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Student Perceptions of Faculty Implementation of Universal Design for Learning

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Abstract

The anecdotal benefits of implementing Universal Design for Learning (UDL) at postsecondary institutions are well documented. The literature suggests that UDL offers students with disabilities enhanced opportunities for engagement, expression, and academic performance. Responding to the call by educators for empirical evidence of UDL's beneficial effects on student learning, performance, persistence, and ultimately retention, this study measured changes and /or improvements in instruction as perceived by students following UDL instructor training and subsequent course delivery modifications. This study also describes the process that was undertaken to develop and implement pre- and post-student surveys, and points the way toward further research regarding the benefits of UDL implementation to postsecondary education.

The number of students with disabilities is growing on college campuses across the nation. In the two decades between 1978 and 1998, the percentage of college freshman with a disability tripled (from 3% to 9%), according to the National Council on Disability (2003). Today an estimated 11% of undergraduates—more than two million—report having some type of disability (National Center for Education Statistics, 2008b; U.S. Government Accountability Office, 2009).

While the *number* of college students with disabilities has grown, the *distribution* of disability types has changed. Indeed, the proportions of non-apparent and apparent disabilities have reversed, with significant growth occurring in the former category and decline in the latter. For example, the percentage of undergraduates who reported having a mental, emotional, or psychiatric condition/depression increased from 17.1% in 2000 to 24.3% in 2008, while the percentage of students who reported an orthopedic or mobility impairment decreased from 29% to 15.1% during the same period. Non-apparent disability categories such as attention deficit disorder (ADD) and specific learning disabilities/dyslexia also represented a higher percentage of the total population of students with disabilities (U.S. Government Accountability Office, 2009).

Adding to the population of students with disabilities are veterans who have sustained injuries in Iraq and Afghanistan, many of whom experience what the RAND Corporation calls the "invisible wounds of war" (Tanielian, et al., 2008). It has been estimated that 20% of returning veterans suffer from post traumatic stress disorder (PTSD) or major depression, while 19% have experienced a traumatic brain injury (TBI) (Tanielian, et al., 2008). Many of these men and women will soon be enrolling in postsecondary education under the new GI Bill. (American Council on Education, 2008; Stiglitz & Bilmes, 2008).

Seen through the lens of enrollment, colleges and universities have come a long way toward meeting the equal access requirements of the law (in particular, the ADA Amendments Act of 2008 (ADAAA) and Section 504 of the Rehabilitation Act of 1973). However, when we look at the number of students with disabilities who actually complete their degree programs, the picture is less encouraging. According to deFur, Getzel, & Trossi (1996), "the likelihood of earning a degree is decreased by the presence of a disability" (p. 232). This was confirmed by Johnson and Fox (2003), who reviewed data from the 1997 National Longitudinal Study and concluded that "students with disabilities are less likely than their non-disabled peers to complete their education" (p. 7). In fact, only 6% of Americans with disabilities ages 21–64 have attained a bachelors degree (National Council on Disability, 2008), and,

according to an earlier study, those who did complete their degree programs took twice as long to do so as their fellow students without disabilities (National Council on Disability, 2003).

Completing a college degree is a challenge for many students, not just those with disabilities, and nearly all two and four year institutions of higher education struggle with issues of persistence, retention, and degree attainment (Murphy, 2006; National Center for Public Policy and Higher Education, 2008). One of the often-cited explanations for this problem is the growing diversity of students on college campuses. As has been shown by numerous studies, students today embody a wide range of diversity in terms of age, life experiences, academic preparation, ethnicity, native language, learning styles, abilities, and disabilities (Chronicle of Higher Education, 2009; Higher Education Research Institute, 2007, 2008; McGuire & Scott, 2006; National Center for Education Statistics, 2008a; Zeff, 2007).

To help improve rates of persistence, retention, and attainment for such a diverse student body, several instructional models have been proposed that build on a set of principles called Universal Design (UD) (Burgstahler, 2008). According to the Center for Universal Design (2009) at North Carolina State University, "Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." Universal Design is an expression of a modern view of disability—one that focuses on the interaction of an individual with his or her environment (Aune, 2000; Rose, Harbour, Johnston, Daley, & Abarbanell, 2008).

Problems of access, according to this view, can often be avoided by eliminating environmental barriers that potentially affect a wide range of people. Manually operated doors, sidewalks, stairs and standing-height drinking fountains, for example, are all potential barriers to someone using a wheelchair, but they also make life difficult for anyone who is carrying a heavy load, using crutches after an accident, or who simply isn't tall enough to reach a drinking fountain. The "universally designed" solutions to these barriers—automatic doors, curb cuts, ramps, elevators and accessible drinking fountains—can be used and enjoyed by everyone. One of the hallmarks of Universal Design is that it "proactively builds in features to accommodate the range of human diversity" (McGuire, Scott, & Shaw, 2006, p. 173).

Not surprisingly, educators have adopted UD as a conceptual and philosophical foundation on which to build a model of teaching and learning that is inclusive, equitable, and guides the creation of accessible course materials. Several models appear in the literature, including Universal Design of Instruction, based on UD's seven original principles, and Universal Design for Instruction, based also on the seven principles but with two additional principles added to specifically address issues of teaching and learning (Burgstahler, 2008).

Another UD model for education is Universal Design for Learning (UDL), which retains UD's spirit of inclusion while reducing the number of principles to just three. Universal Design for Learning has three principles, which are tailored to the instructional environment, are based on cognitive research involving "learning networks." These principles are: 1) multiple means of representation, to give learners various ways of acquiring information and knowledge; 2) multiple means of student action and expression, to provide learners alternatives for demonstrating what they know; and 3) multiple means of student engagement, to tap into learners' interests, challenge them appropriately, and motivate them to learn (Center for Applied Special Technology, 2009).

The ACCESS Project at Colorado State University has adopted this three-part UDL framework to guide its primary mission: ensuring that students with disabilities receive a quality higher education. While never losing sight of the needs of students with disabilities, the Project has broadened its focus to include improved learning opportunities for *all students* (ACCESS Project, 2007). Universal Design for Learning is promoted as a model for good teaching generally, and as such it is becoming an important part of a broader conversation about pedagogy. Through a partnership with the university's Institute for Learning and Teaching, UDL is being addressed in "Master Teacher Seminars" and "Teaching with Technology Workshops" that reach hundreds of faculty and graduate teaching assistants every semester.

The literature about UD in higher education is long on principles and "best practices," but short on empirical evidence of its benefits. In response to the call for more research by scholars in this field (Burgstahler, 2008; McGuire, et al., 2006; Rose, et al., 2008, p. 138; Spooner, Baker, Harris, Delzell, & Browder, 2007), the ACCESS Project put in place a research agenda to examine the effectiveness of providing training to faculty on the principles and practices of UDL. After

reviewing the literature for guidance on possible research designs, it was determined that a study at the University of Guelph in Ontario, Canada, provided a model of how such research might be conducted (Yuval, Procter, Korabik, & Palmer, 2004). Yuval and colleagues describe their efforts to measure the "extent of UID [Universal Instructional Design] implementation, and to assess whether student academic self-efficacy and affective states improved as a result of UID implementation" (Yuval, et al., 2004, p. 1).

Similar to our colleagues at Guelph, the ACCESS team wanted to measure student perceptions following UD training. However, unlike the Guelph study, our research would focus on changes in the teaching behavior of instructors following UDL training. To accomplish this, a new questionnaire was developed based on the three principles of UDL (as opposed to the seven principles of UID). UDL training was also designed around the same three principles. It was decided that a questionnaire should be administered to students both before and after UDL training. Results from the first survey would be used to guide and fine-tune the training that would occur prior to the administration of the second survey. Finally, to cover the full range of UDL practices, the survey questions needed to measure implementation in two distinct areas: classroom instruction and course materials.

The purpose of this study was to measure the effectiveness of UDL instructor training, as indicated by student perceptions of UDL implementation. Determining the feasibility of measuring changes in faculty behaviors via student perceptions was also an important goal. The study also sought to provide data regarding the number of students who identified as having a disability, and of those, the number who had contacted the disability services office to request some type of accommodation.

Method

Focus Groups

The development of our study began with a focus group of educators. With the help of the Dean of the College of Natural Sciences, we identified instructors who teach large, undergraduate "gateway" courses. In three focus group meetings we discussed the principles of UDL and how we might train faculty to incorporate UDL strategies into courses at our university. Following these informative meetings, Introduction to Psychology, with approximately 1,600 students per semester, was targeted for our research.

Survey Development

The survey used in the study was developed and pilot tested one semester prior to the initiation of this study. Questions developed by the ACCESS team were based on the three principles of UDL, which were fundamental in the development of the UDL training: 1) multiple means of representation of information, 2) multiple means of students expressing their knowledge, and 3) multiple means of engaging students in the learning process. Efforts were made to develop survey questions that logically connected with these three principles. "For example, the first question on the survey in the form of a Likert statement, 'The instructor presents information in multiple formats (e.g., lecture, text, graphics, audio, video),' provides a classic demonstration of multiple means of representation." To address the second UDL principle, multiple means of student expression, question 13 on the survey states, "Students in this course are allowed to express their comprehension of material in ways besides traditional tests and exams (e.g., written essays, projects, portfolios)." Similarly, questions 17 through 19—"In this course I feel interested and motivated to learn," "I feel challenged with meaningful assignments," and "The instructor expresses enthusiasm for topics covered in class"—correspond with the third UDL principle of student engagement. Because of the complex nature of teaching and learning, some questions capture more than one UDL principle.

The pilot survey was administered to students in five psychology courses, in which a total of 1,170 students were enrolled and 722 students completed the survey (62%). Based on the student data and feedback from the students and instructors, two questions were added to the survey and several of the questions were refined by the ACCESS team in collaboration with the instructors of the psychology courses. The final survey consisted of 27 questions: 24 of the questions pertained to UDL strategies and 3 questions concerned demographic information regarding grades and disability identification (see Appendix). Even though the process for developing and revising the survey was somewhat informal, we felt confident with the final product because of the extensive feedback we received from the students and expert instructors.

Participants

Participants in the study included five instructors (four taught two sections, and one taught one section) and students from nine sections of Introduction to Psychology. A total of 1,615 students were enrolled in the nine sections; of those, 1,362 students filled out the first survey of the semester and 1,223 students filled out the second survey. Thus, 76% percent of the students completed the second survey.

Procedures

During the first two weeks of the semester, the instructors were given directions for delivering the surveys to the students. The surveys were given to the students in class during the third week of the semester. Students were first shown a cover letter that informed them about the study procedures and requirements for their participation. They were then asked to fill out the survey during the class period and return it to their instructors before leaving class. The survey required 5 to 10 minutes to complete. During the last two weeks of the semester the students were given the opportunity to fill out the survey a second time. The procedure for administering the survey at the end of the semester was the same as at the beginning. Both surveys contained the same questions, and both were anonymous. During the ten weeks between the first and second administration of the survey, the instructors received UDL training, which is described in more detail below.

Training Procedures

The instructors of the Introduction to Psychology courses were Ph.D.-level graduate students who had been selected for teaching fellowships based on demonstration of teaching excellence. The instructors were mentored as a group by an assistant professor during weekly meetings throughout the semester. During five of those meetings, the ACCESS team provided one hour of UDL training. Training topics included techniques in each of the three UDL categories for both classroom teaching and the development of accessible course materials. The study required that the curriculum for this training would be modified, in part, after analyzing the results of the first survey. For example, if students reported feeling more engaged by the use of a classroom response system known as "clickers," the training would be adapted to spend more time exploring the effective use of that technology to achieve the inclusive goals of UDL. In addition to this face-to-face training, ACCESS Project staff created a series of tutorials on how to create "universally designed" Word, PowerPoint, PDF, HTML, and E-Text documents. These tutorials were designed to offer clear explanations of accessibility barriers commonly found in electronic course materials, as well the benefits of UDL techniques for a wide range of users, including those employing assistive technologies. Additionally, step-by-step instructions were provided to facilitate more complex operations such as conversion from one format to another, location of menu commands and selection of dialog box options.

Training Based on Pre-Survey Results

The training for the instructors was designed to highlight the areas in which students' average response was below four points (corresponding to "agree") on the Likert scale for the pre-training survey (see Table 2). The items with an average of less than four points were questions 5, 8, 9, 10, and 14 (see the Appendix for the specific survey questions). To address these areas, the training included discussions regarding summarizing material at critical points across each class session (questions 5 and 10). Two of the questions that fell below the cutoff related to providing course material in electronic formats. Thus, training included information and practical tips on converting course material to a variety of electronic formats. Training also included information on presenting material in multiple formats (i.e., lecture, text, graphics, video, and audio) and engaging students in the learning process, as the instructors were interested in advancing their proficiency in those areas.

Data Analysis

Descriptive statistics were used to provide information about the percentage of students completing the surveys and details about certain demographic questions. T-tests were used to compare students' perceptions of their instructors' use of UDL strategies before and after UDL training. All analyses were conducted using SPSS 14.0. A family-wise alpha level of 0.05 was used to determine levels of significance. Adjustments to the family-wise alpha were made according to the Bonferroni correction—that is, dividing .05 by the number of tests conducted (0.05/24 = .002). Thus, the test-wise alpha used for the study was .002. Cohen's d effect sizes were used for this study. Cohen

Table 1

Number of students enrolled in each section of the course and the number and percentage of students completing the pre-survey and post-survey.

Section/Instructor	# Students Enrolled	Pre-Survey		Post-Survey	
		# Students	%	# Students	%
PSY100 - 001 / Inst1	197	150	76	100	51
PSY100 - 002 / Inst1	182	175	96	149	82
PSY100 - 003 / Inst2	184	156	85	169	92
PSY100 - 004 / Inst2	182	155	85	170	93
PSY100 - 005 / Inst3	122	102	84	108	89
PSY100 - 006 / Inst4	184	140	76	132	72
PSY100 - 007 / Inst4	200	136	68	127	64
PSY100 - 008 / Inst5	182	178	98	145	80
PSY100 - 009 / Inst5	182	170	93	123	68
TOTAL	1615	1362	84	1223	76

Table 2

The differences in student responses on the pre-survey and post-survey (t-tests) for the 24 questions related to UDL strategies.

	Pre-Survey		Post-Survey				95% CI		Cohen's
Question	*M*	*SD*	*M*	*SD*	*t*	*p*	LL	UL	*d*
Q1	4.49	0.66	4.73	0.54	10.09	<.0005	-0.29	-0.19	0.40
Q2	4.34	0.69	4.48	0.69	5.22	<.0005	-0.20	-0.09	0.13
Q3	4.23	0.72	4.36	0.72	4.45	<.0005	-0.18	-0.07	0.02
Q4	1.66	0.82	1.66	0.89	0.09	.927	-0.70	-0.06	0.00
Q5	3.21	1.14	3.37	1.09	3.50	<.0005	-0.24	-0.07	0.14
Q6	4.14	0.75	4.17	0.77	0.99	.320	-0.09	0.03	0.04
Q7	4.33	0.70	4.43	0.69	3.75	<.0005	-0.16	-0.05	0.15
Q8	3.66	1.02	3.91	1.04	6.13	<.0005	-0.33	-0.17	0.24
Q9	3.38	1.00	3.75	1.08	8.74	<.0005	-0.45	-0.29	0.36
Q10	3.96	0.82	4.27	0.78	9.62	<.0005	-0.39	-0.24	0.39
Q11	4.63	0.61	4.63	0.57	0.28	.780	-0.05	0.04	0.00
Q12	3.99	0.79	4.12	0.81	4.09	<.0005	-0.19	-0.07	0.16
Q13	4.08	0.74	4.15	0.84	1.97	.049	-0.12	-0.00	0.09
Q14	3.50	0.91	3.80	0.94	8.14	<.0005	-0.37	-0.23	0.33
Q15	4.12	0.72	4.14	0.76	0.53	.600	-0.07	0.04	0.02
Q16	4.38	0.86	4.37	0.95	0.30	.764	-0.06	0.08	0.01
Q17	4.22	0.80	4.24	0.91	0.66	.507	-0.09	0.04	0.02
Q18	3.99	0.84	4.05	0.92	1.56	.008	-0.12	0.01	0.07
Q19	44.54	0.63	4.59	0.63	1.69	.090	-0.09	0.01	0.08
Q20	4.12	0.83	4.20	0.83	2.46	.014	-0.15	-0.02	0.10
Q21	4.31	0.71	4.40	0.71	3.19	.001	-0.15	-0.04	0.13
Q22	4.35	0.69	4.46	0.68	4.02	<.0005	-0.16	-0.06	0.16
Q23	4.14	0.84	4.28	0.83	4.14	<.0005	-0.20	-0.07	0.17
Q24	4.23	0.72	4.37	0.70	5.14	<.0005	-0.20	-0.09	0.20

Note: CI = confidence interval of the Difference; LL = lower limit; UL = upper limit.
Cohen's *d*: .10 to .30 = small effect; .40 to .70 = medium effect; .80 to 1.0 = large effect (Cohen, 1988).

Key to Survey Questions (Listed in Table 2)
Q1 = Instructor presents information in multiple formats.
Q2 = Instructor's expectations are consistent with syllabus learning objectives.
Q3 = Instructor ties the most important points to the larger objectives of the course.
Q4 = Instructor often speaks while facing the board/screen or looking at notes.
Q5 = The instructor begins each lecture with an outline of what will be covered.
Q6 = The instructor summarizes key points throughout the lecture.
Q7 = Course syllabus clearly describes the content and expectations of this course.
Q8 = Instructor provides electronic equivalents (e.g., HTML, Word, PDF) of paper handouts.
Q9 = Required reading assignments (other than the textbook) are available online.
Q10 = I am able to grasp the key points from instructional videos for this class.
Q11 = Instructor uses instructional technologies (e.g., clickers, RamCT) to enhance learning.
Q12 = Course materials (except textbook) are accessible, clearly organized, and easy to use.
Q13 = Students are allowed to express their comprehension of material in multiple ways.
Q14 = I receive prompt and instructive feedback on all assignments.
Q15 = Technology is used to facilitate communication between students and the instructor.
Q16 = Assignments for this course can be submitted electronically.
Q17 = In this course I feel interested and motivated to learn.
Q18 = I feel challenged with meaningful assignments.
Q19 = The instructor expresses enthusiasm for the topics covered in class.
Q20 = Instructor offers contact with students outside of class time in flexible formats.
Q21 = The instructor explains the real-world importance of the topics taught in this course.
Q22 = The instructor creates a class climate in which student diversity is respected.
Q23 = The instructor is highly approachable and available to students.
Q24 = This course supplements lecture and reading assignments with visual aids.

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defines .10 to .30 as small effect sizes, .40 to .70 as medium effect sizes, and .80 to 1.00 as large effect sizes (Cohen, 1988).

Results

Descriptive Information about the Participants

The nine sections of Introduction of Psychology had a total of 1,615 students enrolled. The pre-survey at the beginning of the semester was completed by 1,362 students (84%) and the post-survey at the end of the semester was completed by 1,223 students (76%). The percentage of students who completed the surveys in the different sections varied from 68% to 98% for the pre-survey, and from 51% to 93% for the post-survey (see Table 1).

Of the students who completed the pre-survey, 1,330 answered the question about disability identification, with 106 reporting that they had a disability (approximately 8%). Only 23 of those students (22%) had contacted the university's student disability services office to seek accommodations for their disabilities. Among students who completed the post-survey, 1,195 answered the question about disability identification, and only 98 reported they had a disability (again, approximately 8%). Twenty of the 98 students who reported a disability had contacted the disability services office (20%).

Differences on the Survey Following Training

Students reported a significant increase in the use of UDL strategies by their instructors after the UDL training on 14 of the 24 questions pertaining to UDL principles, based on the adjusted test-wise alpha level of .002 (see Table 2). Importantly, of those 14 questions, 6 had effect sizes that suggest the improvement was meaningful (Cohen, 1988). Students reported that their instructors presented information in multiple formats (question 1) significantly more after the training (M = 4.79, SD = .54) when compared to before training (M = 4.49, SD .66), $t_{(2559)}$ = 10.09, p <.0005, d = .40. The student responses on question 8, regarding instructors providing electronic equivalents of paper handouts, indicated that the instructors did

provide significantly more of the course materials in electronic format after training (M = 3.91, SD = 1.04) when compared to the student responses before training (M = 3.66, SD = 1.02), $t_{(2504)} = 6.13$, $p < .0005$, d = .24. Students reported that their instructors made significantly more reading assignments available online (question 9) after the UDL training (M= 3.75, SD = 1.08) than students reported before the training (M = 3.38, SD = 1.00), $t_{(2393)} = 8.74$, $p <.0005$, d = .36. Student responses on question 10 demonstrate that the instructors made the key points in videos significantly more apparent to the students after the UDL training (M = 4.27, SD =.78) when compared to before the training (M = 3.96, SD = .82), $t_{(2520)} = 9.62$, $p < .0005$, d = .39. Students reported that their instructors provided feedback on assignments significantly more promptly and more constructively after the UDL training (M = 3.80, SD = .94) compared to before the training (M = 3.50, SD = .91), $t_{(2515)} = 8.14$, $p < .0005$, d = .33. The students also reported that the instructors supplemented significantly more of the lecture and reading materials with visual aids following the UDL training (M = 4.37, SD =.70) compared to before the training (M = 4.23, SD = .72), $t_{(2556)} = 5.14$, $p = < .0005$, d = .20.

Discussion

The results of this study demonstrate that UDL training for higher education instructors may increase their implementation of UDL principles in university classrooms as perceived by their students. Student responses on a questionnaire administered before and after instructor UDL training indicated that the students perceived that the instructors used significantly more UDL strategies following the UDL training compared to the student responses before training. The findings of this study demonstrate significant and meaningful changes on at least six items on the 24 item UDL questionnaire that was developed for this study.

In addition to comparative data regarding instructor implementation of UDL, this study also provides demographic information about students enrolled in multiple sections of a "gateway" course at a major university. Over 1,600 students were enrolled in the nine sections of Introduction of Psychology. Consistent with previous research (National Center for Education Statistics, 2008b; National Council on Disability, 2003; U.S. Government Accountability Office, 2009), 8% of the students enrolled in this course reported that they had a disability. However, only about 20% of students who reported a disability had contacted the disability services office regarding accommodations or services. Previous research suggested that nearly 60% of students with disabilities choose not to disclose their disabilities (Wagner, Newman, Cameto, Garza, & Levine, 2005). Our data demonstrated that nearly 80% of students who indicated they had a disability did not choose to report their disabilities to the university. One explanation for this disparity may relate to the fact that our research data were collected in the fall semester, which would have been the first semester of college for many of the students surveyed. Although an increase in the number of students seeking accommodations did not occur during the semester of study, (22% reported contacting the office at the beginning of the semester and 20% at the end of the semester), it is possible that after the first semester more students may have sought assistance from the disability services office.

The survey developed for this research project provided a mechanism for our team to begin evaluating the effects of training instructors in the use of UDL principles in higher education courses. The remarkable response rate for the survey (84% for pre-survey and 76% for the post-survey) provided the power necessary to demonstrate that students perceived a significant change in their instructors' teaching behaviors following structured training on UDL principles and techniques for their implementation. This significant change held true even when the statistical tests were adjusted for multiple analyses. However, it should be noted that with such a large number of participants it was easier to reach rigorous significant levels and that the meaningfulness of these changes needs to be interpreted with caution.

Based on effect sizes, these differences before and after UDL training were meaningful in several ways. First, many of the questions that demonstrated small to moderate effect sizes related to the topics addressed in the training. The items that the students perceived as being implemented relatively less than other items at the beginning of the semester were emphasized in training, along with other UDL principles. See "Training Based on Pre-Survey Results" in the Method section for details about the specific items that were identified in the pre-survey results for inclusion in the training. The significant changes reflect practical changes because the changes related to the actual training. For example, after instructors received the UDL training,

students reported that their instructors provided more course materials in multiple formats and representations, making the material more accessible for all students (i.e., questions 1, 8, 9, and 24). According to the students, instructors also provided a better summary of the key points from instructional videos after they had received the training (i.e., question 10). Providing a summary of course content is an important aspect of several UDL principles. Summarizing information and concepts—at the beginning of class, following a segment of presented content such as a video, and at the end of each class session—provides students with a variety of representations of the concepts being taught. The summary of material can also be presented in such a way that it engages students in the learning process, another important aspect of UDL. Secondly, several reputable sources have emphasized that effect sizes are often small in social science and educational research. However, these small effects may be meaningful (Cohen, 1988; Wolf, 1986).

The results of this study indicate that UDL training for instructors appears to change students' perceptions about how their instructors present ideas and information, engage students, and allow students to express their comprehension of course content. Two areas of the training appeared to have the most impact on changing instructors' behavior. The first was the importance of presenting concepts in multiple ways and offering course materials in a variety of formats. The second was the need to summarize key concepts before, during and immediately following instruction. The instructors were able to incorporate these UDL strategies into their teaching almost immediately following the training sessions. Discussion during the sessions allowed the instructors to share ideas regarding the techniques they had tried and their success in implementing them. This made implementation of the new strategies less difficult.

Limitations and Recommendations for Future Research

This research did not include a control or comparison course, in which instructors would have received no training, to confirm that the changes reported were due exclusively to the UDL intervention. It is possible that even without the instructor training, students would have reported differences in teaching strategies between the beginning and the end of the semester. Adding comparison classrooms in which instructors teach similar content would help control for factors such as changes in teaching strategies in response to student performance over the course of a semester. In addition, the instructors who participated in UDL training and implementation were Psychology Teaching Fellows, selected because of their teaching experience and demonstrated talent as instructors. Because they were already capable instructors before participating in UDL training, it is possible that student perceptions of their teaching skills would have been quite positive, even without UDL training, due to these instructors' proficiency in addressing the learning needs of their students. In spite of these limitations, the changes that demonstrated significant and meaningful effects were consistent with the content of the training that was provided in this study, supporting the interpretation that training did impact those changes.

Another limitation of this research is that the Likert scale survey questions did not highlight which strategies were perceived by the students as engaging. Engagement is a critical UDL principle and teaching strategy. Much of the training provided to the instructors in this study addressed strategies and activities to increase student engagement. However, the Likert scale questions on the survey did not capture the richness of this aspect of the training. Thus, we were not able to evaluate how the instructor UDL training impacted students' perceptions of their own engagement in the learning process. Future research should be designed to evaluate this aspect of the UDL implementation.

Several other limitations related to the construction of the survey. First, the survey format resulted in some ceiling effects, meaning that many students selected the "agree" or "strongly agree" responses. This ceiling effect resulted in the survey being less sensitive to change, especially for instructors who already employed some UDL principles. Finally, because the survey consisted of only Likert scale questions and had no open-ended questions, we were not able to identify the teaching strategies students recognized as most beneficial to their learning.

Others in this field have called upon institutions of higher education to conduct research that validates the use of UDL strategies in producing better learning outcomes for all students (Izzo, Murray, & Novak, 2008). Research regarding the most effective and efficient means of training instructors is also needed (Izzo, et al., 2008). This study begins to address these issues by showing that training instructors in the use

of UDL principles does impact students' perceptions of their learning experiences. However, more research is needed to evaluate which intervention strategies are most effective. The use of surveys that are designed with some open-ended questions will be important to include in future research to capture the teaching/learning strategies that are perceived as most effective. The use of surveys that are more sensitive to change would also be important to implement in future research. Surveys that include more questions would allow for an increased number of principle features of UDL to be addressed, but a longer survey may not be feasible to administer during class sessions because of the student time involved in completion—time that may interfere with course instruction. Thus, delivering the surveys electronically so they can be completed outside of class time should be considered in future research. Finally, future research should also include the validation of the survey instruments.

Conclusions

The results of this research are promising and indicate that providing higher education instructors with information about UDL principles, along with strategies for implementing those principles in their courses, may enhance the learning experiences of all students, including those with disabilities. The results of this study further indicate that recognizable changes in instructor behavior can result from just a few hours of training. These changes, as observed by the students, correspond to widely-acknowledged best teaching practices (Burgstahler, 2008; Higbee, 2008; McGuire & Scott, 2006; Zeff, 2007). With the increasing diversity of the postsecondary student population (Izzo, et al., 2008; McGuire & Scott, 2006) and the fact that a great percentage of students do not report disabilities to the university, the use of UDL strategies should become a standard component of postsecondary instruction.

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Appendix

Universal Design for Learning – Student Survey

Important Instructions:

1. **This survey is double-sided. Please make sure to answer the questions on both sides.**
2. Fill in answers ONLY on the answer form provided.
3. Use only a #2 pencil.
4. **DO NOT** fill in your name or ID number on the answer sheet.

Note: All information will be used for aggregate purposes only. No individual student will be identified and all results will remain anonymous.

A	B	C	D	E
Strongly Agree	**Agree**	**Neutral or Undecided**	**Disagree**	**Strongly Disagree**

If the question is Not Applicable (N/A) do not fill in a bubble for that question.

1. The instructor presents information in multiple formats (e.g., lecture, text, graphics, audio, video).
2. The instructor's expectations are consistent with the learning objectives stated on the course syllabus or on the study guides.
3. During lecture, the instructor ties the most important points to the larger objectives of the course.
4. The instructor often speaks while facing the board/screen or looking down at his/her notes, laptop, or overhead transparency.
5. The instructor begins each lecture with an outline of what will be covered.
6. The instructor summarizes key points throughout the lecture.
7. The course syllabus clearly describes the content and expectations of this course, specifically or in broad terms.
8. The instructor provides electronic equivalents (e.g., HTML, Word, PDF) of all paper handouts.
9. Required reading assignments (other than the textbook) are available online.
10. I am able to grasp the key points from instructional videos for this class.
11. The instructor uses instructional technologies (e.g., clickers, RamCT) to enhance learning.
12. Course materials (other than the textbook) are accessible, clearly organized, and easy to use.
13. Students in this course are allowed to express their comprehension of material in ways besides traditional tests and exams (e.g., written essays, projects, portfolios).
14. I receive prompt and instructive feedback on all assignments.
15. This course employs technology to facilitate communication among students and between students and the instructor.
16. Assignments for this course can be submitted electronically.
17. In this course I feel interested and motivated to learn.
18. I feel challenged with meaningful assignments.
19. The instructor expresses enthusiasm for the topics covered in class.
20. The instructor offers contact with students outside of class time in flexible formats (e.g., face-to-face, email, online chat, telephone)
21. The instructor explains the real-world importance of the topics taught in this course.
22. The instructor creates a class climate in which student diversity is respected.
23. The instructor is highly approachable and available to students.
24. This course supplements lecture and reading assignments with visual aids (e.g., charts, diagrams, interactive simulations).

Please answer the following questions. No individual student will be identified, and all results will remain anonymous.

25. What grade to you think you will get in this course?
    (Answer "A" for an A, "B" for a B, etc. If you think you will receive an F, answer "E.")

26. I am a student with a disability (for example, a learning disability, ADHD, a physical disability):
    True (mark the "A" bubble) False (mark the "B" bubble)

27. If so, I have contacted the Resources for Disabled Students office (RDS) to request accommodation services: True (mark the "A" bubble) False (mark the "B" bubble)