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What Algebra and Biology Students Have to Say About Universal Design for Learning

By Larry Kortering, Terry McClannon, and Patricia Braziel

Introduction

Success in general education settings is an increasingly important goal for all students, including those identified as having mild disabilities (Cobb Morocco, 2001). The No Child Left Behind Act (NCLB) of 2001 introduces higher performance standards for all students in the general education curriculum. This situation has become especially critical at the high school level as students must succeed in their courses in order to earn a standard diploma, which is required to access most forms of postsecondary education. Meanwhile, the majority of students with learning disabilities continue to spend most or all of their time in the general education classroom at the secondary level (Office of Special Education Programs, 2004). A similar though less pronounced pattern is true for students with other mild impairments, including those with emotional or behavior disorders and those receiving services under Section 504 of the Rehabilitation Act of 1973 (Office of Special Education Programs, 2004). Finally, the evolving labor market has fewer career options for individuals lacking a college education or a standard high school diploma.

Universal Design for Learning

The concept of universal design for learning (UDL) has been emphasized to improve how students with mild disabilities perform in general education (Hitchcock & Stahl, 2004; Scott, McGuire, & Shaw, 2003). Traditionally, content in the general education setting at the high school level has been inaccessible for many students, especially those with disabilities. Typically classroom teachers use course materials like standard textbooks and related support materials to present the curriculum (Pisha & Coyne, 2001), use teacher-centered instruction as the main format for delivering course information, and emphasize the reproduction of basic facts or ideas (Cobb Morocco, 2001). Furthermore, the classroom setting is driven by state-mandated curriculum and final examinations that put considerable pressure on teachers to cover the prescribed curriculum in a timely manner (Hagborg, 1999). Not surprisingly, many students find such settings to be uninteresting (Czikszentmihalyi & Larson, 1984) and frustrating (Kortering & Braziel, 2002; Higgins, Boone, & Lovitt, 2002).

According to the Center for Applied Special Technology (2005), "a key premise of UDL is that curriculum should include alternatives to make it accessible and applicable to students with different backgrounds, learning styles, abilities, and disabilities in widely varied learning contexts" (p. 1). UDL does not imply that one size fits all; rather, it recognizes the unique needs of each learner. UDL principles help educators design their instruction to help more students have better access to the curriculum and thus an opportunity to succeed (Pisha & Coyne, 2001). In some cases, experts have linked UDL to technology-based interventions (Rose & Meyer, 2002), while others have suggested a broader approach inclusive of how teachers structure learning and engage students (Howard, 2003; Scott, McGuire, & Shaw, 2003). This study focuses on the broader definition of UDL.

This study's findings illustrate how students perceive individual interventions anchored by three key UDL principles—multiple ways of representing course content, multiple options for student expression and control, and multiple options for engagement and motivation (Blamires, 1999). These individual interventions were used in standard-diploma track high school algebra and biology classes.

Settings

The study setting included two high schools in adjacent counties in North Carolina. High school A has about 2,400 students, including 12% African-American, 4% Hispanic, and 4% Asian, including Hmong students. High school B serves 1,400 students, with 5% who are identified as ethnic minority (African-American and Hispanic). The schools have, respectively, 20% and 22% of their students eligible for free or reduced-cost lunch. These statistics may underestimate actual poverty rates, because eligible students often fail to participate in free or reduced-cost lunch programs. Both high schools have strong academic reputations, as evidenced by being in the state's top 25% of end-of-course test performances.

Team participants included six algebra and five biology teachers. The teachers taught from one to three classes of standard-diploma track algebra or biology. Their class sizes ranged from 12 to 31 students, with an average between 24 and 27 students. Some teachers used as many as six UDL interventions, while others used none. The types of UDL interventions in algebra classes included:

- The teacher created a series of PowerPoint presentations to teach students how to better use the TI-83 calculator.
- The teacher used a laptop computer, video projector, and software for Algebra 1. The software illustrates the concept of slope and provides visual examples and opportunities for interaction for the students.
- Students learned to recognize and identify algebraic properties through a game. Students are in one of five groups, designated by a color, and each group has a set of properties that correspond to the team's color. A game format was used to test for student understanding.

The types of UDL interventions used in biology classes included:

- Students worked in small groups. Each group has a topic sheet with specific instructions on what the group is to teach to the other groups. After given the time to plan a presentation, the group was videotaped while teaching the class. These videos are then shown to classmates for review.
- Polling software was used to assess an applied genetics unit. The software allowed students to score answers with a remote control; answers were automatically tallied and displayed on a projector.
- The teacher developed a Web page with notes, test reviews, and other class information. Student accessed the Web page from home or outside of class.

As part of a federal grant for UDL at the high school level, teachers participated in from two to four full-day training sessions. The training provided each team of teachers with the technology, including a laptop computer, video projector, digital camera, and camcorder. It also gave the teachers hands-on use of the technology and practice of UDL-related resources in the classroom (e.g., developing instructional movies with the camcorder). Sessions two through four focused on incorporating Internet-based curriculum resources, conducting follow-up work with the new technology, and working in teams to develop specific UDL instructional inter-

ventions. These sessions also included a review of the concept of UDL and provided practical applications for their settings. Teacher participation was voluntary as was their decision to use UDL interventions.

Student Participants

Participants included 320 students (100 algebra and 220 biology) including 18 (6%) identified as learning disabled (LD), 6 (2%) labeled as behavior disordered (BD), and 4 (1%) labeled as mildly mentally handicapped. In addition, 12 (4%) student participants were identified as attention-deficit disordered with or without hyperactivity. Participants were exposed to one to six different interventions depending on their teacher and class setting.

Data Collection Procedures

Participating students provided feedback directly after being exposed to a UDL intervention (see Table 1). Each of 18 interventions (4 algebra, 14 biology) took place in a standard high school class (16 of the interventions) or computer lab (2 of the interventions). Students completed a survey at the end of each class in which a UDL intervention took place. There were 709 responses (189 algebra and 520 biology). Response data were then recorded and provided to the individual teacher. At the end of the year, each teacher received a copy of all the interventions and student responses for their content area.

Findings

The findings included responses from both closed-ended and open-ended questions in the survey.

Closed-Ended Survey Results

A Likert scale of one (strongly disagree) to five (strongly agree) was used to evaluate participants' perceptions of the UDL activity (see Table 1). Participants also indicated whether or not they would like to have access to more UDL interventions.

Across the five items, algebra and biology students reported strong levels of effectiveness, utility, and satisfaction related to the UDL interventions compared to their other academic classes. Both groups also consistently reported learning important and useful information, staying on-task, and working hard.

Table 1. Student Evaluation of UDL Interventions

Students rated their perceptions of the UDL lessons using the following scale:
1 = Strongly Disagree 2 = Slightly Disagree 3 = Unsure 4 = Slightly Agree 5 = Strongly Agree

In comparison to my other high school academic classes…

Algebra	*N*	Mean	Median	SD
Today's activity was more enjoyable.	189	3.84	4.00	1.18
I learned more important information today.	189	3.97	4.00	1.03
I learned more information that was useful.	189	3.94	4.00	1.11
The information I learned will help me more on the end-of-course exam.	189	4.22	5.00	1.02
I stayed more on-task for today's activity.	189	3.80	4.00	1.21
I worked harder today.	189	3.76	4.00	1.20
Would you like to see more of these interventions? Yes: 175 (93%)				

Biology	*N*	Mean	Median	SD
Today's activity was more enjoyable.	520	4.30	4.00	0.86
I learned more important information today.	520	4.31	5.00	0.91
I learned more information that was useful.	520	4.17	4.00	0.91
The information I learned will help me more on the end-of-course exam.	520	4.39	5.00	0.88
I stayed more on-task for today's activity.	520	4.51	5.00	0.73
I worked harder today.	520	4.48	5.00	0.81
Would you like to see more of these interventions? Yes: 458 (88%)				

In addition, an average of 90% across both groups reported wanting access to more UDL interventions.

Open-Ended Survey Results

A series of three open-ended questions helped elicit participant perceptions of the various UDL interventions. Table 2 lists these questions and a description of key themes. In order to be recorded in the table, the themes had to account for a minimum of 15% of total responses for the given question. The sample items that represented each theme were randomly selected.

Students in both general and special education reported very favorable views of UDL interventions. For example, about 90% of all participants expressed an interest in receiving more UDL interventions. Furthermore, the interventions were consistently rated as better (e.g., slightly or strongly agree) than what they experienced in other academic classes. Finally, the open-ended responses suggested that UDL interventions help students to learn and to use technology as an effective learning tool. In contrast, many students could not identify a "worst" part of the UDL interventions, and a majority of participants offered no recommendations for improving them.

A second implication of the study's results is that UDL is best viewed as a tool for changing how teachers think in terms of curriculum access and student success. The study findings showed that high school teachers often are reluctant to change their teaching style, instead preferring to maintain their established routines and behaviors. These findings also suggest that high school teachers may not adopt an innovative strategy unless they redefine it to fit their needs and situation; the goal of better access may not be shared by all high school teachers. Finally, further research is needed to determine whether students in the UDL courses score better on end-of-course tests.

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Table 2. Key Themes and Sample Response Items

	Question/Theme (n and %)	Sample Response Items
	What was the best part of the UDL intervention?	
Biology (n = 589)	Instructional activity (134 or 23%)	• "That we do some activity that helps us;" • "The fact that we got to teach and write on the board;" • "I like this because we got to make a hands-on model;" • "Hands-on stuff;" • "The lab;" and • "Getting to build it."
	The technology (130 or 22%)	• "The PowerPoint presentation;" • "Using the remote controls to answer questions;" • "I could see what I already knew; the PowerPoint was cool;" • "The printable notes from Web site;" and • "Easy access to notes."
	Successful learning or enjoyable learning (84 or 16%)	• "Clarified the steps of mitosis;" • "It made sure I understood it perfectly;" • "It helped me understand what goes on;" • "It helped me visualize the process;" and • "I actually understood what I was doing."
Algebra (n = 189)	Successful at learning (47 or 25%)	• "Learning how to do exponents;" • "Learned new stuff;" and • "Learned what you showed us."
	The technology (30 or 16%)	• "Getting on the computer and learning;" • "Learning about the computer;" and • "The computer-learning thing."
	What was the worst part of the UDL intervention?	
Biology	Instructional activity (169 or 29%)	• "It went slow;" • "Watching other PowerPoints;" • "Took too long;" • "It took everyone too long;" • "The number of cards we had to do;" and • "All of the assignments were a little tedious."
	No worst part (145 or 25%)[1]	"No worst part;" "Nothing;" and "None."
Algebra	No worst part (94 or 50%)[2]	"No worst part;" "Nothing;" and "None."
	Instructional activity (38 or 20%)	• "I already knew how to do it;" • "Doing so many examples;" • "I did not understand how you did fractions;" and • "It was boring listening to teacher."
	Do you have recommendations for improving the UDL intervention?	
Bio	No ideas (325 or 63%)[3]	"No worst part;" "Nothing;" and "None."
Algebra	No ideas (108 or 57%)[4]	"No worst part;" "Nothing;" and "None."
	Change instructional format or routine (37 or 20%)	• "It's a great activity but show more on how to do it;" • "We could make it more of a game;" and • "Make it more fun."

[1] No responses from 21 participants.

[2] No responses from 30 participants.

[3] No responses from 396 participants.

[4] No responses from 40 participants.

Resources

Center for Applied Special Technology (CAST)

http://www.cast.org/

CAST is a nonprofit organization that works to expand learning opportunities for all individuals, especially those with disabilities, through the research and development of innovative, technology-based educational resources and strategies.

The National Consortium on Universal Design for Learning

http://www.cast.org/pd/consortium/index.html

In 1999, researchers at CAST (see above) developed the National Consortium on Universal Design for Learning (NCUDL), a national partnership of educators, schools, and experts committed to improving access to the general education curriculum for all students, including students with disabilities. The NCUDL demonstrates best practices and effective models in consortium schools and disseminates these practices.

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