Implementing Universal Design for Learning (UDL) in Online Courses: Perspectives of Faculty and Students at Prince Sattam bin Abdulaziz University

Amani Abaullah BinJwair[1,*] & Wafaa Ayedh Al-Harthy[1]

[1]Prince Sattam University, Saudi Arabia

*Correspondence: Prince Sattam University, Saudi Arabia

Received: April 29, 2023 Accepted: September 11, 2023 Online Published: November 2, 2023

doi:10.5430/jct.v12n6p143 URL: https://doi.org/10.5430/jct.v12n6p143

Abstract

This study investigates the extent to which universal design for learning (UDL) principles have been used in online courses according to the opinions of professors and students at Prince Sattam bin Abdulaziz University. Using a descriptive approach, the researchers created two questionnaires, one for faculty members and one for students. Each questionnaire contained 36 items on the main principles of UDL: multiple means of representation, multiple means of performance and expression, and multiple means of motivation and participation. The sample consisted of 75 male and femal faculty members and 112 students, who were selected randomly. The results suggested that online courses helped faculty achieve some UDL principles and raise awareness about those principles. There was also high agreement between faculty and students about the positive impact of distance learning, which reportedly increased students' exposure to many UDL elements, such as offering more means of communication and interaction. In addition, students reported high levels of participation in classes implementing UDL principles.

Keywords: universal design for learning, participation, university, online course, distance learning, higher education

1. Introduction

Education is witnessing a shift toward practices derived from scientific research for curriculum and instructional design (Al-Salem, 2016, p. 114). In this context, growing diversity in students' personal, cognitive, linguistic, and cultural backgrounds and motives poses a major challenge for university instructors. To ensure all students have opportunities to learn in a high-quality environment, this study asserts that educators need to develop an understanding of individual differences among students—including their strengths and weaknesses as well as those of the curriculum itself—taking into account learner-curriculum interaction. Therefore, educators should seek flexibility from the beginning of curriculum design to avoid barriers and find solutions that meet the diverse educational needs of learners. A potential solution is employing online learning and universal design for learning (UDL) principles.

UDL is a proactive, evidence-based paradigm for designing learning environments that embrace learner diversity (Meyer et al., 2014). It is founded on the notion that student variability is predictable and that systematic curricular modifications should be based on that predictability (Lohmann et al., 2018). The goal of UDL is to enable flexibility in curriculum and teaching techniques across media, providing equal opportunities for learners and removing obstacles.

The UDL curriculum is characterized by providing multiple concepts for what students learn, tools for expression and performing how they learn, and ways to engage learners in "why" they learn. UDL is also based on the premise that education can be accessible to a wide range of learners when lessons are intentionally designed to include multiple means of accessing and absorbing information, thus facilitating information processing and storage.

The COVID-19 pandemic led to replacing in-person education with online learning. The flexibility offered by online learning has increased educational access and supported a variety of student needs (Dickinson & Gronseth, 2020). This flexibility in time, pace, and location aligns with the UDL approach by providing different ways to present content, engage students, and express learning (Meyer et al., 2014).

Numerous studies have reported a significant improvement in the smoothness of the education process and teacher performance(e.g., Al-Salem, 2016; Craig et al., 2019; Katz, 2015; Lohmann et al., 2018; Meyer et al., 2014; Owiny et al., 2019; Scott et al., 2019; Trust & Pektas, 2018), and help students feeling more in control of their own learning process and to make personal choices to support their own learning after implementing UDL (Kumar & Wideman, 2014). The pandemic has thus shown the importance of exploring the extent to which UDL principles are applied in online courses based on faculty and student perspectives.

1.1 Problem Statement

The Saudi national reform project Vision 2030 seeks to build an education system that helps students meet the needs of the labor market (Vision 2030, 2016). The rapid changes brought on by these reforms combined with the pandemic have put a strain on the Saudi education system, calling for more creative ways of dealing with crises.

According to Jiménez et al. (2007), UDL can make curriculum more accessible regardless of ability, learning preferences, language, or culture. Al-Azawei et al. (2017) recommended institutions blend learning theories, especially UDL principles, with e-learning design to respond to learner needs and preferences. Lohmann et al. (2018) examined the effect of such a design on student participation in online special education teacher-preparation courses. Participatory strategies in UDL helped students improve their connections with teachers, colleagues, and courses.

Previous studies have indicated that properly applying UDL in all aspects of learning may benefit a wide range of learners, including those with special needs (Meyer et al., 2014) or from diverse cultural backgrounds (Firchow, 2016). UDL also provides educators with easy-to-use principles to rethink how to engage with a diverse group of learners (Fovet, 2021). In one study, for instance, students showed improved engagement during a semester, independent of UDL training (Davies et al., 2013). Thus, the relationships between teachers and students that develop during a semester are important for increasing learner participation. In another study, students with and without a disability perceived a positive impact on their learning when teachers followed UDL principles in the classroom (Black et al., 2015).

UDL has gained momentum from research supporting its principles in the classroom, but largely in general education (Chambers & Coffey, 2019; Coyne et al., 2017; Gronseth & Hutchins, 2020; Marino et al., 2014), with research more limited in higher education (Fornauf & Erickson, 2020), despite previous studies (e.g., Schelly et al., 2011) recommending more research on its benefits in after graduate education. Mayer et al. (2014) emphasized the need for further studies on UDL and a strong research base to ensure its continued spread. Kennette and Wilson (2019a) likewise pointed out the lack of studies on student opinions about UDL and their awareness of it in online courses. In response, the current study has sought to identify the extent to which faculty and students apply these principles in their distance learning at a major university in Saudi Arabia.

1.2 Research Questions

The study had one main research question: To what extent are UDL principles applied in online courses according to faculty members and students at Prince Sattam bin Abdulaziz University? The following sub-questions emerged from this question:

1) According to faculty members, to what extent do they apply UDL principles in online courses?
2) According to students, to what extent do faculty apply UDL principles in online courses?
3) Are there significant differences between student and faculty perceptions of the application of UDL principles?
4) Are there significant differences in faculty members' perceived application of UDL principles based on their gender, experience, educational level, or number of training courses?

1.3 Objectives

To answer the research questions, this study had the following objectives:

1) To explore the extent to which faculty members feel they apply UDL principles in online courses at Prince Sattam bin Abdulaziz University.
2) To explore the extent to which students feel that faculty members apply UDL principles.
3) To reveal any significant differences between student and faculty views of the application of UDL principles.
4) To reveal any significant differences in faculty members' perceived application of UDL principles due to faculty demographic variables.

1.4 Significance of the Study

This study is significant in the following ways:

1) Keeping pace with modern educational trends that call for UDL.
2) Responding to educators' calls to keep pace with modern technology.
3) Directing the attention of faculty to UDL in teaching.
4) Providing a scale to assess student and faculty knowledge of UDL.
5) Opening the way for more researchers to conduct UDL studies in different educational stages.
6) Addressing the lack of research surveying students' opinions about the extent to which UDL principles are applied in online courses, their awareness of those principles in their courses (Kennette & Wilson, 2019a), or the perceptions of faculty.

1.5 Limitations

Objective limits: The study was limited to evaluating the perceived level of faculty members' application of UDL principles in online courses at Prince Sattam bin Abdulaziz University.

Spatial limits: The study was limited to the College of Education at Prince Sattam bin Abdulaziz University.

Human borders: Participants were limited to Prince Sattam bin Abdulaziz University students and faculty members.

Time limits: The study was implemented during the second semester of the 2020-2021 (1442 AH) academic year.

2. Theoretical Background

2.1 Principles of UDL

Learners differ in their abilities, aptitudes, and tendencies, and education should take into account these differences. UDL has its roots in architecture, as architects use similar principles to design new buildings and spaces in a way that allows people of all abilities to move easily (Dinmore, 2014). Education adopted this concept to emphasize the need to use multimedia to make the components of the curriculum free of barriers to teaching or learning. UDL accounts for differing needs and thereby offers better support (Meyer et al., 2014). This improves learning outcomes for all students by ensuring access to meaningful approaches and an accurate assessment of skills and knowledge.

Previous studies have found that when UDL is properly applied to all aspects of learning, it can benefit all learners, not just those with special needs (e.g., CAST, 2011; Courey et al., 2013; Meyer et al., 2014). Another reason to reduce obstacles for students is because students might not ask for help when they need it to avoid feeling embarrassed in front of their colleagues and teachers (Kennette & Wilson, 2019b).

UDL considers the needs of diverse individuals from the outset of curriculum design. CAST (2011), an educational research and development organization in the U.S., stated that these principles contrast with traditional approaches that give the learner fewer opportunities to present themselves, participate, or express themselves in different ways. The principles of UDL are summarized below.

The first principle is providing multiple means of representation, which means giving teachers different ways to present content (Meyer et al., 2014). Different students might prefer receiving information from writing, audio recordings, visual material, or by working through a problem. This principle is related to the cognitive networks of the brain that collect information (i.e., how people learn).

The second principle is providing multiple means of expression, allowing students to express what they have learned in different ways (Meyer et al., 2014). Students differ in how they demonstrate mastery of course content; some might prefer writing an essay, answering multiple-choice questions, or applying their knowledge in a concrete problem. This principle is related to the strategies people use to express what they learn.

The third principle is providing multiple means of motivation and engagement, aiming to encourage students to learn by sensing their diverse interests and needs (Meyer et al., 2014). For example, providing students with meaningful instruction and assessment helps engage them in a task because its importance is clearly linked to their goals. Students become more engaged when they feel more secure in the learning space, with reduced distractions leading to sharper focus. This principle is related to the interests and priorities that affect how learners engage in the educational process and the methods that motivate them to learn (i.e., why they learn).

UDL curricula do not focus solely on the learner's mastery of knowledge and skills but also aim for a mastery of

learning itself (Dinmore, 2014). To that end, this framework presents a set of guiding principles for integrating flexible options in curricula and pedagogy under three presentation areas: representation, expression, and participation. It also includes nine principles to guide 31 points of articulation, which detail how the teacher builds flexible pathways in the lesson (Hall et al., 2012).

This study adopted the following definition of UDL:

> a scientifically valid framework for guiding educational practice that provides flexibility in the ways information is presented, in ways students respond or demonstrate knowledge and skills, and in the ways students are engaged. It also reduces barriers in instruction, provides appropriate accommodations, and supports, challenges, and maintains high achievement expectations for all students. (National Center for UDL, 2013)

Online courses are courses offered entirely through the Internet, in this case, via the Blackboard learning platform, where students can access content and activities synchronously or asynchronously anytime and anywhere.

2.2 UDL in Online Courses

UDL focuses on using digital technology and the Internet in the curriculum because of their flexibility. Eftring et al. (2021) studied the benefits and challenges of applying this approach to online learning. An important advantage was that all digital materials could be presented and made accessible to everyone, while a key challenge was the difficulty of involving all learners in online activities and discussions.

Adopting UDL principles in online course design helps clearly represent information, allows students to demonstrate their learning in multiple ways, and increases participation (Davis & Hynes, 2017). Therefore, such considerations should be at the forefront when universities design their online programs, beyond their commitment to accessibility for all learners (Betts et al., 2013). To this end, adopting UDL as part of an institution's culture of support services, course design, and teaching practices allows all learners to benefit, regardless of their abilities (Tobin, 2021). Through online learning, material can be converted into formats that best match individual needs. For example, learners with a hearing impairment can have subtitled videos, while those with a visual impairment can benefit from larger text, text in Braille, and text-to-speech software. In addition, students with poor comprehension can have reinforcement and prompts embedded in the text.

2.3 Previous Studies

Kennette and Wilson (2019a) surveyed how Canadian College of Ontario faculty and students perceived UDL in e-classrooms. The sample consisted of 11 faculty members in general arts and sciences and 17 students majoring in inclusive design for learning. Most elements were found to be beneficial to individual learning, and students considered communication with faculty in and outside the classroom essential to their success. Despite the importance of field trips and participation in selecting course content, these elements have not been implemented in most courses in the Canadian College of Ontario. The current study sought to build on these findings by using a larger sample.

Westine et al. (2019) identified how familiar 150 University of North Carolina faculty were with the principles of UDL, the extent to which the principles were used, and faculty interest in learning more about them. The sample had taught at least one course online; 71.7% were familiar with at least one guiding UDL principle, and 28% were not aware of any. The most common aspects were understanding, expression, and communication, while the least common were effort, perseverance, language, and support. The current study differed from this study by focusing on the extent to which UDL principles were practiced in online learning according to faculty as well as students.

Alquraini and Rao (2018) measured how well special education teachers in Saudi schools understood UDL and their willingness to use it in the classroom. They also identified teachers' perceived need for UDL. A sample of 131 teachers showed a need for professional development, technology and other materials, and additional planning time. The most prominent challenges were the large number of students per class and the lack of clear but flexible policies appropriate to UDL.

Similarly, An-Nasban (2018) measured how much education teachers in primary schools in Riyadh, Saudi Arabia, understood UDL and its perceived importance in teaching social skills. The sample of 140 male and female teachers had some familiarity with UDL principles and largely agreed on its importance. However, women and participants who received training were significantly more likely to consider UDL important.

Al-Salem (2016) sought to use UDL to increase the effectiveness of teachers who had students with hearing impairment in Riyadh. The sample contained 269 male and female teachers. Participants had sufficient familiarity

with UDL, and their interest in it increased after training.

Previous studies have examined the extent to which participants knew about UDL, how much they were interested in knowing more about it, and their willingness to use it. Researchers have also designed training courses based on the needs of the sample. The current study differed from others in this regard by looking at the impact of demographic variables on the perceived application of UDL principles.

3. Methodology

This descriptive study employed questionnaires to collect feedback from participants on how well UDL concepts were used in their online courses.

3.1 Population and Sample

The population consisted of all male and female faculty members and female students at Prince Sattam bin Abdulaziz University in Al-Kharj city, Saudi Arabia. A random sample of each of these groups was drawn from the College of Education. The sample only included women because educational institutions are segregated by gender in Saudi Arabia, making it harder to test both genders.

3.2 Instrument

The first questionnaire determined the extent to which faculty at Prince Sattam University applied UDL principles. It was designed after reviewing previous studies (e.g., Kennette & Wilson, 2019a). The second questionnaire determined the extent to which students thought that faculty applied UDL principles. The first section of each questionnaire solicited demographic information (gender, experience, educational level, and number of training courses), and the second examined the three main aspects of the UDL:

1) Providing multiple means of representation (11 items).
2) Providing multiple means of connection (17 items).
3) Providing multiple means of expression (seven items).

Items were rated on a 5-point Likert scale: 5 = "always" (100%), 4 = "often" (75%), 3 = "sometimes" (50%), 2 = "rarely" (25%), and 1 = "never" (0%). The length of the Likert-scale categories was calculated by subtracting the upper from the lower bound (5 – 1 = 4). The result was divided by the largest value in the scale (4 ÷ 5 = 0.80), and this value was added to the lowest value in the scale (i.e., 1). This process is illustrated in Table 1.

Table 1. Classification of the Likert Scale (limits of average responses).

N	Category	Category limits	
		From	To
1	Always	4.21	5.00
2	Often	3.41	4.20
3	Sometimes	2.61	3.40
4	Rarely	1.81	3.60
5	Never	1.00	1.80

3.3 Instrument Validity

The validity of the scale was verified by submitting the questionnaires to a group of arbitrators with expertise in curriculum, teaching methods, measurement, and evaluation. They assessed the clarity, consistency, and formulation of the items and their suitability to measure what they were intended to measure. Necessary changes were made based on their observations, resulting in two 35-item questionnaires.

3.4 Internal Consistency

To verify the internal consistency of the questionnaires, Pearson's correlation coefficient showed the degree of correlation of each item with the total score of the axis. Tables 2–4 show that each item had a significant positive correlation to its axis, indicating internal consistency and suitability.

Table 2. Correlation of the First-Aspect Items with the Total Score of the UDL Prinsiples

Item	Correlation coefficient	Item	Correlation coefficient
1	0.827**	6	0.781**
2	0.882**	7	0.758**
3	0.608**	8	0.872**
4	0.796**	9	0.877**
5	0.808**	10	0.876**
6	0.781**	11	0.735**

Table 3. Correlation of the Second-Aspect Items with the Total Score of the UDL Prinsiples

Item	Correlation coefficient	Item	Correlation coefficient
1	0.821**	10	0.909**
2	0.841**	11	0.659**
3	0.825**	12	0.755**
4	0.759**	13	0.886**
5	0.922**	14	0.747**
6	0.863**	15	0.646**
7	0.766**	16	0.867**
8	0.749**	17	0.563**
9	0.651**		

Table 4. Correlation of the Third-Aspect Items with the Total Score of the UDL Prinsiples

Item	Correlation coefficient
1	0.605**
2	0.843**
3	0.735**
4	0.812**
5	0.749**
6	0.732**

3.5 Instrument Stability

Instrument stability was confirmed using Cronbach's alpha (see Table 5).

Table 5. Cronbach's Alpha for Instrument Stability

Axis	Number of items	Axis stability
Multiple means of representation	11	0.941
Multiple means of connection	17	0.957
Multiple means of expression	7	0.873
General stability	35	0.974

A high general stability coefficient (0.974) indicated the instrument had a high degree of stability and could be relied on in the field application of the study.

3.6 Statistical Processing

Statistics included frequency, percentage, mean, weighted mean, standard deviation, independent-samples *t*-test, and one-way analysis of variance (ANOVA).

4. Results

4.1 Sub-Question 1

Sub-Question 1 asked, "According to faculty members, to what extent do they apply UDL principles in online courses?" To answer this question, the means of the axes were calculated, as shown in Table 6.

Table 6. Responses on How Much Faculty Applied UDL Principles.

N	Axis	SMA	*SD*	Rank
1	Multiple means of representation	3.47	0.807	3
2	Multiple means of connection	4.14	0.478	1
3	Multiple means of expression	3.90	0.702	2
Axes as a whole		3.88	0.568	

Participants agreed to a moderate degree that faculty applied UDL (M = 3.88 out of 5), and providing multiple means of connection (M = 4.14) ranked first, followed by multiple means of expression (M = 3.90) and representation (M = 3.47).

Table 7 shows how much faculty reportedly provided multiple means of representation.

Table 7. Responses on How Much Faculty Provided Multiple Means of Representation

N	Item		Degree of approval					SMA	*SD*	Rank
			Always (100%)	Often (75%)	Sometimes (50%)	Rarely (25%)	Never (0%)			
6	I provide clear guidelines for the main tasks in my e-courses	*N*	52	13	6	4	-	4.51	0.860	1
		%	69.4	17.3	8.0	5.3	-			
3	I publish worksheets to students via the Blackboard system (available digitally)	*N*	41	16	14	3	1	4.24	0.984	2
		%	54.7	21.3	18.7	4.0	1.3			
2	I present in the course a number of electronic references (e.g., articles, books)	*N*	34	24	8	7	2	4.08	1.088	3
		%	45.3	32.0	10.7	9.3	2.7			
1	I present the content of my e-courses in a variety of ways (e.g., graphics, video, e-text, infographics, concept maps)	*N*	28	28	14	4	1	4.04	0.951	4
		%	37.3	37.3	18.8	5.3	1.3			
8	I record live lectures and make them available for broadcast after the lecture in the form of a podcast or video	*N*	36	12	11	7	9	3.79	1.436	5
		%	48.0	16.0	14.7	9.3	12.0			
10	I offer alternatives to audio information, such as video clips, or visual information, such as describing pictures	*N*	24	15	19	12	5	3.55	1.277	6
		%	32.0	20.0	25.3	16.0	6.7			
11	I recognize patterns and relationships in the content of my electronic courses (e.g., using an electronic concept map)	*N*	19	17	22	12	5	3.44	1.222	7
		%	25.3	22.7	29.3	16.0	6.7			
9	I provide a glossary of terms in my e-courses	*N*	21	16	12	11	15	3.23	1.503	8
		%	28.0	21.3	16.0	14.7	20.0			
7	Real or virtual field trips are included in the courses	*N*	9	11	23	11	21	2.68	1.347	9
		%	12.0	14.7	30.6	14.7	28.0			
4	I embed subtitles in videos	*N*	11	11	14	17	22	2.63	1.422	10
		%	14.7	14.7	18.7	22.7	29.2			
5	I use a TTS program to convert written text into audible words	*N*	5	8	9	12	41	1.99	1.310	11
		%	6.7	10.7	12.0	16.0	54.6			
Overall average								3.47	0.807	

Participants mostly agreed that faculty provided multiple means of representation (M = 3.47). The averages for the items in this axis ranged from 4.51 to 1.99. The highest was "I provide clear instructions for the main tasks in my e-courses" (M = 4.51), followed by "I publish worksheets to students via the Blackboard system (available digitally)" (M = 4.24), while "I use a TTS program to convert written text into audible words" got the lowest average (M = 1.99).

Table 8 shows how much faculty reportedly provided multiple means of connection.

Table 8. Responses on How Much Faculty Provided Multiple Means of Connection

N	Item		Degree of approval					SMA	*SD*	Rank
			Always (100%)	Often (75%)	Sometimes (50%)	Rarely (25%)	Never (0%)			
26	I use neutral language and comprehensive examples without prejudice (e.g., race, gender, culture)	*N*	69	3	3	-	-	4.88	0.434	1
		%	92.0	4.0	4.0	-	-			
28	I motivate students to give their best when doing work related to the course	*N*	64	8	3	-	-	4.81	0.485	2
		%	85.3	10.7	4.0	-	-			
27	I keep the educational environment free of threats and distractions	*N*	62	11	2	-	-	4.80	0.465	3
		%	82.6	14.7	2.7	-	-			
17	I communicate with students inside or outside the classroom via bulletin board, email, or social media	*N*	62	10	3	-	-	4.79	0.501	4
		%	82.7	13.3	4.0	-	-			
16	I connect course content to the real world	*N*	54	16	5	-	-	4.65	0.604	٥
		%	72.0	21.3	6.7	-	-			
25	I answer students' questions in different ways (e.g., discussion board, email, or other means)	*N*	55	15	4	1	-	4.65	0.647	٦
		%	73.4	20.0	5.3	1.3	-			
18	I provide clear, specific feedback on the tasks required in the e-course	*N*	54	9	11	1	-	4.55	0.793	7
		%	72.0	12.0	14.7	1.3	-			
19	I provide feedback to students on oral or written tasks according to the student's learning style (e.g., audio, visual)	*N*	47	18	7	-	3	4.41	0.960	8
		%	62.7	24.0	9.3	-	4.0			
23	The course included activities for group and cooperative work among students (e.g., discussions, projects)	*N*	40	24	7	4	-	4.33	0.859	9
		%	53.4	32.0	9.3	5.3	-			
22	I make student presentations available online	*N*	41	14	14	4	2	4.17	1.083	10
		%	54.6	18.7	18.7	5.3	2.7			
12	I put interesting assignments in the course	*N*	41	14	14	4	2	4.17	1.083	11
		%	54.6	18.7	18.7	5.3	2.7			
15	I use hands-on activities in the classroom	*N*	30	4	18	3	-	4.08	0.897	12
		%	40.0	32.0	24.0	4.0	-			
20	I allow students to resubmit assignments after marking them	*N*	26	23	19	6	1	3.89	1.021	13
		%	34.7	30.7	25.3	8.0	1.3			
24	I provide the learner with opportunities for self-assessment	*N*	34	11	18	7	5	3.83	1.288	14
		%	45.3	14.7	24.0	9.3	6.7			
13	I allow some autonomy and control over student learning (e.g., having options for assignments or tests)	*N*	17	30	18	8	2	3.69	1.026	15
		%	22.6	40.0	24.0	10.7	2.7			
21	I ensure that students evaluate each other as part of the course assessment	*N*	16	18	30	5	6	3.44	1.142	16
		%	21.3	24.0	40.0	6.7	8.0			
14	I allow students to decide on some topics for the e-course	*N*	13	11	18	14	19	2.80	1.424	17
		%	17.3	14.7	24.0	18.7	25.3			
Overall average								4.14	0.702	

Participants mostly agreed that faculty provided multiple means of connection (M = 4.14). The averages for these items ranged from 4.88 to 2.52. The highest mean was for "I use neutral language and comprehensive examples without prejudice (e.g., race, gender, culture)" (M = 4.88 out of 5), followed by "I motivate students to give their best when doing work related to the course" (M =4.81). The lowest was "I allow students to decide on some topics for the e-course" (M = 2.52).

Table 9 shows how much faculty reportedly provided multiple means of expression.

Table 9. Responses on How Much Faculty Provided Multiple Means of Expression

N	Item		Degree of approval					SMA	*SD*	Rank
			Always (100%)	Often (75%)	Sometimes (50%)	Rarely (25%)	Never (0%)			
35	I provide opportunities for students to monitor their learning progress (e.g., posting their grades on Blackboard)	*N*	52	19	3	1	-	4.63	0.632	1
		%	69.4	25.3	4.0	1.3	-			
34	I guide students to set goals and develop their learning strategies	*N*	37	26	9	2	1	4.28	0.879	2
		%	49.3	34.7	12.0	2.7	1.3			
29	I provide flexibility with due dates for key assignments (e.g., I allow assignments to be submitted later than the scheduled date with a grade deduction)	*N*	38	19	11	5	2	4.15	1.074	3
		%	50.6	25.3	14.7	6.7	2.7			
32	I provide samples of the tasks required in my e-courses	*N*	31	26	12	6	-	4.09	0.947	4
		%	41.3	34.7	16.0	8.0	-			
30	I offer optional assignments and exercises to practice applying the course content	*N*	26	23	14	8	4	3.79	1.189	5
		%	34.6	30.7	18.7	10.7	5.3			
33	I instruct students to do more challenging activities than the previous one	*N*	21	21	23	9	1	3.69	1.052	6
		%	28.0	28.0	30.7	12.0	1.3			
	I provide sufficient time for online tests (e.g., the test can be taken at any time on Wednesday, bearing in mind that the test period is 45 minutes)	*N*	14	7	19	13	22	2.71	1.459	7
		%	18.7	9.3	25.3	17.3	29.4			
Overall average								3.90	0.702	

Participants mostly agreed faculty provided multiple means of expression (M = 3.90). Averages for the items ranged from 4.63 to 2.71. The highest was for "I provide opportunities for students to monitor their learning progress (e.g., posting their grades on Blackboard)" (M = 4.63), followed by "I guide students to set goals and develop their learning strategies" (M = 4.28). The lowest was "I provide sufficient time for online tests (e.g., the test can be taken at any time on Wednesday, bearing in mind that the test period is 45 minutes)" (M = 2.71).

4.2 Sub-Question 2

Sub-Question 2 asked, "According to students, to what extent do faculty apply UDL principles in online courses?" To answer this question, the means of the axes were calculated, as shown in Table 10.

Table 10. Results for How Much Faculty Applied UDL

N	Axis	SMA	*SD*	Rank
1	Providing multiple means of representation	3.55	0.809	2
2	Providing multiple means of connection	3.69	0.687	1
3	Providing multiple means of expression	3.52	0.812	3
The axes as a whole		3.61	0.694	

Participants agreed to a moderate degree that faculty applied UDL principles (M = 3.61). Means of connection had the highest mean, followed by means of representation (M = 3.55) and expression (M = 3.52).

Table 11 shows how much faculty reportedly provided multiple means of representation.

Table 11. Results on How Much Faculty Provided Multiple Means of Representation

N	Item		Degree of approval					SMA	*SD*	Rank
			Always (100%)	Often (75%)	Sometimes (50%)	Rarely (25%)	Never (0%)			
6	Clear instructions are given for the main tasks of the e-course	*N*	63	58	33	10	1	4.04	0.939	1
		%	38.1	35.1	20.0	6.1	0.6			
1	E-course content is presented in a variety of ways (e.g., graphics, video, e-text, infographics, concept maps)	*N*	45	65	44	11	-	3.87	0.891	2
		%	27.3	39.3	26.7	6.7	-			
2	A number of electronic references are presented in the course (e.g., articles, books)	*N*	47	54	47	14	3	3.78	1.014	3
		%	28.5	32.7	28.5	8.5	1.8			
3	Worksheets are posted for students on Blackboard (available digitally)	*N*	57	49	32	20	7	3.78	1.169	4
		%	34.6	29.7	19.4	12.1	4.2			
11	I recognize patterns and relationships in course content (e.g., using electronic concept maps)	*N*	42	57	49	13	4	3.73	1.008	5
		%	25.5	34.5	29.7	7.9	2.4			
8	Live lectures are recorded and available for viewing after the lecture in the form of a podcast or video	*N*	42	41	45	26	11	3.47	1.217	6
		%	25.5	24.7	27.3	15.8	6.7			
10	The instructor provides alternatives to audio information, such as video clips, or visual information, such as describing images	*N*	36	44	49	24	12	3.41	1.189	7
		%	21.8	26.7	29.7	14.5	7.3			
4	Subtitles are included in videos	*N*	32	48	39	39	7	3.36	1.163	8
		%	19.4	29.2	23.6	23.6	4.2			
9	The instructor provides a glossary of terms in the e-course	*N*	40	38	38	30	19	3.30	1.327	9
		%	24.3	23.0	23.0	18.2	11.5			
7	Real or virtual field trips are included in the courses	*N*	38	39	36	28	24	3.24	1.365	10
		%	23.0	23.7	21.8	17.0	14.5			
5	Course files can be read using a TTS program that converts written text into audible words	*N*	21	49	44	26	25	3.09	1.253	11
		%	12.7	29.6	26.7	15.8	15.2			
Overall average								3.55	0.809	

Participants mostly agreed that faculty provided multiple means of representation (M = 3.55). The averages for the items on this axis ranged from 4.04 to 3.09. The item with the highest mean was “Clear instructions are given for the main tasks of the e-course” (M = 4.04), followed by “E-course content is presented in multiple ways (e.g., graphics, video, e-text, infographics, concept maps)” (M = 3.87), while the lowest were “Course files can be read using a TTS program that converts written text into audible words” (M = 3.09) and “Real or virtual field trips are included in the courses” (M = 3.24).

Table 12 shows how much faculty reportedly provided multiple means of connection.

Table 12. Results for How Much Faculty Provided Multiple Means of Connection

N	Item		Degree of approval					SMA	*SD*	Rank
			Always (100%)	Often (75%)	Sometimes (50%)	Rarely (25%)	Never (0%)			
17	The instructor communicates with students inside or outside the classroom via bulletin board, email, or social media	*N*	80	54	28	3	-	4.28	0.808	1
		%	48.5	32.7	17.0	1.8	-			
23	The course includes activities for group and cooperative work among students (e.g., discussions, projects)	*N*	72	59	29	5	-	4.20	0.835	2
		%	43.6	35.8	17.6	3.0	-			
27	The instructor keeps the educational environment free of threats and distractions	*N*	62	65	32	6	-	4.11	0.841	3
		%	37.6	39.4	19.4	3.6	-			
28	Students are motivated to give their best when doing work related to the course	*N*	55	64	36	9	1	3.99	0.911	4
		%	33.3	38.8	21.8	5.5	0.6			
25	Students' questions are answered in different ways (e.g., discussion board, email, or other means)	*N*	59	60	32	11	3	3.98	0.994	٥
		%	35.7	36.4	19.4	6.7	1.8			
22	Presentations are available to students	*N*	53	58	48	6	-	3.96	0.872	٦
		%	32.1	35.2	29.1	3.6	-			
26	The instructor uses neutral language and comprehensive examples without prejudice (e.g., race, gender, culture)	*N*	67	49	29	14	6	3.95	1.120	7
		%	40.6	29.7	17.6	8.5	3.6			
18	Clear and specific feedback on the tasks required in the e-course is provided	*N*	53	57	45	10	-	3.93	0.914	8
		%	32.1	34.5	27.3	6.1	-			
19	Feedback is provided to students on oral or written tasks according to the student's learning style (e.g., audio, visual)	*N*	47	55	43	19	1	3.78	1.008	9
		%	28.5	33.3	26.1	11.5	0.6			
16	The instructor connects course content to the real world	*N*	45	55	49	14	2	3.77	0.985	10
		%	27.3	33.3	29.7	8.5	1.2			
12	Interesting tasks are offered in the course	*N*	42	53	50	15	5	3.68	1.048	11
		%	25.5	32.1	30.3	9.1	3.0			
24	The course provides the learner with opportunities for self-assessment	*N*	35	43	51	23	13	3.39	1.192	12
		%	21.2	26.1	30.9	13.9	7.9			
15	Practical activities are used in the virtual classroom	*N*	39	34	51	30	11	3.36	1.215	13
		%	23.6	20.6	30.9	18.2	6.7			
20	Students are allowed to resubmit assignments after they have been graded	*N*	29	45	44	37	10	3.28	1.172	14
		%	17.6	27.3	26.7	22.3	6.1			
13	Some autonomy and control over student learning is allowed (e.g., having options for assignments or tests)	*N*	29	46	42	31	17	3.24	1.239	15
		%	17.6	27.8	25.5	18.8	10.3			
21	Students are required to evaluate each other as part of the course assessment	*N*	31	22	54	34	24	3.01	1.297	16
		%	18.8	13.3	32.8	20.6	14.5			
14	Students are allowed to decide on some topics for the e-course	*N*	22	33	43	35	32	2.87	1.309	17
		%	13.3	20.0	26.1	21.2	19.4			
Overall average								3.69	0.687	

Participants mostly agreed that faculty provided multiple means of connection (M = 3.69), with means ranging from 4.28 to 2.87. The highest was for "The instructor communicates with students inside or outside the classroom via bulletin board, email, or social media" (M = 4.2 8), followed by "The course includes activities for group and cooperative work among students (e.g., discussions, projects)" (M = 4.20). The lowest were "Students are allowed to decide on some topics for the e-course" (M = 2.87) and "Students are required to evaluate each other as part of the course assessment" (M = 3.01).

Table 13 shows how much faculty reportedly provided multiple means of expression.

Table 13. Results for How Much Faculty Provided Multiple Means of Expression

N	Item		Degree of approval					SMA	*SD*	Rank
			Always (100%)	Often (75%)	Sometimes (50%)	Rarely (25%)	Never (0%)			
34	The instructor guides students to set goals and develop their learning strategies	*N*	41	57	49	17	1	3.73	0.971	1
		%	24.8	34.6	29.7	10.3	0.6			
35	The instructor provides opportunities for students to monitor their learning progress (e.g., posting their grades on Blackboard)	*N*	46	58	40	13	8	3.73	1.100	2
		%	27.9	35.2	24.2	7.9	4.8			
32	The instructor provides samples of the tasks and costs required in the e-course	*N*	47	48	44	21	5	3.67	1.111	3
		%	28.5	29.1	26.7	12.7	3.0			
29	There is flexibility in the due dates of key assignments (e.g., later assignments are allowed with a grade deduction)	*N*	41	50	45	15	14	3.54	1.202	4
		%	24.8	30.3	27.3	9.1	8.5			
33	The instructor instructs students to do more challenging activities than the previous one	*N*	33	52	56	18	6	3.53	1.045	5
		%	20.0	31.6	33.9	10.9	3.6			
30	Optional assignments and exercises are offered to practice applying the course content	*N*	30	52	46	27	10	3.39	1.141	6
		%	18.1	31.5	27.9	16.4	6.1			
31	The instructor provides sufficient time for online tests (e.g., the test can be taken at any time on Wednesday, bearing in mind that the test period is 45 minutes)	*N*	35	32	39	26	33	3.06	1.417	7
		%	21.2	19.4	23.6	15.8	20.0			
Overall average								3.52	0.812	

Participants mostly agreed that faculty provided multiple means of expression (M = 3.52), with means ranging from 3.73 to 3.06. The item with the highest mean was "The instructor guides students to set goals and develop their learning strategies" (M = 3.73), followed by "The instructor provides opportunities for students to monitor their learning progress (e.g., posting their grades on Blackboard)" (M = 3.73). The lowest were "The instructor provides sufficient time for online tests (e.g., the test can be taken at any time on Wednesday, bearing in mind that the test period is 45 minutes)" (M = 3.06) and "Optional assignments and exercises are offered to practice applying the course content" (M = 3.39).

4.3 Sub-Question 3

Sub-Question 3 asked, "Are there significant differences between student and faculty perceptions of the application of UDL principles?" Independent-samples *t*-tests were run to look for significant differences between teacher and student responses (see Table 14).

The results showed no significant differences between teachers and students' attitudes about multiple means of representation. However, faculty were significantly more likely to agree (at 0.01 or less) that they provided multiple means of association and expression, as well as with the axes as a whole.

Table 14. T-test Results for Differences between Teachers and Students

Axis	Group	*N*	*M*	*SD*	*t*-value	Indication	Comment
Multiple means of representation	Teachers	75	3.47	0.807	-0.732	0.465	Nonfunction
	Students	165	3.55	0.809			
Multiple means of connection	Teachers	75	4.14	0.478	5.775	0.000**	Function
	Students	165	3.69	0.687			
Multiple means of expression	Teachers	75	3.90	0.702	3.518	0.001**	Function
	Students	165	3.52	0.812			
Axes as a whole	Teachers	75	3.88	0.568	3.130	0.002**	Function
	Students	165	3.61	0.694			

** significant at 0.01 level or less.

4.4 Sub-Question 4

Sub-Question 4 asked, "Are there significant differences in faculty members' perceived application of UDL principles based on gender, experience, educational level, or number of training courses?"

4.4.1 Gender

Independent-samples *t*-tests were run to identify significant differences between participating faculty members according to gender (see Table 15).

Table 15. T-test Results for Differences between Participants According to Gender

Axis	Gender	*N*	*M*	*SD*	*t*-value	Indication	Comment
Multiple means of representation	Male	37	3.32	0.745	-1.628	0.108	Nonfunctional
	Female	38	3.62	0.847			
Multiple means of connection	Male	37	4.05	0.503	-1.528	0.131	Nonfunctional
	Female	38	4.22	0.444			
Multiple means of expression	Male	37	3.75	0.684	-1.888	0.064	Nonfunctional
	Female	38	4.05	0.695			
Axes as a whole	Male	37	3.76	0.554	-1.823	0.072	Nonfunctional
	Female	38	4.00	0.565			

The results yielded no significant differences between male and female participants.

4.4.2 Years of Experience

A one-way ANOVA was employed to look for significant differences between participants according to years of experience (see Table 16).

Table 16. ANOVA Results for Differences between Participants According to Years of Experience

Axis	Contrast source	Sum of squares	Degrees of freedom	Mean squares	*F* value	Significance	Comment
Multiple means of representation	Between groups	1.480	3	0.493	0.749	0.527	Nonfunctional
	Within groups	46.752	71	0.658			
	Total	48.232	74	-			
Multiple means of connection	Between groups	0.066	3	0.022	0.093	0.964	Nonfunctional
	Within groups	16.875	71	0.238			
	Total	16.941	74	-			
Multiple means of expression	Between groups	0.636	3	0.212	0.420	0.739	Nonfunctional
	Within groups	35.827	71	0.505			
	Total	36.463	74	-			
Axes as a whole	Between groups	0.368	3	0.123	0.370	0.775	Nonfunctional
	Within groups	23.546	71	0.332			
	Total	23.913	74	-			

The results showed no significant differences in participant attitudes according to years of experience.

4.4.3 Educational Level

The researchers used a one-way ANOVA to identify significant differences between participant responses according to educational level (see Table 17).

Table 17. ANOVA Results for Differences between Participants According to Educational Level

Axis	Contrast source	Sum of squares	Degrees of freedom	Mean squares	*F* value	Significance	Comment
Multiple means of representation	Between groups	1.277	2	0.638	0.979	0.381	Nonfunctional
	Within groups	46.955	72	0.652			
	Total	48.232	74	-			
Multiple means of connection	Between groups	0.172	2	0.086	0.368	0.693	Nonfunctional
	Within groups	16.769	72	0.233			
	Total	16.941	74	-			
Multiple means of expression	Between groups	0.062	2	0.031	0.061	0.941	Nonfunctional
	Within groups	36.401	72	0.506			
	Total	36.463	74	-			
Axes as a whole	Between groups	0.317	2	0.158	0.484	0.619	Nonfunctional
	Within groups	23.597	72	0.328			
	Total	23.913	74	-			

The study found no significant differences between participant attitudes according to educational level.

4.4.4 Number of Training Courses

A one-way ANOVA was run to identify significant differences between participants according to the number of training courses they had taken (see Table 18).

Table 18. ANOVA Results for Differences between Participants According to Number of Training Courses

Axis	Contrast source	Sum of squares	Degrees of freedom	Mean squares	*F* value	Significance	Comment
Multiple means of representation	Between groups	2.735	3	0.912	1.423	0.243	Nonfunctional
	Within groups	45.497	71	0.641			
	Total	48.232	74	-			
Multiple means of connection	Between groups	1.808	3	0.603	2.827	0.045*	Function
	Within groups	15.133	71	0.213			
	Total	16.941	74	-			
Multiple means of expression	Between groups	4.951	3	1.650	3.719	0.015*	Function
	Within groups	31.511	71	0.444			
	Total	36.463	74	-			
Axes as a whole	Between groups	2.439	3	0.813	2.688	0.053	Function
	Within groups	21.475	71	0.302			
	Total	23.913	74	-			

*Function at 0.05 or less.

The test showed no significant differences in participant attitudes about means of representation or axes as a whole according to number of training courses. However, there were significant differences regarding means of association and expression.

A Scheffe test was run to determine the validity of the differences between categories for number of training courses

(see Table 19).

Table 19. Scheffe Test Results to Verify Differences between Categories for Number of Training Courses

Axis	Training courses	*N*	SMA	1-5	6-10	11-15	16+
Multiple means of connection	1-5	39	4.02	-			*
	6-10	23	4.25		-		
	11-15	6	4.03			-	
	16+	7	4.50				-
Multiple means of expression	1-5	39	3.70	-	**		*
	6-10	23	4.17		-		
	11-15	6	3.69			-	
	16+	7	4.35				-

**Function at 0.01 or less. *Function at 0.05 or less.

Participants who had taken 6-10 training courses were significantly more likely (at 0.01 or less) than those with 18 cycles to agree they provided multiple means of expression. In addition, those with 16 or more cycles were significantly more likely than those with 1-5 to agree they provided multiple means of connection and expression.

5. Discussion

5.1 Main Question

The main research question asked, "To what extent are UDL principles applied in online courses according to faculty members and students at Prince Sattam bin Abdulaziz University?"

Faculty and students agreed on the extent to which faculty applied UDL principles in online courses, with a high approval rate of 75%. During the pandemic, students were exposed to many elements of UDL, and their responses indicated that most of these elements were perceived as beneficial to their learning. This result could also be due to the university's requirement for all faculty members to design their online courses according to Quality Matters standards. This requirement helped faculty and students apply many UDL standards by providing multiple means of communication, such as discussion forums, email, alert messages, and live virtual classrooms, which increased student participation and communication with faculty.

These results agree with Kennette and Wilson (2019a), who showed that students saw UDL as a positive part of their learning, were exposed to many UDL elements, and found most of those elements useful to their individual learning. Students in Kennette and Wilson (2019a) study also reported communication with faculty was essential to their success. Despite the importance of field trips and participation in selecting course content, these elements have not been implemented in most courses.

5.2 Sub-Question 1

The first sub-question asked, "According to faculty members, to what extent do they apply UDL principles in online courses?"

Faculty reported that they frequently applied most UDL principles, a finding consistent with Westine et al. (2019). The principles in the correlation axis were the most common, possibly because of greater awareness of the importance of communicating with students through e-learning platforms and using tools on Blackboard to enhance student participation and communication. The axis of expression was somewhat higher than the axis of representation, which could be attributed to the university having more interest during the pandemic on issuing instructions to faculty about the need to offer more flexibility, perform online tests, and provide models that facilitate learning due to students having different levels of access to the Internet. The university was requiring all faculty to give students opportunities to monitor their progress, such as by posting grades on Blackboard and providing necessary feedback. The representation axis ranked third, which might be explained by a lack of adequate training.

These results agree with Kennette and Wilson (2019a) in that most participants indicated that some of the most used elements were posting content on the learning management system, providing clear instructions for assignments, answering questions, communicating with students outside the classroom, and allowing students to monitor their progress by posting their scores. Another finding consistent with Kennette and Wilson (2019a) was that the least used elements were field trips, allowing students to choose course content, and letting them resubmit assignments. This

result differs from Al-Salem (2016), in which the axis of expression came first, followed by representation and association, and Westine et al. (2019), in which representation came first, followed by association and expression.

5.3 Sub-Question 2

The second sub-question asked, "According to students, to what extent do faculty apply UDL principles in online courses?"

Based on student responses, the correlation axis came in first place, which could be due to the sudden transition to e-learning during the pandemic. This shift allowed students to use many means of communication with faculty, some of which were not available previously. Examples include communicating with teachers through bulletin boards, email, and social media. The representation axis was slightly higher than expression. This could be due to students having more alternatives to receive course content after moving to online learning. This result differs from Kennette and Wilson (2019a), in which the axis of representation came first, followed by association and expression.

5.4 Sub-Question 3

The third sub-question asked, "Are there significant differences between student and faculty perceptions of the application of UDL principles?"

The results showed no significant differences in attitudes about multiple means of representation, but there were significant differences regarding means of association and expression. This agreement might be attributed to the full transition of both faculty and students to e-learning. Such agreement between faculty and students is echoed in Kennette and Wilson (2019a).

5.5 Sub-Question 4

The fourth sub-question asked, "Are there significant differences in faculty members' perceived application of UDL principles based on gender, experience, educational level, or number of training courses?"

The results showed no significant differences in attitudes based on gender, years of experience, or educational level. However, participants who had taken 16 or more training courses were significantly more likely than those who had taken 1–5 courses to claim that they provided multiple means of connection and expression. This was likely due to that group receiving more training in e-learning, leading them to apply UDL principles more often.

6. Conclusion

6.1 Recommendations for Policy and Practice

The purpose of the study is to investigate the extent to which universal design for learning (UDL) principles have been used in online courses according to the opinions of professors and students at Prince Sattam bin Abdulaziz University. Descriptive approach is used, Two questionnaires—one for faculty members and another for students—are employed. The results showed that online courses assisted teachers in implementing some UDL principles and increasing awareness of the UDL principles. The benefits of distant learning, which apparently improved students' exposure to several UDL components by providing additional opportunities for communication and engagement, were also widely agreed upon by both teachers and students. Students also indicated significant participation in lessons using UDL principles.

Based on the findings, this study recommends including peer evaluation as part of course assessment, letting students select some course topics, converting text into audio files, and providing subtitles or scripts for videos. Universities should offer intensive training to spread the UDL philosophy and introduce effective methods for designing online course content. Policymakers should consider applying UDL principles in e-learning and distance learning because of their positive effects on learner participation and perceptions. Teachers and e-content designers should focus more on designing e-courses according to UDL to motivate learners to accept those principles.

6.2 Limitations and Suggestions for Future Studies

Since this study was limited to male and female faculty members and female students at one Saudi university, the results could not be generalized beyond those groups. Future research would benefit from a larger sample from different universities. More studies are needed that explore the obstacles to applying UDL in online university courses. Researchers could find ways to improve how UDL is implemented, examine the effectiveness of a UDL training program, and assess the effectiveness of online courses designed with UDL principles.

References

Al-Azawei, A., Parslow, P., & Lundqvist, K. (2017). The effect of universal design for learning (UDL) application on e-learning acceptance: A structural equation model. *International Review of Research in Open and Distributed Learning: IRRODL*, *18*(6), 54-87.

Alquraini, T., & Rao, S. (2018). Assessing teachers' knowledge, readiness, and needs to implement universal design for learning in classrooms in Saudi Arabia. *International Journal of Inclusive Education*, *24*(1), 103-114. https://doi.org/10.1080/13603116.2018.1452298

Al-Salem, M. (2016). Teaching efficiency of teachers of the deaf and hard of hearing through the principles of comprehensive design for learning. *Specialized International Educational Journal*, *5*(4), 114-134.

An-Nasban, L. (2018). *The level of knowledge of intellectual education teachers about the principles of comprehensive learning design and its importance from their point of view in teaching social skills* [Unpublished master's thesis]. King Saud University, Saudi Arabia.

Betts, K., Cohen, A., Veit, D., Alphin, H., Broadus, C., & Allen, D. (2013). Strategies to increase online student success for students with disabilities. *Journal of Asynchronous Learning Networks*, *17*(3), 49-64. https://doi.org/10.24059/olj.v17i3.324

Black, R., Weinberg, L., & Brodwin, M. (2015). Universal design for learning and instruction: Perspectives of students with disabilities in higher education. *Exceptionality Education International*, *25*(2).

CAST. (2011). *Universal design for learning (UDL) guidelines version 2.0*. Wakefeild, MA: Author. Retrieved from https://udlguidelines.cast.org/more/downloads

Chambers, D., & Coffey, A. (2019). Guidelines for designing middle-school transition using universal design for learning principles. *Improving Schools*, *22*(1), 29-42. https://doi.org/10.1177/1365480218817984

Courey, S. J., Tappe, P., Siker, J., & LePage, P. (2013). Improved lesson planning with universal design for learning (UDL). *Teacher education and special education, 36*(1), 7-27. https://doi.org/10.1177/0888406412446178

Coyne, P., Evans, M., & Karger, J. (2017). Use of a UDL literacy environment by middle school students with intellectual and developmental disabilities. *Intellectual and Developmental Disabilities*, *55*(1), 4-14. https://doi.org/10.1352/1934-9556-55.1.4

Craig, S., Smith, S., & Frey, B. (2019). Professional development with universal design for learning: Supporting teachers as learners to increase the implementation of UDL. *Professional Development in Education*, *35*(1), 1-16. https://doi.org/10.1080/19415257.2019.1685563

Davies, P., Schelly, C., & Spooner, C. (2013). Measuring the effectiveness of universal design for learning intervention in postsecondary education. *Journal of Postsecondary Education and Disability*, *26*(3), 195-220.

Davis, J., & Hynes, G. (2017). Applying universal design principles to engage online learners. In *Proceedings of the Graduate Student Research Conference in Business and Economics (Gradconf)*, 28.

Dickinson, K. J., & Gronseth, S. L. (2020). Application of universal design for learning (UDL) principles to surgical education during the COVID-19 pandemic. *Journal of Surgical Education*, *77*(5), 1008-1012. https://doi.org/10.1016/j.jsurg.2020.06.005

Dinmore, S. P. (2014). The case for universal design for learning in technology enhanced environments. *International Journal of Cyber Ethics in Education*, *3*(2), 29-38. https://doi.org/10.4018/ijcee.2014040103

Eftring, H., Olaussen, E., Petrie, H., Saarela, M., Ladonlahti, T., & Torkildsby, A. (2021). From face-to-face to online UDeL camps: Supporting staff at higher education institutions in developing universal design for elearning (UDeL). In I. Verma (Ed.), *Universal design 2021: From special to mainstream solutions* (pp. 144-160). IOS Press.

Firchow, N. (2023). *Universal design for learning: Improved access for all*. Retrieved from https://www.greatschools.org/gk/articles/universal-design-for-learning-improved-access-for-all/

Fornauf, B., & Erickson, J. (2020). Toward an inclusive pedagogy through universal design for learning in higher education: A review of the literature. *Journal of Postsecondary Education and Disability*, *33*(2), 183-199.

Fovet, F. (2021). Exploring the use of universal design for learning to reengage students with social, emotional, and behavioural difficulties. In D. Ktoridou, E. Doukanari, & N. Eteokleous (Eds.), *Fostering meaningful learning experiences through student engagement* (pp. 175-195). IGI Global.

https://doi.org/10.4018/978-1-7998-4658-1.ch009

Gronseth, S., & Hutchins, H. (2020). Flexibility in formal workplace learning: Technology applications for engagement through the lens of universal design for learning. *TechTrends*, *64*(2), 211-218. https://doi.org/10.1007/s11528-019-00455-6

Hall, T. E., Meyer, A., & Rose, D. H. (Eds.). (2012). *Universal design for learning in the classroom: Practical applications.* Guilford press.

Jiménez, T., Graf, V., & Rose, E. (2007). Gaining access to general education: The promise of universal design for learning. *Issues in Teacher Education*, *16*(2), 41-54.

Katz, J. (2015). Implementing the three block model of universal design for learning: Effects on teachers' self-efficacy, stress, and job satisfaction in inclusive classrooms K-12. *International Journal of Inclusive Education*, *19*(1), 1-20. http://dx.doi.org/10.1080/13603116.2014.881569

Kennette, L., & Wilson, N. (2019a). Universal design for learning (UDL): Student and faculty perceptions. *Journal of Effective Teaching in Higher Education*, *2*(1), 1-26. https://doi.org/10.36021/jethe.v2i1.17

Kennette, L., & Wilson, N. (2019b). Universal design for learning (UDL): What is it and how do I implement it. *Transformative Dialogues: Teaching & Learning Journal*, *12*(1), 1-6. https://doi.org/10.36021/jethe.v2i1.17

Kumar, K. L., & Wideman, M. (2014). Accessible by design: Applying UDL principles in a first year undergraduate course. *Canadian Journal of Higher Education, 44*(1), 125-147. https://doi.org/10.47678/cjhe.v44i1.183704

Lohmann, M., Boothe, K., Hathcote, A., & Turpin, A. (2018). Engaging graduate students in the online learning environment: A universal design for learning (UDL) approach to teacher preparation. *Networks: An Online Journal for Teacher Research*, *20*(2). https://dx.doi.org/10.4148/2470-6353.126

Marino, M., Gotch, C., Israel, M., Vasquez, E., Basham, J., & Becht, K. (2014). UDL in the middle school science classroom: Can video games and alternative text heighten engagement and learning for students with learning disabilities? *Learning Disability Quarterly*, *37*(2), 87-99. https://doi.org/10.1177/0731948713503963

Meyer, A., Rose, D., & Gordon, D. (2014). *Universal design for learning: Theory and practice*. CAST Professional Publishing.

National Center for UDL. (2013). *How has UDL been defined?* Retrieved from http://www.udlcenter.org/aboutudl/udldefined

Owiny, R., Hollingshead, A., Barrio, B., & Stoneman, K. (2019). Engaging preservice teachers in universal design for learning lesson planning. *Inclusion*, *7*(1), 12-23. https://doi.org/10.1352/2326-6988-7.1.12

Schelly, C., Davies, P., & Spooner, C. (2011). Student perceptions of faculty implementation of universal design for learning. *Journal of Postsecondary Education and Disability*, *24*(1), 17-30.

Scott, L., Bruno, L., Gokita, T., & Thoma, C. (2019). Teacher candidates' abilities to develop universal design for learning and universal design for transition lesson plans. *International Journal of Inclusive Education*, *26*(4), 333-347. https://doi.org/10.1080/13603116.2019.1651910

Tobin, M. (2021). Just in time: Teaching for deep learning with universal design for learning (UDL). In *2021 MLA Annual Convention*. MLA. Retrieved from https://mla.confex.com/mla/2021/meetingapp.cgi/Session/10779

Trust, T., & Pektas, E. (2018). Using the ADDIE model and universal design for learning principles to develop an open online course for teacher professional development. *Journal of Digital Learning in Teacher Education, 34*(4), 219-233. https://doi.org/10.1080/21532974.2018.1494521

Vision 2030. (2016). 2030 رؤية المملكة العربية السعودية [Saudi Vision 2030]. Retrieved from https://www.vision2030.gov.sa/

Westine, C., Oyarzun, B., Ahlgrim-Delzell, L., Casto, A., Okraski, C., Park, G., Person, J., & Steele, L. (2019). Familiarity, current use, and interest in universal design for learning among online university instructors. *International Review of Research in Open and Distributed Learning*, *20*(5), 20-41. https://doi.org/10.19173/irrodl.v20i5.4258

Acknowledgments

We greatly appreciate the valuable contributions of the vacility members of Prince sttam Bin Abdulaziz University who participated in this study.

Authors contributions

All authors read and approved the final manuscript, also all the authors contributed equally to the study.

Funding

This study is supported via funding from Prince sattam bin Abdulaziz University project number (PSAU/2022/02/21940).

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.