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## A Scoping Review of Universal Design for Learning in United States Allied Health & Medical Education

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# A Scoping Review of Universal Design for Learning in United States Allied Health & Medical Education

## Abstract

*Background:* Universal design for learning (UDL) is considered best-practice for embracing inclusion for students with disabilities and there is growing evidence of its effectiveness in primary, secondary, and postsecondary education. However, little is known about if and how UDL is being implemented into United States graduate allied health and medical school curriculum as well as evidence of its benefits.

*Method:* We used Arksey and O'Malley's (2005) methodological framework. Search engines were: PubMed, CINAHL Complete, ERIC, GoogleScholar, and Scopus. Data were analyzed by the research team using Covidence to organize articles, screen, and complete a full-text review. Data extraction was completed by identifying key themes in the manuscripts and categorizing articles accordingly.

*Results:* Six studies were eligible: three intervention and three descriptive articles. Findings identify a need for UDL in these programs but research regarding the effect of implementation of this framework into medical and allied health programs is lacking.

*Conclusion:* There is a scarcity of research on UDL in graduate education from the United States. Much of the literature found on use of UDL in medical and allied health graduate level programs is non-experimental or descriptive. Future research is recommended to examine the impact of UDL in graduate education.

## Comments

The authors declare that they have no competing financial, professional, or personal interest that might have influenced the performance or presentation of the work described in this manuscript.

## Keywords

occupational therapy, universal design for learning, education, graduate students

## Cover Page Footnote

The authors would like to thank Patricia Chavez for their assistance in providing resources for data organization.

## Credentials Display

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A recent report suggests that between the years 2008 and 2016, the percentage of college students in the United States self-identifying as having a disability almost doubled. It is now at 19%, with postbaccalaureate data signifying these are low identification statistics (National Center for Education Statistics, 2022). In fact, according to the National Longitudinal Transition Study-2 (NLTS2), 72% of postsecondary students who were identified by their secondary school and who self-identified as having a disability chose not to disclose this information to their postsecondary institution (Newman et al., 2011). The statistics are even more disparate when examining medical schools, where fewer than 1% of students identify as having a disability (Zazove et al., 2016). In postsecondary and graduate school settings, including occupational therapy programs, students must self-identify to request accommodations. The literature suggests that allied health and medical students who identify as having a disability often choose not to request formal accommodations because of the stigma it creates (Kendall, 2016). Disability-related stigmas can lead to internalized oppression (Watermeyer & Görgens, 2014) or the belief among students that they are not fit to become health care practitioners (Kendall, 2016).

Although the Americans with Disabilities Act (1990) was a landmark civil rights legislation intent on removing barriers to participation for people with disabilities, it only provided minimum guidelines on how to make environments accessible across communities, including the academic setting. However, guidelines do exist in the framework of universal design for learning (UDL) on methods to proactively create and deliver curricula in accessible and usable ways to support all learners (Balta et al., 2020). There is a substantial amount of evidence describing the implementation of UDL as a means to increase access for all students with or without formal accommodations in elementary (Gauvreau et al., 2019) and high school (King-Sears & Johnson, 2020), as well as a growing body of literature on the effectiveness of UDL in undergraduate postsecondary programs (Davies et al., 2013; Kennette & Wilson, 2019). There is also a small but increasing body of research on the acceptability of UDL by faculty and students and its utility for supporting student learning needs at the undergraduate level (Davies et al., 2013; Kennette & Wilson, 2019).

The Center for Applied Special Technology (CAST) designed the UDL framework based on universal design (UD) in architecture to consider the diverse needs of all users (Rose & Meyer, 2002). UDL is informed by cognitive neuroscience research that focuses on methods to engage multiple cognitive processes to create the “optimal environment for learning” (Balta et al., 2020, p. 72). The UDL framework can guide educators to proactively incorporate multiple methods of learning and assessment that accommodate and support all users versus implementing accommodations for an individual student.

Allied health, including occupational therapy and medical schools, often lack the necessary accommodations that students with visible and non-visible disabilities require (Wells & Kommers, 2020). Despite the rising prevalence of disability rates in allied health and medical school programs (Meeks et al., 2019), there is a dearth of research showing the implementation and effects of UDL in these programs. Taken together, the increased presence of students with disabilities in allied health and medical schools and the lack of knowledge of UDL in these academic settings suggest a timely need to conduct a review of the literature to identify the gaps in knowledge on the implementation, acceptance, and effectiveness of UDL in these settings. Occupational therapy academic programs could use this information to incorporate those components of UDL found to be effective into their programs to support all students’ learning experiences. Therefore, this study aimed to identify research on UDL in allied health and medical education to understand better (a) how UDL is applied, (b) what outcomes are used to assess its utility and

effectiveness, (c) the most common perceived barriers to implementing UDL, and (d) recommendations for future UDL research in allied health and medical school settings, building on earlier preliminary findings reported from this project (Gawron et al., 2022).

### **Disability in Higher Education**

Meeks et al. (2019) surveyed 87 accredited allied health and medical schools through a web-based method to look at the number of students with disabilities, types of disabilities, and forms of accommodation they received. Sixty-four schools responded with data on the prevalence of students with disabilities from 2016 and 2019, showing an increase from 2.6% in 2016 to 4.9% in 2019. The most common disabilities include psychological, attention-deficit/hyperactivity, and chronic health conditions, with an increase of students reporting psychological (20.4% in 2016 to 32.3% in 2019) and chronic health disabilities (13.3% in 2016 to 18.0% in 2019). Of these students, 93.3% reported receiving accommodations for their disability (Meeks et al., 2019). However, this study does not include information on the satisfaction level of these students with their accommodations. Wells and Kommers (2020) conducted a study examining the transition of students with disabilities from undergraduate to graduate schools, specifically in STEM, legal, and health fields. They note that medical schools do not always provide adequate accommodations for students with disabilities because of their strict technical standards, which some view as outdated and restrictive (Wells & Kommers, 2020). Technical standards in allied health sciences and medical school programs have historically required students to demonstrate motor functions, intellectual abilities, and capacities of observation, communication, and analysis (Ouellette, 2013). These technical standards often create significant barriers to requests for reasonable accommodation from students with disabilities (Zazove et al., 2016). Moreover, research on student satisfaction with accommodation finds mixed perceptions depending on accommodation needs and the context of the task (McKee et al., 2016). Limited satisfaction with accommodations may be because of the failure to achieve the original intent of the ADA, which was that services be as integrated as possible into the context of academia.

### **UDL**

UD is a concept that involves creating spaces, products, and ideas that are accessed, understood, and usable by all populations (Jones, 2014). UD aims to build environments that consider the varied abilities of all users to the greatest extent possible and inherently minimize or eliminate the need for individualized accommodations (Steinfeld & Maisel, 2012). There are seven guiding principles of UD: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use.

These same seven UD principles have been applied to educational environments to create the UDL framework (Elder & Gumus, 2013; Rose & Meyer, 2002). UDL embodies traditional UD with additional importance placed on multiple means of representation, action and expression, and engagement (Kennette & Wilson, 2019). In classroom and curriculum planning, students are presented with information through multiple mediums for visual, auditory, and tactile learning. These strategies can support students of all abilities, and when the UDL framework is included in the design of classroom environments, diverse learning needs are addressed and all learners are given the opportunity to learn in various ways. Allowing multiple means of action and expression gives students freedom in how they demonstrate comprehension involving more than traditional learning. Multiple means of engagement offer students autonomy in their

learning and curriculum requirements. This is especially important since the call by the disability community for more inclusive classrooms is all too prevalent (Love et al., 2019).

UDL has been shown to increase engagement and improve academic and social outcomes for students in classrooms from Pre-K to Grade 12 (Crevecoeur et al., 2014). Systematic reviews of the literature on postsecondary education found a small body of research identifying the benefits of different features of UDL (Schreffler et al., 2019; Seok et al., 2018). One study described using UDL in online university courses (Houston, 2018) specifically to optimize student-instructor engagement. One review of UDL in postsecondary settings critically examines literature that used UDL as an intervention to support students with disabilities or as a framework to challenge notions of normalcy in educational programming (Fornauf & Erickson, 2020). The findings from Fornauf and Erickson (2020) suggest many educators see it both as an intervention and a framework, but they argue for its value as a framework to disrupt the discourse of normalcy in postsecondary education and urge the need for further research. Another review (Roberts et al., 2011) of the literature on postsecondary education suggests UDL's benefits but importantly identifies the current nascent literature base to justify its effectiveness as a means to improve student experiences and academic performance.

### **Why a Scoping Review**

Despite systematic and scoping reviews of UDL in Pre-K, secondary, and postsecondary education, no review of the literature appears to exist examining UDL in allied health and medical school education. However, one systematic review of the literature explored UDL use in anatomy courses for allied health care students (Dempsey et al., 2021). This review highlighted the critical need for much more research on UDL's best practice recommendations as well as outcomes. Arksey and O'Malley (2005) define and give a standard framework for performing scoping reviews and note that the main strength of scoping reviews is their ability to be thorough and transparent in the research mapping process, allowing researchers and other professionals to use the data effectively. These authors point out that the main purpose of a scoping review is to highlight gaps in the research. Scoping reviews also clarify and define terminology, indicate key concepts or factors, and examine the methods of research studies. As there is a growing presence of students with disabilities in allied health and medical education, a review of literature on UDL is needed. Therefore, the current study will use a scoping review to investigate the implementation of UDL in medical and allied health graduate school programs.

### **Method**

We used the Arksey and O'Malley (2005) methodological framework for this scoping review. This framework is composed of a 5-step process that ensures that the scoping review is thorough, robust, and transparent. The five steps are as follows: (a) identify the research question; (b) identify relevant research; (c) select studies; (d) chart the data; and (e) collate, summarize, and report the results (Arksey & O'Malley, 2005).

#### **Stage 1: Identify the Research Question**

Our study aimed to identify gaps in the research on UDL in graduate-level allied health and medical education settings that might then be used to inform future researchers of the necessity for further evidence of the benefits of UDL implementation. This study's research questions are:

1. How, what, and where are UDL principles being implemented into graduate allied health and medical school education?

2. What outcomes related to UDL implementation in graduate-level allied health and medical programs are being used to determine its effectiveness?
3. What are the barriers to implementing UDL in higher education?
4. What types of recommendations based on UDL principles were provided?

### **Stage 2: Identify the Relevant Research**

To answer these questions, a thorough literature search was conducted using the following search engines: PubMed, CINAHL Complete, ERIC, Google Scholar, and Scopus. Boolean search terms were used to combine the topics of interest. Search terms included the following: (“universal design” OR “UDL”) AND (“medical school” OR “medical schools” OR “graduate medical education” OR “graduate nursing education” OR “allied health education” OR “allied health school”). We also used Arksey and O’Malley’s (2005) technique, which describes the use of reference lists during the search for relevant studies. This involves finding promising studies and then checking the list of sources that those studies include in their reference list to expand potential studies to be included.

### **Stage 3: Study Selection**

Inclusion criteria for this scoping review focused on (a) studies published in the past 20 years; (b) UDL principles, design, or implementation is the primary focus of the article; (c) medical and allied health education programs; and (d) 3/3 research team members must agree on inclusion. Qualitative and quantitative research as well as non-research descriptive studies were eligible for inclusion. The original search of the literature returned 73 journal articles. Studies were excluded from our review if they were: (a) conducted outside of the United States, (b) undergraduate-level education, (c) non-medical or non-allied health graduate programs, and (d) non-peer-reviewed articles or dissertations. All studies that fit our inclusion criteria based on the title and abstract were then uploaded into a data extraction software called Covidence, a web platform that consolidates data entry and processing for literature review research (Covidence Systematic Review Software, 2022). Articles were screened based on their title and abstract by all research team members. Based on that screening, articles were either designated for further analysis or considered irrelevant based on the exclusion criteria. Seventy-three studies initially seemed to fit the inclusion criteria and were imported for initial screening and 11 duplicates were removed leaving 62 studies for screening of abstracts. The sixty-two articles were divided equally between the three research team members and were subsequently reviewed. Following abstract screening, 39 studies were deemed irrelevant leaving 23 studies for full-text review. These 23 remaining studies were again divided equally, with two out of three researchers reaching agreement on the article's inclusion. Following full-text review, 17 studies were excluded leaving six studies that fit our inclusion criteria and were included in this paper. Covidence creates a PRISMA diagram that explains the process, which is provided below (see Figure 1).

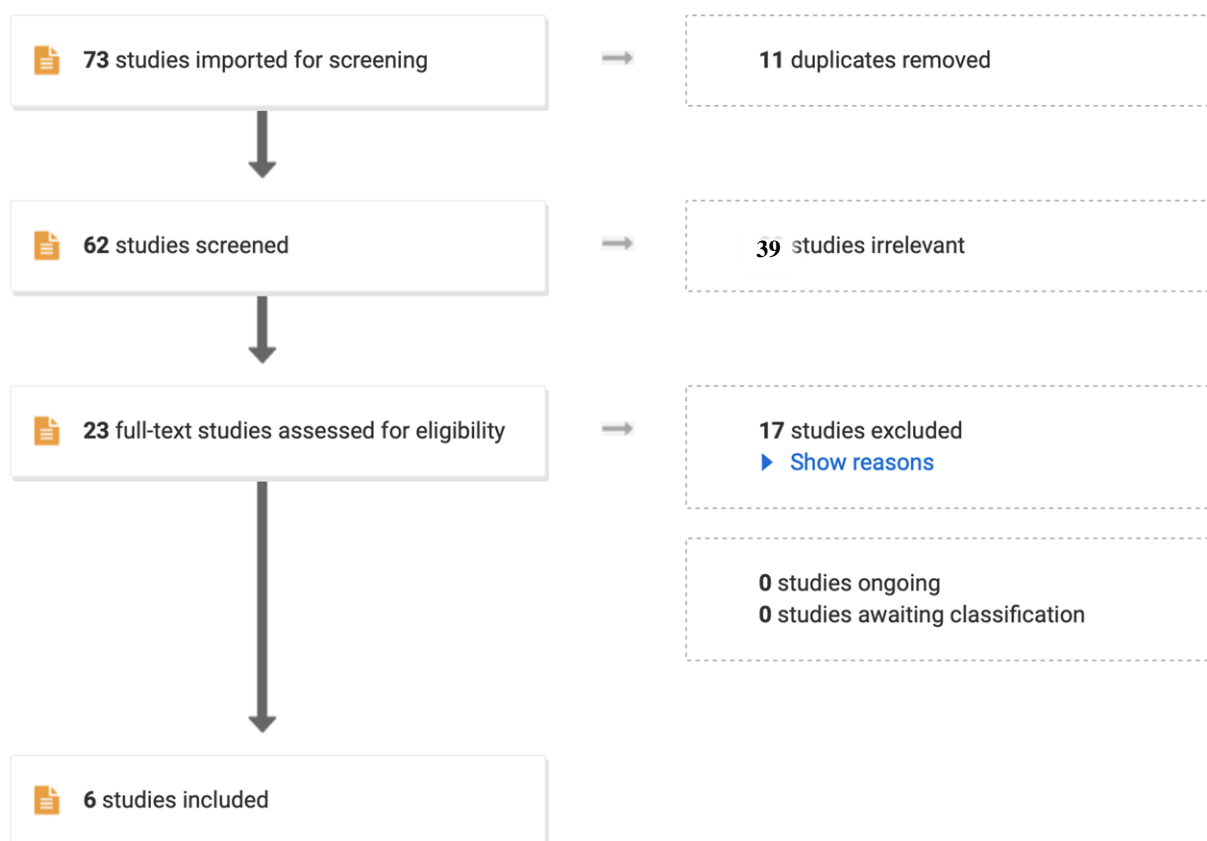
### **Stage 4: Charting the Data**

Once the six articles were chosen to be included, data were extracted (see Table 1 and Table 2) and entered into Covidence, with at least two research team members assigned to review each article. This method of collecting, reviewing, and analyzing studies is in line with the framework described by Arksey and O’Malley (2005). In Covidence, we created two unique templates that allowed us to categorize articles based on specific domains of interest that were noticed among the final articles and would be included in scoping review results (see Table 1 and Table 2). A research meeting was conducted with three out of three researchers in agreement to achieve consensus on distinguishing article characteristic: intervention articles describing implementation of methods of UDL into a curriculum, or a descriptive article with

recommendations on concepts of UDL use in allied health and medical education. This resulted in three articles identified as intervention and three articles descriptive. Among the intervention articles, data extracted included: academic program type, participants, study design and measures used, type of UDL methods implemented, and any noted outcomes (see Table 1). Of the descriptive articles, data extracted included: academic program type, UDL principles described, type of recommendations, and recommendation examples (see Table 2). Descriptive articles were included in this scoping review as they provided helpful suggestions for future research and it was unanimously agreed on by the research team during abstract screening that these contribute to the growing body of research to support UDL. The knowledge from both categories of intervention and descriptive manuscripts could also provide information for use by occupational therapy academic programming.

### Figure 1

#### *Process of Study Selection*



**Table 1***Summary of Intervention Articles*

Citation	Program Type	Participants	Study type & Method used	Examples of UDL Implementations	Outcomes
Anderson, Davis, D., & McLaughlin, M. K. (2019). Implementing Universal Design instruction in Doctor of Nursing Practice education. <i>Nurse Educator</i> , 44(5), 245–249. <a href="https://doi.org/10.1097/NNE.00000000000000642">https://doi.org/10.1097/NNE.00000000000000642</a>	Doctor of Nursing Practice	The Doctor of Nursing Practice (DNP) at Georgetown University, School of Nursing and Health studies, has an average class size of 12 students. They incorporate UDL into three doctoral hybrid courses: Translational Research, Communication and Collaboration in Healthcare Systems, and Organizational Theory and Behavior	<u>Type:</u> Non-experimental Case Study  <u>Method:</u> Precourse assessments, assessment of student choices, and collection of anecdotal feedback.	Changes were implemented in three classes. They used: - Precourse self-assessments to gauge preferred learning styles and familiarity with course objectives - Several options for assignments (writing a paper vs. making a video) - Different formats for content (textbook with read/watch/listen options, videos, recorded lectures, and more) - Along with other UDL implementations	Faculty received positive feedback, with 73% of students choosing a creative format as opposed to a traditional paper in assignments. Moreover, qualitative feedback from students was positive across the three courses where UDL was used.
Meeks, L. M., Jain, N. R., & Herzer, K. R. (2016). Universal Design: Supporting students with Color Vision Deficiency (CVD) in medical education. <i>Journal of Postsecondary Education and Disability</i> , 29(3), 303–309.	Medical School	A United States medical school (name not mentioned) enrolled six students with CVD who reported difficulty during their first year	<u>Type:</u> Non-experimental Case Study  <u>Method:</u> Faculty's report on implementing UDL-informed interventions; student report's on increased access of learning materials.	Implementations for students with Color Vision Deficiency (CVD) in a medical school consisted of: - Visual-based interventions including black instead of red text on PowerPoints and black and white images next to colored ones - Distributed "Recommended Strategies for Addressing CVD in Medical Education" handout with statement encouraging disclosure of CVD and screenings, which were provided via Student Health - Provided education with practical tips for managing CVD in a classroom setting	Students with CVD reported they could access and easily understand traditionally color-dependent class information
Simmons, Willkomm, T., & Behling, K. T. (2010). Professional power through education: Universal course design initiatives in occupational therapy curriculum. <i>Occupational Therapy in Health Care</i> , 24(1), 86–96. <a href="https://doi.org/10.3109/07380570903428664">https://doi.org/10.3109/07380570903428664</a>	Occupational Therapy	128 occupational therapy graduate university students. The students were split into two cohorts. Cohort 1 (n = 64) took the course in 2006 and Cohort 2 (n = 64) took the course in 2007	<u>Type:</u> Experimental Cohort Design	The experimental cohort design contrasted two occupational therapy cohorts: - One had a traditional learning environment, using PowerPoint lecture, text reading, and a hands-on lab manual - The other had videos/text demonstrations, kinesthetic learning, role-playing, student presentations, mini workshops, guest speakers, and traditional instructor lecture	- The differences were not significant for the Exam 1 (t = .860, p = .355); however, they were for Exam 2 (t = 7.01, p = .000) and Exam 3 (t = 3.88, p = .000) with Cohort B receiving higher test scores - Cohort B also expressed a satisfaction score of 4.0 to 4.8 (1 being the lowest, 5 being the highest) with the UDL implementation



**Table 2***Summary of Descriptive Articles*

Citation	Program Type	Principles	Article type	Recommendation Examples
Dickinson, K. J., & Gronseth, S. L. (2020). Application of Universal Design for learning (UDL) principles to surgical education during the COVID-19 pandemic. <i>Journal of Surgical Education</i> , 77(5), 1008–1012. <a href="https://doi.org/10.1016/j.jsurg.2020.06.005">https://doi.org/10.1016/j.jsurg.2020.06.005</a>	Medical Education-Surgical Education	Multiple means of engagement Multiple means of representation Multiple means of action and expression	Perspective on Use of UDL principles in virtual learning	-Self-assessments and faculty assessments of simulated tasks using home-recorded video tools in a virtual classroom design -Developing a variety of information formats (including text, visuals, audio, and video). Live closed-captioning available for synchronous tools, such as Microsoft Teams -Synchronous and asynchronous discussion sessions that can be text-based using learning management systems (Blackboard and Canvas), video-based via Flipgrid, Zoom, or Microsoft Teams, and collaborative mind mapping. Using pictures and recordings in lectures to incorporate meaningful connections
Kannan, J. & Kurup, V. (2012). Blended learning in anesthesia education: current state and future model. <i>Current Opinion in Anesthesiology</i> , 25(6), 692–698. <a href="https://doi.org/10.1097/A.CO.0b013e32835a1c2a">https://doi.org/10.1097/A.CO.0b013e32835a1c2a</a>	Medical Education-Anesthesiology Education	Multiple means of engagement Multiple means of representation Multiple means of action and expression	Review of types of UDL principles for use in blended learning experiences	-Online quizzes and student-led teaching sessions -Didactic face-to-face session, case-based discussions, hands-on workshops, electronic access to documents, videos, and articles -Having students help plan didactic teaching sessions, incorporating game technology for learning, such as jeopardy, and discussion forums
Murphy, Panczykowski, H., Fleury, L., & Sudano, B. (2020). Implementation of Universal Design for learning in occupational therapy education. <i>Occupational Therapy in Health Care</i> , 34(4), 291–306. <a href="https://doi.org/10.1080/07380577.2020.1780663">https://doi.org/10.1080/07380577.2020.1780663</a>	Occupational Therapy	Multiple means of engagement Multiple means of representation Multiple means of action and expression	Exploratory survey of educator use of UDL	-Displaying enthusiasm for course content, providing examples and application of information, providing feedback to learners, explicit statement of learning objectives, use of grading systems, case-based learning, and use of incentives and games -Class discussions, lab experiences, images, lecture, small group discovery, use of journal articles, and audio representation -In-class discussions, projects, practicums, and test

## Results

Of the six articles included in this study, all were published within the last 10 years, despite the search including articles from the past 20 years. This suggests a small but growing interest in the discussion surrounding UDL principles in allied health and medical school education. Only one article identified a specific disability of interest, which was color vision deficiency (CVD) (Meeks et al., 2016), and just one article focused solely on the need for virtual UDL changes (Dickinson & Gronseth, 2020). Three articles were from medical education, two were from occupational therapy, and one was from nursing.

### Implementation of UDL Principles

To answer the research question “How, what, and where are UDL principles being implemented into allied health and medical school education?” we identified only three studies describe the implementation of UDL interventions in allied health and medical school curriculums. Of these, only

Simmons et al. (2010) used a research design (experimental cohort) to determine the impact of UDL on students. The other two intervention articles, Anderson and McLaughlin (2019) and Meeks et al. (2016), reported on the implementation of UDL in academic programs as case study (Anderson & McLaughlin, 2019; Meeks et al., 2016) reports.

The experimental cohort design study conducted by Simmons and colleagues (2010) focused on the effect of providing multiple methods of learning by contrasting two occupational therapy cohorts: (a) one that had a more traditional learning environment, using PowerPoint lectures, text reading, and a hands-on lab manual and (b) one with another cohort that had videos and text demonstrations online, kinesthetic learning where students practiced movements, role-playing, student presentations, mini workshops, guest speakers, and traditional instructor lectures. The students' grades were then compared among three different exams throughout the semester (Simmons et al., 2010).

Anderson and McLaughlin (2019) similarly provided multiple options for learning class information. This case study report implemented curriculum changes in three hybrid classes for a Doctor of Nursing Practice program, including giving choices for assignments (writing a paper vs. making a video) and using different formats and options for content (textbook with read, watch, or listen options; videos; recorded lectures; and podcasts for synchronous and asynchronous content). They also used a precourse self-assessment completed by the students to identify familiarity with the class objectives using a Likert scale along with a free response questionnaire regarding learning strategies to further understand students' needs. The following year's class filled out a self-assessment on their preference of course objectives and learning styles using a Likert scale. These were then considered when teaching the class. Faculty were also instructed to be more tolerant of errors during a project and to prompt open communication with and between students. They kept class sizes small with circular seating to encourage discussion and provided thorough, straightforward syllabi, rubrics, and descriptions of assignments.

The case study report conducted by Meeks et al. (2016) reported on interventions specifically for six students with CVD in a medical school. Meeks et al. (2016) distributed a "Recommended Strategies for Addressing CVD in Medical Education" handout with a statement in the student handbook encouraging disclosure of CVD and screenings, which they provided via student health services. Students were also taught practical tips for managing CVD in a classroom setting. Core faculty partnered with Disability Services staff to develop interventions to weave into courses using UDL principles to remove barriers in the curriculum and testing. Key UDL principles were implemented into the program to attend to the needs of students with CVD. As a result, most examples provided in the article were visual based, including switching laser pointers from red to green, using black instead of red text on PowerPoints to denote important concepts, and using black and white images next to colored ones.

### **Outcomes Being Used**

The second research question of this scoping review was: "What outcomes related to UDL implementation in higher-level allied health and medical programs are being used to determine its effectiveness?" In terms of the outcomes, all three intervention studies describing implementing UDL principles reported that students favored the curriculum changes. Anderson and McLaughlin's (2019) case study noted that faculty received enthusiastic feedback about the course flexibility, with 73% of students choosing a creative format (video, podcast, etc.) as opposed to a traditional paper when given the choice. Meeks and colleagues' (2016) case study report similarly found that students with CVD confirmed they could access and easily understand traditionally color-dependent class information. Furthermore, faculty

reported that implementing UDL changes was uncomplicated, noting little to no impact on their preparation time for lectures or exams (Meeks et al., 2016).

Of the six articles, Simmons et al. (2010) was the single study to use an experimental design that resulted in identifying several significant outcomes. These researchers found that satisfaction regarding UDL implementation from Cohort B (the cohort with additional learning methods) was rated between 4.0 and 4.8 (1 being the lowest and 5 being the highest possible rating), signifying they were generally happy with the changes. These students also tended to do better academically than Cohort A on exam scores. These researchers conducted an independent t-test to compare the two cohorts' three exam scores. The differences were not significant ( $t = .860$ ,  $p = .355$ ) for the first exam. However, there was a significant difference in scores for the last two exams. The second exam found that scores were significantly different ( $t = 7.01$ ,  $p = .000$ ), with Cohort B demonstrating higher scores. Exam 3 had similar results as Exam 2. The difference was significant ( $t = 3.88$ ,  $p = .000$ ), with Cohort B once again receiving higher test scores. Overall, Cohort B, with the UDL implementation, did significantly better for the final two exams than Cohort A and had higher satisfaction ratings from students. Simmons et al. (2010) noted that the students may have needed a few weeks to adapt to the changes and use the extra resources to account for Exam 1 results. In terms of faculty opinion about UDL changes, only one study by Meeks et al. (2016) examined this. The study found that faculty reported the changes were easy to implement and carry into the future.

### **Barriers to Implementing UDL**

The third research question was: "What are the barriers to implementing UDL in higher education?" Of the three intervention articles that implemented UDL, two articles described a various barriers to implementation. Simmons et al. (2010) acknowledged time as a barrier to UDL implementation in medical and allied health programs citing the time required for faculty to seek out and attend UDL training, the time it would take to initially integrate principles into coursework, and the limited time to cover the curriculum with UDL approaches. Anderson and McLaughlin (2019) also described barriers to UDL implementation that suggest the students may need time to adapt to the new learning environment and may feel overwhelmed with the variety and quantity of material.

### **UDL Recommendations**

To answer this study's final question: "What types of recommendations based on UDL principles were provided?" we examined literature from both intervention and descriptive articles. Three articles supported the core principles of UDL, which include providing multiple means of engagement, representation, and action and expression. Each article provided recommendations for UDL without actual implementation of these into coursework. Descriptive articles by Dickinson and Gronseth (2020), Kannan and Kurup (2012), and Murphy et al. (2020) provide specific examples to promote the use of the UDL framework and core principles to support graduate-level allied health and medical students. Recommendations were also provided by the intervention studies; however, these were more targeted based on the needs of the student community.

Study suggestions that related to the first core principle of UDL, providing multiple means of engagement, included the use of self-assessments and faculty assessments of simulated tasks using home-recorded video tools in a virtual classroom design (Dickinson & Gronseth, 2020), providing online access to quizzes and student-led teaching sessions (Kannan & Kurup, 2012), faculty displaying enthusiasm, examples and application of information, case-based learning, self-assessments, explicit statements to outline learning objectives, use of grading systems, use of incentives and games, and providing feedback

to the learner (Murphy et al., 2020). Intervention findings provided by Anderson et al. (2019) explained that when attempting to keep learners interested and engaged in the content, faculty should first assess new cohorts' learning preferences, learners' baseline knowledge, and skills for a course before the beginning of a semester. Anderson et al. (2019) further explained that this precourse self-assessment allows faculty to identify individual and group learning needs based on the course objectives, so that time and attention are dedicated to the appropriate objectives using applicable UDL strategies.

The second core UDL principle recommends providing multiple means of representation, which Murphy et al. (2020) described could be achieved through class discussions, lab experiences, and images, as well as lecture, small group discovery, and use of journal articles. Two studies recommended providing a variety of information formats, including text, visuals, audio, and video to support multiple means of representation (Dickinson & Gronseth, 2020; Murphy et al., 2020). Dickinson and Gronseth (2020) suggested that live closed-captioning be available during synchronous learning. Kannan and Kurup (2012) provide recommendations to support multiple means of representation in anesthesiology education by promoting students' retention of concepts through self-regulation by incorporating didactic face-to-face sessions, case-based discussions, hands-on opportunities for learning, workshop videos, and electronic access to documents. Based on implementation findings to support students with multiple, flexible methods of presentation, Simmons et al. (2010) suggested that students would benefit from being offered PowerPoint lectures, guest speakers, kinesthetic learning in class, videos, role-playing, and traditional lecture format.

Recommendations for the third core UDL concept, providing multiple means of action and expression, include in-class discussions, projects, practicum experiences, and tests (Murphy et al., 2020). Dickinson and Gronseth (2020) recommend synchronous and asynchronous discussion sessions that are text-based using learning management systems (e.g., Blackboard and Canvas) while also incorporating video-based elements using Flipgrid, Zoom, or Microsoft Teams. Collaborative mind-mapping group exercises can also promote multiple means of action and expression (Dickinson and Gronseth, 2020). Inquiry-based learning through engaged questioning; having students help plan didactic teaching sessions; incorporating game technology for learning, such as Jeopardy; and discussion forums would support the third core UDL principle for implementation (Kannan & Kurup, 2012). Furthermore, researchers (Meeks et al., 2016) recommended that instructors uphold this principle by optimizing access to tools and assistive technologies. Meeks et al. (2016) explain that medical students with CVD benefit from faculty providing resources to obtain and use colored overlays, specialized glasses (e.g., Enchroma), color-converting software programs (e.g., the Daltonizing algorithm), and alternative color staining (not red or green).

### **Discussion**

UDL is a philosophical and practical approach that aims to create fully inclusive spaces of learning that proactively ensure that the needs of diverse learners are the standard of practice across an institution. Faculty and university professionals are using UDL to shift from reactively accommodating students to proactively implementing inclusive strategies to support all learning needs. Despite evidence that UDL is effective in supporting students in primary and secondary schools, there is a lack of evidence demonstrating implementation in higher education settings, especially at the graduate level. One purpose of this scoping review was to better understand the gap in literature focused on UDL implementation in allied health and medical programs in the United States. The decision to exclude studies from outside of the United States was made based on different educational structures between countries (Burkhardt et al.,

2010; von Zweck et al., 2023) as well as differences in philosophic, cultural, and legal approaches to accessibility and accommodations in education (Johnstone & Edwards, 2020). A scarcity of research exists on the topic of UDL implementation in allied health and medical programs in the United States, as exhibited by review findings: only six studies identified explored this topic, three of which included intervention articles and three of which included descriptive articles providing recommendations for implementation.

The literature that does exist is primarily descriptive in nature. These studies have shown positive rates of student and faculty satisfaction anecdotally or through surveys in response to incorporating UDL. These reports identify that UDL usage helped increase student learning access, while faculty reported that curriculum changes were easy to implement and carry into the future (Anderson et al., 2019; Meeks et al., 2016). The only experimental study exploring the use of UDL in allied health and medical studies conducted by Simmons et al. (2010) found that the group of students that engaged in adapted UDL-based coursework were more satisfied and received significantly higher exam scores in two of three exams in comparison to their peers that engaged in the traditional learning environment. Results from Simmons et al. (2010) demonstrated similar findings to those that have found UDL an effective tool in promoting learning in elementary and high school settings (Gauvreau et al., 2019; King-Sears & Johnson, 2020).

The simplest and most common forms of UDL in allied health and medical programs include allowing students to learn course content through a variety of formats, including text, visuals, audio, video, and hands-on labs (Anderson et al., 2019; Simmons et al., 2010). These teaching strategies mimic those that have also been shown to support diverse learning needs in undergraduate-level studies. Dean et al. (2016) demonstrated how, given the opportunity to engage with a variety of instructional tools (PowerPoint, lecture notes, clickers, and textbooks in printed, electronic, or audio form through the program MindTap), students perceived each instructional tool as being effective in helping them learn. Similarly, Rao et al. (2015) suggested that undergraduate educators teaching online courses consider replacement of information provided from books with various other sources of information, providing audio versions of articles, creating narrated presentations, using web-based instructional modules, providing text transcripts for audio and video files, and closed-captioning for videos. These studies directly demonstrate how common instructional tools and methods upholding the UDL framework can be easily translated into undergraduate studies as well as allied health and medical programs.

Although many educators and students have expressed the value of UDL implementation to support diverse learning needs, there continues to be barriers to UDL implementation in higher-level education. One barrier to UDL implementation in medical and allied health programs is limited time in the busy schedules of educators to receive training on the UDL framework. Spencer (2005), as cited by Simmons et al. (2010), states that educators' lack of experience in understanding the fundamental principles of creating an accessible curriculum and instructional designs prevents professors from delivering course content in such a way that adequately supports all learning needs. UDL training can be beneficial in promoting educator understanding of this framework; however, evidenced-based articles, such as this scoping review, can also serve as an opportunity for faculty to understand and gain recommendations to create an accessible learning environment through a UDL framework lens. It should be noted that when considering UDL use in the graduate-level setting, educators should refrain from feeling the need to implement this framework in an all-or-nothing methodology. Incremental and flexible changes can be easily made to curriculums over time (Meeks et al., 2016). Changes as small as faculty

displaying enthusiasm for course content can be in support of the UDL framework (Murphy et al., 2020).

A second identified barrier limiting UDL implementation in higher-level education settings includes potential student challenges of adjustment in having a variety of means of engagement, which can lead to a student being overwhelmed with the variety and quantity of content material while feeling the need to review all material provided (Anderson & McLaughlin, 2019). One way to combat this barrier is for faculty to clarify the UDL framework's core goals to help students understand why their professors are choosing to provide multiple means of engagement (Anderson & McLaughlin, 2019). This clarification would help students recognize and feel that their unique learning styles are being supported in the given curriculum.

Based on this scoping review's findings, it is clear that UDL is not part of the mainstream in the United States allied health and medical academic setting, including occupational therapy. This may be partly because of a lack of knowledge or the hesitancy of academic administrators and faculty to examine this framework. For the students to benefit, educators must first realize the capability of UDL and receive training on implementing UDL features. In a study exploring the effectiveness of UDL application in college-level education, Davies et al. (2013) identified that professors who had received 5 hr of UDL training could effectively increase the use of these strategies. As recommended by Love et al. (2019), educators must first acknowledge that use of UDL will not change the core structure of one's class; educational topics and the material covered will maintain the same integrity. Once a professor has recognized the potential of UDL, they can then obtain adequate training to support their students in their learning endeavors (Davies et al., 2013). In addition, UDL has been found to increase collaboration between both instructors and students, creating a "community of learners," which has implications for the socioemotional development of students (Elder & Gamus, 2013). Furthermore, research done on the perceptions of UDL principles in a college course shows that both students and professors found these techniques useful to their learning (Kennette & Wilson, 2019).

### **Limitations and Conclusion**

This review had some limitations that should be highlighted when interpreting the results. For example, the inclusion criterion required articles to be chosen from the United States, as graduate allied health and medical school curriculums, access and accommodation standards, and learning styles could vary by country, limiting the generalizability of the results beyond the United States. Excluding studies from outside the United States reduced the number of articles examined to only six, limiting the amount of data that was gathered. In addition, inclusion criteria limited articles published in the past 20 years, as these would hold the most relevant results with regard to present-day curricula. Another limitation is that grey literature and articles such as dissertations were excluded, and as UDL is such an innovative and emerging approach in education, this literature could be of value. Despite these limitations, the findings can support efforts to develop and implement UDL in graduate-level allied health and medical education.

Of the articles included in this review, two were from occupational therapy. One of these was an experimental study that concentrated on the impact of UDL implementation in a graduate-level occupational therapy program (Simmons et al., 2010). These results demonstrate that UDL's instructional method appears to be a beneficial process for producing some of the key goals delineated in the AOTA Vision 2025. The AOTA Vision for 2025 aims to guide the profession of occupational therapy in further maximizing "health, well-being, and quality of life for all people, populations, and communities through effective solutions that facilitate participation in everyday living" (AOTA, 2017, p. 1). Therefore, UDL

framework implementation should continue to be promoted to maximize the learning capacity of students attending similar professional programs.

The U.S. Department of Health and Human Services recommends that to reduce health disparities, allied health and medical schools should focus on attending to the demographic makeup of providers in the health care workforce. However, despite these efforts, these programs continue to largely exclude students with disabilities because of the many technical standards for admission and completion of these programs (Brown et al., 2021; Meeks et al., 2018; McKee et al., 2016). Accommodations do not support the full inclusion of students with different learning needs; however, the UDL framework does. This study highlights the benefits of UDL usage as a method to support diversity, equity, and inclusion of students with disabilities in allied health and medical schools.

Much more research is needed on the use, utility, and impact of UDL for higher education, including allied health and medical academic programming. Future researchers should consider exploring feasibility and acceptability studies from the perspectives of administrators, faculty, and students. Additional future research could include pilot implementation studies to determine how best to examine UDL's impact and, alternatively, randomized controlled studies to determine the individual as well as community impacts of UDL implementation.

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