Journal of Effective Teaching in Higher Education

Universal Design for Learning (UDL): Student and Faculty Perceptions

Lynne N. Kennette[1], Ph.D.
Nathan Andrew Wilson, ABD
Durham College, Oshawa, Ontario Canada

Abstract. Universal design for learning (UDL) ensures that content is accessible to the largest audience by removing learning impediments (CAST, 2011a). However, few scholars have surveyed students about how much UDL they encounter in their courses or how important they perceive these course modifications to be, especially in a post-secondary context. To this end, students at a Canadian college were surveyed. In a follow-up survey, faculty were also asked to report on how they thought their students perceived and valued their UDL usage. UDL perceived usage and perceived usefulness data were compared across both students and faculty and there was much agreement across the samples. Disagreements are discussed.

Keywords: universal design for learning, student perception, faculty perceptions, usage, usefulness

Universal design refers to the idea of crafting physical spaces that maximize usability for as many people as possible. It is conceptually rooted in 1980s architectural circles, specifically those established by North Carolina State University's Ron Mace. From architecture, educators adapted and applied the concept to the learning environment. Reframed as universal design for learning (UDL), teachers, instructional designers, and curriculum specialists (notably Anne Meyer, David H. Rose, and their colleagues at the Harvard Graduate School of Education and the Center for Applied Special Technology, CAST) considered how best to make all course components barrier-free. To be most successful, advocators argued that UDL guidelines should be used to frame a course from its inception, rather than retrofitting a course after the fact. Properly applied to all facets of learning, UDL would conceivably benefit all learners, and not solely those individuals with learning challenges or students with disabilities (CAST, 2011a; Courey, Tappe, Siker, & LePage, 2012; Meyer, Rose, & Gordon, 2014). Reducing the barriers and impediments facing all students also meant that individuals would no longer need to self-identify as requiring accommodations.

While any educator should ensure that subject content is flexible and accessible to the greatest number of students, this is especially important in higher education for two reasons. First, the number of students with mental health or other learning barriers is on the rise (Fichten, Jorgensen, Havel, & Barile, 2006; Ontario University & College Health Association, 2016; Raue & Lewis, 2011), which alone warrants revisiting UDL principles in curriculum development. Some have reported that as many as 60-80% of students with disabilities in higher education make the decision

[1] Corresponding Author: lynne.kennette@durhamcollege.ca

not to disclose (and therefore not obtain the required services) for fear of stigmatization by their peers, instructors, or community (Black, Weinberg, & Brodwin, 2014; Claiborne, Cornforth, Gibson & Smith, 2010; Marshak, Van Wieren, Ferrell, Swiss, and Dugan, 2011; Schelly, Davies, & Spooner, 2011; Wagner, Newman, Cameto, Garza & Levine, 2005). Following the principles of UDL allows for the reduction of learning barriers between students with disabilities and those without, without the need for students to disclose their disability to others (Al-Azawei, Serenelli, & Lundqvist, 2016). A recent meta-analysis showed almost exclusively positive student outcomes, including increasing student satisfaction and engagement (Al-Azawei et al., 2016). Second, researchers also suggest that culturally diverse learners benefit from the implementation of UDL principles (Chita-Tegmark, Gravel, Serpa, Domings, & Rose, 2012); this is important when considering the increasing number of international students on our campuses (Statistics Canada, 2016). As scholars rightly note: "the traditional teaching approach of 'one-size-fits-all' cannot meet learner diversity in contemporary learning" (Al-Azawei et al., 2016, p. 53). While anecdotal evidence has long suggested that individuals learn in ways that are specific to them, new knowledge produced within the past twenty-five years or so has certainly "elucidated the great variability of the human capacity to learn" (Meyer, Rose, & Gordon, 2014, p. 49). Therefore, a curriculum that is both UDL based and culturally informed is key to meeting the needs of our increasingly diverse twenty-first century classrooms.

The UDL Framework

CAST developed the UDL framework (see Appendix A for graphic organizer; CAST, 2011b) to include 3 principles (divided into 9 more specific guidelines, each of which further sub-divide into multiple checkpoints): multiple means of representation, multiple means of action and expression, and multiple means of engagement (CAST, 2011a). Instructors are guided to craft lessons and courses with built-in scaffolds and approaches that will support and meet the needs of all students, which includes providing materials to learners in various formats, allowing flexibility in how students demonstrate their learning, and motivating students to become active agents in their own learning (Courey et al., 2012). According to Rose and Strangman (2007), these principles mirror three key features of any learning environment and map on to three different learning networks in the brain. The *what* of learning (course content) is located in the posterior regions of the cortex, the *how* of learning (assessments) is located in the frontal regions of the cortex, and the *why* of learning (motivation) is in the medial regions of the nervous system. Because each learner is unique as to the strength of each of these learning networks, each learner will also be unique in the way that they learn (Rose & Strangman, 2007; Meyer, Rose, & Gordon, 2014).

Multiple Means of Representation

Each student has a preferred way to receive information. For some, it may be textual, for others visually and/or aurally, and others still critically by way of working through a given problem. By providing students with information in

multiple ways, each student will engage more profoundly with the material, thereby making more neural connections (Rose & Strangman, 2007; Courey et al., 2012). While students admittedly find it difficult to connect multiple representations of the same concept, it is necessary to do so in many fields (e.g., science) in order to think critically and solve problems (Kozma, 2003). Exposing students to multiple representations of the same concept fosters a deeper understanding, especially if they are also able to engage in dialogue about the content (Kozma, 2003; Courey et al., 2012).

Multiple Means of Action and Expression

Students also vary in their preferred way to demonstrate (i.e., communicate) their mastery of course content. Some students prefer writing an essay, while others prefer multiple-choice testing. Some students prefer to apply their knowledge to a concrete problem, while others still prefer a more expressive option. Each variance allows students to demonstrate their knowledge of the content, but in a way that benefits them. In one study, interviews revealed that giving students access to multiple means of action and expression on a discussion board (where students could respond in prose, via recording, or through illustration) allowed students to contribute their ideas in more efficient ways (Goldowsky & Coyne, 2016). Even standardized test scores are affected by the mode used to respond: paper vs. computer. Specifically, when students had greater familiarity with the responding mode, students performed significantly higher; students with greater computer literacy scored higher on the test when responding on the computer, while students with less computer familiarity performed better when completing the handwritten test (Russell, 2000). It is clear from these results that providing multiple means of action and expression is beneficial to students.

Multiple Means of Engagement

The affective component of learning is captured in the third UDL principle: multiple means of engagement. Students' interest and motivation must be maintained throughout the learning process, and one way this can be done is through choice. The ability for control and autonomy are important for workplace engagement (Pink, 2011). Providing students with meaningful instruction and authentic assessments will help engage them because the significance to be derived is clear and it is concretely linked to their eventual career. Frequent and personal interactions such as providing strategies for improvement as part of instructor feedback on assessments also engages students. Additionally, student engagement increases when they feel safer in the learning space and limited distractions result in sharper focus. Providing choice increases intrinsic motivation and the amount of effort the person puts into the task (Patall, Cooper, & Robinson, 2008). Furthermore, providing students with relevant assessments and learning experiences (i.e., those directly related to students' goals) appear to be even more important for student motivation, at least for adolescent students (Assor, Kaplan, & Roth, 2002). Both of these (choice and relevance) are examples of this UDL principle.

Experiment 1

Despite a wealth of knowledge about particular aspects of UDL and their benefits to student learning, gaps remain. In fact, Meyer, Rose, and Gordon (2014) recently stressed the need for a stronger research base as UDL guidelines continue to proliferate. From our perspective, we have found less research devoted to students' perception of the UDL framework in action, as it were, in the classroom. Little research exists surveying students about how much UDL they encounter in their courses or how important they perceive these course modifications to be to their success.

A handful of studies have examined students' perceived usage of UDL in the classroom. Using a pre-post design, two recent studies have found that students do perceive more UDL usage by instructors after those instructors have been trained on the use of UDL, especially when it came to these instructors offering more varied modes of representation (Davies, Shelly, & Spooner, 2013; Schelly et al., 2011). When compared to a control group, Davies et al. (2013) actually showed that improvements in engagement occurred over time during the semester, regardless of UDL training. This suggests that instructor rapport with students and the relationships which develop as the semester progresses are important for actively engaging participants' perceived enthusiasm. However, these studies did not examine instructors' perceived use of UDL.

To our knowledge, only one study has explicitly examined perceived usefulness of UDL principles in the student population. Black et al. (2015) showed that both students with and without a disability perceived a positive impact on their learning when instructors followed UDL principles in their classroom. However, their review of UDL activities within the classroom is not as comprehensive as our examination, relying on a rating scale form 1 ("*Not useful/important*") to 3 ("*Very useful/important*") and therefore could not compare usage rates with perceived usefulness.

Method

Participants

Participants were students enrolled in the one-year General Arts and Science certificate program at Durham College, in Ontario, Canada. They were invited to complete the survey through an announcement on the program page of their learning management system. Although approximately 600 students were enrolled in the program that semester, only a small subset of these students would have accessed their program page on the LMS during our recruitment period and seen the announcement, so it is impossible to speculate a meaningful response rate for students. In total, only 17 students provided answers to the survey questions. However, since each of these students is providing data for all of their courses (6 per semester), we feel that the data they provide offer valuable insight into their

experience with UDL at the college. No demographic data were collected to protect student privacy, as required by our institutional Research Ethics Board. A more detailed discussion of this is located in the Concluding Remarks section.

Materials

The authors developed the survey to gather student perceptions on two key questions: "For each item, indicate how much you have experienced this in your courses." and "For each item, indicate how useful you think these things would be in helping you learn in your courses. Please answer for each item, even if you did not experience it in any of your courses." Below these prompts were 36 items which tapped into each of the three UDL principles such as "Include subtitles on videos," "Offer interesting and relevant major assignments", and "Provide sufficient or unlimited time for tests." These 36 items were adapted from the list of CAST (2011a) checkpoints for each of the three UDL principles (Appendix B for items). The questionnaire appears to be high in face validity as it lists the UDL checkpoints as items. Since these survey items each refer to one of the UDL checkpoints, and each item is empirically supported by a list of scholarly evidence cited on the CAST website in support of each of these checkpoints (CAST, 2018), interested readers may refer to them for examples of best practices to use in their classrooms. The full list of the final survey items is included in the tables of the Results section.

Procedures

All students enrolled in the General Arts and Science program were recruited to participate in the study by way of an announcement in an information-dissemination course page for their program in the learning management system. Interested students ($N = 17$) simply clicked on the SurveyMonkey URL provided in the announcement and rated each of the 36 items; first for their impressions of how much that item is used in their courses, and then for how useful they perceived each of the items to be. The questionnaire took approximately 10 minutes to complete. It was live for a three-week period and students were reminded twice during that period.

Results and Discussion

Usage

Table 1 displays how much students report encountering each of the UDL elements in their classrooms. Students report that faculty use these elements in their classrooms "a lot", especially for the elements related to multiple means of representation. That is, students reported that the material was frequently presented in multiple formats, and that they felt moderately motivated to succeed in the course, and were given adequate options and flexibility for how they showed mastery of the course content. Students rarely encountered field trips ("not at all" = 94%) in their courses, and were also infrequently provided with streaming video or audio of their face-to-face classes ("not at all" = 47.06%). For the most part,

faculty decided on the course content ("not at all" = 58%) and students are not given the opportunity to resubmit course work ("not at all" = 52.94). Faculty frequently post handouts ("a lot" = 81.25%) and slides ("a lot" = 70.59%) on the LMS are often available outside of class by answering questions ("a lot" = 70.59%) and communicating with students ("a lot" and "a moderate amount" combined = 88.24%). Faculty also provide students with rubrics for assignments ("a lot" and "a moderate amount" combined = 88.24%) and are able to monitor their progress on the LMS ("a lot" = 70.59%).

Table 1

Student reporting of UDL usage in their classrooms.

		Percentages				
	For each item, indicate how much you have experienced this in your courses at Durham College. How much did your teacher:	Not at all	A little bit	A moderate amount	A lot	Unsure
Representation	Present the same course content in multiple ways (graphics, video, text, graphic organizers/concept maps, etc.)	11.76	29.41	23.53	35.29	0.00
	Offer an electronic version of the textbook	11.76	29.41	23.53	23.53	11.76
	Post handouts on DC Connect (or make them available digitally)	6.25	12.50	0.00	81.25	0.00
	Include subtitles on videos (closed captioned)	35.29	11.76	29.41	5.88	17.65
	Upload files can be read using text-to-speech software (e.g., Word documents PDFs)	11.76	5.88	5.88	52.94	23.53
	Provide clear guidelines for major assignments (e.g., example/sample assignment)	5.88	17.65	35.29	35.29	5.88
	Include a field trip	94.12	5.88	0.00	0.00	0.00
	Capture class lectures and made them available to stream after class (video or podcast)	47.06	29.41	5.88	11.76	5.88
	Make available a glossary of terms (on DC Connect, in the textbook, or other)	35.29	17.65	11.76	29.41	5.88
	Offer alternatives for auditory info (e.g., transcripts of videos) and visual info (e.g., description of images)	23.53	29.41	11.76	23.53	11.76
	Highlight patterns and relationships in the course content	25.00	12.50	31.25	18.75	12.50
Engagement	Offer interesting and relevant major assignments	6.25	37.50	31.25	25.00	0.00
	Allow for some autonomy and/or control in student learning (e.g., options for assignments (topic or format); or choices on tests (choose 1 of 2 essay questions; or pick 5 of the following terms to define)	23.53	11.76	35.29	23.53	5.88
	Let students decide which topics are covered in the course	58.82	5.88	5.88	11.76	17.65
	Use hands-on activities in class	18.75	31.25	12.50	25.00	12.50
	Connect course content to real world experiences	5.88	29.41	17.65	47.06	0.00
	Communicate with students (in class, outside of class, via message board or email)	5.88	5.88	23.53	64.71	0.00

		Percentages				
	Provide clear and specific feedback on assignments	17.65	52.94	29.41	0.00	0.00
	Offer a choice of how students want to receive feedback on assignments (e.g., verbal or written feedback)	35.29	29.41	5.88	23.53	5.88
	Allow students to re-submit assignments	52.94	35.29	5.88	0.00	5.88
	Include peer-evaluation as part of the coursework	35.29	23.53	23.53	17.65	0.00
	Make PowerPoint slides available to students	0.00	11.76	17.65	70.59	0.00
	Include group work and collaboration with other students (e.g., discussions)	0.00	23.53	17.65	58.82	0.00
	Provide opportunities for self-assessment/self-evaluation and reflection	5.88	29.41	11.76	52.94	0.00
	Answer questions about course content or assignments outside of class (e.g., discussion board, email)	5.88	5.88	17.65	70.59	0.00
	Use gender-neutral language and inclusive examples (race/culture, etc.)	17.65	17.65	5.88	52.94	5.88
	Minimize threats and distractions in the learning environment	17.65	23.53	11.76	47.06	0.00
	Motivate students to do their best work	11.76	23.53	17.65	47.06	0.00
Expression	Flexible due dates on major assignments (e.g., allowed to turn it in late)	29.41	35.29	11.76	17.65	5.88
	Offer ungraded or optional assignments to practice the course content	11.76	23.53	29.41	29.41	5.88
	Provide sufficient (or unlimited) time for tests	29.41	11.76	35.29	23.53	0.00
	Provide rubrics for major assignments	5.88	5.88	17.65	70.59	0.00
	Guide you using increasingly difficult activities or assignments	17.65	11.76	29.41	41.18	0.00
	Guide goal-setting and the development of student learning strategies	11.76	5.88	35.29	47.06	0.00
	Provide opportunities for students to monitor progress (e.g., grades posted on DC Connect)	5.88	11.76	11.76	70.59	0.00

Note: DC Connect refers to our Learning Management System.

Usefulness

Table 2 shows how useful students perceived each UDL element to be. With the exception of a few elements – field trips, peer evaluations, allowing students to resubmit assignments, giving students the choice of selecting which content is covered in the course, and capturing the lecture to make them available for later streaming – the UDL elements were rated as being helpful to student learning at least a moderate amount. This was especially true for having faculty available outside of class time to answer questions ("a lot" = 100%), providing rubrics for assignments ("a lot" = 90.91%), sharing lecture slides ("a lot" = 91.67%), providing clear feedback on assignments ("a lot" = 91.67%), regular communication with students ("a lot" = 91.67%), motivating students to do their best work ("a lot" = 91.67%), and posting handouts on the LMS ("a lot" = 91.67%). It seems that a key element for students is faculty communication.

Table 2

Students' usefulness ratings of UDL principles.

		Percentages				
	For each item, indicate how useful you think these things would be in helping you learn in your courses. Please answer for each item, EVEN IF YOU DID NOT EXPERIENCE IT in any of your courses.	Not at all	A little bit	A moderate amount	A lot	Unsure
Representation	Present the same course content in multiple ways (graphics, video, text, graphic organizers/concept maps, etc.)	0.00	0.00	16.67	83.33	0.00
	Offer an electronic version of the textbook	16.67	0.00	25.00	33.33	25.00
	Post handouts on DC Connect (or make them available digitally)	0.00	0.00	0.00	91.67	8.33
	Include subtitles on videos (closed captioned)	8.33	8.33	8.33	66.67	8.33
	Upload files can be read using text-to-speech software (e.g., Word documents PDFs)	16.67	0.00	8.33	66.67	8.33
	Provide clear guidelines for major assignments (e.g., example/sample assignment)	0.00	0.00	8.33	83.33	8.33
	Include a field trip	25.00	25.00	16.67	8.33	25.00
	Capture class lectures and made them available to stream after class (video or podcast)	25.00	8.33	16.67	50.00	0.00
	Make available a glossary of terms (on DC Connect, in the textbook, or other)	0.00	8.33	8.33	83.33	0.00
	Offer alternatives for auditory info (e.g., transcripts of videos) and visual info (e.g., description of images)	8.33	16.67	16.67	58.33	0.00
	Highlight patterns and relationships in the course content	8.33	8.33	16.67	50.00	16.67
Engagement	Offer interesting and relevant major assignments	0.00	8.33	8.33	75.00	8.33
	Allow for some autonomy and/or control in student learning (e.g., options for assignments (topic or format); or choices on tests (choose 1 of 2 essay questions; or pick 5 of the following terms to define)	0.00	0.00	16.67	83.33	0.00
	Let students decide which topics are covered in the course	25.00	8.33	8.33	41.67	16.67
	Use hands-on activities in class	0.00	0.00	16.67	75.00	8.33
	Connect course content to real world experiences	0.00	0.00	8.33	83.33	8.33

		Percentages				
	Communicate with students (in class, outside of class, via message board or email)	0.00	0.00	8.33	91.67	0.00
	Provide clear and specific feedback on assignments	0.00	8.33	0.00	91.67	0.00
	Offer a choice of how students want to receive feedback on assignments (e.g., verbal or written feedback)	0.00	16.67	33.33	41.67	8.33
	Allow students to re-submit assignments	16.67	8.33	16.67	41.67	16.67
	Include peer-evaluation as part of the coursework	8.33	16.67	8.33	58.33	8.33
	Make PowerPoint slides available to students	0.00	0.00	0.00	91.67	8.33
	Include group work and collaboration with other students (e.g., discussions)	0.00	16.67	16.67	58.33	8.33
	Provide opportunities for self-assessment/self-evaluation and reflection	8.33	8.33	33.33	50.00	0.00
	Answer questions about course content or assignments outside of class (e.g., discussion board, email)	0.00	0.00	0.00	100.00	0.00
	Use gender-neutral language and inclusive examples (race/culture, etc.)	0.00	0.00	16.67	66.67	16.67
	Minimize threats and distractions in the learning environment	8.33	0.00	8.33	83.33	0.00
	Motivate students to do their best work	0.00	0.00	8.33	91.67	0.00
Expression	Flexible due dates on major assignments (e.g., allowed to turn it in late)	8.33	8.33	8.33	58.33	16.67
	Offer ungraded or optional assignments to practice the course content	8.33	8.33	8.33	75.00	0.00
	Provide sufficient (or unlimited) time for tests	8.33	16.67	8.33	66.67	0.00
	Provide rubrics for major assignments	0.00	0.00	0.00	90.91	9.09
	Guide you using increasingly difficult activities or assignments	8.33	0.00	8.33	66.67	16.67
	Guide goal-setting and the development of student learning strategies	0.00	0.00	16.67	83.33	0.00
	Provide opportunities for students to monitor progress (e.g., grades posted on DC Connect)	0.00	15.38	0.00	84.62	0.00

Note: DC Connect refers to our Learning Management System.

Summary

Taken together, the usage and usefulness data paint a consistent picture: students are exposed to many elements of UDL in their classrooms and they find most of these elements to be useful to their individual learning. They perceive faculty communication as a key component of their success (i.e., feedback on assignments, communication outside of class, and responding to emails). Fortunately, the elements they encounter most (e.g., rubrics, communication, and sharing lecture slides) are also the ones they perceive as most helpful for their learning, while many of the elements they did not frequently encounter (e.g., field trips, streaming lectures, choosing course content) were also perceived as not particularly valuable. One limitation should be pointed out however, and that is the small sample of students who responded to the survey: only 17 out of several hundred students in the program provided us with data, but their responses are still valuable as a semi-representative sample of our student population. See the Concluding Remarks section for a more elaborate discussion.

Experiment 2

Student perceptions are important as they provide a glimpse into their realities. However, faculty perceptions are equally valuable and there are limited publications surveying faculty on their use and perceived usefulness of UDL principles. Assessing faculty perceptions of UDL in the classroom with give us a different perspective on the same reality and allow us to better understand what is happening in classrooms, and how useful specific elements of UDL are perceived to be by faculty.

Method

Participants

Participants were faculty teaching in the one-year General Arts and Science certificate program at an Ontario college. Approximately 40 faculty members were invited to complete the survey through email with an equal proportion being full-time employees and contract instructors. In total, 11 faculty members responded to the survey, yielding a response rate of approximately 28%. No demographic data were collected to maintain our colleagues' privacy and reduce the risk of identification. For a more detailed discussion, see the Concluding Remarks section.

Materials

The authors adapted the student survey from Experiment 1 as necessary to reflect the faculty's perspective. For example, in the student survey (Experiment 1), the first question asked "For each item, indicate how much you have experienced this in your courses," while in the survey for faculty, the question was reworded to "For each item, indicate how much you use it in your courses." The second question was similarly reworded to reflect a faculty's perspective. Faculty responded to the same 36 items as had the students in Experiment 1.

Procedures

Faculty teaching courses in the General Arts and Science program were recruited via email to participate in the study. Interested faculty clicked on the SurveyMonkey URL provided in the email and completed the adapted survey from Experiment 1, first rating their usage of each of the 36 items, and then their perceived usefulness. The questionnaire took approximately 10 minutes to complete. It was live for a two-week period and faculty were sent one reminder email one week after the initial recruitment email.

Results and Discussion

Usage

Table 3 shows how frequently faculty report using each of the UDL in their classrooms. The most used elements were posting content on the LMS (handouts "a lot" = 81.82; slides "a lot" = 100%), providing clear guidelines for assignments ("a lot" = 81.82%), answer questions and communicate with students outside of class ("a lot" = 90.91% and 81.82%, respectively), provide feedback on assignments ("a lot" = 90.91), and allow students to monitor their progress in the course by posting grades to the LMS ("a lot" = 100%).

The UDL elements that faculty reported not using very frequently include field trips ("not at all" = 72.73%), capturing and streaming lectures ("not at all" and "a little bit" combined = 100%), allowing students to decide course content ("not at all" and "a little bit" combined = 100%), offering a choice of how students receive feedback on assignments ("not at all" and "a little bit" combined =90.91%), and allowing students to resubmit assignments ("not at all" and "a little bit" combined = 72.73%).

Table 3
Faculty reporting of UDL usage in their classrooms.

		Percentages				
	For each item, indicate how much you use it in your courses at Durham College. How much did you:	Not at all	A little bit	A moderate amount	A lot	Unsure
Representation	Present the same course content in multiple ways (graphics, video, text, graphic organizers/concept maps, etc.)	0.00	0.00	45.45	54.55	0.00
	Offer an electronic version of the textbook	27.27	0.00	9.09	63.64	0.00
	Post handouts on DC Connect (or make them available digitally)	0.00	0.00	18.18	81.82	0.00
	Include subtitles on videos (closed captioned)	18.18	9.09	18.18	54.55	0.00
	Upload files can be read using text-to-speech software (e.g., Word documents PDFs)	0.00	9.09	9.09	54.55	27.28
	Provide clear guidelines for major assignments (e.g., example/sample assignment)	0.00	9.09	9.09	81.82	0.00
	Include a field trip	72.73	9.09	18.18	0.00	0.00
	Capture class lectures and made them available to stream after class (video or podcast)	63.64	36.36	0.00	0.00	0.00
	Make available a glossary of terms (on DC Connect, in the textbook, or other)	36.36	9.09	0.00	54.55	0.00
	Offer alternatives for auditory info (e.g., transcripts of videos) and visual info (e.g., description of images)	45.45	9.09	36.36	9.09	0.00
	Highlight patterns and relationships in the course content	9.09	18.18	9.09	54.55	9.09
Engagement	Offer interesting and relevant major assignments	9.09	18.18	27.27	45.45	0.00
	Allow for some autonomy and/or control in student learning (e.g., options for assignments (topic or format); or choices on tests (choose 1 of 2 essay questions; or pick 5 of the following terms to define)	27.27	18.18	27.27	27.27	0.00
	Let students decide which topics are covered in the course	63.64	36.36	0.00	0.00	0.00
	Use hands-on activities in class	0.00	9.09	36.36	54.55	0.00
	Connect course content to real world experiences	0.00	0.00	27.27	72.73	0.00
	Communicate with students (in class, outside of class, via message board or email)	0.00	0.00	18.18	81.82	0.00

		Percentages				
	Provide clear and specific feedback on assignments	0.00	0.00	9.09	90.91	0.00
	Offer a choice of how students want to receive feedback on assignments (e.g., verbal or written feedback)	63.64	27.27	0.00	9.09	0.00
	Allow students to re-submit assignments	54.55	18.18	18.18	9.09	0.00
	Include peer-evaluation as part of the coursework	54.55	0.00	45.45	0.00	0.00
	Make PowerPoint slides available to students	0.00	0.00	0.00	100.00	0.00
	Include group work and collaboration with other students (e.g., discussions)	18.18	9.09	18.18	54.55	0.00
	Provide opportunities for self-assessment/self-evaluation and reflection	27.27	0.00	45.45	27.27	0.00
	Answer questions about course content or assignments outside of class (e.g., discussion board, email)	0.00	0.00	9.09	90.91	0.00
	Use gender-neutral language and inclusive examples (race/culture, etc.)	0.00	9.09	27.27	63.64	0.00
	Minimize threats and distractions in the learning environment	0.00	0.00	27.27	72.73	0.00
	Motivate students to do their best work	0.00	9.09	27.27	63.64	0.00
Expression	Flexible due dates on major assignments (e.g., allowed to turn it in late)	18.18	36.36	36.36	9.09	0.00
	Offer ungraded or optional assignments to practice the course content	9.09	27.27	45.45	18.18	0.00
	Provide sufficient (or unlimited) time for tests	9.09	9.09	27.27	54.55	0.00
	Provide rubrics for major assignments	9.09	9.09	18.18	63.64	0.00
	Guide students using increasingly difficult activities or assignments	0.00	9.09	27.27	54.55	9.09
	Guide goal-setting and the development of student learning strategies	9.09	27.27	18.18	36.36	9.09
	Provide opportunities for students to monitor progress (e.g., grades posted on DC Connect)	0.00	0.00	0.00	100.00	0.00

Note: DC Connect refers to our Learning Management System.

Usefulness

Table 4 shows how useful faculty perceived each UDL element to be for students. Many of the elements that faculty did not include in their courses were elements that faculty also did not perceive as helpful to student learning. For example, including a field trip ("not at all" and "a little bit" combined = 55.55%), allowing students to decide course content ("not at all" and "a little bit" combined = 77.77%), allowing students to re-submit assignments ("not at all" and "a little bit" combined = 44.44%), and including peer-evaluation as part of the course ("not at all" and "a little bit" combined = 44.44%).

Where faculty felt that students benefitted most from UDL principles were by presenting material in multiple ways ("a lot" = 77.78%), posting handouts and slides on the LMS ("a lot" = 77.78% for each), providing clear guidelines on assignments ("a lot" = 88.89%), providing interesting major assignments ("a lot" = 77.78%) and hands-on learning activities ("a lot" = 77.78%), answering questions outside of class time ("a lot" = 100%), motivating students to do their best work ("a lot" = 100%), minimizing threats ("a lot" = 88.89%), and posting grades on the LMS to allow students to monitor their progress ("a lot" = 100%).

Table 4
Faculty's rating of the perceived usefulness of UDL principles for students.

		Percentages				
	For each item, indicate how useful you think these things are in helping your students learn in your courses. Please answer for each item, EVEN IF YOU DO NOT USE IT in any of your courses.	Not at all	A little bit	A moderate amount	A lot	Unsure
Representation	Present the same course content in multiple ways (graphics, video, text, graphic organizers/concept maps, etc.)	0.00	11.11	11.11	77.78	0.00
	Offer an electronic version of the textbook	22.22	22.22	33.33	11.11	11.11
	Post handouts on DC Connect (or make them available digitally)	0.00	11.11	0.00	77.78	11.11
	Include subtitles on videos (closed captioned)	0.00	0.00	44.44	33.33	22.22
	Upload files can be read using text-to-speech software (e.g., Word documents PDFs)	0.00	22.22	22.22	22.22	33.33
	Provide clear guidelines for major assignments (e.g., example/sample assignment)	0.00	0.00	11.11	88.89	0.00
	Include a field trip	11.11	44.44	22.22	11.11	11.11
	Capture class lectures and made them available to stream after class (video or podcast)	22.22	11.11	22.22	22.22	22.22
	Make available a glossary of terms (on DC Connect, in the textbook, or other)	22.22	0.00	22.22	55.56	0.00
	Offer alternatives for auditory info (e.g., transcripts of videos) and visual info (e.g., description of images)	11.11	33.33	33.33	22.22	0.00
	Highlight patterns and relationships in the course content	11.11	11.11	11.11	55.56	11.11
Engagement	Offer interesting and relevant major assignments	0.00	0.00	22.22	77.78	0.00
	Allow for some autonomy and/or control in student learning (e.g., options for assignments (topic or format); or choices on tests (choose 1 of 2 essay questions; or pick 5 of the following terms to define)	11.11	22.22	22.22	44.44	0.00
	Let students decide which topics are covered in the course	33.33	44.44	11.11	11.11	0.00
	Use hands-on activities in class	0.00	11.11	11.11	77.78	0.00
	Connect course content to real world experiences	0.00	11.11	88.89	0.00	0.00

		Percentages				
	Communicate with students (in class, outside of class, via message board or email)	0.00	11.11	88.89	0.00	0.00
	Provide clear and specific feedback on assignments	11.11	0.00	88.89	0.00	0.00
	Offer a choice of how students want to receive feedback on assignments (e.g., verbal or written feedback)	22.22	33.33	22.22	11.11	11.11
	Allow students to re-submit assignments	33.33	11.11	22.22	33.33	0.00
	Include peer-evaluation as part of the coursework	33.33	11.11	33.33	22.22	0.00
	Make PowerPoint slides available to students	0.00	11.11	11.11	77.78	0.00
	Include group work and collaboration with other students (e.g., discussions)	11.11	11.11	22.22	55.56	0.00
	Provide opportunities for self-assessment/self-evaluation and reflection	11.11	11.11	33.33	44.44	0.00
	Answer questions about course content or assignments outside of class (e.g., discussion board, email)	0.00	0.00	0.00	100.00	0.00
	Use gender-neutral language and inclusive examples (race/culture, etc.)	0.00	22.22	22.22	55.56	0.00
	Minimize threats and distractions in the learning environment	0.00	0.00	0.00	100.00	0.00
	Motivate students to do their best work	0.00	0.00	0.00	88.89	11.11
Expression	Flexible due dates on major assignments (e.g., allowed to turn it in late)	33.33	0.00	44.44	22.22	0.00
	Offer ungraded or optional assignments to practice the course content	11.11	0.00	33.33	55.56	0.00
	Provide sufficient (or unlimited) time for tests	11.11	11.11	33.33	44.44	0.00
	Provide rubrics for major assignments	0.00	11.11	33.33	55.56	0.00
	Guide you using increasingly difficult activities or assignments	0.00	0.00	33.33	44.44	22.22
	Guide goal-setting and the development of student learning strategies	11.11	0.00	44.44	33.33	11.11
	Provide opportunities for students to monitor progress (e.g., grades posted on DC Connect)	0.00	0.00	0.00	100.00	0.00

Note: DC Connect refers to our Learning Management System

Summary

Taken together, the usage and usefulness data provided by faculty show that elements of UDL are consistently included in their curriculum, perhaps because they perceive these elements as valuable to student learning. The elements that faculty did perceive as valuable to students' learning were typically integrated into their course curriculum. Although the response rate for faculty was also small, it is likely more representative of all the courses in the General Arts and Science program as full-time faculty teach 8-10 courses per year, while contract employees typically teach 2-4; full-time faculty appeared to be more likely to complete the survey based on the open-ended comments that were made by respondents and participants' self-identification to the researchers.

General Discussion

Comparing the data from students (Experiment 1) and faculty (Experiment 2) can show us where discrepancies may exist for usage and perceived usefulness for elements of UDL.

Usage

Importantly, there is much agreement on which UDL principles are present in the classroom, but there were also some interesting perceived differences. One of these elements was offering an electronic version of the textbook. Perhaps students were not aware that e-books existed for their courses, because two-thirds of faculty reported that an e-text was available, but less than one-quarter of students did. So, although the electronic format may be provided as an option to students, they may not actually be aware of this alternate means of representation.

In terms of using hands-on activities in the classroom, faculty believe they are providing students with far more hands-on activities than students report experiencing them. This difference is likely due to how this question was operationalized by each group of respondents, (i.e., which activities would be considered hands-on) and expectations for the classrooms (e.g., instructors may have higher expectations based on their knowledge of best practices in the classroom). And, although many faculty respondents report that they do not offer many alternatives for auditory and visual information, students reported a greater amount of alternatives in their classrooms. Here again, the difference may have more to do with a mismatch between student and faculty expectations for alternative formats.

One key element where students and faculty disagreed had to do with faculty highlighting patterns and relationships to students in the classroom. Students perceived far less highlighting of these relationships than faculty report using. This discrepancy may be due to the level at which faculty are highlighting these patterns; if they are beyond the cognitive abilities of the students, these patterns may not be fully understood by students. Research by Kennette and Frank (2013)

and Bowman, Frame, and Kennette (2013) have shown that peers are in a unique position to bridge the knowledge gap between expert instructors and novice students as their cognitive sets are more similar and can therefore explain concepts or relationships between them at the students' level. Related to this, and possibly caused by the same underlying issue, faculty believe they are almost always providing clear feedback on assignments, but students are more divided on this. The final element that we wish to highlight is related to the principle of engagement. Faculty believe they are providing a safe and distraction-free environment, but may not be aware of what can be distracting to students (in both their personal and academic lives), as student perceptions differed from faculty's perceptions. We may think our students are not distracted in the classroom, but they report that they are. We may not notice, of course, but there may be students nearby whispering or students on Facebook on their laptops near the front of the class. There are policies we may be able to put in place to reduce in-class distractions (such as asking students with laptops to sit near the back of the class), but it is unlikely that instructors can eliminate all distractions in the learning environment.

Usefulness

For the elements that students and faculty disagreed on in terms of usefulness, students typically perceived the UDL elements as more useful than faculty did. For example, there was disagreement on the value of including peer-evaluation as part of the coursework. Students felt that evaluating their peers was a more critical feature of their success than faculty did. This is perhaps because students have experienced dysfunctional groups more than faculty have been made aware and they would like to have a mechanism to declare these transgressions; alternately, students may feel that peer-evaluations would serve as a deterrent to non-participatory group members. This is an interesting finding as, anecdotally, faculty report students' dislike for group work (Kennette & Hanzuk, 2017). An accurate explanation is beyond the scope of this paper, and, although we can speculate, future research should address this paradox empirically.
Capturing lectures and posting online for later viewing or listening was another area of disagreement as to its perceived helpfulness for understanding course material. Two-thirds of student respondents felt that capturing lectures for later streaming was moderately or very helpful, while less than half of faculty respondents felt this way. Of course, it is possible that students' perceived value for this item reflects, in part, a desire to be able to miss class without missing content. However, since students also reported moderate usefulness for text-to-speech compatible files, perhaps it is simply that students prefer to have access to auditory course content, perhaps to listen to while riding the bus to campus.

Finally, far more students saw autonomy or control (e.g., assignment or test format options) as being helpful to their learning than did faculty. We know from the literature on motivation (see Pink, 2011) that autonomy and control are important components of motivation and this is likely what is driving this difference in perception as faculty already have most of the control in the typical classroom.

Concluding Remarks

The good news is that there is much agreement in which UDL principles are present in the classrooms, but there were also some differences in the student and faculty perspectives. Some of these differences may have to do with the frame of reference each is bringing to the classroom or by the lack of explicit transparency by faculty (for example, having a reflection as part of an assignment, but not labelling it as such).

One important limitation which warrants further discussion is the small sample size and the lack of demographic data collected to describe our sample. Especially in Experiment 1 (students), respondents were a very small portion of the total population and may not have been a representative sample. As this study was descriptive in nature and we had not hypothesized tied to any particular demographic criteria, our school's IRB discourages the collection of these data as they significantly increase the risk of identification.

However, the lack of sample demographics and the low response rate should not necessarily be interpreted as our sample coming from an unrepresentative subset of the program's student population. It is also important to remember that each student is enrolled in 6 courses per semester, so each respondent is providing data on 12 courses in the program. In Ontario colleges, which would be similar to 2-year schools in the US, there is very little research conducted by faculty, and so students are not used to seeing these opportunities. Furthermore, there are typically no incentives for participation in research by students. In our experience, participation rates to in-person classroom recruitment are typically only around 10% and offering an incentive negligibly increases this rate (by 1-2%). Research is simply not part of the expectations for students at our school.

What can we learn from these data? In general, students find UDL principles to be useful for their learning and faculty are overall pretty good at including these elements in their curriculum. When designing curriculum, particular consideration may be given to the elements that students found especially beneficial, however faculty should also ensure that they include elements from all three principles of UDL. It is important to note that the data reported here are student and faculty perceptions. Student perceptions of usefulness are not backed up by performance data. Future research should examine whether the perceived usefulness of these UDL principles by students correlates with student performance data such as course grades.

References

Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016) Universal Design for Learning (UDL): A content analysis of peer-reviewed journal papers from 2012-2015.

Journal of the Scholarship of Teaching and Learning, 16(3), 39-56. Retrieved from https://files.eric.ed.gov/fulltext/EJ1104867.pdf

Assor, A. Kaplan, H. & Roth, G. (2002). Choice is good, but relevance is excellent: Autonomy-enhancing and suppression teacher behaviours predicting students' engagement in schoolwork. *British Journal of Educational Psychology, 72,* 261-278. doi: http://dx.doi.org/10.1348/000709902158883

Black, R. D., Weinberg, L. A., & Brodwin, M. G. (2015). Universal Design for Learning and Instruction: Perspectives of students with disabilities in higher education. *Exceptionality Education International, 25(*2), 1-26. Retrieved from https://ir.lib.uwo.ca/cgi/viewcontent.cgi?article=1131&context=eei

Bowman, M., Frame, D. L., & Kennette, L. N. (2013). Enhancing Teaching and Learning: How Cognitive Research Can Help. *Journal on Excellence in College Teaching: Brain-Based Learning (Special Issue), 24*(3), 7-28.

CAST (2011a). *Universal Design for Learning Guidelines version 2.0*, Wakefield, MA. Retrieved from http://udlguidelines.cast.org/binaries/content/assets/udlguidelines/udlg-v2-0/udlg_fulltext_v2-0.doc

CAST (2011b). *Universal Design for Learning Guidelines version 2.0 [graphic organizer]*, Wakefield, MA. Retrieved from http://udlguidelines.cast.org/binaries/content/assets/udlguidelines/udlg-v2-0/udlg_graphicorganizer_v2-0.pdf

CAST (2018). Universal Design for Learning Guidelines. *Center for Applied Special Technology.* Retrieved from http://udlguidelines.cast.org

Chita-Tegmark, M., Gravel, J. W., Serpa, M. L. B., Domings, Y., & Rose, D. H. (2012). Using the universal design for learning framework to support culturally diverse learners. *Journal of Education, 192*(1), 17-22. doi: 10.1177/002205741219200104

Claiborne, L. B., Cornforth, S., Gibson, A., & Smith, A. (2010). Supporting students with impairments in higher education: Social inclusion or cold comfort? *International Journal of Inclusive Education, 15*(5), 513–527. doi: 10.1080/13603110903131747

Davies, P. L., Schelly, C. L., & Spooner, C. L. (2013). Measuring the effectiveness of universal design for learning intervention in postsecondary education. *Journal of Postsecondary Education and Disability, 26*(3), 195-220. Retrieved from https://eric.ed.gov/?id=EJ1026883

Fichten, C. S., Jorgensen, S., Havel, A., & Barile, M. (2006). *College students with disabilities: Their future and success.* Retrieved from https://eric.ed.gov/?id=ED491585

Goldowsky, B. N. & Coyne, M. (2016, April). Supporting engagement and comprehension online through multiple means of expression. In H. Tokagi (Chair), *Accessible Multimedia.* Symposium conducted at the meeting of the Web for All Conference, Montreal, Canada. Retrieved from https://dl.acm.org/citation.cfm?doid=2899475.2899488

Kennette. L. N. & Hanzuk, W. (2017, May 1). Group work and collaborative activities for all. *Faculty Focus.* https://www.facultyfocus.com/articles/instructional-design/group-work-collaborative-activities/

Kennette, L. N., & Frank, N. M. (2013). The value of peer-review opportunities for students in writing-intensive classes. *Psychology Teaching Review, 19*(2), 106-111.

Kozma, R. (2003). The material features of multiple representations and their cognitive and social affordances for science understanding. *Learning and Instruction, 13*(2), 205-226. doi: http://dx.doi.org/10.1016/S0959-4752(02)00021-X

Marshak, L., Van Wieren, T., Ferrell, D. R., Swiss, L., & Dugan, C. (2011). Exploring barriers to college student use of disability services and accommodations. *Journal of Postsecondary Education and Disability, 22*(3), 151–165. Retrieved from https://eric.ed.gov/?id=EJ906688

Ontario University & College Health Association (2016). *National College Health Assessment.* Retrieved from http://oucha.ca/ncha.php

Patall, E. K., Cooper, H., & Robinson, J. C. (2008). The effects of choice on intrinsic motivation and related outcomes: A meta-analysis of research findings. *Psychological Bulletin, 134*(2), 270-300. doi: 10.1037/0033-2909.134.2.270

Pink, D. (2011). *Drive: The Surprising Truth About What Motivates Us*, New York, NY: Riverhead Books.

Raue, K., & Lewis, L. (2011). *Students with Disabilities at Degree-Granting Postsecondary Institutions* (NCES 2011–018). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office. Retrieved from https://nces.ed.gov/pubs2011/2011018.pdf

Rose, D. H., & Strangman, N. (2007). Universal design for learning: Meeting the challenge of individual learning differences through a neurocognitive perspective. *Universal Access in the Information Society*, *5*(4), 381-391. doi: https://doi.org/10.1007/s10209-006-0062-8

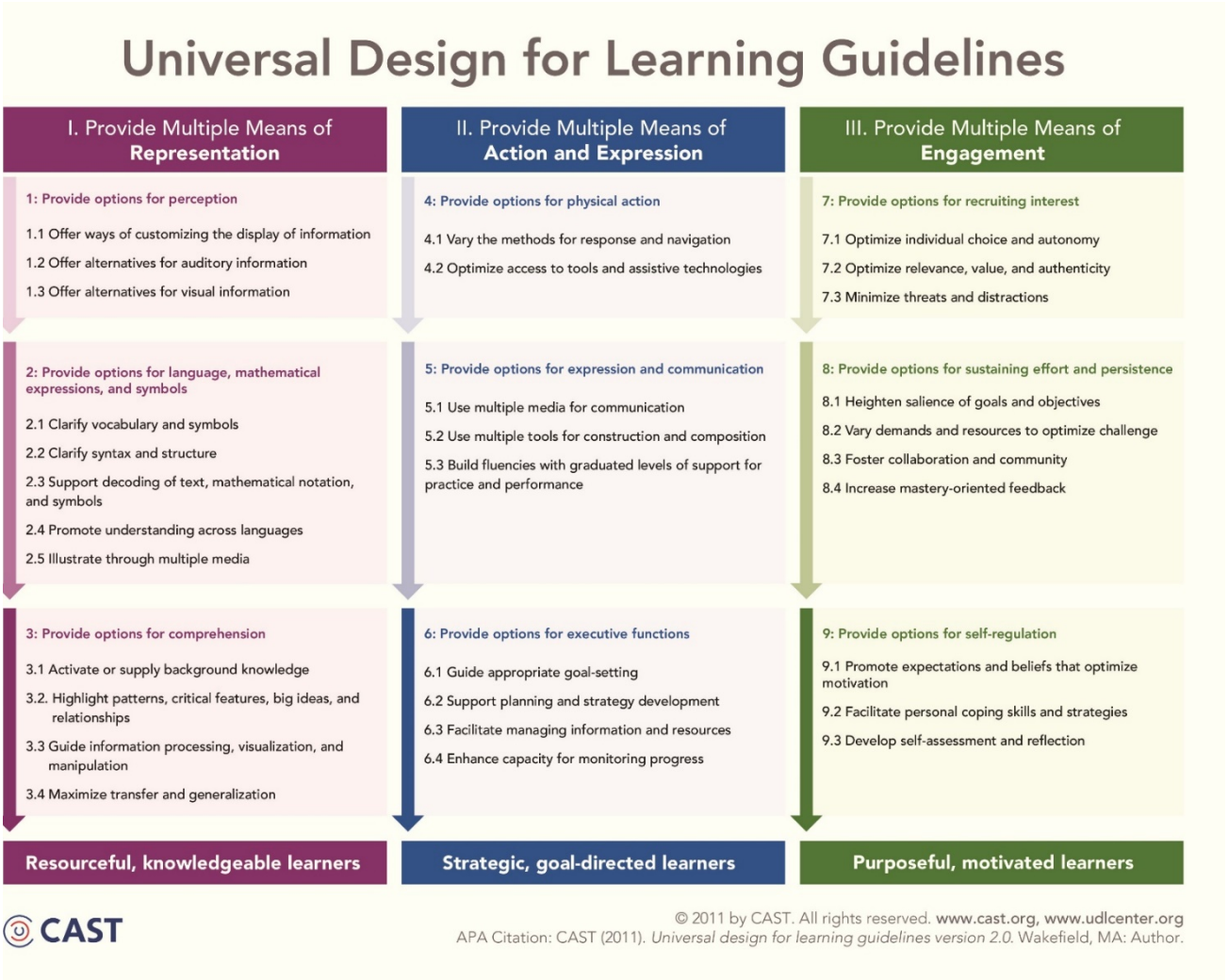
Russell, M. (2000). It's Time to Upgrade: Tests and administration procedures for the new millennium. *The Secretary's Conference on Education Technology 2000*, U.S., Department of Education. Retrieved from https://files.eric.ed.gov/fulltext/ED452833.pdf

Schelly, C. L., Davies, P. L., & Spooner, C. L. (2011). Student perceptions of faculty implementation of universal design for learning. *Journal of Postsecondary Education and Disability, 24*(1), 17-30. Retrieved from https://accessproject.colostate.edu/assets/PDFs/Schelly,%20Davies,%20Spooner%202011.pdf

Statistics Canada (2016). *International students in Canadian Universities 2005-2005 to 2013-2014*. Retrieved from http://www.statcan.gc.ca/pub/81-599-x/81-599-x2016011-eng.htm

Wagner, M., Newman, L., Cameto, R., Garza, N., and Levine, P. (2005). *After High School: A First Look at the Postschool Experiences of Youth with Disabilities. A Report from the National Longitudinal Transition Study-2 (NLTS2)* Menlo Park, CA: SRI International. Retrieved from www.nlts2.org/reports/2005_04/nlts2_report_2005_04_complete.pdf

Appendix A



Graphic Organizer of UDL framework (CAST, 2011b).

Appendix B

Student items (Experiment 1). DC Connect is our college-branded Learning Management Site (LMS).

Present the same course content in multiple ways (graphics, video, text, graphic organizers/concept maps, etc.)

Offer an electronic version of the textbook

Post handouts on DC Connect (or make them available digitally)

Include subtitles on videos (closed captioned)

Upload files can be read using text-to-speech software (e.g., Word documents PDFs)

Provide clear guidelines for major assignments (e.g., example/sample assignment)

Include a field trip

Capture class lectures and made them available to stream after class (video or podcast)

Make available a glossary of terms (on DC Connect, in the textbook, or other)

Offer alternatives for auditory info (e.g., transcripts of videos) and visual info (e.g., description of images)

Highlight patterns and relationships in the course content

Offer interesting and relevant major assignments

Allow for some autonomy and/or control in student learning (e.g., options for assignments (topic or format); or choices on tests (choose 1 of 2 essay questions; or pick 5 of the following terms to define)

Let students decide which topics are covered in the course

Use hands-on activities in class

Connect course content to real world experiences

Communicate with students (in class, outside of class, via message board or email)

Provide clear and specific feedback on assignments

Offer a choice of how students want to receive feedback on assignments (e.g., verbal or written feedback)

Allow students to re-submit assignments

Include peer-evaluation as part of the coursework

Make PowerPoint slides available to students

Include group work and collaboration with other students (e.g., discussions)

Provide opportunities for self-assessment/self-evaluation and reflection

Answer questions about course content or assignments outside of class (e.g., discussion board, email)

Use gender-neutral language and inclusive examples (race/culture, etc.)

Minimize threats and distractions in the learning environment

Motivate students to do their best work

Flexible due dates on major assignments (e.g., allowed to turn it in late)

Offer ungraded or optional assignments to practice the course content

Provide sufficient (or unlimited) time for tests

Provide rubrics for major assignments

Guide you using increasingly difficult activities or assignments

Guide goal-setting and the development of student learning strategies

Provide opportunities for students to monitor progress (e.g., grades posted on DC Connect)