Walking the UDL Walk

Designing an Online Course About UDL

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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/expression. 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
Multiple Means of Engagement	• Course modules consistently organized (7) • Syllabus and Online Expectations Letter outlining requirements and expectations (7; 9). • 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) • Instructor available via email, FAQ blog, and synchronous virtual hours (7) • Self-monitoring checklist to check off the completed work in each module (8) • All major assignments broken into manageable chunks with flexible deadlines (8) • Mastery-oriented text/video feedback from the instructor and peers enabling revisions (8) • Choice to complete some activities individually or in small groups (8) • Discussions both class-wide and small groups organized by learners' areas of interest (8) • Optional readings and UDL videos allowing to choose relevant materials (8) • Video/text-based overview highlighting objectives and actions in each module (9) • Rubrics, outlines, and exemplars of projects, frequent reminders (9) • Making connections between content and personal experiences in reflections (9) • Ungraded self-assessments encouraging students to apply the UDL planning process (9)
Multiple Means of Representation	• All course materials accessible (1) • Course readings offered in both printable and digital formats (when possible; 1) • Each module lecture offered in four different formats: narrated video, regular PowerPoint for note taking, audio MP3, and transcript of the narration (1) • Free text-to-speech tools demonstrated and explored to access course materials (2) • Captioned interviews with experts providing different perspectives (2) • Infographics used to introduce key terms for the module (2; 3) • 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) • Optional websites, podcasts, and videos allowing students to personalize their learning (3)
Multiple Means of Action/Expression	• Activities and discussions submitted in traditional (text) and alternative formats (video, interactive presentation, infographic, Padlet, graphic organizer, etc.; 4; 5) • Instructor-created wiki sharing an abundance of tools organized by UDL principles (4) • Students choosing to explore and apply those or other tools in their activities (5) • Executive functions supported through semi-weekly announcements and strategically placed "Stop & Think" reflection questions embedded in the modules (6) • Self-monitoring checklists helping students stay on track (6)

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

Occupation: All Participants (n = 132)	
General education teachers	46.2%
Language arts	14.8%
Math	11.5%
Science	4.9%
Social studies	18%
Language/ESL	6.6%
Specials (music, art, PE)	14.8%
All subjects in elementary grades	29.5%
Special education teachers	20.5%
Other educators (AT specialists, SLPs, OTs, principals, librarians, behavior technicians, adult services)	26.5%
Full-time students	6.8%
Grade Levels: In-service Educators (excluding full-time students; n = 123)	
Elementary	25.2%
Middle	24.4%
High	15.4%
Mixed (secondary middle/high; K-12; K-8, 3-8, etc.)	18.7%
Other (related services, adult services, higher education)	16.3%

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 formats 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 examples, 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

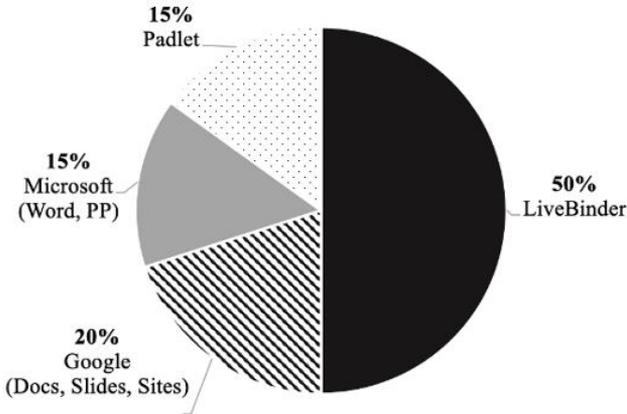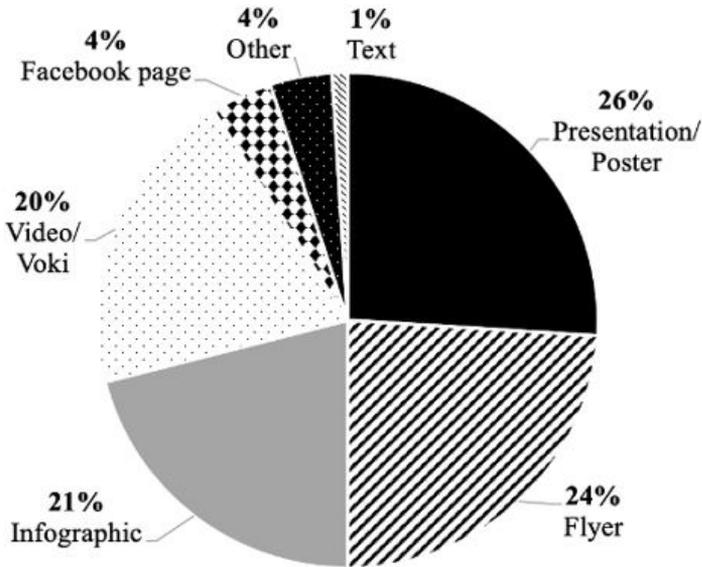UDL Resource Notebook Assignment Completed in Different Formats

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

UDL Guidelines	Percentage of Students
UDL Guideline 1. Provide options for perception	**97%**
UDL Guideline 2. Provide options for language & symbols	74.2%
UDL Guideline 3. Provide options for comprehension	94.7%
UDL Guideline 4. Provide options of physical action	67.4%
UDL Guideline 5. Provide options for expression & communication	98.5%
UDL Guideline 6. Provide options for executive functions	90.2%
UDL Guideline 7. Provide options for recruiting interests	96.2%
UDL Guideline 8. Provide options for sustaining effort & persistence	88.6%
UDL Guideline 9. Provide options for self-regulation	74.2%

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

Provide Multiple Means of Engagement	Provide Multiple Means of Representation	Provide Multiple Means of Action/Expression
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 set up 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 reflect on 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

Final Questionnaire Responses Organized by UDL Principles

Multiple Means of Engagement	
Q4: The expectations of activities and assignments were clearly stated.	**4.88 (.35)**
Q13: The feedback from the instructor was helpful and sufficient.	4.85 (.51)
Q16: Instructor actions/course activities (e.g., reflection blogs) reinforced the development of a sense of community among course participants.	4.05 (.87)
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/expression, 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 guidelines1 (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 of 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 in-service 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 final questionnaire:

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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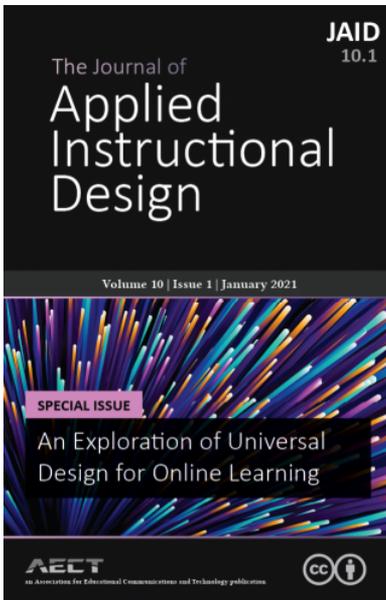
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