Moving Beyond What We Think We Know: A Review of UDL Research

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Abstract
In this paper, we review 125 studies published between 2000 and early 2019, that investigated the use of UDL in early childhood through postsecondary education settings. Highlights of our results include the finding that basic conceptualizations of UDL vary in significant ways, affecting the possibility of drawing conclusions about its impact and efficacy. UDL research is being disseminated to a variety of audiences, but is associated most frequently with special education. Research about UDL has increased and research quality has improved.

Keywords
Universal Design for Learning, UDL, Universal Design for instruction, UDI, research.

INTRODUCTION

Universal Design for Learning (UDL) has become one of the foremost approaches guiding the design of instruction in today's classrooms. Nearly 20 years ago, Rose and Meyer (2002) adapted the architectural philosophy of universal design to education. For architects, universal design refers to the design and composition of environments so they can be used "to the greatest extent possible without limitations of age, size, ability, or disability" (Centre for Excellence in Design (http://universaldesign.ed/What-is_Universal_Design/). As applied to education (Rose & Meyer, 2002), UDL is defined as "a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn" (http://www.cast.org/our-work/about-udl.html#.W51aZNKgWo.)

The UDL framework is defined by three basic instructional principles: provide multiple means of engagement, provide multiple means of representation, and provide multiple means of action and expression. CAST, the foremost authority and international advocate and developer of UDL, further articulates UDL through a set of guidelines and checkpoints.

Despite its prominence in policy (e.g., ESSA, IDEA, the Higher Education Act of 2008) and practice, claims about the empirical evidence for UDL warrant scrutiny. Roberts, Park, Crown, and Cook (2011) conducted a systematic review of research about UDL in postsecondary education. Examining eight papers published between 2000 and 2009, they concluded that there is limited support for the impact of UDL on outcomes of importance to postsecondary educators and students.

More recently, Rao and colleagues conducted two systematic reviews of UDL research—one focusing on the application of different models of UDL (Rao, Ok, Bryant, 2014) and another on UDL intervention studies (Ok, Rao, Bryant, & McDougall, 2017). These reviews included studies conducted with preschool through postsecondary populations. Both reviews analyzed 13 studies. The authors concluded that research offers some evidence of positive outcomes associated with the application of UDL. However, effect sizes, computed in the Ok et al. (2017) study, were highly variable. In both reviews, the authors found multiple issues including insufficient operational definitions of UDL, limi-

tations in descriptions of samples and interventions, and non-causal research designs.

As these reviews show, much of the research done to date does not lend itself to a quantitative review. We hoped to capture a fuller picture of the research base on which educators and others may rely for evidence about the impact of UDL. Therefore, we adopted a more liberal definition of inclusion criteria for this review, defining research as any study in which the authors explicated a systematic process for both collecting and analyzing data. Furthermore, the results presented had to be consistent with the specified data collection and analysis procedures. Our review sought to answer the following questions:

1. Where is research about UDL being published and to which target audiences?
2. What target populations are included in UDL research?
3. What are trends in the nature and quality of UDL research conducted between 2000 and February 2019?
4. What research designs are used in UDL research?
5. What outcomes are investigated in UDL research and how are they measured?
6. What is the role of UDL in studies that purport to investigate it?
7. What is the impact of UDL on teaching and learning?

METHODS

Studies were drawn from peer-reviewed journals published between 2000 and March 2019. Two authors conducted keyword searches in the major educational databases ERIC and EBSCOHost, using the search terms UDL, UDI, universal design for learning, universal design for instruction, and universal instructional design. We also hand-searched reference lists of seminal papers (particularly research reviews). This process led to 402 papers. We eliminated papers that were editors' introductions, calls for papers in a journal, or that included one of our keywords but were not about UDL or education. This reduced the dataset to 368 papers. We scanned these, reading abstracts and the body of the paper as necessary to determine if they met our criteria for research. This process reduced the dataset to 123 papers representing 125 studies. The other 245 papers defined or described UDL, gave examples of how to approach it in practice, or discussed its implications for teaching and learning. It is worth noting that the 123 papers we analyzed comprised 32% of the 386 papers.

All authors of this paper participated in the analysis. A codebook, which iteratively emerged from a team analysis and discussion of a set of 20 studies, was developed to guide the subsequent coding of study features. Inter-rater reliability was computed among the authors for over 25% of the papers and, overall, was above 85%. Discrepancies were resolved by consensus.

RESULTS

Most papers (85%) were published in journals that had a focus on special education. A smaller but substantial number of papers were in journals that targeted general education audiences (61%). Forty-four percent targeted teacher education, and 10% focused on higher education in general. (Because some journals target more than one audience or topic, these percentages sum to more than 100). Nearly one-third of the journals included technology as a primary focus. Papers were spread across 88 unique journals, with most publishing only one UDL study.

Regarding the nature of UDL research, the most common research designs were quasi-experimental or descriptive, consisting of one group pretest/post-test designs, one group post-test only designs, and case studies. Almost all studies used experimenter-developed measures unique to that study, although a few adapted measures from other studies or used standardized achievement measures. Overall, surveys and questionnaires were the most commonly used research instruments.

With slight deviations from year to year, there has been a steady increase in the number of peer-reviewed research publications, with more studies published in 2017 than in any year between 2000 and 2016. In fact, half the studies in this review have appeared in press between January 2014 and February 2019. More rigorous designs, including experimental and single-case, are more common in the past three years. Furthermore, fidelity of implementation and measures of social validity, considered important aspects of high-quality research (Odom, Brantlinger, Gersten, Horner, Thompson, & Harris, 2005), are being incorporated in more recent studies.

In the 125 studies described in these 123 papers, there were three distinct groups of study participants: higher education instructors or faculty (17% of the studies), early childhood through secondary students (30% of the studies), and post-secondary participants (51% of the studies). Postsecondary participants included students in higher education programs, teachers, paraprofessionals, and others who worked in educational settings.

In studies with higher education faculty, UDL research centered on faculty understanding, perceptions, and attitudes toward UDL. Only a few studies investigated the impact of UDL instruction or experiences on faculty behaviors or course development. Data among higher education samples were most commonly collected via surveys or interviews.

Research about the use of UDL with postsecondary samples was more diverse. Forty-five percent of these studies focused on teacher preparation to use UDL in current or future educational settings. The remainder addressed UDL to deliver instruction or to impact variables that could improve the educational experiences of course or workshop participants. Variables investigated among postsecondary samples included attitudes, motivation, and perceptions of equity and inclusion. Measurement of attitudes, most often through surveys and interviews, were a common focus of these studies as were assessments of self-perceived knowledge and skills. Postsecondary studies that investigated teacher preparation were more likely to include measures of participant learning, often assessed through artifacts that included lesson plans, reflections, presentations, and, in a few studies, observations of teaching practices. Several teacher preparation studies collected data about the performance of the K-12 students who were taught by study participants. Perhaps, not surprisingly, these studies showed how difficult it was to document changes in student outcomes as a result of training education students to use UDL.

Studies with early childhood through 12th grade participants were even more diverse in their nature, outcomes, and measures. Students' attitudes and opinions of their experiences were examined in many studies, but researchers also investigated the impact of UDL-aligned interventions on academic outcomes—most often STEM or literacy. Achievement outcomes were typically examined through researcher-developed tests or other measures that closely aligned with what was taught.

Two-thirds of the studies we reviewed incorporated technology. Examples of technology-supported UDL in these studies included learning management systems, podcasts, online assessments, text-to-speech technology, videogames, WebQuests, and digital storybooks. In many studies, UDL was implemented through the typical affordances of technology, such as the opportunity for an instructor to present information through both video and text. In other studies, researchers implemented more sophisticated and responsive technologies, such as games or online learning systems, noting how features of these technologies were consistent with UDL. In a few studies (e.g., Dalton, Proctor, Uccelli, Mo, & Snow, 2011; King-Sears et al., 2015; Marino, Gotch, Israel, Vasquez, Basham, & Becht, 2014; Proctor, Dalton, Gresham, 2007; 2013) researchers intentionally designed technology-based interventions that incorporated UDL principles to address student challenges and barriers.

DISCUSSIONS AND CONCLUSIONS

Based on keyword searches, we located 368 papers published in peer-reviewed journals over the past 20 years that addressed UDL. If we had extended our search beyond peer-reviewed publications to include books, chapters, reports, and blogs or other non-peer-reviewed Internet sources, we have little doubt that this number would quadruple. We determined that 32%, or 123 of these papers, reported research that had some bearing on the operationalization, training, or implementation of UDL. Because we used a liberal definition of research, the number of papers we included in our analysis is much greater than earlier reviews (e.g., Ok, Rao, Bryant, & McDougall, 2017; Rao, Ok, & Bryan, 2014; Roberts, Park, Brown, & Cook, 2011).

Our analysis shows that UDL is utilized by a cross section of educators in a variety of fields and settings. There also appears to be an interest in UDL research among global audiences, as 12 (10%) of the studies we reviewed are published in international journals. However, despite claims that UDL is suited to the needs of all learners, it appears to be most often associated with special education, as demonstrated by the finding that 85% of the studies we reviewed are published in special education journals.

It is encouraging to see that UDL research continues to increase in quality and quantity. Developments in the UDL research community may stimulate further advancements. For example, the *UDL Reporting Criteria*, developed by Rao and colleagues, were created to guide researchers and reviewers in conducting and evaluating UDL research. These include explicit criteria for addressing and reporting learner variability, instructional environments, UDL features incorporated into the study, and the relation between UDL and study outcomes, findings, and implications (Rao, Smith, Edyburn, Grima-Farrell, Van Horn, & Yalom-Chamowitz, 2018). With the intention of improving measurement in UDL research, Evmenova and colleagues are in the process of collecting a database of UDL measures that can be shared with and searched by UDL researchers (Evmenova, Johnson, Okolo, & Moore, 2018).

However, advances in the technical quality of research cannot overcome a problem at the center of research about UDL. As expected in any body of research, variations in a practice or intervention will be associated with differences in learner characteristics, settings, research designs, and measures. However, the studies we reviewed illustrate essential differences in researchers' conceptualization and operationalization of UDL—an issue that that has significant implications for the development of a research base. We found that some studies use UDL exclusively as an *interpretive framework* for materials, or practices that were not originally or intentionally designed with UDL principles in mind. These studies often involve extant technology applications whose flexibility affords the exercise of UDL principles such as student choice or enhanced engagement. However, UDL is not a key consideration in the design or implementation of these studies. Rather, UDL appears an afterthought.

Other studies conceptualize UDL primarily as a *design process*. In these, UDL is taught or used as framework to create responsive instructional materials and practices and/or to change attitudes about diverse students, teaching, and learning. The target outcomes of these studies tend to be changes in planning, products, or attitudes, with little attention to the way in which UDL is translated into actual practice.

In yet other studies, UDL is viewed primarily as a set of *instructional practices*, that when intentionally implemented, will result in changes in teaching and learning. In many of these studies, the process of design itself is secondary or of less interest. Outcomes of interest are more likely to include measures of changes of the individuals who are the recipients of these materials and practices.

As education aspires to become increasingly evidence-based, akin to science and medicine, all those involved in policy, instruction, and research are compelled to ask questions about the efficacy of practices. Our analysis shows that it is misleading to attempt to generalize across this body of scholarship to answer the question: is UDL effective? Given the diversity of contexts, learners, and outcomes to which UDL has been applied, and differences in researchers' operationalization of the construct itself, there can be no singular or simple answer to this question. We have argued elsewhere that research and practice can benefit from more sophisticated conceptualizations of UDL and more nuanced research questions (Okolo, Spiro, & Daley, in press). Our research team looks forward to these advances in UDL research as we seek to help UDL reach its potential for improving educational outcomes.

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