has] to figure out what works for [him or her].” The data indicates participants’ readiness to self-regulate their multitasking and off-task behaviors in an effort to support their journeys toward expert learning.

Higher education faculty can expect a wide range of learners in online learning platforms, which according to a study based on responses from more than 2,800 colleges and universities conducted by the Online Learning Consortium, 6.7 million learners have enrolled in at least one online course, and approximately 32 percent of all postsecondary education learners now register in at least one online class during their educational careers (Allen & Seaman, 2013; Houston, 2018). Similarly, the global Covid-19 pandemic led to profound changes in social interaction and organization in the educational sector, and many institutions have instituted new eLearning protocols (Murphy, 2020). As a result, the benefits of implementing the UDL supports in instructional design for a growing number of online learners is becoming increasingly valuable and relevant.

This study adds to the body of research related to learners’ attention, memory, and multitasking behaviors. Our findings also contribute to the literature on what learners believe and understand about attention, memory, and multitasking. Thus, learning opportunities and conversations about distractions and attention may improve an instructor’s ability to manage digital class distractions and more effectively engage online and traditional classroom students. However, the researchers acknowledge limitations of the study. For example, the participants in this study were enrolled in academic courses and were aware of the concepts the modules targeted. Therefore, self-reported responses may be subject to unconscious bias. Future research could explore the impact of participation in brief online experiences like “Attention Matters!” through an examination of long-term impact on beliefs and behaviors. Also, the convenience sample was limited to students attending one public university in southwest Florida. Future research could investigate similarities or differences in student perceptions in varying demographics and how perceptions related to these concepts have the potential to contribute to the development of “expert learners” who are, each in his or her own way, resourceful and knowledgeable, strategic and goal-directed, purposeful and motivated.

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Universal Design for Learning in the Geosciences for Access and Equity in Our Classrooms

Alanna K. Higgins & Aaron E. Maxwell

Universal Design for Learning (UDL) is an educational framework that has been employed in K-12 environments and generally improves learning outcomes for a variety of learners; however, its use in Higher Education (HE) to date has been much more limited. Studies of HE geosciences curriculum, including human geography, physical geography, geology, and environmental geoscience, suggest that learning barriers exist for many students, highlighting the need for curricular revision and the implementation of UDL. This paper reviews this literature to argue for increased engagement of UDL principles in geoscience education to create accessible and equitable classrooms. The authors then describe two geoscience courses that employed these principles to highlight the value of implementing UDL in the geosciences to effectively educate students with different learning preferences and needs. We highlight the value of UDL in geosciences, describe barriers that hinder its adoption, and describe best practices and make recommendations for its implementation.

Introduction

The modality of Higher Education (HE) is ever-changing, with current shifts focusing on the blended/hybrid or online formats (Madaus, 2013). Online and hybrid classes continue to grow across all types of HE institutions. Recently, the COVID-19 pandemic has amplified these shifts in course modalities. These instructional methods and course delivery changes are rife with promise regarding increasing accessibility and improving learning outcomes but can also exacerbate existing inequalities within the educational - and broader social - landscape. The educational framework of Universal Design for Learning (UDL) addresses barriers within the learning environment to remedy these issues based on the principle of equitable use.

Within HE, the disciplines within geosciences could considerably benefit from utilizing UDL principles to make education more accessible and equitable. We use the term ‘geosciences’ to capture the breadth of ‘geo’ work, including human and physical geography, geology, and earth sciences. We have included this seemingly wide array of studies into the moniker of ‘geosciences’ as they share a hands-on and applied approach to studying environmental questions. Geoscience work encompasses the myriad ways of examining Earth systems, which includes human-environment interactions. These fields also share the ability to explore a variety of topics through the lens of place, space, and time. Additionally, curriculum across the geosciences prepares students for various professions and further research – necessitating the creation of an inclusive learning environment to meet the manifold set of goals and a diverse student audience.

Throughout this paper, we explore the application of UDL principles in geosciences to argue that the field could benefit from engagement with this framework. Additionally, we explicate and examine the challenges faced in implementing UDL in two courses within a geosciences department. One is a cross-listed undergraduate/postgraduate course focused on intermediate Geographic Information Science (GIScience) topics and taught in-person with online components. The other class is an introductory-level course on the regional geographic approach, taught fully online. Importantly, the first course occurred pre-pandemic, with the second taught during the emergency remote instruction. While we discuss the need for UDL in geoscience education overall, we bring in the temporal aspect of emergency remote teaching as it has highlighted the need for increased accessibility of course materials.

Collectively, these course descriptions highlight the value of implementing UDL in geosciences education to effectively reach students with different learning preferences and needs. Further, applying these principles can increase the flexibility of use, which is especially beneficial in times of unanticipated instructional interruptions such as the COVID-19 pandemic. Overall, the paper argues for the use of UDL principles across all geoscience curriculum to make strides in creating accessible and equitable classrooms.

Universal Design for Learning, and its Implementation in the
Geosciences

UDL is both an educational framework and a set of principles based in the science of learning, cognitive psychology, and neuroscience. UDL pushes educators to change the narrative on accommodations “and instead challenge ourselves to create a learning space that might not need to make accommodations in the first place” (Gannon, 2020, p. 75). Stemming from the Universal Design movement in architecture and its seven principles (Connell et al., 1997), the principle of equitable use is a fundamental value that underlies Universal Design, and in turn, UDL.

The focus on equitable use pivots UDL away from having a singular emphasis on a learner’s disability status. UDL scholars and activists argue that when we narrow down who we accommodate for, we narrow down access for all (Tobin & Behling, 2018). Our understanding of ‘access’ draws from Ribot and Peluso’s oft-cited discussion within geography, which sees access “as the ability to benefit from things – including material objects, persons, institutions, and symbols” (2003, p. 153). Regarding pedagogy, this means both the right and opportunity to utilize education, acquiring course materials, and the means to enter into spaces.

UDL’s goal is to create a curriculum that can be understood and used, regardless of individual learning situations or needs (T. E. Hall et al., 2012; Rose et al., 2005, 2006; Rose & Meyer, 2006). By removing environmental barriers, the greatest range of students can access and engage in learning, instead of focusing on the so-called ‘average’ learner. Awareness of environmental barriers occurs alongside adjustments for individual student needs and abilities to create approachable and navigable learning experiences. It is this attention to creating a just learning environment through removing barriers that leads UDL to be an aid in radically transforming education for all learners (Leconte et al., 2007; Tobin & Behling, 2018; University of Georgia et al., 2017; Venkatesh, 2015).

CAST outlines three main principles of UDL through multiple means of 1) engagement, 2) representation, and 3) action and expression (CAST: About Universal Design for Learning, 2020). The ‘multiple means’ signifies that varying modes are used to meet each of these principles. The framework underlies curriculum development (Rapp, 2014) and is a powerful instructional design tool when implemented at the broader programmatic level.

The removal of barriers and use of multiple means includes providing choices for students, including giving students time to access materials, making documents screen reader-friendly, creating/screencasting videos, and thinking about alternative assignments to the old standbys of term papers and final exams. Additionally, these changes help all students - while not everyone may have a disability, we all get sick, learn differently, and have an assorted understanding and history with course content, thus making equitable access a large component in successful course participation (Shaw, 2011).

While frequently employed across the K-12 setting, HE does not fully or even commonly utilize UDL (Crevecoeur et al., 2014; Rao et al., 2014; Tobin & Behling, 2018). Despite this overall lack of uptake, several publications discuss UDL-based instructional design in HE (see Burgstahler, 2013; Jorgenson et al., 2013; La et al., 2018; Roote et al., 2006). Additionally, Al-Azawei et al. (2016) found that courses using UDL principles had higher student engagement and satisfaction. Additionally, the need for creating an inclusive learning environment in postsecondary education has increased with the expansion of online learning and the complications and opportunities this modality brings, even more so during the emergency remote teaching resulting from the COVID-19 pandemic. This points to the necessity for further application of UDL at the HE level, and in the next section, we outline the particular need for UDL’s approach in geoscience education.

UDL in the Geosciences

The geosciences are an area of HE that could expressly benefit from a deeper engagement with UDL. The National Center for Science and Engineering Statistics’ 2019 report Women, Minorities, and Persons with Disabilities (National Science Foundation, 2019) found that people with disabilities (along with other marginalized groups) continue to be underrepresented in fields within science and engineering. There are many structural reasons this occurs, with Mol and Atchison (2019) arguing that the ‘exclusive image’ geoscience departments project around learning environments and physical ability exacerbates this issue. Additionally, many practices that make up geoscience work – fieldwork, laboratory environments, and assessments – have traditionally been geared towards the typical student. Due to this, Atchison and Libarkin (2013) call for an evaluation of geoscience instruction to improve access. This is important to consider for geoscience students and all students, as it is a common requirement for them to complete a lab course for graduation (Asher, 2001). Making any required field camp/work accessible is not only an ongoing issue in geosciences – including some programs in our department – but raises questions about what counts as geoscience work and learning. With geoscience work shifting towards Geographic Information Systems (GIS) and geocomputational courses, changing requirements from solely field or lab-based classes and incorporating accessible experiences is something programs need to consider. This can help students who
Asher (2001) describes the UDL’s principles of multiple means of engagement and action. These principles allow students the autonomy over their learning, the computer software to create formative assessments for learning environments more accessible. Wilson et al. (2011) worked towards making assessments and classroom environments more accessible. A subset of geoscience instructors have been trained in disability services (Hendricks et al., 2017; Nairn, 1999), and the use of instructional aids trained in disability services (Hendricks et al., 2017; Mol & Atchison, 2019; Stokes et al., 2019). This is unsurprising, as fieldwork is almost ubiquitous across geoscience programs and departments (Mol & Atchison, 2019; Stokes et al., 2019), and “the culture of geosciences is inherently focused on fieldwork” (Carabajal & Atchison, 2020, p. 61). Concerns around fieldwork include accessible field design (Stokes et al., 2019), barriers to participation (T. Hall et al., 2004; T. Hall & Healey, 2005), assumption of able-bodiedness (Mol & Atchison, 2019; Nairn, 1999), and the use of instructional aids trained in disability services (Hendricks et al., 2017). A subset of geoscience instructors has been working towards making assessments and classroom environments more accessible. Wilson et al. (2011) used computer software to create formative assessments for students to exercise autonomy over their learning, following UDL’s principles of multiple means of engagement and action. Asher (2001) describes the planning and accommodations used to make their classroom accessible to a visually impaired student, which also created benefits for the entire class through more in-depth descriptions in presentations and the use of audio files they could listen to before or after class.

However, these taper applications of inclusive courses could benefit from further discussions focused on building geoscience curriculums that are accessible to all by design and not just when a student has a disability. Carabajal et al. (2017) found a lacuna in geoscience literature documenting evidence of the effectiveness of overall inclusive teaching. Feig et al. argue that not only do most geoscience instructors have insufficient knowledge of disabilities but also have difficulty “reconciling accommodation with fieldwork learning goals” (2019, p. 66). Fairfax and Brown (2019) echo this, arguing that not only is there a lack of training around this issue amongst geoscience instructors, but that lack, in turn, serves to create a discouraging learning environment for students.

Furthermore, much of the literature does not focus on the roadblocks experienced when trying to implement UDL. While they talk about the need for inclusive education and changes in fieldwork, assessments, and training, there is a gap in the discussion about the explicit engagement of UDL principles in building geoscience courses or programs. Our paper seeks to address this gap by discussing our experiences building different geoscience classes, including the temporal distinctions of pre- and post-COVID-19 pandemic teaching and issues we experienced trying to create a more equitable and accessible classroom. We hope this contribution will continue the discussion of inclusive teaching in geosciences and help instructors consider UDL principles to move past the somewhat constricted focus on disabilities and instead focus on creating an equitable classroom for all.

**Description of Courses**

In the described courses below, we observed several learning barriers. Amongst our students’ caregiving responsibilities, full-time jobs, and/or heavy course loads limited time and energy to devote to specific courses, highlighting the need for increased flexibility in accessing material and student engagement. Monetary issues are also abundant, such as requiring expensive texts, laboratory manuals, and/or software to complete and be successful in the course. Technological constraints may be exacerbated by online or emergency online instruction, such as the requirement to access specialized software or interact with coarse materials on various devices with varying operating systems and screen sizes. Such barriers further complicate computer and data literacy issues and take away from the student’s ability to
focus on key course materials and concepts. Some barriers noted above that are of particular concern in the geosciences were not an issue in our classes; for example, our courses do not have field components or laboratory experiments. Therefore, our description of courses and the following discussion revolves around these barriers within classroom accessibility.

100-Level Geography Course

Geography 102: World Regions is an undergraduate course designed to introduce students to geography by examining the interconnectedness of people, places, and systems in major world regions. Students of varying stages and degrees commonly attend the course, as it is a requirement for undergraduate Geography majors and non-majors to use it to fulfill general education requirements. This leads to an assemblage of students across knowledge, experience, and abilities. Therefore, learning barriers arose from many sources, such as issues accessing material across devices, WIFI or broadband outages, to physical or cognitive challenges alongside caregiving or employment commitments.

Within our department, the course traditionally consists of a large in-person lecture and occasionally as an online option but also occurs in a condensed 6-week course over the summer term. This course was taught in the Summer of 2020, originally planned for in-person over six weeks but shifted online following the COVID-19 pandemic outbreak. The instructor used the ADDIE model to assess learner needs and possibilities of course delivery, then design and integrate materials, implementing objectives, learner needs and possibilities of course delivery, then syllabus, LMS, and each week’s presentation. The instructor did this to provide flexibility through multiple means of representation and action and expression, especially in allowing students to customize how information was displayed.

To gauge the learner population, students took a poll before the course to gauge needs and preferences, particularly concerning issues of technological access and shifting social/vocational obligations because of the pandemic. The poll questions doubled as a way to provide options for recruiting curiosity about course material to optimize choice, autonomy, and interest in the course to stimulate effective networks (CAST, Inc., 2018). Students for this course were primarily engaged with employment or caregiving duties on top of other summer course requirements, necessitating an asynchronous approach to course design and materials. The instructor recorded lectures, tutorials about the learning management system (LMS), and class updates, then posted the recordings to the LMS alongside PDFs of all lectures and reading material. Students also had the option to attend office hours throughout the week if needed. The lecture PDFs, recorded videos, and virtual office hours took place to provide multiple means of representation through alternatives in auditory and visual information and to guide visualization and comprehension of course concepts (CAST, Inc., 2018). These multiple means of engagement and representation were necessary for a learner base who accessed course material through various devices (e.g., smartphones, tablets, or computers).

Suggestions from the UDL literature helped with developing online course materials to optimize the use of readings and lectures, alongside materials able to be used with assistive technologies. This included: using header formats to indicate new sections of the syllabus or presentation, including alternative text for pictures and diagrams, formatting PDFs of the lectures to be accessible (have searchable text, using colors that had sufficient contrast, using URLs instead of hyperlinks), and offering Word documents of materials when able (which may allow students to make fonts bigger, different colors, etc.). Additionally, the course calendar and due dates existed into easy-to-read tables incorporated into the syllabus, LMS, and each week’s presentation. Underlying all assessments was the philosophy of Mastery Learning, which argues that most learners understand the material, but the time this takes varies among learners (Bloom, 1968; Carroll, 1963). Following Bloom (1971) and Guskey (2010), the course was designed to use initial group instruction (via a recorded presentation), the use of formative assessments for progress monitoring (quizzes and discussion posts), and corrective instruction. Students received corrective instruction through a rubric and in-depth feedback on assignments to address comprehension issues. Students were able to take this feedback and resubmit updated assignments, with the goal being that this corrective instruction would aid in both learner comprehension for the specific assignment and class material in the future (Guskey, 2008). This design occurred with the understanding that students were navigating the intricacies of everyday life and the increased pressures and traumatic nature of the pandemic. While mastery-oriented feedback is listed under the engagement column of CAST’s UDL Guidelines (CAST, Inc., 2018), it draws from all three networks of UDL. In designing this course, mastery learning helped build student perseverance, comprehension of material, and increased executive function through the opportunity to track their progress on an assignment.

Additionally, the instructor supplied course materials in a way that aspired to be read and/or downloaded on all types of devices (desktop/laptop, tablet, or smartphone). Lectures were recorded using Zoom but then posted on YouTube with the link shared to students via email and the LMS. Quizzes were on Google Forms so that students
could have an easier time accessing them across all devices rather than in the LMS. Perhaps most importantly, the course text was open-access and readable online or downloaded as a PDF to the students’ device. Any ‘class updates’ that necessitated more than a sentence were recorded and shared in the same way as the lectures. Given the learners’ need for flexible time access to materials, the instructor designed several methods for navigating material, including a weekly email with all information and links, alongside an organized module system in the LMS. The multiple media used for communication – both between and with instructor and students – allowed students to construct assignments in creative and expository ways.

**Cross-Listed Upper-Level Geography Course**

Geography 350/550: GIScience is an intermediate-level geospatial science course that prepares undergraduates and graduates to complete more advanced geospatial coursework focused on specific topics, such as spatial analysis, geocomputation and programming, and cartographic design. The course has traditionally consisted of a lecture session and a required, linked weekly lab component, taught in a computer lab and relying on commercial, geospatial software. Students majoring in Geography, Geology, or Environmental Geoscience commonly take the course. Additionally, it serves as an elective for other majors, such as Civil Engineering. Since the course focuses on the use, visualization, and analysis of digital map data in a software environment, learning barriers arise from varying degrees of computer and data literacy. While grasping key concepts and techniques in geospatial analysis, students must also become comfortable working in unfamiliar software environments with datasets not commonly encountered. A basic grasp of college-level algebra is adequate to conceptualize the course’s mathematical components; however, lack of mathematical knowledge and spatial reasoning skills can also be a barrier.

Recently, the instructor has experimented with changing the modality of the course. During the Spring 2020 semester, prior to the COVID-19 interruptions, this course occurred as an online lecture component and extended in-person lab session. Each lab section began with a recitation to reinforce the assigned lecture material, followed by a two-hour, hands-on lab session consisting of software-based activities relating to and reinforcing the lecture content. To provide multiple modes of instruction, lecture content was hosted on the instructor’s webpage. It consisted of annotated lecture slides generated using the iSpring software, practice, non-graded questions embedded within the modules, and links to short YouTube videos demonstrating key topics. The goal was to accommodate a variety of learners by relying on a variety of media and presentations (Rose et al., 2006). Generated videos were short (generally less than ten minutes in length) and focused on key and/or difficult concepts. All lab content and required data were also hosted on the course website and were available throughout the semester. The instructor designed the website outside of the LMS using responsive web design to foster accessibility on a variety of devices and screen sizes. Given the wide variety of materials provided, the students were not required to buy a textbook. Grading in the course consisted of short quizzes, a midterm and final exam, graded lab exercises and activities completed during the recitation section, and less-guided lab challenges. Ultimately, the goal was to focus in-person class time on discussion and reinforcement of more complex topics.

Due to the COVID-19 pandemic, the course moved online in the middle of the semester. The fully online delivery resulted in an altered syllabus and course design, which was facilitated by the existing online content (Whittle et al., 2020). The instructor delivered material asynchronously to accommodate student schedules and caregiving responsibilities. Students completed lab exercises independently and were able to schedule time with the instructor and/or teaching assistant for help. The greatest difficulty resulting from the unexpected switch to online delivery related to the need for specialized software, which students had to install and license on their personal computers. To minimize computer and data science literacy barriers, the instructor and teaching assistant scheduled meetings with individual students using screen share technology, which allowed for real-time troubleshooting and guidance. Plans for the future are to develop substitute lab exercises using free and open-source software alternatives to reduce cost and allow for the lab exercises to be completed on a wider variety of computers and operating systems. However, this has proven to be a larger undertaking, as generating the original lab content, which makes use of commercial software, took several years. Also, since software updates regularly, maintaining multiple sets of exercises using different software environments increases the burden of maintaining the course content long term.

Several components of this course, which rely on UDL principles, stand out as effective. First, the availability of open-source, web-hosted, responsive instructional materials allowed students to interact with the content at their convenience on various devices and spend extra time exploring concepts that they found particularly interesting and/or challenging (Coombs, 2010). The use of guided lab exercises followed by less-guided lab challenges allowed the student to gradually transition to independent spatial problem-solving. Multiple modes of expression, including text- and graphic-based web content, short web videos, in-class discussion, and lab
exercises and challenges allowed a varied and effective learning experience (CAST, Inc., 2018). Screen share technology helped manage computer and data literacy barriers.

The Challenges and Promises of UDL in the Geosciences

Despite overall growth in geoscience job markets, recruitment and retention at the undergraduate level continue to be an issue in the discipline, particularly in learners from marginalized and underserved communities (Martinsen et al., 2012; O’Connell & Holmes, 2011; Summa et al., 2017). Summa et al. (2017) geoscience education and curriculum needs to shift towards a focus on overall skill and conceptual acquisition across programs rather than in individual courses. However, we argue that any curriculum changes will not be successful unless barriers within these learning environments are first addressed. Therefore, we believe that geosciences - across fields, programs, and institutions - should adopt UDL to make curriculum more accessible. We follow the reasoning from the Information Resources Management Association (2020) that instructors must provide an inclusive teaching and learning environment for students to succeed. This is particularly salient given the current global circumstances pushing teaching and learning further into the online environment.

But challenges persist in the implementation of UDL, not only in geosciences but also in HE. Our course descriptions show that a mix of institutional, situational, and technological circumstances creates roadblocks to implement UDL principles. Particularly salient was a lack of engagement with UDL principles at both the department and university level. However, this echoes the lack of employment across HE generally (Tobin & Behling, 2018) along with a dearth of research on UDL in STEM HE (Schreffler et al., 2019). This presents challenges in the form of extra time needed to consider existing barriers, how to potentially overcome them, create adjustments, and then implement them. Without institutional support, individual instructors may face barriers themselves in implementing principles to address barriers in their classrooms. While instructors do have control over their classrooms, they still exist within the broader teaching and learning culture at a given institution. Assistance with UDL principles, barrier identification, and creating/implementing adaptations at the institutional level will help instructors to easily implement UDL in courses.

Situationally, despite our planning, we encountered several roadblocks and challenges in implementing certain UDL techniques. One such roadblock - which we both were able to overcome - is access to course materials. For the 100-level course, the instructor wanted a textbook accessible on multiple devices and was screen reader-friendly, along with being financially feasible for students. In the cross-listed 300-/500-level course, there were difficulties with the switch to students using personal devices because of the pandemic. The textbook issue was solved with the help of the Geography Subject Librarian at West Virginia University, who helped locate an appropriate open-access text. The software issue was resolved with general licenses but is being further addressed through the future use of open-access software and remote desktops. Technologically, there were constant issues with adding alternative text to images in course materials and adding subtitles to recorded presentations. While PowerPoint has an option to generate descriptions for alternative text, the quality of these descriptions was not only inadequate but sometimes completely inaccurate. Furthermore, a larger challenge that proved unassailable was the attempt to close caption the recorded lecture presentations. The option in the presentation software would not yield the correct verbalizations, and in some cases, do not operate at all. This could be due to a technological issue with the hardware used, but we found that many others who tried this option also struggled. Attempting to overcome this, the instructor uploaded the recordings to the video-sharing platform and attempted to provide subtitles there. However, the main way of providing subtitles is typing them in, which was not a viable option due to time and resource constraints. These technological problems are wider issues that need attention from not only HE but software companies. Moreover, this also points to difficulties arising from skills gaps in technology (for both instructors and learners), which Lee et al. (2013) point out can create an excessive workload and decrease motivation.

Although these challenges exist, UDL is instrumental in reaching the promise of accessibility across the field of geosciences. The issue of fieldwork is a particular example – which neither of us had as a requirement for within the courses discussed; however, this instructor has organized and taught a fieldwork course in the past. As Dzombak (2020) recently argued, the current stoppage in outdoor and group exercises due to the COVID-19 pandemic can be a pivot point for the geosciences to reconsider these experiences in search of more inclusive ways to obtain learning objectives. She points out that these requirements are not only “outdated at best and biased/exclusionary at worst,” but with the proliferation of interdisciplinary work within geosciences, fieldwork may no longer serve as useful training for our students (Dzombak, 2020, para. 7). We are not advocating ‘throwing the baby out with the bathwater’ in the removal of fieldwork but adjusting the approach and its use as a blanket requirement in programs. For instance, geoscientists who analyze digital data may not find value
in the experience, and by implementing UDL principles in fieldwork to begin with – e.g., considering the implementation of multiple means of engagement through virtual or other sensory ‘field’ trips – excises the need to individually accommodate students by making fieldwork broadly accessible.

Regarding the specific challenges linked to our discussed courses, the proliferation of UDL across HE and geosciences, in particular, would help to rectify those situations. While open-access software is becoming more popular, the continued reliance on licensed software creates barriers when institutional technology is not readily available. Additionally, larger shifts in technology (and potentially campaigns from HE for these shifts) can help make alternative text and subtitles easier to implement. Underlying all of this is a proposed institutional employment and support of UDL – including, but not limited to, readily available UDL resources and suggestions for instructors – which can help make the principles a norm within HE and move beyond the need for individual accommodations.

These roadblocks should not be used in service of arguing that UDL as a whole is challenging, rather, we highlight them to discuss the apparent need for further utilization of UDL in geosciences and HE altogether. Additionally, while UDL is beneficial no matter the course’s circumstances or modality, our experiences have taught us that it is even more important in the emergency remote teaching of the COVID-19 pandemic. Regardless of the majority of instructors and institutions calling this type of shift online learning, Hodges et al.’s (2020) designation of emergency remote teaching as the “temporary shift of instructional delivery to an alternative delivery mode due to crisis circumstances” is more appropriate for these situations. Emergency remote teaching (ERT) contrasts with the training and time invested in the specific instructional design that online learning requires (Nilson & Goodson, 2017). Our discussed courses fall into this designation, as we had to shift them online due to the pandemic. Whittle et al. (2020) propose that for emergency remote teaching to be effective, pedagogy needs to follow available resources and be practicable in implementation. While still not an easy switch, the shift to ERT is marginally easier because UDL principles around multiple means of engagement, representation, and action and expression were already partially in place. Because there were different options for students to access and perceive course material along with an understanding of what barriers in the online learning environment may exist, the ERT portion of the 300-/500-level course and the entire 100-level course were able to be more accessible. However, not all instructors are aware of or familiar with UDL, and many have had trouble quickly shifting material online (Whittle et al., 2020). Therefore, not only does utilizing UDL benefit the geosciences in opening our field to all who want to study it, but the UDL principles are imperative for the current time-related issues of online teaching during a pandemic. Furthermore, this points to the need to teach principles of UDL to instructors teaching at the HE level.

Conclusion

UDL has helped us address barriers within our classes in our personal goals of making education as equitable as possible. By making class design “smart from the start” (Pisha & Coyne, 2001) the courses aimed to remove barriers like accessibility and time constraints through providing screen-reader friendly material, course information and concepts in multiple formats, and flexibility in accessing content which helps students choose the best time for them to learn. This helps to create inclusive environments for all students, not just those with disabilities, but those with full-time jobs, parents and caregivers, students from historically marginalized groups, and any other situations which constrain access and concentration. These are important considerations to address the various barriers many students experience, not only in ERT but in Geoscience education as a whole.

While technology is helpful – especially during ERT – it must be used alongside effective teaching practices such as UDL (Bain, 2020; Coombs, 2010; King-Sears, 2009). We have argued that an engagement with UDL helps create more accessible and equitable classrooms, which is of particular importance during the shifts in teaching and learning from the COVID-19 pandemic. Additionally, creating accessible and equitable curriculum is of paramount concern for geosciences, especially considering the continued underrepresentation of historically marginalized groups (National Science Foundation, 2019). Addressing concerns around retrieval and use of course materials, the software necessary for courses, time constraints, and curriculum/course requirements (such as physical fieldwork) will help geoscience instructors to build their classes to be accessible from the very beginning. Focusing on access rather than accessibility will help to overcome not only the ‘exclusive image’ of geoscience programs (Mol & Atchison, 2019) but the very real barriers to geoscience participation.

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Inclusive Instructional Design: Applying UDL to Online Learning

Kavita Rao

Universal Design for Learning (UDL) is a framework that can guide the development of inclusive learning environments. The UDL guidelines, used as part of an instructional design process, provide a structure to proactively design flexible pathways and provide options that can support all learners. This article describes how educators can use a step-by-step process to design lessons that incorporate UDL guidelines. When designing instruction for online delivery, it is necessary to consider additional factors to ensure that all learners can access instruction and engage in meaningful learning experiences. The article describes how UDL can be used as a framework for inclusive instructional design online and provides

Introduction

Universal Design for Learning (UDL) is a framework that can guide the development of inclusive learning environments. UDL has three principles, which are to provide multiple means of 1. representation, 2. action and expression, and 3. engagement. Each of these principles has three guidelines that define how educators and instructional designers can provide options and supports when designing instruction (see udlguidelines.cast.org for more information on UDL’s three principles, nine guidelines, and 31 checkpoints). The UDL framework, used as part of an instructional design process, provides a structure to proactively design lessons that integrate inclusive strategies and options that can support all learners in the classroom (Meyer et al., 2014). Researchers have examined and described the application of UDL to enhance inclusive practices at various levels (K12 and postsecondary) and for varied instructional purposes (Ok et al., 2017; Rao et al., 2014).

Technology-based learning environments and digital tools provide powerful means to put UDL principles into action (Meyer & Rose, 2005; Ok & Rao, 2019). Digital tools for teaching and learning include hardware (e.g., laptops, mobile devices), software (e.g., applications, apps, extensions), and technology-based environments (e.g., websites, content management systems). Many features of digital learning environments align with UDL principles, providing options for multiple means of representation, action and expression, and engagement. The multimodal nature of digital tools facilitates the integration of varied formats and flexible options into the learning experience. Using digital tools, educators can easily represent information in varied formats (e.g., combining text, visuals, audio) and integrate features that allow the user to choose how to consume information (e.g., enabling text to speech to listen while reading). Students can create media and express themselves in varied and multimodal ways. Technology-based environments can also be engaging, allowing educators to provide authentic and relevant learning opportunities and opportunities for interaction and collaboration. In these ways, online learning environments that inherently require the use of digital tools as a means for delivery and instruction present many opportunities for incorporating and applying UDL. Taking UDL guidelines into account during the instructional design process, educators can determine how to meaningfully integrate digital delivery formats, digital tools, and instructional strategies when designing inclusive online learning experiences.

Foundational Concepts of UDL

UDL was developed in the 1990s and early 2000s by the Center for Applied Special Technology (CAST) as a framework for developing curriculum that is more accessible for all, including students with and without disabilities. Considering the needs of students at the margins of our educational systems, a central premise of UDL is that the curriculum, rather than the learner, needs to change (Meyer & Rose, 2005). Meyer and Rose emphasized the power of digital media as a means for developing flexible curriculum that can support the varied needs, abilities, and interests of students in the classroom. Grounded in values of social justice and inclusion, a central premise of UDL is that curriculum should proactively be developed with flexible and engaging options that are available to all learners. Two fundamental tenets of UDL are that we can address learner variability and reduce barriers in curriculum and instruction through intentional and proactive design. The ultimate goal of UDL is to develop expert learners. These three core concepts that underlie UDL-based instructional design are briefly described below in the following sections.
Addressing Learner Variability

UDL is based on the premise that learner variability is the norm. UDL researchers emphasize that there is no "average" or "typical" learner and that all learners have varied abilities, strengths, experiences, and preferences (see Figure 1), aspects that can be dynamic and changing depending on one’s context and development (Meyer et al., 2014). As an instructional design framework, UDL provides a structure to proactively build in supports that address the learner variability that exists within any group. Taking learner variability into account, the process of planning instruction in alignment with UDL guidelines allows educators to consider and integrate flexible and supportive options that are helpful for all learners from the outset. UDL-based instruction can make existing educational practices more inclusive, by providing supports to a wider range of learners. However, for students with disabilities who require specially designed instruction in alignment with their individualized educational plans, educators must also provide individualized supports as needed (e.g., specific accommodations, modifications, targeted interventions).

Reducing Barriers in Curriculum and Instruction

In regard to creating inclusive environments, UDL advocates emphasize that it is useful to consider the curriculum, rather than the student, as “disabled” (Meyer & Rose, 2005). An essential aspect of UDL is to identify barriers in the curriculum and in the instructional process and to reduce or eliminate those barriers by designing appropriate supports. We routinely use curriculum resources, design lessons, and develop and implement various instructional activities. To create a truly inclusive learning environment, we must consider how to give students meaningful access to curriculum and instruction during the instructional design process. UDL focuses on the proactive reduction of barriers, taking into account the variability of learners from the outset and building flexible pathways and supports for the learning process. By proactively identifying and reducing barriers in curriculum and instruction, we can create educational environments that are more inclusive by design.

Developing Expert Learners

An essential goal of UDL is to support the development of agency and self-awareness, allowing students to become "expert learners" on their learning journeys. These are the attributes of expert learners that correspond to the three UDL principles (Meyer et al., 2014):

1. Being purposeful and motivated (related to the UDL principle of engagement) refers to learners’ abilities to be goal-directed, sustain effort, and self-regulate as they learn.
2. Being resourceful and knowledgeable (related to the UDL principle of representation) refers to learners’ abilities to activate and connect to prior knowledge, recognize strategies to structure and retain knowledge, and transfer and generalize what they learn.
3. Being strategic and goal-directed (related to the UDL principle of action & expression) refers to learners’ abilities to plan and organize how they learn, be strategic learners, and self-monitor as they learn.

These foundational UDL concepts—addressing learner variability, reducing barriers, and developing expert learners—are the basis of intentional and inclusive instructional design. Using UDL as they design instruction, educators can consider how to provide flexible and engaging learning environments, using strategies and tools that address the varied needs and profiles of learners in any given classroom. Instead of designing for a mythical “average learner”, UDL-based design broadens access to a broader range of learners and provides a framework for inclusive instructional design.

Application of UDL to Online Teaching and Learning

Although UDL has gained prominence in the past two decades and is widely referenced in inclusive education efforts worldwide, questions remain on how to apply and implement UDL most effectively in traditional face-to-face and online learning environments (Rao et al., 2014). In the past two decades, a significant body of literature on
UDL in both K-12 and higher education environments has emerged. Many researchers have addressed UDL applications in online learning environments in higher education (Evmenova, 2018; Gravel et al., 2017; Hollingshead, 2018; Rao & Tanners, 2011; Tobin, 2014).

As educators have made a rapid shift to online learning due to the COVID-19 pandemic, it has become even more relevant to examine how teachers can apply UDL to design instruction for online environments. Digital tools and multimodal formats that are used for online teaching provide many ways to address UDL. To ensure that these tools are used to support all learners in the online/hybrid classroom, it is helpful to consider their usage as part of an intentional design process (Basham et al., 2016; Greer et al., 2014). Using a proactive design process that explicitly integrates UDL, teachers can be better prepared to support all learners online, including students with disabilities and English language learners, and other students who experience challenges while learning.

**Purpose Statement**

This article presents how educators and instructional designers can take UDL into consideration during the process of designing curriculum and instruction. The UDL-based design process can be applied to all instructional delivery formats, including traditional face-to-face classroom environments, fully online learning environments, and blended or hybrid formats (Smith & Basham, 2014). This article presents the following processes and related tools that can help educators use UDL as part of an inclusive instructional design process:

1. Using the UDL Design Cycle (Rao & Meo, 2016), a step-by-step process for considering learner variability and reducing barriers in instruction, as part of the lesson planning.
2. Designing learning experiences for online delivery, taking into account when to use synchronous/asynchronous methods and how to integrate digital tools for instruction meaningfully.
3. Using the UDL Reporting Criteria to articulate how UDL is applied to the design and implementation of lessons and related student outcomes.

**The UDL Design Cycle**

To many, the term UDL evokes the framework made up of three principles, nine guidelines, and 31 checkpoints. While this is indeed the essence of UDL, there is more to using the framework; educators must consider how to apply these principles, guidelines, and checkpoints to design inclusive learning environments proactively.

Although there has been much written on UDL implementation, there is no consensus on how to apply the framework in practice (Smith et al., 2019). At the surface, UDL is a set of best practices for ensuring that learning supports are provided, providing a menu of options that support learners. The UDL checkpoints are indeed a collection of best practices for providing options for representation, expression and action, and engagement. The 31 checkpoints were derived from an extensive review of the research studies conducted by CAST during the development of the framework (CAST, 2018). Many of the UDL checkpoints are identical to strategies that teachers use to differentiate instruction, so they can seem familiar to teachers, especially those trained in inclusive practices or special education.

Although UDL can be used in this manner, as a menu of recommended options to integrate into instructor, educators can more meaningfully design inclusive practices by considering the UDL guidelines as part of a systematic instructional design process called the UDL Design Cycle (Rao & Meo, 2016).

The UDL Design Cycle (Rao & Meo, 2016) integrates the core components of commonly used instructional design models and processes, such as ADDIE and Backwards Design (Bond & Dirkin, 2019). Similar to the ADDIE process, the UDL Design Cycle begins with a learner analysis and bases instructional design decisions on what we know about our learners. As with Backwards Design, the UDL Design Cycle begins with identifying the end goals and defining the evidence of learning before developing instructional methods.

The unique contribution of the UDL Design Cycle (see Figure 2) to these existing instructional design processes is the consideration of learner variability and the proactive integration of supports and scaffolds to reduce barriers in curriculum and instruction. Using the UDL guidelines within this design process, educators can create learning environments that integrate varied supports to reduce barriers and increase meaningful access to learning for all. The UDL Design Cycle begins with a consideration of learner variability factors. These factors are then taken into account in each of the steps of the design process. The first step is to develop a few clear goal statements and then to reflect on what knowledge and skills students will need to master those goals. The next three steps - developing assessments and making decisions about methods and materials - follow from this initial step of developing clear goals. Throughout the design process, learner variability should be taken into account. Design decisions should be made with a consideration of students’ abilities/strengths, support needs, preferences/interests, and backgrounds/experiences. Within this instructional design process, the UDL guidelines and checkpoints can be used to integrate supports that address learner variability and
reduce barriers in the curriculum.

Using this structured approach, teachers can consider where the potential barriers lie in curriculum and instruction and build in options for representation, expression, and engagement, as appropriate. This process also keeps the focus on learner variability during the development of methods and materials, encouraging the instructional designer to build in options related to the varied preferences, abilities, and backgrounds of their learners in addition to providing supports and scaffolds (Rao & Meo, 2016). It is important to note that learner variability is systematic and predictable to some degree, with common instructional barriers and related support needs that can arise for many groups of students. With consideration of the typical barriers that can arise, we can build in supports for variability without knowing the exact population of students. Detailed examples of how to apply the UDL Design Cycle to lesson planning and design can be found in books such as Design and Deliver: Planning and Teaching Using UDL (Lord-Nelson, 2020) and UDL for Language Learners (Torres & Rao, 2019).

Figure 2
UDL Design Cycle

When designing lessons for the online environment, teachers can use the UDL Design Cycle and take into account these additional considerations. The sections below provide detail on some of the additional considerations for UDL-based design noted in Figure 3, providing elaboration on ways to design more inclusive and supportive environments online.

Learner Variability in the Online Environment

In the online learning environment, it is necessary to consider factors related to learner variability that affect a students’ ability to engage and succeed in relation to the demands of this learning format. In addition to abilities/strengths, support needs, preferences, and backgrounds/experiences, there are specific attributes that affect how students engage and learn online. One attribute is access to online learning, both in technical and cognitive senses. On the technical front, access includes having the necessary devices, internet connectivity, and physical space to engage in online learning. Access also refers to levels of knowledge and experience of using tools to learn online. Some students may be more adept at navigating the expectations of online learning environments because of their familiarity with learning management systems and digital tools than...
Another important consideration is variability in students’ ability to engage in online learning experiences. When doing asynchronous activities in online learning, students engage in learning activities independently without a teacher present to guide the learning experience in real-time. This requires several executive function and self-regulation skills. Executive function skills include the ability to plan and organize oneself and to be self-directed learners. For younger students, who have not yet developed the skills to learn independently, managing time and schedules for online learning require significant support from parents or other family members/adults.

In alignment with UDL, teachers can build in supports for executive function and self-regulation using instructional strategies to support persistence and organization in the online learning environment. These can include clear and consistent instructions (e.g., using “hyperdocs,” a document with multiple hyperlinks that serves as a central point to access information and resources in a clear and consistent way), shared checklists for students to track progress, opportunities for check-ins and regular interaction with the teacher. Giving students opportunities to understand how they learn best and what strategies work for them in the online learning environment is important for supporting self-regulation.

**Chunking Lessons for Online Delivery**

When designing lessons for the online learning environment, teachers should begin by identifying the overall goals for a unit of instruction and then determine how to meet those instructional goals through a series of online learning experiences. Without the pre-determined structure of a class period, online learning requires teachers to think about instructional time in a different way. Instead of planning instruction to fit within a set amount of time, lessons can be structured as a series of instructional activities. The time that activities take will vary depending on the learner’s needs and skills (and in the case of younger learners, students may also need guidance from parents at home.)

It can be useful to consider how to reach the goals through shorter learning experiences (“chunks”) and then make decisions about the teaching and learning activities within each chunk. For each learning experience, the teacher should consider supports needed in relation to the learning activities students must do. For example, if students need to learn new content, the learning experience will require content delivery (e.g., by reading, watching a video, etc.), followed by some means to check on students’ comprehension and engagement with the content. This can be done using a synchronous meeting where students discuss the content or engage in activities with peers or the teacher or through a formative assessment for that learning experience. Similarly, when students need to practice skills or apply what they have learned, learning experiences can give them opportunities to incrementally express what they are learning, with opportunities for teacher feedback or interaction built in.

To make instructional decisions for learning experiences, teachers can use the systematic process of the UDL Design Cycle and take into consideration some of the additional factors relevant for online learning (see Figure 3). The Online Learning Experience Design Worksheet (See schoolvirtually.org/online-design-worksheet) is a tool that teachers can use to plan lessons for the online environment. This worksheet incorporates the steps of the UDL Design Cycle and provides a structure for considering each of the steps denoted in Figure 3.

**Integrating Synchronous Meetings to Support Learners**

When designing inclusive instruction for the online environment, it is important to consider how to use synchronous meetings to reinforce and extend upon instruction that students must do on their own time. If educators are able to use both asynchronous and synchronous formats for their online classrooms, it is important to make decisions about how to use the two formats most effectively in tandem. Asynchronous learning activities give students the opportunity to prepare and process information. These can include accessing course resources, completing assignments independently, or participating in an online discussion forum. Synchronous learning activities take place at the same time with others online, for example, meeting for an online class session (e.g., using Google Meet or Zoom) or working together in real time using collaborative e-learning tools (e.g., Google Docs).

Synchronous meetings can be a powerful way to check in, interact, give feedback, and make connections with lessons that students are otherwise working on independently. Synchronous meetings should be intentionally designed to clarify areas that students may have questions about, extend what they have been asked to do on their own time, and provide opportunities to connect and interact with the instructor and with peers. Synchronous meetings can also be conducted in small group formats or as one-on-one meetings with the teacher to provide additional opportunities for interaction and individualized support for students as needed.

**Mastery-Oriented Feedback to Support Engagement and Persistence**

In the online environment, teachers can help students engage and persist by creating a presence and embedded
ways to communicate and interact regularly. Formative assessments provide an authentic and useful way to interact with students and support the development of knowledge and skills. To support engagement, one of the UDL guidelines highlights the need to provide supports for effort and persistence by “increasing mastery-oriented feedback.” Mastery-oriented feedback focuses on the process of learning, valuing effort and practice, rather than evaluating students solely on fixed targets of performance (CAST, 2018). Mastery-oriented feedback encourages perseverance and focuses on the development of efficacy, helping students develop skills with guidance. This can be in the form of specific feedback on how to meet expectations for an assignment and/or the provision of models/examples of a target response.

Providing mastery-oriented feedback is an especially important strategy to incorporate within online learning experiences. Without the built in structure of an in-class experience, students can benefit from strategies that encourage effort and persistence when learning in online formats. Mastery-oriented feedback is effective when it is specific and timely. When designing learning experiences, teachers can embed formative assessments that let them provide mastery-oriented feedback highlighting for their learners what they are doing well, what they can continue to work on, and how they can meet targets. In the online learning environment, teachers can provide mastery-oriented feedback using collaborative and interactive digital tools that facilitate leaving comments and notes using text, audio, and/or video.

**Purposefully Integrating Features of Digital Tools**

Digital tools are the materials and resources at the foundation of online learning experiences. Because online learning inherently relies on technology-based delivery of instruction, it is a natural environment in which to incorporate various digital tools for teaching and learning. However, using the tools alone does not make learning more accessible or reduce barriers. Understanding which features of digital tools can provide supports for learners is an essential aspect of UDL-based design for online environments. When designing for online learning, teachers should consider the features and affordances of digital tools and how these can be integrated with instructional strategies to support learners.

The multimodal nature of digital technology provides various options for students that can be helpful for many and essential for some. For example, text-to-speech (TTS), a feature built into many digital textbooks and available as a browser extension, is a powerful way to support students with reading skills such as decoding, fluency, and comprehension. Tools that allow users to interact with or create content using text, images, audio, and video also provide powerful supports for demonstration and application of knowledge and collaboration/interaction with peers and teachers. By considering these tools in the context of the UDL Design Cycle, teachers can select tools that align with lesson goals and use instructional strategies that incorporate the support features of the tools. Table 1 provides a few examples of key skills areas and digital tools that can support students (Dawson et al., 2019; Ok & Rao, 2019). Please note that this table does not provide a comprehensive list of all tools, but examples of tools that can be used to reduce barriers in both online and traditional face-to-face environments. More information on UDL-based design and digital tools can be found on the School Virtually website (www.schoolvirtually.org).

**Table 1**

**Examples of Digital Tools**

<table>
<thead>
<tr>
<th>Skills</th>
<th>Reducing barriers and providing support with digital tools</th>
<th>Examples of Digital Tools</th>
</tr>
</thead>
</table>
| Reading                            | • Utilize digital text features, such as text to speech, annotations, vocabulary and comprehension supports, translation | • Text to Speech  
• Literacy support extensions (e.g., Read & Write for Chrome)  
• Just Read  
• Natural Reader  
• Voice Dream Reader (app)  
• Using digital text features of e-textbooks |
|                                    | • Text-to-Speech (TTS) helps with decoding and reading fluency; Dual Highlighting with TTS helps students track the word being read out aloud |                                                                                                                                              |
|                                    | • Literacy support tools allow teachers and students to annotate and highlight digital text, which can support comprehension |                                                                                                                                              |
| Writing                            | • Digital graphic organizers support brainstorming and planning  
• Speech to text tools support generation of text  
• Grammar and spell-check tools support revision and editing | • Digital graphic organizers (Lucid Chart, MindMup, Kidspiration Maps)  
• Speech to Text apps  
• Grammarly, Ginger (browser extensions) |
| Demonstration of knowledge         | • Multimodal tools that allow students to integrate text, images, audio, and video can provide ways to demonstrate what they know  
• Multimodal tools can provide ways for students to develop and express ideas with feedback from the teacher | • Book Creator, UDL Book Builder  
• Infographics (e.g., Canva, Piktochart)  
• Flippgrid  
• Padlet |
| Organization and Self-Regulation   | • Checklist apps  
• Calendar and reminder tools  
• Weekly Check-in form | • Google Keep  
• Evernote  
• Google Forms |
UDL Reporting Criteria

The last two steps of the UDL Design Cycle focus on implementing, reflecting on, and revising lessons. The considerations for these steps are similar in all delivery formats, whether online, blended, or face-to-face. In these phases, teachers implement the lesson they designed, reflect on which elements of the lesson worked well, consider which UDL-based strategies supported learners, and revise the lesson (or upcoming) lessons as needed. The UDL Reporting Criteria (UDL RC) can facilitate these steps, providing a structure for recording design decisions in the planning phase, describing implementation, and reflecting on outcomes related to UDL.

Describing UDL Design Decisions and Implementation

Because UDL application can take on so many forms, the ways in which UDL is described varies greatly across studies (Rao et al., 2014). This has made it challenging to define what a UDL-based lesson or intervention looks like and what its outcomes and implications are. To provide a consistent format for describing applications of UDL, the UDL Implementation and Research Network (UDL-IRN) research committee developed the UDL Reporting Criteria (UDL RC). The UDL RC provide a structure for defining why and how UDL guidelines are applied during the planning, design, and implementation phases and for articulating student outcomes in relation to UDL components. The UDL RC were designed to be useful not only to researchers but also for teachers to articulate how they made design decisions related to UDL and what the outcomes were for their students (Rao et al., 2018; Rao et al., 2019).

The UDL RC can be used for a broad range of educational applications, including curriculum design, lesson planning, and designing and reporting on UDL-based educational interventions. The UDL RC capture the essential aspects of UDL-based design and implementation in these three categories: 1. Learner Variability and Environment, 2. Proactive and Intentional Design, and 3. Implementation and Outcomes. The UDL RC, available for free download from the UDL-IRN website at https://udl-irn.org/udl-reporting-criteria, provides additional information on each of these categories.

Adaptations for Teachers

After the UDL RC were published on the UDL-IRN website, teacher educators have adapted them to support teacher usage of the criteria. The adapted version uses the three categories from the UDL RC noted above and expands the RC with additional guidance that can help K-12 teachers articulate how they have designed with UDL and implemented UDL-based lessons. The Adapted UDL RC for Teachers organizes the three categories into two distinct areas: 1. Before Lesson Implementation and 2. After Lesson Implementation. Using this format, teachers can record their instructional design and lesson planning decisions before lesson implementation. The Before Lesson Implementation area captures information on learner variability, aligning decisions made to use UDL checkpoints to lesson goals and variability. The After Lesson Implementation section allows teachers to document how the lesson went, identifying specific data and student artifacts as evidence of student outcomes in relation to the UDL-based strategies used in the lesson.

Table 2

Adapted UDL Reporting Criteria for Teachers

<table>
<thead>
<tr>
<th>Area and Criteria</th>
<th>Teacher Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learner Variability and Environment</td>
<td>a) Student Information and Setting Describe the learning variability among your students that is your focus. Describe the setting for the UDL practice/intervention (e.g., inclusive classroom, grade level, subject area).</td>
</tr>
<tr>
<td>2. Proactive and Intentional Design</td>
<td>a) Learning Goal What is the learning goal of the lesson? What foundational knowledge and/or skills might the student need in order to meet the learning goal?</td>
</tr>
<tr>
<td></td>
<td>b) Addressing Barriers and/or Increasing Access Provide a description of specific challenges, barriers, or issues of access that the design or intervention is intended to reduce or eliminate so students may achieve the learning goal. This can include barriers related to environment, curriculum, and/or instruction.</td>
</tr>
<tr>
<td></td>
<td>c) Application of UDL Guidelines and Checkpoints Provide details about how and which of the nine UDL guidelines and/or the 31 checkpoints are applied to your practice/intervention. This can include information on how UDL guidelines and checkpoints are applied to goals, assessments, methods, and/or materials.</td>
</tr>
<tr>
<td></td>
<td>d) Designing to Address Variability Describe aspects of design that address learner variability. This can include a description of how flexibility, choice, or engagement will be addressed in the lesson or intervention. How will the rigor of the lesson be maintained despite barrier removal?</td>
</tr>
<tr>
<td>3. Implementation and Outcomes</td>
<td>a) Description of Implementation of UDL Practice Describe how the UDL-aligned practice was implemented. Highlight information on the UDL-based aspects of the practice in relationship to the learning goal in 2a and level of rigor. The UDL-based aspects should align with what is described in 2d. Possible sentence starters for this section include: ● Students were... ● Teacher was... ● The learning environment was...</td>
</tr>
<tr>
<td></td>
<td>b) Outcomes/Findings in Relation to UDL In addition to describing the overall outcomes of the UDL implementation, describe UDL components in relation to outcomes for learners pertaining to the learning goal in 2a, as well as to other relevant outcomes. The following methods could be used to determine outcomes: ● student perception survey data ● formative or summative scores ● anecdotal observations ● observational data (qualitative/quantitative) ● student artifacts</td>
</tr>
<tr>
<td></td>
<td>c) Implications Describe implications of the outcomes/findings in relation to UDL-based aspects of practice.</td>
</tr>
</tbody>
</table>

NOTE: These criteria were adapted from the original UDL Reporting Criteria (UDL RC), which can be found at https://edtechbooks.org/-EDs
Conclusion

Teachers may not think of themselves as instructional designers, but design is at the heart of what teachers do when they create and implement lessons. Lesson plans, which teachers create daily, are the product of instructional design, a process that experienced teachers may do reflexively. Teachers make instructional planning decisions based on their knowledge of strategies and prior experiences with teaching. Universal Design for Learning provides a framework to make instructional design decisions with a focus on the inclusion of all learners, and the UDL Design Cycle gives teachers a way to intentionally and systematically design for all learners. By considering learner variability from the outset, teachers can reduce barriers and proactively support students to reach mastery of learning goals.

Online learning environments pose new barriers that were not there in the traditional classroom. However, along with the barriers, the digitally-mediated nature of online learning presents new possibilities for supporting students. In particular, digital tools and technologies have features that make it easy to provide multiple means of representation, action and expression, and engagement. By considering the UDL guidelines and making systematic instructional design decisions, teachers can reduce barriers and proactively integrate supports for their learners in the online learning environment.

References


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Challenges and Opportunities in Adhering to UDL Principles to Design Online Courses

Ahmed Lachheb, Victoria Abramenko-Lachheb, & Lesa Huber

In this article, we share the opportunities and the challenges in adhering to the Universal Design for Learning (UDL) framework to design higher education online courses. We highlight specific instructional design examples to discuss the opportunities and challenges that we have encountered. We conclude by reflecting on UDL as a design tool and ponder the following question: Do design tools guide or serve us? By reflecting on our combined 40 years of design practice experience, we believe we offer valuable design knowledge of the UDL framework to scholars of design, educators, and practitioners.

Introduction

The knowledge of design practitioners has always been valuable, benefiting design theory, education, and practice (Cross, 2001; Nelson & Stolterman, 2014; Stolterman et al., 2009; Schön, 1983; 1987). Scholars rely on designers’ knowledge to understand design practice in situ, to introduce design tools grounded in practice, to develop signature pedagogies for educating future designers, and to suggest ways that can improve design practice. Designers’ knowledge in the instructional design and technology (IDT) discipline is also valuable, as contemporary IDT scholarship emphasized (Boling et al., 2017; Gray et al., 2015; Lachheb & Boling, 2018; Rowland, 1992; Sentz et al., 2019; Sentz & Stefaniak, 2019; Smith & Boling, 2009; Tracey & Boling, 2014). In that spirit, we—the authors who work as instructional and learning designers—share in this article the challenges and opportunities in adhering to the Universal Design for Learning (UDL) framework to design online courses in graduate and undergraduate higher education settings. We do so by relying on our repertoires of design precedents (Boling, 2021) and by reflecting on our combined 40 years of instructional and learning design experience.

What UDL Means to Us?

Broadly speaking, a design prescription is a recommendation for how to design something that is authoritatively put forward by a group, organization, and/or entity in the design profession. From our practitioner perspective, the UDL framework fits this definition of a design prescription. It is packed as a set of design guidelines and grounded in the ‘authority’ of scientific knowledge and principles, which mandates to design instruction in a way that results in: (1) multiple types and means of learning materials; (2) multiple opportunities for student engagement; and (3) multiple options for students to demonstrate mastery of learning. Further, adhering to the UDL framework allows designers to comply with accessibility standards as mandated and authoritatively put forward by Section 508 of the Rehabilitation Act and to design successful learning experiences. The UDL framework—including its sets of design guidelines—could also be an instructional design theory that fits the learner-centered paradigm of instructional design theories and models (Reigeluth et al., 2017). In this sense, UDL is a theoretical design tool (Lachheb & Boling, 2018; Yanchar et al., 2010).

Throughout our design education and professional training, we have been introduced to UDL through foundational literature (e.g., CAST: Center for Applied Special Technology, 2018; Moore, 2007; Spector et al., 2014). We recognize that UDL has roots in the idea of barrier-free design that emerged in the 1950s across the world (Moore & Elsworth, 2014). Such roots evolved later in the 1990s when Ron Mace, a Professor of North Carolina State University, introduced Universal Design to advocate for designing physical buildings and environments to accommodate all users, particularly those with physical limitations and disabilities. The most comprehensive definition of UDL that we recognize is by Moore (2007):

Using a set of principles for design, it [UDL] takes diversity of the learner population into account from the start and builds features into the learning materials, environment, and system that allow a broad set of learners to access the learning (both the content and the instructional strategies) and accomplish learning goals. (paragraph 4)

The Center for Applied Special Technology (CAST)—where the UDL framework originated—defines UDL as a “design approach to curriculum, that minimizes barriers, and maximizes learning for all learners” (CAST,
When we consider these definitions, we can frame UDL as a design framework that advocates for multiple means of engagement, representation, and action and expression. This framework is based on the notion that there are separate networks in the brain (recognition, strategic, and affective) and ponders how these networks should be thought of when designing instruction. A UDL-guided design expects a great variability among students’ needs, preferences, and capacities. Thus, it refutes the idea of one “typical” student persona.

Design Opportunities with UDL

One of the core values that we cherish is that the learning experiences and instructions that we design should be inclusive and responsive to students’ diverse needs. After all, we all remember that one class or learning experience where we felt unnoticed, underappreciated, or neglected. We do not wish for any student to experience the same when they interact with what we design. The UDL framework, in this sense, provides our design work with opportunities to put our core design value into practice, so no student we design for is left behind. Being informed with UDL, we designed—and continue to design—online courses that include multiple types and means of learning materials that can speak to the diversity of students’ preferences, multiple opportunities for students’ engagement, and assessments that include multiple options for students to demonstrate their mastery of learning. Throughout the next sections, we highlight relevant examples to the nine UDL guidelines, as highlighted by CAST (2018). The following table (Table 1) is a graphic organizer of the UDL guidelines and checkpoints, and the corresponding examples and figures referenced in the next sections.

Table 1

<table>
<thead>
<tr>
<th>UDL Guideline/#</th>
<th>Guideline &amp; Checkpoint</th>
<th>Corresponding Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1: Perception</td>
<td>Interact with flexible content that doesn’t depend on a single sense like sight, hearing, movement, or touch.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 1.1: Offer ways of customizing the display of information</td>
<td>Figure 4</td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 1.2: Offer alternatives for auditory information</td>
<td>Figure 1</td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 1.3: Offer alternatives for visual information</td>
<td>Figure 2</td>
</tr>
<tr>
<td>#2: Language &amp; Symbols</td>
<td>Communicate through languages that create a shared understanding.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 2.5: Illustrate through multiple media</td>
<td>Figure 2</td>
</tr>
<tr>
<td>#3: Comprehension</td>
<td>Construct meaning and generate new understandings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 3.1: Activate or supply background knowledge</td>
<td>Figures 5a &amp; 5b</td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 3.2: Highlight patterns, critical features, big ideas, and relationships</td>
<td>Figures 6a, 6b &amp; 6c</td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 3.3: Guide information processing and visualization</td>
<td>Figures 3a &amp; 3b</td>
</tr>
<tr>
<td>#4: Physical Action</td>
<td>Interact with accessible materials and tools.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 4.1: Vary the methods for response and navigation</td>
<td>Figures 7a &amp; 7b</td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 4.2: Optimize access to tools and assistive technologies</td>
<td>Figure 8</td>
</tr>
<tr>
<td>#5: Expression &amp; Communication</td>
<td>Compose and share ideas using tools that help attain learning goals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 5.1: Use multiple media for communication</td>
<td>Figure 9</td>
</tr>
<tr>
<td>#6: Executive Functions</td>
<td>Develop and act on plans to make the most out of learning.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 6.1: Guide appropriate goal-setting</td>
<td>Figure 11</td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 6.3: Facilitate managing information and resources</td>
<td>Figures 10a &amp; 10b</td>
</tr>
<tr>
<td>#7: Recruiting Interest</td>
<td>Spark excitement and curiosity for learning.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 7.2: Optimize relevance, value, and authenticity</td>
<td>Figures 12a &amp; 12b</td>
</tr>
<tr>
<td>#8: Sustaining Effort &amp; Persistence</td>
<td>Tackle challenges with focus and determination.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 8.3: Foster collaboration and community</td>
<td>Figure 13</td>
</tr>
<tr>
<td>#9: Self Regulation</td>
<td>Harness the power of emotions and motivation in learning.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 9.1: Promote expectations and beliefs that optimize motivation</td>
<td>Figure 14</td>
</tr>
<tr>
<td></td>
<td>● CHECKPOINT 9.3: Develop self-assessment and reflection</td>
<td>Figure 15</td>
</tr>
</tbody>
</table>

Multiple Types and Means of Learning Materials

One of the most important points that we discuss in our...
initial design meetings is the design and development of learning materials. Often, faculty come to us with a predetermined decision about what specific kind of learning material they wish to present to their students (e.g., a paid textbook, a collection of journal articles, and/or only video lectures, etc.). Through negotiation and by presenting to them the idea that learning material variability increases the quality of their course design, we eventually design and develop multiple types and means of learning materials for the online courses we designed. For example, we search for open educational resources (OERs) and advocate for their use instead of (or in addition to) using a textbook (Figure 1). We rely on videos available online and on the institution’s repository of video archives to present rich audiovisual content for students (Figure 2).

Figure 1
Weekly Readings

Authors Note: In addition to the video lecture and the course textbook, weekly readings are drawn from OERs (2-5 bulleted points) (UDL guideline/checkpoint 1.2: offer alternatives for auditory information).

Figure 2
Open Educational Resources Used and Provided

Authors Note: Videos from HBO YouTube channel and a news articles are provided to students as “lecture supplements” (UDL guideline/checkpoint 1.3: offer alternatives for visual information; UDL guideline/checkpoint 2.5: illustrate through multiple media).

Additionally, when we produce a video lecture, we always provide the students with a copy of the slides as a ‘presentation handout,’ giving them the freedom to watch the lectures, read the slides, or do both (Figure 3a and Figure 3b). Additionally, students are provided with options regarding how they can interact with the learning materials by choosing to focus on the slides or the video feed of their instructor (Figure 4).

Figure 3a
Slides are Attached Under the Video Lecture

Authors Note: Slides used in the lecture are available for download in a PDF format (UDL guideline/checkpoint 3.3: guide information processing and visualization).

Figure 3b
Alternative Summary of the Video Lecture is Provided

Authors Note: Slides used in the lecture and an alternative summary of the video lecture are available for download in a PDF format (UDL guideline/checkpoint 3.3: guide information processing and visualization).

Figure 4
Option to Customize the How to View the Video Lecture
Authors note: Students are given the option to customize the way they can view the video lecture (UDL guideline/checkpoint 1.1: offer ways of customizing the display of information).

In addition, given that most courses we design are graduate-level and tailored to specific degree programs, we design activities and materials to activate or supply background knowledge needed for the course (‘Getting Started’ or ‘Pre-Requisite Knowledge’ module, Figure 5a and Figure 5b). In the design of learning materials, we work with faculty to highlight the patterns, critical features, big ideas, and their relationships through creating a detailed course syllabus (Figure 6a), custom course structure and navigation (Figure 6b), and module overviews (Figure 6c).

Figure 5a

Getting Started Module for Students to Complete

Authors Note: The ‘Getting Started’ module is for students to complete before starting the course (UDL guideline/checkpoint 3.1: activate or supply background knowledge).

Figure 5b

‘Civics Refresher’ Module for Students to Complete

Authors Note: The ‘Civics Refresher’ Module is for students to complete before starting the course (UDL guideline/checkpoint 3.1: activate or supply background knowledge).

Figure 6a

Course Syllabus

Authors Notes: The course syllabus shows the course schedule pattern for each week (UDL guideline/checkpoint 3.2: highlight patterns, critical features, big ideas, and relationships).

Figure 6b

Course Homepage
Authors Note: The course homepage shows a custom course structure/navigation (UDL guideline/checkpoint 3.2: highlight patterns, critical features, big ideas, and relationships).

Figure 6c
Timeline for Module Completion

Authors Note: In an online graduate course module, a suggested timeline for module completion for students is listed (UDL guideline/checkpoint 3.2: highlight patterns, critical features, big ideas, and relationships).

Multiple Means of Action and Expression

Being informed with the UDL framework helped us design multiple means for action, expression, and communication from students. For example, when designing a course site, we ensure that students can easily access the necessary resources and do not have unnecessary items in the navigation menu (Figure 7a).

Additionally, we ensure that the course home pages include key information about the course, faculty contact information, and course resources. We do this so that students have different methods for navigation (Figure 7b). Each course we design has a separate module called ‘Getting Started’ that includes sections about accessibility and information on where on-campus students can receive help (Figure 8).

Figure 7a
Course Navigation Menu

Authors Note: A screenshot from an online graduate course that shows a customized navigation menu (UDL guideline/checkpoint 4.1: vary the methods for response and navigation).

Figure 7b
Graduate Course Homepage

Authors Note: Various methods of course navigation in a course homepage (UDL guideline/checkpoint 4.1: vary the methods for response and navigation).

Figure 8
Accessibility and Adaptability Technology Resources
Authors Note: The page includes resources to accessibility and adaptability technology resources (UDL guideline/checkpoint 4.2: optimize access to tools and assistive technologies).

When we design courses, we ensure that faculty have different options to communicate with their students, specifically during emergencies. Thus, as informed by the UDL guidelines on expression and communication, we work with faculty to consider multiple communication means that students can use to communicate with them. For instance, students can email their faculty, send a message through the learning management system, call a faculty office number, or meet via Zoom. These means are usually listed on the course homepage and the syllabus’ first page (Figure 9).

Figure 9

Faculty Contact Information Section

Authors Note: in the course homepage, the faculty contact information is listed (UDL guideline/checkpoint 5.1: use multiple media for communication).

Further, we believe that it is critical that instructional designers and faculty consider and integrate various tools aligned with students’ learning needs and can foster students’ learning. For instance, we work with faculty to adopt multiple technologies (e.g., Quick Check formative assessment tools, assignments tools, and two different discussion tools; one embedded within the learning management system and the other as an external tool). We see firsthand how these tools have fostered learning, community building, and engagement.

In addition, being informed of the UDL framework has helped us design and integrate different types of scaffolds. Such scaffolds have been necessary to guide students through authentic projects, which has required them to apply their knowledge and skills in real-life settings. For instance, in an online course in which students are assigned to conduct their own population needs analysis, they are offered to complete this project in chunks. That is, students’ major project is chunked into several deliverables. The rationale behind this is to engage students in a progression of tasks and provide students with opportunities to track their progress with timely faculty feedback.

Informed with the UDL executive functions guidelines, we provide students with checkpoints and checklists to help them track their learning progress. For instance, each course has an overview page of each module that lists learning objectives, learning materials, and assignments. The rationale for including those overview pages is to help students see the purpose behind each learning activity and assignment and to mentally organize the presented material into a coherent structure (Figure 10a).

Figure 10a

A Screenshot from an Online Undergraduate Course that Shows a Section of a Week Overview Page Home Page (UDL Guideline/Checkpoint 6.3: Facilitate managing information and resources)

Authors Note: The module includes an overview chart (UDL guideline/checkpoint 6.3: facilitate managing information and resources).

Additionally, being informed by the guidelines of facilitating the management of information and
resources, the online courses we design typically include detailed descriptions of all course assignments. We also provide templates that students can use to get started on their thought process and organize their ideas to complete their assignments (Figure 10b). Students can also find a brief description of learning materials, such as readings and to-do lists. At the end of each module, students can find a checklist for each week to help them track their progress (Figure 11).

Figure 10b
Assignment Description

![Assignment Description](image)

Authors Note: A page dedicated to show the assignment description (UDL guideline/checkpoint 6.3: facilitate managing information and resources).

Figure 11
End-of-Module Checklist

![End-of-Module Checklist](image)

Authors Note: A screenshot from an online undergraduate course that shows an end-of-module checklist (UDL guideline/checkpoint 6.1: guide appropriate goal setting).

Multiple Opportunities for Student Engagement

We assert that high student engagement with course materials, activities, faculty, and other students is key for a successful learning experience and, thus, a successful course design. We believe in active learning approaches, which contribute to students taking ownership of their own learning. To this end, as instructional designers, we ensure that the learning materials, activities, and learning interactions are designed for high student engagement. Informed with UDL guidelines of engagement (guidelines 7-9), we design various activities to ensure high student engagement. Graduate courses that we design are often competency-based courses. Such competencies are authentic to the students’ future professional practice (e.g., public health practitioner). To optimize relevance, value, and authenticity of the course, we developed video testimonials from former students (Figure 12a) to address the ‘So what?’ question of learning activities (Figure 12b).

Figure 12a
Video Testimonials from Program Alumni

![Video Testimonials from Program Alumni](image)

Author Note: The video testimonials from program alumni highlights the value of the learning experiences the students are about to start (UDL guideline/checkpoint 7.2: optimize relevance, value, and authenticity).

Figure 12b
Rationale for Assignment

![Rationale for Assignment](image)

Authors Note: A needs assessment can be defined as the process of collecting and assessing data that describe the nature and magnitude of a community’s needs, as well as its assets (human, financial, organizational, intellectual, institutional, and people) that can help with program planning. The needs and assets assessment is a resource that will help to assess school corporations, community-based organization, faith-based agencies, health care facilities, etc. to help decide the priority outcomes related to the health issues of a specific targeted population. Specifically, the priority outcomes also help to decide the critical health content and skills that need to be included in the intervention. The assessment is the first step communities take in the program planning process because it helps develop appropriate goals and objectives. It also provides current and relevant data that can be used to develop funding proposals and to justify to funders why resources are needed to support programs and interventions (‘Building Skills for Health Literacy: Human Sexuality,” Wisconsin Department of Public Instruction). Information collected through needs assessments need to be able to address the following:

1. The extent, magnitude, and scope of the problem in the community;
2. Current efforts to address the problem;
3. Gaps in existing services.
Authors Note: The page contains a rationale for the assignment and why it is important (UDL guideline/checkpoint 7.2: optimize relevance, value, and authenticity).

We also rely on group projects and discussions, as well as projects where students work with community groups, to not only foster collaboration and a sense of community but also to increase the authenticity of the learning experiences (Figure 13). Last and not least, to increase self-regulation and to optimize individual choice and autonomy for students, we designed discussion activities in an open-ended way (Figure 14), and we provided multiple formative and informal assessment opportunities for students to check their own understanding of the course materials (Figure 15).

Figure 13A
Screenshot from an Online Graduate Course Group Assignment Where Students Are Asked to Work with an Organization from the Community (UDL Guideline/Checkpoint 8.3: Foster Collaboration and Community)

Authors Note: A group assignment where students are asked to work with an organization from the community (UDL guideline/checkpoint 8.3: foster collaboration and community).

Figure 14
Course Discussion

Authors Note: In an online graduate course discussion, students are free to choose between two formats of introduction posts—a video or a written post (UDL guideline/checkpoint 9.1: promote expectations and beliefs that optimize motivation).

Figure 15
Formative/Ungraded Quiz

Authors Note: A formative/ungraded quiz is included in online graduate class (UDL guideline/checkpoint 9.3: develop self-assessment and reflection).

Challenges of Adhering to the UDL Framework: Obstacles & Opportunities

The opportunities that the UDL framework provides for our design work also come with challenges. Throughout the next sections, we highlight a few challenges that we encountered, framed as obstacles in adhering to the UDL framework, and we comment on how we addressed each obstacle. These obstacles, despite their immense complexity, challenge our design practice but do not make us less committed to the core values and principles of the UDL framework.

Interpretation of the UDL Guidelines: Obstacle & Opportunity

While each UDL guideline’s explanation is provided on the CAST website, these explanations are rather broad, which opens room for ambiguous interpretation—an obstacle that we faced in adhering to the UDL framework. We have witnessed how each designer in our team can interpret these guidelines differently, based on their tacit design knowledge and their core design judgments (Boling et al., 2017). As a result, the variety among the
While working with different faculty on course design, we noticed certain resistance to following UDL guidelines—a third obstacle we faced in adhering to the UDL framework. The main reason for this resistance is that each faculty approached their course design project with their own teaching philosophy and ideas on teaching. After all, most of the faculty we have worked with are excellent teachers with impressive experience. For example, one faculty pushed back against the idea of multiple means for action and expression when we suggested giving students multiple options to submit their assignment of an ‘elevator pitch.’ They cited a legitimate concern—it will result in an unlevel playing field for students, and thus, it could be an inequitable and a non-inclusive practice. Another faculty was willing to implement the ideas we suggested that are informed with UDL. Still, they insisted on having an efficient process of grading students’ artifacts and not worrying about technical issues they may encounter with the students’ multiple formats of deliverables.

To overcome this obstacle, we had to rely on our repertoires of design precedents (Boling, 2021). We showcase to faculty good examples from their peers to increase their motivation and interest in adopting UDL-informed practices. We also cite personal experiences with teaching and learning to bring more credibility to our UDL-informed design suggestions. We treat each faculty and their course design project as a unique situation in which we address their concerns through empathy and respect.

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**Conclusion**

The challenges we faced adhering to the UDL framework do not make us less committed to designing equitable and inclusive learning experiences. After all, design work is by nature always constrained, challenging, and
requires—sometimes difficult—tradeoffs. As we commented throughout the paper, we appreciate the core values of UDL, and we continue to embrace them. We think that we are able to strike a happy balance between the opportunities we have and the challenges we encounter in adhering to UDL; thus, we do not have to sacrifice efficiency over effectiveness and appeal (Honebein & Honebein, 2015).

We firmly believe in the following idea: design tools, such as UDL, serve us and do not guide us. UDL, like any other theoretical design prescriptions, must be put in the service of designers’ judgments to design rich, inclusive, and responsive learning experiences. We believe that designers should adopt a designerly approach to design tools’ selection and use (Lachheb & Boling, 2018; Stolterman et al., 2009). This approach means that design tools are serving what the designer needs and not scaffold or direct their design in a predetermined way. This approach also mandates designers to grow a good ability to evoke strong instrumental judgments that help them select what design tools to use, how, when, and why (Lachheb & Boling, 2018; Lachheb & Boling, 2021).

Eventually, designers in our discipline can face the challenges—such as we listed earlier with UDL—by coming up with design tools for themselves, informed by their tacit knowledge and the reality of their design practice. Relying solely on scholarly tools as offered in traditional IDT literature will not get instructional designers far enough in facing their intricate design problems and wicked practice. With a designerly approach to design tools, we can “[...] contribute to advancement in the field robustly and affect positively the types of instructional design problems we can take on and the ability of our designers to flex with the nature of those problems” (Lachheb & Boling, 2018, p. 49).

References


Adopting and Applying the Universal Design for Learning Principles in Online Courses

Beth Oyarzun, Bryndle L. Bottoms, & Carl Westine

The Universal Design for Learning (UDL) principles suggest that providing learners multiple means for engagement, representation, and action and expression will help learners become purposeful and motivated, resourceful and knowledgeable, and strategic and goal-directed (CAST, 2018). The purpose of this study was to explore the challenges and opportunities of adopting UDL principles for online course design using the decision-making process as the theoretical framework as defined by the Diffusion of Innovation theory (Rogers, 2003). Seven online faculty were interviewed regarding the challenges and opportunities that hindered or helped their decision to adopt the UDL principles in online course design. Additionally, three faculty participants volunteered course materials as examples of how they applied UDL principles. Results highlight ways institutions of higher education can promote faculty adoption of UDL principles for online course design.

Introduction

Online courses and programs have a firm footing and continued growth in higher education. According to Allen and Seaman (2017), distance education served more than six million learners in the fall of 2015, which was a 3.9% increase in one year. Furthermore, approximately 30% of all learners enrolled in higher education took at least one online course, and of those, more than 80% were undergraduate learners (Allen & Seaman, 2017). Since online courses and programs are serving more substantial numbers of learners, there is a need to understand how to make online courses applicable and productive for a broad population of diverse learners with various needs.

The Universal Design for Learning (UDL) framework optimizes learning experiences for all learners, regardless of instructional medium, based upon research of how learning occurs (CAST, 2018). Three main principles comprise the framework: (1) multiple means of representation, (2) engagement, and (3) action and expression. The principles encourage and define ways to allow learners to interact with the multiple types of content and various ways to interact with the instructor and each other (see Table 1). Additionally, the principles encourage faculty and designers to provide learners to express content mastery in various ways when appropriate. Three more specific guidelines within each principle dictate ways to operationalize UDL in practice.

Table 1

A Description of UDL Principles and Guidelines

<table>
<thead>
<tr>
<th>Principles</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle 1: Providing Multiple Means of Representation</td>
<td>Alternatives for auditory and visual information or offering ways of customizing the display of information.</td>
</tr>
<tr>
<td>Principle 2: Providing Multiple Means of Action &amp; Expression</td>
<td>Varying the methods for response and navigation; optimizing access to tools and assistive technologies.</td>
</tr>
<tr>
<td>Principle 3: Providing Multiple Means of Engagement</td>
<td>Optimizing individual choice, autonomy; relevance, value, and authenticity; minimize threats and distractions.</td>
</tr>
</tbody>
</table>
The Diffusion of Innovation (DOI) theory provides a framework to guide the adoption of an innovation within an organization to increase the odds of success (Rogers, 2003). In this study, the innovation is the adoption of the UDL guidelines for online course design in higher education institutions. The theory defines five key elements in diffusion: (a) the innovation, (b) adopters, (c) communication channels, (d) time, and (e) the social system. This study aims to gain insight into UDL guidelines' adoption through the lens of the DOI theory.

**Literature Review**

**UDL**

The UDL framework relies on a combination of neuroscience and educational research (CAST, 2018; Ostrowski et al., 2017). It provides a proactive way to plan for all learners' success, which negates the need to retrofit content when learners differ in abilities. It requires shifting from the traditional rigid approach of instructional planning to a more flexible learner-centered, individual approach (Al-Azawei et al., 2016).

Research suggests that applying UDL principles and guidelines support learning (Capp, 2020) in both the K-12 (Brand et al., 2012; Ok et al., 2017) and higher education (Rao et al., 2014) environments. UDL aims to produce purposeful, motivated, resourceful, knowledgeable, strategic, and goal-directed learners. The principles give guidelines to provide options that empower learners to control the learning process and allow self-expression. Lepp and Fierke (2017) found that learners had more positive learning experiences when allowed to develop learning goals and influence the course outcomes, followed by reflection attainment of those goals and outcomes. Additionally, Smith (2012) applied the UDL framework to a graduate research methods course and found a positive relationship between learner interest and engagement. However, while these studies all point to UDL implementation benefits, some faculty find the UDL principles and guidelines challenging to put into practice due to the complexity of the framework (Edyburn, 2010). There is a need for additional professional development opportunities and examples to understand the application of the framework.

**UDL in Online Learning**

Research on UDL has recently gained momentum within an online learning environment due to increased demand for online courses. Designing and developing online instruction is a time-intensive process, and retrofitting content to suit the needs of diverse learners becomes more complicated than traditional instruction. Therefore, applying the UDL framework to consider diverse learners' needs during the initial design and development phase can save time and resources.

Multiple studies report benefits for learners. He (2014) designed an online education course based on the UDL framework. Learners reported higher confidence and self-efficacy for online learning and interest in teaching online in the future. Rao and Tanners (2011) created an online course with the UDL framework as a guide. They found that 92% of learners who participated reported value in the course delivery. Similar findings exist in graduate courses. For example, after designing a course using UDL principles, 83% of graduate learners reported that a choice in assignments positively impacted course completion and success (Engleman & Schmidt, 2007). More recently, Scott et al. (2015) explored learner perceptions of three online courses designed with UDL principles and found positive impacts on learner perceptions of learning.

Despite these positive examples of applying UDL in online learning environments, many online instructors remain unfamiliar with UDL principles. Still, others who are, sometimes choose not to implement them in their courses. Westine et al. (2019) found that approximately 72% of online-teaching faculty at a large southeastern university were familiar with at least one UDL principle. However, only 38-60% claimed to implement UDL in their online course - depending on which guideline. The least implemented guideline was language, mathematical expression, and symbols. The most implemented guideline was expression and communication. Research demonstrates a need to examine the faculty decision-making process to adopt UDL for online course design.

Scott and McGuire (2017) suggest that Rogers’ (2003) DOI theory is a useful strategy for studying UDL adoption within an online learning context. According to Scott and McGuire (2017), DOI theory elements support the UDL implementation process through four specific areas: time and decision-making, time and individual innovativeness, time and rate of adoption by the field, and communication channels and social systems.

**Theoretical Framework**

Rogers’ (2003) DOI theory explains how, why, and at what rate innovations spread within a social system. The decision process has five stages: knowledge, persuasion, decision, implementation, and confirmation, which can be influenced by various factors: (a) the attributes of the innovation, (b) time, and (c) communication channels. The first stage is knowledge - when an individual learns of an innovation through various communication channels.
within the social system. The second stage, persuasion, is when individuals form positive or negative attitudes towards the innovation based upon knowledge gained. There are five characteristics of innovations: relative advantage, compatibility, complexity, trialability, and observability. For an individual to feel persuaded to use an instructional innovation, the innovation should have a clear advantage and be compatible with the current adopter’s practice. Decision is the third stage where an individual makes a clear decision to adopt or not adopt the innovation, which influences the rest of the decision process stages. The implementation stage, the fourth stage, is when the individual puts the innovation to use in practice. The final stage is confirmation - when the individual decides that this innovation helps the adopter reach desired goals.

**Purpose of Study**

Multiple studies have shown that UDL within face-to-face classrooms is efficient and productive resulting in higher achievement (Al-Azawei et al., 2016; Capp, 2020). Furthermore, UDL is drawing increased attention as a framework to promote electronic content accessibility and making instruction more inclusive (Al-Azawei et al., 2016). However, significant gaps in the adoption of UDL in online learning environments suggest more research is needed to understand the faculty decision process to adopt UDL guidelines for online course design.

The present research study extends a survey research effort (Westine et al., 2019) which quantified the level of knowledge and implementation of UDL principles within an online learning environment at a large southeastern university. In that study, the authors surveyed approximately 150 online instructors to gauge familiarity with and implementation and use of the UDL guidelines. Additionally, the survey determined instructor interest in learning more about each UDL guideline. In this follow-up study, the researchers conduct qualitative interviews of select survey participants and perform a content analysis of online course materials volunteered by a subset of the interviewees implementing at least one UDL guideline. The goal was to gain practical examples to inform training in applying UDL guidelines in online course design to ensure effective learning for all.

Therefore, the purpose of the current research effort is to identify the influences on faculty’s decision-making process at various stages of adopting the UDL principles to guide their online course design. Results will inform higher education institutions on the challenges and opportunities that faculty experience during adoption decisions and inform future practices to facilitate more widespread implementation of UDL in online course design. The research questions are:

1. What opportunities and challenges influence faculty with prior knowledge of UDL principles to adopt these principles to design online class(es)?
2. How have faculty applied UDL guidelines in their online classes to adhere to the UDL principles of providing multiple forms of engagement, representation, and action and expression?

**Methods**

**Research Design**

This research study is a case study of a bounded system (Merriam, 2009), which is defined as Merriam (2009) as the object of study using descriptive techniques. The bounded system were online instructors at a large southeastern university with familiarity of UDL principles. Online instructors with familiarity of UDL principles were interviewed about their decision to adopt and implement UDL strategies. Elements of phenomenology were used to study how the UDL framework is implemented within online instruction through the lens of the decision-making process as defined in the DOI theory (Merriam, 2009). The research design explored how the system was implemented and the goal was to analyze instructional decisions made by online instructors. The design utilizes the DOI framework as a coding system and draws codes from the work of Scott and McGuire (2017) using a deductive coding method.

**Participants**

Interview participants were purposefully selected from Westine et al. (2019) survey respondents who provided information on UDL implementation and indicated a willingness to engage in follow-up interviews. Thirty-four survey participants volunteered for interviews. As shown in Figure 1, the researchers created mutually exclusive groups based on their level of implementation of known UDL guidelines.

![Mutually Exclusive Groups of Interviewee Volunteers](image)

The first group, full familiarity and implementation of UDL guidelines, was the largest group and was composed of participants who reported implementation of each
guideline for which they were familiar. The next group, some familiarity and some implementation of known UDL guidelines, captured participants who were familiar with some or all UDL guidelines but chose to implement a subset of the known guidelines. The some familiarity and no implementation group signified individuals that knew of at least one UDL guideline but did not implement any. This was the smallest group. The seven interview participants were two tenured faculty, one tenure track faculty, two clinical faculty, and two lecturers.

A random number generator selected three participants from each category to invite for interviews. Of the nine invited participants, seven responded and agreed to a meeting: two from the full implementation group, two from the mixed implementation group, and three from the no implementation group.

Data Collection

The researchers conducted semi-structured interviews, which consisted of nine questions regarding the decision to adopt UDL principles for online course design (See Appendix). The conversations were recorded and transcribed. The research team carefully reviewed and edited the transcriptions to ensure accuracy. The four participants who implemented UDL guidelines were invited to provide content samples. Three participants agreed and provided various artifacts, including assignment descriptions, syllabi, and access to online learning system courses. Two of these participants were in the full implementation group, and one was in the mixed implementation group. The research team reviewed the materials to identify examples.

Data Analysis

The transcriptions were uploaded into NVivo 12 software and coded. The predetermined codes are based on the work of Scott and McGuire (2017). Two research team members thoroughly read and coded sentences within the interview transcripts separately. To ensure validity, the coders met after coding the second, fifth, and seventh interviews to compare codes and arrive at a consensus. Table 2 displays examples of coded passages.

<table>
<thead>
<tr>
<th>Codes</th>
<th>Quotes</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision Process: knowledge and awareness</td>
<td>I think part of it has been through searching to see what our best practices in education, particularly online education, to see what's going to be the best way to reach the students, what's going to be the best way to get them engaged in the courses, to help them achieve their goals.</td>
<td>This quote describes how the faculty gained knowledge and awareness of UDL.</td>
</tr>
<tr>
<td>Decision Process: knowledge and awareness &amp; formal social system</td>
<td>I did it on my own but what I did is it, I typed it with my annual (evaluation). We have an annual evaluation to create teaching, service and research goals for each year and so I typed that into my teaching goal. I found it was a good way to objectively know there I was going to be improving my teaching rather than setting out on my own and thinking “Oh this will be a good year” or “this would be a good conference to go to”.</td>
<td>This quote describes that faculty gained knowledge and awareness of UDL on their own and how they relied on a formal social system to guide their knowledge goals.</td>
</tr>
</tbody>
</table>

Results

Research Question 1

To answer research question one, “What opportunities and challenges influence faculty with prior knowledge of UDL principles to adopt these principles to design online class(es)?” We examined the data for opportunities and challenges of adoption through each stage of the decision making process. The results are organized by each stage of the decision-making process, discussing opportunities and challenges found within each stage.

Adopting UDL Principles

The stages of the innovation decision process guide the presentation of the findings and include enabling factors and existing barriers to adoption experienced by the participants. Much of the conversations centered on the knowledge and awareness and the persuasion stages of the decision process, highlighting the importance that faculty place on initial exposure to UDL principles, training, and what helped persuade UDL implementation.
Knowledge and Awareness

Knowledge of UDL is linked most clearly to communications. Interviewees frequently mentioned professional development training as to where they learned about UDL, highlighting the role of interpersonal communications. Although not specific to UDL, Quality Matters (QM) training emerged as a source of information related to UDL (QualityMatters.org, 2020). Interviewees also referenced the Center for Teaching and Learning (CTL) at the university as an interpersonal communications source about QM and other teaching resources. One respondent found the training sessions with CTL were too few and not personalized enough. This respondent also noted a lack of an online component, which created a barrier to accessing CTL training, mainly since online faculty are not frequently on campus. The lecturers also highlighted this lack of a connection concerning communication. They noted the likelihood of missing information in department meetings due to not being required to attend, not having strong near peer relationships with departmental faculty, and an inability to be on campus to access CTL and other resources.

Exploring the nature of how participants learned about UDL, the researchers saw a variety of responses. One interviewee raised the issue of a lack of education and pedagogy training for graduate faculty and the role this plays in the knowledge of UDL. Relatedly, another interviewee described their search process that led to the UDL framework. Yet, one respondent mentioned the original survey in the initial wave of research as a first concrete exposure to the UDL framework.

The constraint mentioned most was time to learn about UDL. Multiple respondents noted the value of formal structures to help manage this time. Supporting this concept was the notion that there are “...so many initiatives in this college, that it’s really hard... because we have meetings, and we’ve been revising our programs.” One respondent emphasized that it was useful to have CTL support learning strategically across a week in pieces rather than all at once within a training while designing a course. Another faculty described setting goals for learning about UDL in annual evaluations to prioritize learning. These examples highlight the need for a clear strategic initiative towards UDL from the organization to prioritize UDL.

Persuasion

Participants stated that they were persuaded to adopt UDL principles due to the perceived overlap between innovation characteristics with their current position and the support of various communication channels. For instance, one participant mentioned that the framework promotes good teaching practice, so it was not hard to persuade them to adopt. Similarly, another participant noted a belief that UDL would improve learner engagement, which meant it would assist with more effective teaching and learning.

With the participant pool, mass media such as the CAST website’s research, interpersonal communication through workshops offered at the university via CTL, and near peers such as encouraging colleagues within departments influenced persuasion. Participants vocalized trying to persuade others to adopt UDL standards. For example, one participant highlighted the importance of persuading colleagues by offering a workshop for faculty within the college. Through this workshop, the participant became a resource for faculty to ask for advice - essentially becoming the near peer for colleagues.

Conversely, faculty barriers to adopting UDL principles included a lack of time or incentives to redesign an online course with UDL principles, organizational or leadership support, and specific resources or examples that helped understand how the UDL principles directly applied to particular disciplines. Participants expressed knowledge of existing resources but cited not having the time or motivation to explore those resources as the primary barrier. Incentives and administrative support were noted as a possible way to help create time and motivation for faculty to examine existing resources for ideas to implement UDL principles. Additionally, participants suggested a need for better examples. In particular, gleaning examples from faculty within the institution can make more personalized, pertinent resources more readily available.

Decision, Implementation, and Confirmation

The final three stages of the innovation decision process were less represented in the data since many participants had not moved past the persuasion stage. Therefore, the combined results appear in this section. The data suggested that collecting learner feedback, both formally and informally throughout the course, can provide multiple opportunities for confirmation about the decision to adopt UDL principles. No specific barriers emerged in the decision or confirmation phase. However, barriers did surface in the implementation phase. Participants expressed a lack of knowledge of how to allow and uniformly assess learners expressing mastery in various ways efficiently. Inheriting a course that was designed by someone else and did not include UDL principles also presented challenges for adopting the UDL principles. Technological barriers were also mentioned, such as the institution frequently changing the learning management system causing the faculty hesitation to redesign existing content.
Research Question 2

To answer research question two, “How have faculty applied UDL guidelines in their online classes to adhere to the UDL principles of providing multiple forms of engagement, representation, and action and expression?” a content analysis was conducted to examine how each faculty were using the guidelines within their online course. The examples are presented organized by guideline.

Application Examples of UDL in Online Contexts

In response to the need for more illustrative demonstrations, several examples are presented below to illustrate how faculty are applying UDL in their classes. For context before viewing examples, it is helpful first to understand a bit of each participant's teaching background that provided material. Participant 1 is a lecturer in the College of Liberal Arts and works as a full-time instructor at a nearby community college, teaching various online courses in the humanities. Participant 2 teaches face-to-face and online graduate courses in the College of Education. Participant 3 teaches several online courses in the College of Arts and Sciences based in the area of science, technology, engineering, and mathematics (STEM).

Examples for Principle 1: Multiple Means of Action and Expression

Participant 1 incorporated learner choice of products into assignments. They indicated that, “trying to let them present their ideas in as many possible ways as I can, particularly if the class is not a writing-intensive course, there is no reason that they need to write me an essay at the end.” For example, in one assignment, twelve characters were listed from the referenced literature and learners were asked to pick three to focus on for the assignment. Within the same assignment, learners chose two or three questions from seven options to write responses. Additionally, a final online discussion assignment required learners to synthesize topics. For this assignment, students decided and showcased knowledge gained in the format of their choosing. Learners could choose to create videos, presentations, or playlists of songs to show mastery of concepts on an assignment.

Examples for Principle 2: Multiple Means of Engagement

Participant 2 assigned a sizable final project in smaller stages to create more opportunities for revision and feedback. One phase of the final project included a peer review, which gave learners ownership and accountability for themselves and each other in addition to multiple opportunities to interact with each other and the instructor.

Participant 1 engaged learners using group assignments completed via discussion boards with a different group leader for each assignment. Learners chose group members and projects were evaluated by a rubric that included lead learner responsibilities and teammates’ roles. This rotation of duties allowed learners to frequently interact with various classmates in different roles and the instructor around various tasks throughout the semester.

Examples for Principle 3: Multiple Means of Representation

Participant 2 expressed that the face-to-face classroom enhanced the ability to accommodate various learners that each holds unique ideologies and diverse perspectives. Still, it became more challenging to accommodate in an online setting. Explicitly thinking about these diversities when planning the online course was essential to ensure accommodations for all learners. Participant 2 provided various videos, podcasts, or readings that engage learners when it was time to start a new topic or new module.

Participant 1 requested learners to report which instructional methods were or were not effective at least twice during the course. This information assisted in adjusting instructional methods or providing supplemental materials. By seeking the learner's perspective multiple times, Participant 1 was able to adapt to match preferences and monitor progress.

Participant 3 initially assessed learner ability levels to determine the most appropriate instructional methods. The goal was to build confidence in learner abilities early in the semester to lessen anxiety. Therefore, privacy was valued with feedback and communication. An online course provided more opportunity to discuss assignments in private via email or phone conversations, which allowed for more personalized instruction aimed at the specific needs of individual learners.

Discussion

This study's results bring some practical insight into how higher education institutions can influence faculty decisions to adopt UDL principles and some examples used to implement the UDL guidelines online. First, to increase knowledge and awareness, institutional leadership could identify and promote faculty’s priorities and incentives to create time to learn and motivation to adopt. Time was a barrier mentioned by all participants. That aligns with Moriarty (2007), who evaluated barriers
to faculty adopting UDL for online course design and found that technology and pedagogical competence, along with time, were critical barriers. Singleton (2017) also found faculty lack of time and lack of leadership emphasis as barriers to adoption. However, once the course design is established with UDL guidelines implemented, it could save faculty planning time and allow more time to focus on facilitation. Therefore, the significant time commitment is before course delivery. This concept is supported by Freeman (2013), who examined time requirements to develop and teach online courses and found evidence that teaching an online course the second and third time becomes about as time-consuming as teaching a face-to-face course the second and third time.

Once establishing priorities, incentives, and motivation to overcome barriers is accomplished, then a centralized pedagogy training center such as CTL could play an essential role in promotion and training. Given that participants highlighted CTL as a valuable information source and a need to connect concepts to teaching practices, incorporating targeted examples within CTL training on UDL would allow for fruitful discussions on implementation ideas to other courses. These discussions, in turn, would increase community engagement regarding UDL. Training interventions have been proven effective for implementing UDL (Davies et al., 2013). Singleton et al. (2019) suggest that strategies should be more prescriptive. Perhaps targeted communications that included training with context-specific best practices and examples would be beneficial. In addition, more diverse training options that included multiple modes and access for part-time faculty could be helpful and model inclusiveness for distance faculty. These suggestions align with Hromalik, Myhill, and Carr (2020), who designed and implemented UDL training for community college faculty and provided insights for successful practice. For example, they suggest offering a multiday academy or a brief workshop presentation as a primer to garner interest rather than providing a series of individual workshops throughout the academic year. The authors also emphasized the importance of modeling UDL practices within the training.

Persuasion to adopt can be promoted through interpersonal and near peer relationship channels in addition to mass media communications. The DOI theory recommends targeting some innovative faculty in various departments to adopt and use UDL principles in online courses, which could serve as near peers to help persuade additional faculty to join and provide context-based examples for their colleagues (Rogers, 2003). This concept was highlighted in faculty conversations. They mentioned they benefited from a near peer relationship or that they served as a near peer in their college. Organizations can create opportunities to persuade faculty to adopt UDL principles in online course designs through mass media and interpersonal communications. The channels provide avenues to promote the organization’s goals, give support, and resources/examples that are in context, so faculty can see how it applies to their fields and courses. This practice aligns with the recommendation of Singleton et al. (2019). They investigated perceptions of instructional designers implementing UDL in which the faculty and instructional designers (ID) relationship was a theme of importance, mainly since the faculty relied heavily on the IDs for ideas. For fields that have limited knowledge of teaching theory, providing training to fill that gap would be beneficial.

Once persuasion is achieved, proper implementation is a crucial element of the decision-making process. For instance, Lombardi, Murray, and Gerdes (2011) evaluated faculty perceptions of UDL versus their action and found there was a discrepancy as to what faculty reported and implemented. This result also appeared in our conversations with faculty as at least one participant reported familiarity with UDL in the initial survey but then stated in the interview that the survey was the first time they had more formally seen the principles. Faculty peers can influence and share ideas to foster proper implementation. Perhaps learning communities could be established to encourage faculty to share ideas. Departments could promote new ideas or critical reminders through emails or workshops to maintain fidelity. Departments or colleges could also provide incentives to faculty interested in learning and applying UDL principles, such as a course release or additional compensation to increase motivation. Given that several experienced faculty noted overlaps of UDL with good teaching practices in general, emphasizing these incentives with newer faculty who are investing in building up teaching capacity may be a productive avenue. These recommendations align with Serrano-Johnson (2020), who examined leadership practices that would support UDL adoption within a community college setting and recommended providing professional development, supportive leadership and encouragement, and building community around effective implementation practices.

Finally, faculty who know and are implementing UDL principles will move through the decision-making process to the final stage of confirmation (Scott & McGuire, 2017). At this stage, the department and faculty can continue to research to show the importance and successes of UDL principles in online course design. It is essential at this stage that other peers, who may be laggards of the implementation process as identified by Roger (2003), are aware of the positive results and then start to see the effects of UDL. Instructors that have been
using the implementation from the beginning can serve as a strategic resource to help address the gap in knowledge and strengthen the implementation of UDL across the institution. These recommendations align with Moore et al. (2018) who defined five levels of implementation for UDL in higher education: pre-implementation through university level implementation. Through the levels peer support and success were emphasized by participants as influences for adoption.

**Limitations**

This research was limited to one sizable Southeastern university and a small intentional sample of seven online instructors. This university has experienced several LMS transitions over time, which makes results less generalizable to all institutions. Instructors were not incentivized and indicated a willingness to participate in follow-up interviews. However, all did mention their desire to have more training on this topic of online instructional design and UDL. A small lottery incentive of online instructional tools (valued at approximately $100) was provided to one randomly chosen interview participant. Additionally, some of these instructors may have, in the past, received a monetary stipend, training, and instructional design support to design their online courses. While this may not skew the data, it could be a factor in the participants’ overall positive experience.

**Conclusion**

The purpose of this research was to explore the faculty experience of adopting UDL into online course designs. Results point to the need to grow communication and training surrounding UDL such that other instructors can improve instructional designs to have more inclusive courses. Faculty interviews highlight several valuable development opportunities aligned with the UDL guidelines as well as barriers to implementation.

This research underscores the importance of educating faculty about UDL principles and the value of adopting UDL principles for online course design to increase teaching quality and, therefore, satisfaction for the instructor and all learners (Chen et al., 2018). Additionally, while UDL adoption will undoubtedly increase the accessibility of the content, it can also prevent the need for retrofitting course designs for learners with disabilities Rogers-Shaw et al. (2017). For institutions to create a sustained implementation of UDL, leadership would need to buy in and instill accountability measures.

Important needs still reside in the areas of knowledge generation and persuasion. By studying the experiences of individuals who implemented UDL, faculty can begin a different narrative surrounding UDL toward promoting increased communication and proactive teaching enhancement. Expansion of strategic practices that promote UDL guidelines and contribute to the diffusion of innovation within the higher education context is needed. Future UDL training should prioritize specific UDL guidelines that align with quality teaching to minimize the marginal time and resource investment required of faculty.

**References**


Singleton, K. J. (2017). Integrating UDL principles and practices into the online course development process: A delphi study. [Unpublished doctoral


Appendix

Interview Questions

1. How did you become familiar with the UDL principles and guidelines?
2. Please describe the context in which you teach?
3. Please describe your interest and use of Universal Design for Learning within that context.
4. What influenced you to decide to use any of the UDL guidelines?
5. What influenced you to decide NOT to use any of the UDL guidelines?
6. What do you think would influence you or other faculty in deciding to use the UDL guidelines?
7. Have you received feedback on the efforts you have made to implement UDL?
8. Do you have any implementation examples that you would be willing to share with the research team?
9. May we have access to your courses to collect implementation examples, or will you provide the research team with some?
Learning from COVID-19:
Universal Design for Learning Implementation
Prior to and During a Pandemic

Jennifer Renée Kilpatrick, Suzanne Ehrlich, & Michelle Bartlett

This study examined whether higher education faculty knowingly and/or unknowingly applied UDL principles prior to and during the COVID-19 rapid online teaching and learning (ROTL) transition. Researchers collected data through a survey that was disseminated nationwide and completed by higher education faculty (n = 38). Findings included a shift in instruction modality where 50 percent of synchronous in person instruction moved to asynchronous online instruction or optional synchronous remote instruction. Additionally, there was an unsurprising, considerable increase in the use of technology to support student engagement with course content. Researchers identified themes in the barriers (e.g., time, resources, training) to applying UDL principles both prior to and during the COVID-19 ROTL transition. Suggestions for overcoming those barriers are also included.

Introduction

Higher education has gone through many periods of change and transition throughout history with none quite so abrupt as the COVID-19 rapid online teaching and learning (ROTL) transition in March 2020 (Bartlett, 2020). At the time that we are writing this article, our discussions in higher education are focusing on before and during the COVID-19 pandemic because we do not know what after will look like. The world has changed in many ways, from the way we attend events, to the way we shop and dine out, to the way we teach and learn. We will likely never return to the way that life was before COVID-19 (Daniel, 2020). Instead, we will adapt to a new normal. In higher education, we will want to learn from and continue any adaptations or innovations that were beneficial, so that we can continue to improve teaching practice.

Universal Design for Learning (UDL) is a promising approach to instruction with the potential to maximize learning experiences and minimize barriers for all students (Bernacchio & Mullen, 2007; Rose & Mayer, 2008) by using a flexible course design that incorporates UDL principles. Research indicates UDL is effective in responding to the challenges of online teaching and learning (Coombs, 2010; He, 2014; Lancaster, 2011). Knowing this, our research team was interested in determining whether or not higher education faculty were intentionally and/or unintentionally implementing UDL principles in their course design prior to and during COVID-19. We developed and disseminated a survey to explore what higher education faculty were doing nationwide.

This survey study examined the retrospective perspectives of higher education faculty on their implementation of UDL principles in course design both prior to and after the onset of COVID-19 in Spring 2020 and Summer 2020 courses. The purpose of the study was to determine whether faculty were knowingly and/or unknowingly applying UDL principles prior to and during the COVID-19 ROTL transition. In this article, we will share what faculty reported regarding their course design, as well as barriers faced with regard to UDL implementation. The findings provide valuable insights and recommendations that could be applicable in future higher education course design.

It is important to clearly differentiate the type of online teaching and learning that happened during the ROTL transition from online teaching and learning that is intentionally planned (Hodges et al., 2020; Lambert & Schuck, 2020). ROTL vastly differs from well-planned, intentional traditional online teaching and learning. Throughout this manuscript, we will use the term ROTL to differentiate from any intentional remote or online instruction that happened prior to or during the pandemic. Given the limited time and resources to get content online during the ROTL transition, this distinction is especially important (O’Keefe et al., 2020) to the findings and interpretation of this research.

Universal Design for Learning (UDL)

UDL is a framework designed to support learners by reducing barriers and maximizing learning by creating equity, and providing an opportunity for all students to achieve (Black, Weinberg, & Brodwin, 2014). It guides the design of instructional goals, assessments, methods, and materials. UDL guidelines “can be applied to any discipline or domain to ensure that all learners can access and participate in meaningful, challenging learning opportunities” (CAST, 2020). The framework is organized...
according to three principles from CAST (2020): multiple means of engagement, representation, and action and expression. All students, including those with disabilities, can benefit from a course designed with UDL principles because there are less barriers in place (Schelly et al., 2011). While students with disabilities are able to receive accommodations in higher education classrooms, many students do not disclose accommodation needs to the university. According to Dickenson & Gronseth (2020), “UDL involves planning flexibility into curricular design from the outset, recognizing that learners are varied in their learning preferences and capabilities, motivational characteristics, and environmental constraints” (p.1008). This flexibility supports faculty and students in overcoming barriers to teaching and learning through a proactive, rather than reactive, approach. Studies find a positive effect of UDL implementation on both teachers and students with and without disabilities (Davies et al., 2013; Hall et al., 2015; Kumar & Wideman, 2014).

**UDL & Online**

The majority of UDL implementation and research has been done in the context of face-to-face K12 environments. However, with the continued acceleration of online course design in higher-education environments, UDL has recently been seen as valuable in shaping online course design. Quality Matters (QM™), a certifying body of online course design structures, recently added UDL as a measure in their primary evaluation tool (Robinson & Wizer, 2017). While QM has contributed to the spotlight on consideration for UDL in online course design and delivery, not all courses undergo review. Therefore, online courses are not necessarily assessed for the presence of UDL principles. Al-Azawei, Serenelli, and Lundqvist (2016) note while UDL adoption cannot address all the obstacles of online learning, “using multiple means of representation, expression, and engagement can motivate learners to achieve their learning goals more effectively and enjoyably” (p. 52).

When designing and delivering higher education online coursework, there are several considerations that are important. Chertoff and Thompson (2020) created a list of best practices for online instruction. Many of these practices are related to UDL principles and keeping students’ needs at the forefront. While Chertoff and Thompson write with K12 education in mind, three important steps that higher faculty can employ to make sure that student needs are taken into account. First, it is vital for faculty to provide opportunities for students to share their experiences and needs and for instructors to engage in empathetic listening to make sure that students feel understood, heard, and connected (Baran & AlZoubi, 2020). Second, instructors should check in frequently for understanding (O’Shaughnessy, 2020). Finally, faculty should give students ample opportunities to reflect on their learning (Costa & Kallick, 2008). Chertoff and Thompson (2020) also recommend considering motivational design principles and communicating frequently and flexibly, both of which are relevant to higher education teaching and learning.

**UDL and Faculty**

One of the most significant gaps in UDL research is an understanding of the applicability of the framework (Al-Azawei et al., 2016). Instructors from disciplines outside of education and psychology are largely not aware of UDL principles and may not know how to implement the framework in their discipline. While UDL is still relatively new in the higher education setting, Black, Weinberg, and Brodwin (2014) found that familiarity with UDL is not significantly correlated with implementation of UDL principles. In fact, they found that some faculty were implementing UDL principles unknowingly. However, research has identified training, resources, and time as critical factors to the successful implementation of UDL (Fovet et al., 2014; Tobin, 2018). These factors may be helpful in overcoming barriers to UDL implementation.

Faculty experience a number of barriers to UDL integration in designing online teaching and learning (Chapko, 2017). According to Kumar and Wideman (2014), preparing multiple means of representation or grading learner achievement in a UDL-inspired course design requires more time than traditional courses. Therefore, it is not surprising that time (lack thereof) is often a major barrier for faculty consideration of UDL implementation (Green, 2019). Another potential barrier is the lack of UDL training and/or resources. Haynes (2020) found that implementation is more effective when well-documented strategies for implementing UDL in online courses is available indicating a need for faculty to have clear examples for how to implement UDL in their discipline. It is important to note that faculty members cannot be the only catalyst for UDL integration in higher education. Administration and students must also become knowledgeable in understanding the value of and advocating for UDL use in support of learning design (Kramer, 2019).

**UDL & Resistance**

Another gap in the research on UDL is examining whether there is actual resistance to implementation of UDL principles. LaRocco and Wilken (2013) surveyed higher education faculty and found they were at a stage of concern (Hord et al., 2006) that centered on themselves for each of the principles of UDL. In other words, “individuals are most often thinking about how an innovation will affect them personally, and what is required on their part in terms of effort, time commitment, and knowledge and skill development” (p.
9). They concluded that non-users were likely due to a lack of campus-wide initiatives and the limited research on application in postsecondary settings. Fovet (2018) suggests there is resistance and that the resistance is related to technology integration. He asserted “UDL becomes almost mythically feared because teachers assume that a mastery of technology is required before one can use and implement the framework” (p. 8).

Naturally, training in UDL and technology supports implementation of UDL; however, existing structures may not have values embedded to support the mindset and action of UDL implementation across an institution. There needs to be a systematic institutional approach for implementation to be successful. Fovet (2018) found that schools in Canada attempted the following approaches to respond to barriers, including resistance: ecological context mapping, top-down and bottom-up implementation, communities of practice, demystifying the role of technology, focusing on sustainability, and strategic planning.

**Purpose**

While there is an ongoing demand for further research on the implementation of UDL, suddenly now there is an additional need to examine the impact of COVID-19 on implementation of UDL principles. We hypothesized the ROTL (Bartlett, 2020) course delivery impacted the ways in which faculty approached engagement, representation, and action and expression in higher education courses. This study examined these impacts via a retrospective faculty perspective. Faculty, many of whom were not experienced with online teaching, suddenly and unexpectedly encountered a number of new instructional design challenges as they adapted instruction to an online format for the remainder of the Spring 2020 semester and into the Summer 2020 semester.

Although the Centers for Disease Control and Prevention (CDC) publishes recommendations on school preparedness for pandemic flu (CDC, 2017), schools, both K-12 and higher education institutions, were underprepared for the sudden instructional impacts of the COVID-19 pandemic (Bartlett & Warren, 2021). Many higher education institutions have documented plans for the continuity of education during a pandemic. In fact, it is often referenced in course syllabi. While institutions have not faced a pandemic with this level of impact in the last century, they did have opportunities to learn from past pandemics, including the H1N1 pandemic in 2009.

The Center for Infectious Disease Research and Policy (CIDRAP, 2010) published a report on lessons learned from twelve universities during the H1N1 pandemic. The report identifies the lessons learned and actions and challenges ahead. CIDRAP outlines that institutions prepare for flexible modification of attendance policies and provide “distance learning,” and the report emphasizes developing distance learning capabilities in some institutions, including teaching strategies, faculty preparation, and information technology infrastructure. Similar to CIDRAP (2010), we aim to document lessons learned from this pandemic and discuss potential challenges and responses in the future. The purpose of this study was to examine implementation of UDL by higher education faculty, exploring whether knowledge of UDL principles and strategies better prepares faculty to provide instruction and continuity in the event of future pandemics or emergencies.

**Methods**

In this study, we collected data using an open-ended survey and analyzed data using qualitative analysis methods. The survey, developed by the research team, was distributed through various instructional design and higher education networks using listservs and social media to capture a wide-range of participants. The survey, which consists of a total of 14 questions, was designed to gather data on course modalities, application of UDL principles, and perceived barriers to the application of UDL principles through questions regarding pre- and post-COVID-19 instructional practice. In August 2020, participants were asked to reflect on their Spring 2020 and Summer 2020 courses, to consider their instruction prior to and during the COVID-19 ROTL transition, and to answer the questions accordingly. The following primary research questions guided both the development of the survey and the analysis of the data:

1. How did higher education faculty engage students with course content pre- and post-the onset of COVID-19?
2. How did higher education faculty represent course content pre- and post-the onset of COVID-19?
3. How did higher education faculty assess students’ knowledge/understanding of course content pre- and post-the onset of COVID-19?
4. What barriers do higher education faculty report around implementation of UDL principles during course design and development both pre- and post-the onset of COVID-19?

**Instrumentation**

The online survey was designed by the researchers to examine higher education faculty perceptions about UDL prior to and during the COVID-19 pandemic that caused many instructors, who were inexperienced in online teaching and learning, to shift rapidly to teaching in online environments. The online survey, which can be found in the Appendix, consisted of a total of 14 questions organized into seven sections. The first section consisted
of two multiple-choice questions about the course format prior to and during COVID-19. The second section included only 1 question, which asked whether or not faculty used UDL in their courses prior to and during COVID-19. After completing section two, participants were provided with a definition of UDL. In sections three through six, they were asked to respond to nine open-ended questions that were grouped into sections according to the constructs being examined in the four research questions: engagement, representation, action and expression, and barriers. We chose to use an open-ended question design for the questions because of the disadvantages of leading participant responses with a closed question design (Krosnick, 1999). Prior to each of these sets of questions, participants were provided with definitions of the construct being examined in the section. In section seven, participants were asked to respond to two multiple choice demographic information questions to provide the research team with context for their responses.

Data and Participants

Faculty from four-year higher education institutions were invited to participate in the study through purposeful sampling. The survey was administered via Google Forms, and participants were asked to give informed consent prior to beginning the survey and provided with contact information for the researchers. A total of 41 participants began the survey; however, only 38 participants completed all questions in the survey. These 38 participants were used in the analysis. Table 1 provides information regarding the participants’ course modality prior to and during COVID-19 instruction. The survey question allowed for multiple responses by participants to indicate the various formats they taught their courses. As a result, there is overlap in the responses, and the numbers for each modality add up to a total (n = 53; n = 39) that is greater than the total number of participants (n = 38).

Table 1

<table>
<thead>
<tr>
<th>Modality of Instruction</th>
<th>Pre COVID-19</th>
<th>During COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Person</td>
<td>30</td>
<td>N/A</td>
</tr>
<tr>
<td>Online Asynchronous</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>Required Online Synchronous</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Optional Online Synchronous</td>
<td>N/A</td>
<td>15</td>
</tr>
<tr>
<td>Hybrid</td>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Prior to the pandemic a majority (n = 30) of participating faculty taught some or all in-person courses. During the pandemic, a portion of these faculty members (n = 11) transitioned to required attendance synchronous online learning, half (n = 15) transitioned to optional attendance synchronous online learning sessions, and the remaining (n = 4) transitioned to asynchronous online learning. While the majority of participants (n = 27; 71%) indicated that they believed they did apply UDL principles both before and during the pandemic, some participants (n = 5; 13%) indicated that they did not know what UDL was.

Because course-level and course size impact course design, we also asked about these topics to provide context for the participants’ responses to the questions about UDL principles. Participants were asked (see Figure 3) to indicate the level of students they primarily taught (i.e., freshman, sophomore, junior, senior, masters, doctoral, other). Participants were permitted to select more than one response, so there is overlap in the following participant responses: 19 (50%) taught freshmen, 18 (47%) taught sophomores, 16 (42%) taught juniors, 15 (39%) taught seniors, 11 (29%) taught Masters students, 6 (16%) taught doctoral students, and 2 (5%) taught other (e.g., JD, MD) students. See Figure 1.

Figure 1

Level of Course(s) Taught

Participants were also asked about the size of their courses. Again, because participants were able to select more than one response, there is overlap in the responses that follow: 25 (66%) taught courses of 25 students or less, 15 (39%) taught courses of 26-50 students, six (16%) taught courses of 51-100 students, and four (11%) taught courses of over 100 students. See Figure 2.

Figure 2

Average Course Enrollment Size(s)
Data Collection and Ethical Considerations

Data was collected for several weeks at the beginning of the Fall 2020 semester. We used purposive volunteer sampling in order to not limit the data findings by geography, discipline, or institution-type. Higher education faculty teaching in Spring 2020 at any type of four-year institution (e.g., state college, public university, private university) were eligible to participate. Survey recruitment was done via higher education organization listservs as well as relevant social media groups. The recruitment statement contained information regarding the IRB approval, the study, and the research team, along with a link to the survey created on Google Forms. Participants provided informed consent prior to beginning the survey and were not contacted for follow-up. The survey was intentionally designed to take approximately 10-15 minutes to complete, knowing higher education faculty are limited in the time they have to participate in survey research.

Data Analysis

Data was read in its entirety by all three researchers before applying a manual, open, qualitative coding process in Google Sheets. We began with using open coding (Strauss, 1987; Strauss & Corbin, 1990) examining the responses for the set of questions in each section to identify the differences between the pre- and post-COVID-19 responses for each participant. We then used the differences in the participants’ responses to create both descriptive and in-vivo codes (Saldana, 2016). In subsequent rounds of analysis, we identified patterns in the data (Miles & Huberman, 1994) and collapsed similar codes into categories (Lincoln & Guba, 1985). Throughout all rounds of analysis, all three researchers engaged in analysis of the data and met several times to understand varying perspectives, illuminate blind spots, and develop a group consensus (Harry et al., 2005). Triangulation (Patton, 1999) was used to establish credibility and confirmability (Lincoln & Guba, 1985).

Findings

Modality

Upon initial review of the data, responses to survey questions 1 and 2 demonstrated a substantial synchronous-to-asynchronous shift in instructional modality pre-COVID-19 instruction to during COVID-19 instruction. Of the 38 participants, 30 taught face-to-face prior to the pandemic. Of these 30 instructors, 15 moved to a required synchronous online format, 11 moved to an optional synchronous online format, and four moved to an asynchronous online format. Roughly half of the instructors who originally delivered synchronous instruction moved from required weekly synchronous interaction with students to primarily asynchronous interaction with students. This notable shift potentially impacts engagement, representation, and action and expression as a result of COVID-19 (Smith, 2020). Because we did not ask what was required or suggested by participants’ institutions, it is unknown whether these modality decisions were made by institutions, faculty, or a combination of the two.

Engagement

RQ1: How did higher education faculty engage students with course content pre- and post-the onset of COVID-19? Faculty identified various instructional methods for representation of content pre-COVID-19 such as whole group discussion, small group discussion, discussion boards, group activities/projects, practice/demonstration of skills, and presentations. The majority of participants indicated distinct changes in the strategies used to engage students during COVID-19. In examining the changes made in the engagement strategies used by faculty after the onset COVID-19, there was an unsurprising substantial increase in engagement through technology. See Table 2.

Table 2

Methods Used Pre and Post Onset of COVID-19
Prior to COVID-19, participants indicated that discussions took place in whole groups and small groups via face-to-face conversations, discussion boards, and Facebook groups. During COVID-19 there was increased mention of discussion board use. Participants also noted the use of breakout rooms, virtual polling, and chat features to engage students in whole group and small group discussions (Lowenthal et al., 2020). One participant used the chat feature and mentioned less engagement post-COVID-19. Another participant chose to eliminate discussion, but added individual student conferences. While one participant eliminated group activities, most faculty indicated that group activities were still conducted with the support of breakout rooms, wikis, and other digital collaboration tools. Additionally, one participant noted adding group activities post-COVID-19. Although one participant mentioned reducing the scope of group projects, most participants indicated the same level of group projects and skills-based learning, and one faculty member added more “hands-on project-based learning opportunities.” One participant noted that live demonstrations were replaced by virtual demonstrations (i.e., via telepractice).

It is not surprising that the use of technology emerged as a significant change noted from pre-to post-COVID-19, as faculty needed to use technology to accomplish the same types of engagement they used prior to COVID-19 (Johnson et al., 2020). Participants provide insight into how technology tools can be used for engagement purposes. One participant wrote:

I think that the engagement aspect post COVID-19 also required me to have extra flexibility as STUDENTS transitioned. Just because *I* knew about all of this did not mean *they* did and I found that students (across the board for different delivery types) needed a lot of grace in their transition. I had to remember that everyone was learning FROM a different place (both metaphorically and physically) than they may have been accustomed to (just as I was teaching from a different place in the same way). This fluidity of my teaching and acceptance of them made a big difference to the students (based on their feedback and continuation of the course post COVID-19).

The effort of faculty to quickly adapt and incorporate new technologies was noted in their use of Zoom, Team, and other platforms not only to host class sessions, but also to connect with students one-on-one for meetings and debriefings. Technology was a bridge for learning and a means of engaging with students. Without technology the same methods of engagement would not have been possible. While this highlights synchronous connections, asynchronous video also provides an alternative for engagement as highlighted in the study on moving beyond Zoom by Lowenthal et al. (2020).

**Table:**

<table>
<thead>
<tr>
<th>Principle</th>
<th>Methods Reported</th>
<th>Changes during COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>• Whole Group Discussion</td>
<td>• Majority indicated distinct changes</td>
</tr>
<tr>
<td></td>
<td>• Small Group Discussion</td>
<td>• Increased use of technology</td>
</tr>
<tr>
<td></td>
<td>• Discussion Boards</td>
<td>• Increased use of discussion boards</td>
</tr>
<tr>
<td></td>
<td>• Group Activities/Projects</td>
<td>• Use of breakout rooms, virtual polling, wikis, and chat features</td>
</tr>
<tr>
<td></td>
<td>• Practice/Application of Skills</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Presentations</td>
<td></td>
</tr>
<tr>
<td>Representation</td>
<td>• Lecture</td>
<td>• Approximately half indicated changes</td>
</tr>
<tr>
<td></td>
<td>• Discussion</td>
<td>• Methods were eliminated, added, and/or replaced</td>
</tr>
<tr>
<td></td>
<td>• Assigned Readings</td>
<td>• Increased attention to accessibility</td>
</tr>
<tr>
<td></td>
<td>• Videos</td>
<td>• Use of videos, podcasts, video conferencing, and narrated screencasting</td>
</tr>
<tr>
<td></td>
<td>• Slides</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Handouts/Worksheets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Writing on Board</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Interaction/Practice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Attention to accessibility</td>
<td></td>
</tr>
<tr>
<td>Action &amp; Expression</td>
<td>• Quizzes</td>
<td>• Approximately half indicated changes</td>
</tr>
<tr>
<td></td>
<td>• Exams</td>
<td>• Most common change was the elimination or replacement of exams and skills-based assignments</td>
</tr>
<tr>
<td></td>
<td>• Application &amp; Skills-Based Assignments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Written Assignments</td>
<td>• Some added assignments</td>
</tr>
<tr>
<td></td>
<td>• Reflection Assignments</td>
<td>• Some provided of options for assignments/assessments</td>
</tr>
<tr>
<td></td>
<td>• Presentations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Discussion Boards</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Projects (Group &amp; Research)</td>
<td></td>
</tr>
</tbody>
</table>

RQ2: How did higher education faculty represent course content pre- and post-the onset of COVID-19? Faculty identified various instructional methods for representation of content prior to COVID-19 such as lecture, discussion, assigned readings, videos, slides, handouts/worksheets, writing on a board, and interaction. Additionally, attention to accommodations and
accessibility was noted by several participants who taught online pre-COVID-19 (Smith, 2020). For example, faculty used closed captioning, American Sign Language (ASL) translations, and alt-text for images. These additions made their content more accessible for English Language Learners, as well as students who are deaf, hard of hearing, and/or visually impaired. Participants also included some responses to these questions that were related to engagement (i.e., RQ1) both individually and in groups. For example, they noted “exercises to apply the knowledge” and “group work to work on example problems.” See Table 2.

Approximately half of the participants indicated that there was no change in the representation of course content after the onset of COVID-19. Other participants indicated that they had eliminated, added, or replaced representation strategies previously used (Johnson et al., 2020). For example, two participants eliminated discussion. However, two participants added online discussion forums. Participants also added videos, podcasts, video conferencing, and narrated screen-casting. Some participants also indicated attention to accommodations and accessibility. For example, they provided slides and recordings of synchronous lectures. One instructor indicated that labs were replaced by videos, simulations, and animations. This demonstrates the potential for establishing digital resilience in learning from the pivot and what will last beyond this remote and online learning event (Baghat & Kim, 2020).

**Action and Expression**

RQ3: How did higher education faculty assess students’ knowledge/understanding of course content pre- and post-the onset of COVID-19? Participants noted the use of the following primary methods of action and expression in their courses: quizzes, exams, application and skills-based assignments, written assignments, presentations, and reflections. Also mentioned were discussion boards, group projects, research projects, and homework. Discussions did not specifically address whether content was designed and easily transferred to the online space, which could have been a contributing factor in the decision-making process for assessments (Chang & Fang, 2020). See Table 2.

In examining the changes from instruction prior to and during COVID-19, we found that approximately half of the participants did not change their assessment methods. For example, one participant used reflective journals/blog posts, quizzes with unlimited attempts, writing assignments, and lesson activities both prior to and during the pandemic. Another reported reflective journaling, quizzes, exams, skill-based assignments both prior to and during the pandemic. Among the participants who made changes, the change most common was elimination or replacement of exams and skills-based assignments. While many participants chose to move exams online, some eliminated exams. One participant replaced exams with quizzes and open-book assessments. Another participant replaced exams with a skills-based project. Participants were creative in their approach to skills-based assignments. One participant replaced a live practicum with a simulated project. Another participant replaced skills-based assignments with discussion boards.

Some participants added assignments, such as quizzes and self-reflections. Some faculty provided additional choices post-COVID-19. For example, one participant adjusted the assessment format by giving students additional options to demonstrate learning, they wrote “gave students additional options, for example, write a 5-page paper or create a 10-minute video or podcast that discusses the topic and cites sources. The objectives are the same but the delivery can be to their comfort.” Another participant allowed students to do a group/team project, as was originally assigned, or to submit an individual project. In summing up the changes to assessment, one participant wrote, “There was very little change in how I assessed students (it was just a change in how they delivered their knowledge to me).”

**Barriers and Challenges**

RQ4: What barriers do higher education faculty report around implementation of UDL principles during course design and development both pre- and post-the onset of COVID-19? The majority of participants (73%) reported intentionally applying UDL principles both before and during COVID-19; however, in response to survey questions 10 and 11, a majority of participants also listed specific barriers to application of UDL principles both pre-and post-COVID-19, with only five participants reporting no barriers pre-COVID-19 and four participants reporting no barriers post-the onset of COVID-19.

Participants primarily reported a lack of awareness, resources, time, and technology tools as barriers to UDL both before and after the onset of COVID-19. See Figure 3. A total of seven participants indicated unawareness of UDL principles. One participant indicated unawareness mostly. Hadn’t sat down and figured out what it would mean in my courses.” Nine participants indicated lack of supports/preparedness. Some of these participants there was a “lack of examples,” lack of “university guidance,” “lack of familiarity with best practices,” and “lack of awareness on how best to accomplish UDL in a remote teaching/learning environment.”

Insufficient time was the most commonly reported barrier to UDL application both pre-and post-COVID-19. Over half of the participants responded “it’s very time consuming” and “I feel like I’m already stretched too thin by just doing the very, very basics.” One participant
replied “it takes time, preferably free of distraction, to think about additional options and opportunities for students to interact with content and express their learning.” Another indicated “survival; playing too many roles outside of instructor, both personally and professionally (chief tech officer, chief homeschooler, chief cook and cleaner, chief mentor and emotional support for students).”

Technology was another commonly cited barrier to application of UDL, especially post-COVID-19, with almost one third of participants providing responses related to technology availability. One participant specified a “lack of easily accessible resources (OERs) that were available,” while another mentioned a “lack of technology available in F2F classrooms.” Post-COVID-19, many participants mentioned additional technology barriers, including student lack of access to high-speed internet and the limitations of platforms (e.g., Zoom) used by their university. This finding was similar to barriers noted in Bhagat and Kim (2020).

Figure 3

Barriers: Lack of Awareness, Resources, Time, and Technology

Four participants indicated that they (intentionally) did not attempt to implement UDL. Two of these participants reported that the course had already been designed and they did not make any changes. One reported that the course was “already designed for UDL.” However, the other did not explain whether or not the course design applied UDL principles. Additionally, two participants reported lack of desire to implement UDL. One participant wrote, “Never heard of UDL. Sounds like pretty much everything else out there. I have been teaching asynchronously online for 20 years and figured out how to make this work some time ago.” Another replied, “I don’t know of specific barriers, I tend not to like initiatives like this (and I have already forgotten what it is).”

Overcoming Barriers

While a few participants reported that they have not overcome the barriers, the majority of the participants shared strategies that were successful. We found that these strategies could be organized into the following categories: staying determined/committed, asking for support, engaging in professional development, finding technology solutions, and neglecting other responsibilities. Participants focused their responses on overcoming barriers presented during the ROTL. Many shared responses related to staying determined and committed to engagement, representation, and action and expression. They reported creating new materials and redesigning learning experiences. Additionally, using coping skills and setting attainable goals helped keep them focused and moving forward. One participant revealed “I redesigned the course top to bottom about 5 times as I tried one idea after another to get to the goals I wanted.” Another participant mentioned “building up material over time.” As one participant pointed out, they had “no choice but to make things happen.”

While faculty were able to overcome many barriers with commitment and determination, they also sought support from colleagues. Participants reported reaching out to other faculty and collaborating with others to share resources and tips throughout the ROTL. They mentioned asking for help, talking to colleagues, asking friends, finding new materials through connections with colleagues, and collaborating with team members and a learning designer. These findings are similar to Cutri et al.’s (2020) findings that there is a need among faculty to connect with others for empathetic support. One participant stated “the pandemic has brought together faculty in my discipline from all over the US and other countries. We’ve shared a wealth of resources with each other including strategies, assignments, OERs and other phenomenal support.”

In addition to asking for support from colleagues, faculty also engaged in both formal and informal professional development, often learning informally through participation in social networks (Buckley & Nimmon, 2020). Several participants attended training or workshops and one participant reported “I went to several UDL workshops to get a better idea of how to implement it in my courses.” Another revealed “I spent the summer strengthening my hybrid and online teaching knowledge.” Others reported searching the internet or using websites to “find tech workarounds” and increase their instructional skills.

Many participants shared that integration of technology helped them overcome barriers. Instructional technology, such as utilizing more discussion boards, online quizzes, and web conferencing allowed faculty to represent course content, engage students, and assess learning through action and expression. Participants reported specific personal or university offered solutions to overcome barriers. For example, one participant replied “I
purchased some less expensive tech to use over the summer." Another participant reported "we use a streaming service for videos so students don’t have to wait to download videos. Our campuses and centers are open with computer access and WiFi for students."

Even with determination, support, professional development, and technology, time remained a significant barrier. Several participants reported not being able to overcome this barrier. Additionally, many participants discussed having to make sacrifices. One participant wrote "I neglected my research." Another replied "I did more work for the same crappy pay." Several mentioned working longer hours. However, one participant revealed, "I let some stuff go/skipped some assignments." Whether the elimination of content and assignments was due to time or re-evaluation of course objectives, it is clear that there was a substantial change in the course design prior to and during COVID-19 (Johnson et al., 2020).

While participants reported the strategies mentioned to overcome barriers, not all barriers seemed to be surmountable. One participant shared "most barriers were structural and beyond my control. I worked to redesign learning experiences to make the barriers irrelevant. This took time, and the time requirement barrier is insurmountable." Additionally, not all participants were interested in making changes. In reference to overcoming barriers, one participant wrote "I did not. I did not wish to." On the other hand, most participants did respond with strategies they had used to overcome barriers or indicated that they had not yet overcome the barriers, which indicates they are still seeking, or expecting, solutions. One participant replied, "For now, (there are) no real solutions yet." Another participant wrote, "I still need to work on it. Another participant responded, "I have not overcome them yet. (It is a) work in progress."

Discussion

The findings of this study were related to modality, flexibility, time, resources, and technology. These were the primary factors impacting both the implementation of UDL and the barriers to the implementation of UDL.

Modality and Flexibility

While we noted the finding of change in teaching and learning modality, what remains unknown is why more than half of participants who were originally teaching face-to-face chose not to shift to a required synchronous delivery during the pandemic. A shift in instruction modality from synchronous to asynchronous has a number of implications for the types of engagement, representation, and action and expression strategies that can be implemented (Dickinson & Gronseth, 2020). For example, while discussion is possible in both modalities, synchronous and asynchronous discussion (in any format) is qualitatively different. After the onset of COVID-19, there was an increased use of discussion boards among study participants. The type of organic verbal conversation that happens in a face-to-face or synchronous online course is quite different from a written conversation that does not happen in real time. Because we did not ask a question about modality decision making, the reason for this shift remains unknown. It may have been the result of an intentional decision (made by the professor alone or in conjunction with students) or it may have been a recommendation or directive given by the institution.

Another consideration of modality is its relationship to accessibility. Considering accessibility could have impacted the choice to use asynchronous or optional synchronous session delivery for some faculty. At the same time, the modality chosen could have knowingly and/or unknowingly impacted accessibility for some faculty and students (Barton, 2020). There was an increase in attention to accessibility and accommodation during ROTL. This indicates that faculty were more aware of accessibility needs during ROTL and were designing instruction with accessibility in mind. This may be why some research has indicated that online teaching and learning can be more effective for students with disabilities (Hall et al., 2015).

A final consideration of modality is its relationship to flexibility. Half of the participants who were teaching face-to-face prior to the onset of COVID-19 moved to an optional synchronous format allowing students flexibility in attendance. Students were able to attend or not attend sessions according to individual needs. Optional synchronous sessions allowed faculty to communicate flexibly, and perhaps more frequently with students, as recommended by Chertoff and Thompson (2020). Also related to flexibility, some faculty reported providing choices in assessment during ROTL. This suggests that faculty were not only more aware of accessibility needs for students with disabilities, but also the need to be flexible and provide options for all students which can impact motivation, engagement, and outcomes.

Time & Resources

The pandemic instigated changes in workload for both faculty and students (Adedoyin & Soykan, 2020). During ROTL, time was clearly a scarce resource for many, with over half of the participants mentioning it as a barrier to UDL implementation. Time also impacted UDL implementation in other ways. The most common change to assessment was the elimination or replacement of exams and skills-based activities. These changes appear to lighten the load for the students or for faculty during
this unprecedented time. Faculty have had the time or support to transition exams or skills-based activities to an online format. Additionally, they may have been checking in with students to determine their needs and how to best support and assess their learning (Baran & AlZoubi, 2020).

Another factor related to time is value. Tend to devote time to the things that we value. While Black and colleagues (2014) found that familiarity with UDL is not significantly correlated with implementation of UDL principles, indications in our findings reveal UDL implementation was not a priority for those unaware of UDL or unconvinced of the benefits of UDL. These participants did not devote their time to UDL implementation. Instead, they resisted it as similar to a trend rather than a framework for learning, as Fovet (2018) also found.

A few participants noted support and resources offered by the university (e.g., instructional design support, collaboration with peers, etc.) eased the workload required for transitioning to ROTL. Resources mentioned by participants are similar to the approaches that Kovet (2018) reported have been used in K12 settings in Canada. This suggests that faculty at institutions with a support system for implementation from the top-down are better equipped to overcome the barriers to UDL implementation. It also supports the findings that training, resources, and time are critical factors to the successful implementation of UDL (Fovet et al., 2014; Haynes, 2020; Tobin, 2018).

Technology

There was a clear increase in the use of technology in teaching and learning after the onset of COVID-19 (Johnson et al., 2020). This is unsurprising. Because faculty were no longer able to deliver content in person, they were forced to use technology as the vehicle for delivery. Also unsurprising was the finding of a substantial increase in the infusion of technology by the faculty who were teaching face-to-face prior to the onset of COVID-19. These faculty likely had greater demand for creating new course content because courses were not initially designed for the online/remote environment. Of the participants who reported teaching face-to-face prior to the sudden shift to remote teaching and learning, only one participant specifically stated that they used a learning management system (LMS) to supplement the in-person class. While many faculty members were likely using LMS to some extent prior to the pandemic, they did not mention this in their survey responses. This could indicate that they were not using it extensively and taking advantage of all of the features and instead relying on face-to-face opportunities for engagement, representation and action and expression. Therefore, the instructors who were teaching in person prior to COVID-19 made the largest transition in their instructional practices during the ROTL by considering new ways to represent content and engage and assess students.

Despite the increased use of technology, not all experiences with technology during ROTL were positive. Some faculty noted the limited opportunities for engagement with some technologies they used (e.g., YouTube Live) or the limited access to certain technologies among faculty and students. For example, some students and faculty did not have access to high-speed internet and used hotspots or access to computer devices to access courses through cell phones (Bartlett, 2020). Faculty who did not typically teach online may not have had the financial support to have paid accounts for their courses and their students. As with any situation, not all technologies are created equal, nor the opportunities to choose which technologies to use to delivery course content. The limitations of the technology provided by universities may have contributed to the limited delivery options available to faculty. Coupled with limitations of foundational knowledge of online learning pedagogy, access to technology compounds an already challenging scenario in which faculty were not fully prepared to leverage advanced technologies to support learning. These findings add support for the promise of the intentional strategy of demystifying the role of technology and focusing on technology as the tool and not the driver of UDL (Fovet, 2018).

Limitations

The study had several limitations. First, the study included a small sample size. Although it was disseminated through several networks, the response rate was low. It is probable that the low response rates were due to the saturation of surveys regarding COVID-19 practice within higher education at the time of data collection, as well as limited time faculty have to devote to activities outside of main priorities during the pandemic. More participants could have provided more variety in the responses and additional insights into different experiences. Second, the survey itself included a limited number of questions and did not ask about motivations during decision making. Third, the study only captured the experiences of faculty at four-year year institutions because it was not distributed to additional types of academic institutions (e.g., technical colleges, community colleges) in higher education spaces. Finally, this study focused only on faculty perspectives and does not provide insight into student experiences or perceptions of instruction during COVID-19 ROTL.
Implications and Future Directions

When the pandemic is over, higher education teaching and learning need not return to the way things were prior to the pandemic. Our findings indicate that faculty made changes and overcame barriers to UDL implementation. We can learn from this forced opportunity and continue to use technology to increase UDL implementation, expanding the various means of engagement, representation, and action and expression. Given the findings of this study, we offer several suggestions to incorporate UDL into online course design in the future. This section highlights specific examples of what online instruction designed with UDL principles in mind does and does not look like, provides suggestions for overcoming barriers, and includes recommendations for future research.

Non-UDL Vs. UDL Design

Often courses, whether due to unawareness or resistance, are designed in opposition to UDL principles. Rather than creating avenues for student success, non-UDL design presents undue barriers to student learning and decreases access, outcomes, and validity of learning assessments. Table 3 provides examples demonstrating the differences in non-UDL and UDL design. While Table 3 shows a few examples of how to alter existing course design and deliverables to incorporate UDL principles, there are countless ways to do so. UDL can be adapted and modified for various disciplines and relies on the experimentation of faculty members to advance UDL integration across curricula. It may look different depending on the content, context, and modality of the course.

Table 3

Non-UDL vs. UDL Design

Overcoming Barriers

This study suggests while the term UDL is widely known among university professors, significant barriers exist to UDL implementation, including awareness, time, resources, and technology. However, if institutions approach UDL implementation using a top-down approach, provide campus-based services (e.g., training,
instructional design support, implementation examples), and facilitate communities of practice, outcomes will be more successful. Knowing that time is a significant barrier, administration should look for ways to support faculty with instructional designers, graduate assistants, and course load assignments. It will be helpful for institutions to collect information from faculty on what is working in their particular context and amplify success stories. Focus should not be how technology can drive engagement, representation, and action and expression. Instead, faculty should determine which technologies can support types of engagement, representation, and action and expression included in their teaching. Finally, faculty should keep flexibility and accessibility in mind when designing teaching and learning (Dickinson & Gronseth, 2020).

Future Directions

This study leaves several questions to be answered in future research. Because this study examined only faculty experiences and perceptions, a logical next step would be to examine student experiences and perceptions. Within the discussion of instructional modality, we noted that the rationales for choosing specific course delivery options are unknown. There is an opportunity for further research around factors impacting delivery decisions (e.g., institutional requirements, faculty choice, etc.) and how these decisions impact student experiences and outcomes. Additionally, the ways technology hinders or fosters instructional delivery and student success is a topic for future inquiry related to implementation of UDL in higher education courses, including accessibility (or lack thereof) of such technologies. Finally, after COVID-19 instruction, there should be further examination into how current teaching and learning practices during COVID-19 can impact future teaching and learning. As instructional design approaches continue to evolve and faculty continue to employ strategies and technologies used during the pandemic, the implementation of UDL principles post-pandemic need to be explored.

Conclusion

COVID-19 forced a ROTL transition for instructors and learners around the globe in PK12 through higher education institutions. This examination of instructional design in higher education prior to and during COVID-19 provides valuable insights to guide future instructional design. In comparing course design prior to and during COVID-19, changes were noted in all areas of UDL – engagement, representation, and action and expression. Participants also provide insights for overcoming barriers to UDL implementation. The lessons learned from this study of instruction during initial months of COVID-19 potentially inform UDL implementation efforts in higher education currently and after the pandemic.

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Appendix

Universal Design for Learning (UDL) in Higher Education Instruction

Pre- and Post- COVID 19 Instruction Faculty Survey

Course Format

1. Pre-COVID 19 Onset Instruction: What was the primary format of your course? (Select all that apply)
   - Online Asynchronous
   - Online Synchronous
   - Face-to-face
   - Hybrid
   - Other: ___________

2. Post-COVID 19 Onset Instruction: What was the primary format of your courses? (Select all that apply)
1. Required Online/Remote Synchronous
2. Optional Online/Remote Synchronous
3. Online Asynchronous
4. Other: ___________

Application of UDL Principles

3. Do you intentionally use or apply Universal Design for Learning principles in your course design the majority of the time?
4. Yes, only before the onset of COVID-19
5. Yes, before and after the onset of COVID-19
6. Yes, only after the onset of COVID-19
7. No
8. I’m not sure
9. I don’t know what UDL is

Universal Design for Learning

Universal Design for Learning (UDL) is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn. It is an instructional approach that includes considering the diverse needs, strengths, and interests of individuals, as well as the ‘what’, ‘how’, and ‘why’ of learning, during curriculum design (CAST, 2020).

Representation

UDL, the “What” of Learning is referred to as Representation. Representation refers to the means through which instructors present content to be learned. UDL encourages the use of multiple means of representation to present content to students (CAST, 2020).

4. Pre-COVID 19 Onset Instruction: How did you primarily represent the content you teach to students? (e.g., spoken lecture, slides, assigned reading, videos)
5. Post-COVID 19 Onset Instruction: How did you primarily represent the content you teach to students? (e.g., spoken lecture, slides, assigned reading, videos)

Engagement

In UDL, the “Why” of Learning is referred to as Engagement. Engagement refers to the means through which students engage with the content. UDL uses multiple means of engagement to stimulate interest and motivation for learning (CAST, 2020).

6. Pre-COVID 19 Onset Instruction: How did you primarily engage students in learning the content of your course? (e.g., whole-class discussion, discussion boards, small group activities, practice of skills)
7. Post-COVID 19 Onset Instruction: How did you primarily engage students in learning the content of your course? (e.g., whole-class discussion, discussion boards, small group activities, practice of skills)

Action/Expression

In UDL, the “How” of Learning is referred to as Action/Expression. Action/Expression refers to the ways in which students are assessed. UDL uses multiple means of action/expression to differentiate the ways that students can express what they know (CAST, 2020).

8. Pre-COVID 19 Onset Instruction: How did you primarily assess students’ knowledge or understanding of the content of your course? (e.g., reflective journaling, quizzes, exams, skill-based assignments)
9. Post-COVID 19 Onset Instruction: How did you primarily assess students’ knowledge or understanding of the content of your course? (e.g., reflective journaling, quizzes, exams, skill-based assignments)

Barriers

This section inquires about the perceived challenges faced in implementation of UDL principles during course design and development both pre and post COVID-19.

10. Pre-COVID 19 Onset Instruction: What barriers did you encounter with attempting to apply UDL principles to course development? (e.g., unaware of UDL principles, the course was already designed, time required to provide multiple means, type of technology available)
11. Post-COVID 19 Onset Instruction: What barriers did you encounter with attempting to apply UDL principles to course development? (e.g., unaware of UDL principles, the course was already designed, time required to provide multiple means, type of technology available)
12. Post-COVID 19 Onset Instruction: How did you overcome the barriers you mentioned in question 11?

Course Information

Consider the majority of the courses you taught in Spring 2020 when answering the following questions.

13. What level students do you primarily teach? (Select all that apply)
1. freshmen
2. sophomores
3. juniors
4. seniors
5. masters level
6. doctoral student
7. other (i.e., JD, MD)

14. What is the average enrollment in the courses you teach? (select all that apply)
   1. Less than 25 students
   2. 25 - 50 students
   3. 51 -100 students
   4. more than 100 students
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