Universal Design for Learning in California Community Colleges: A View towards Increasing Student Engagement and Success

Community colleges make a significant impact on post-secondary education in the United States, as they improve the employment and economic prospects of vulnerable student populations that are often underrepresented in higher education. These students have the most to gain from educational attainment, yet present a formidable challenge for community colleges, as they typically arrive with significant variability in their college preparedness skills. Universal Design for Learning could play a big role addressing the aforementioned challenge, as it has the potential to improve student engagement and learning for all students. In particular, it could support students with disabilities, connecting them with inclusive curricula, and reducing the need for individual accommodations. This paper examines the benefits and criticisms of Universal Design for Learning, as well as the research on student engagement, with a view towards broadening the implementation of Universal Design for Learning in community colleges in the United States, as well as in higher education in general.

Keywords: *universal design for learning (UDL), student engagement, inclusive pedagogy*

Introduction

The California community college system is the tropical forest of higher education diversity. Admitting all who apply, California community colleges fertilize a richly variegated canopy for learners of all abilities. The system must invest in fertilizing the forest floor to support and sustain this rainforest's interdependent layers. By pollinating efficacious teaching practices that meet all students' needs, California community colleges can sustain and flourish the rich diversity in their ecosystem. Universal Design for Learning (UDL) is a well-established instructional design philosophy, that could possibly serve this purpose. Nevertheless, despite its potential, UDL is not yet widely implemented in higher education, especially in community colleges.

The paper begins by quantifying the impact of the California community college system. It investigates the changing landscape of higher education and recounts the development of inclusive course design. Subsequently, it examines the benefits and criticisms of UDL and attempts to establish the need for further research in UDL implementation in higher education and especially in community colleges, with a view towards increasing student engagement and learning in courses offered using a variety of modalities.

Community Colleges

Community colleges are two-year, lower-division, higher-education institutions, sometimes referred to as junior colleges or vocational schools. They are a crucial component of the infrastructure of higher education and have a significant impact on education in the U.S. In California they constitute an important component of a three-tiered public education system, in partnership with the University of California (UC) and the California State University (CSU) systems (California State Department of Education, 1960). In 2020, the 1,044 community colleges in the U.S. enrolled nearly half of all undergraduate students – 11.8 million (American Association of Community Colleges, 2020). California community colleges enroll one in every four Californians between the ages of 18 and 24 (California Community Colleges Chancellor's Office, 2021e). In fact, one in every four community college students in the nation attends a California community college. With more than 2.1 million students at 116 colleges, the California Community College system is the country's most extensive higher education system (California Community Colleges Chancellor's Office, 2021a).

It is well documented that educational attainment ensures against economic hardship. Increased educational attainment levels correlate with increased median annual earnings and decreased unemployment probability. The community college population includes some of the most vulnerable students who have the most to gain from educational attainment. However, community college students take more time and units to complete degrees due to their part-time status, acclimating to academic culture, and the need to take remedial courses. Community college faculty face instructional challenges of rampant learner variability in the classroom, yet have little to no formal teacher training, particularly in Career Education Technology (CTE) fields.

Economic Prospects for Underserved Students

With a mission and vision of putting students first (California Community Colleges Chancellor's Office, 2021f), the California community college system promises students life-changing opportunities through social mobility (California Community Colleges Chancellor's Office, 2021a). From 2000 to 2018, the National Center for Education Statistics (2021a) data consistently reported higher median annual earnings for young adults aged 25-34 with higher educational attainment. In 2019, the median earnings of young adults with high school completion were $35,000 and increased with every level of educational attainment: $39,700 for some college (but no degree); $40,000 with an associate degree; $55,700 with a bachelor's degree, and $70,000 with a master's degree or higher (NCES, 2021a).

Educational attainment increases workers' earnings and reduces unemployment probability (NCES, 2019a). In 2019, for people with no disabilities aged 25 and over, unemployment rates were 11.5% for those with less than a high school diploma, 8.8% for high school graduates (but no college), 7.6% for some college or associate degree, and 4.7% for bachelor's degree and higher (U.S. Bureau of Labor Statistics, 2021b). People with disabilities face additional employment

barriers (Hansen & Dawson, 2020); in 2020, persons with a disability between the ages of 16 to 64 were nearly twice as likely to be unemployed (13.4%) compared to persons with no disability in the same age range (7.9%) (U.S. Bureau of Labor Statistics, 2021a).

Disproportionate Inequalities for Students of Color

Minority students also face inequalities in employment. The staggering racial inequalities that exist across the nation became evident in Silicon Valley (northern California's San Francisco Bay Area), during the COVID-19 pandemic. The regional tech industry, often criticized for its lack of diversity, was spared any notable economic downfall during the pandemic and continued to thrive, while Black and Hispanic/Latinx workers filed 1.5 times more unemployment insurance claims than their White counterparts (Massaro, 2021). The initial concentration of unemployment claims was in lower-income occupations (31%), with the most significant impact in the accommodations and food sector (41%) (Massaro, 2021). Additionally, in the 2021 Silicon Valley poll, a higher proportion of Hispanic/Latinx and Black or African American participants felt financially insecure compared to White or Asian counterparts, in part due to the high cost of living in Silicon Valley (Joint Venture Silicon Valley, 2021).

A Prolonged and Strenuous Student Journey

Community college students experience significant adversity in their educational expedition. Many come with insufficient academic preparation for college-level work. Financial constraints, work demands, and family commitments impede the number of credits they earn each term. Taking fewer courses per term and taking breaks from college results in longer times to complete their academic programs (Moore & Shulock, 2010; Offenstein, Moore, & Shulock, 2010). On the other hand, many students struggle with excess unit accumulation before transferring. Although they only need 60 credits to transfer from a two-year community college to a four-year university, in the 2019-2020 academic year, the average number accumulated by associate degree earners in California was a staggering 84 units, significantly higher than the 60-unit transfer requirement (Cal-PASS Plus, 2021). Community college students accumulate excess units because of remedial courses, inefficient course sequencing patterns, and lack of academic preparedness (Community College Research Center, 2018).

Learner Variability

The student diversity that makes the California Community College system so unique poses challenges for instructional effectiveness. College instructors must simultaneously meet the needs of students across generations, students with disabilities, students learning English, and students with increasing family and employment demands outside of the classroom. As more students are diagnosed with learning disabilities, those students are more likely to attend a two-year

community college (Hansen & Dawson, 2020). Additionally, students have varying comfort levels and access to technology, while many struggle with acclimating to an academic environment as first-generation students.

Research has documented that a student's learning is as unique as their fingerprints (CAST, 2018a; Meyer et al., 2014). Each learner's brain is unique and complex due to genetic and environmental influences and consists of three networks: (a) the recognition network (how sensory information is received in the brain), (b) the affective network (how information is processed and relayed for meaning at the center of the brain), and (c) the strategic network (how information is organized within the frontal lobes for a response). A faculty member's responsibility is to engage learners through all three networks; however, community college faculty lack sufficient pedagogical training to do so.

Insufficient Teacher Preparation

Unlike their counterparts in universities, community college faculty focus on teaching rather than research. Nevertheless, they struggle to learn how to teach on their own, as current hiring and training practices do not require or emphasize pedagogical training. To teach in the California Community College system, faculty must meet statewide minimum qualifications for their discipline. While they need a master's degree, they are not mandated to attend training on effective pedagogical practices; instead, they are expected to learn on the job (Hansen & Dawson, 2020). Credentials, which include pedagogical training, are not required to teach in the community college system as they are in the public K-12 system (Arambula & Lovelace, 2019).

Additionally, ongoing faculty professional development programs are inconsistent across college and district boundaries and many fail to encourage effective classroom practices, as they lack specific goals, often go without attendee feedback, and suffer from low faculty attendance (Hromalik et al., 2020). Worse yet, instructional reform efforts cater more to developmental education, tutoring, and academic support services, ignoring faculty input (Bailey, Smith Jaggars, & Jenkins, 2015).

The impact of the faculty preparation gap is significant, considering the numbers of professionals who receive their training at community colleges. Community colleges train 7 in 10 of California's nurses, 8 in 10 police officers, firefighters, and EMTs. Approximately one third (29%) of UC graduates and more than half (51%) of CSU graduates begin their studies in community colleges, while nearly half of the students who earn a bachelor's degree in STEM fields from any UC campus transfer from a community college (California Community Colleges Chancellor's Office, 2021e). Clearly, more needs to be done to prepare community college instructors in pedagogy to better support student success.

Acceleration of Distance Education Modalities

The COVID-19 pandemic accelerated changes in many industries, including the growth of distance education. In the California community colleges, distance

education debuted in 2001 and steadily climbed to 16% of full-time equivalent students (FTES) in the 2018–2019 academic year. By the 2020–2021 academic year, online modalities grew to 60% of the total – 51% asynchronously and 9% synchronously – with only 39% of instruction delivered through non-distance education methods. In comparison, in the 2000–2001 academic year, 99% of the FTES were in non-distance education methods (California Community Colleges Chancellor's Office, 2021c). Hence, pedagogical research must consider the colossal shift to virtual classrooms.

Increasing Diversity in Higher Education

Postsecondary student population has become more diverse. According to the American Council on Education (ACE), the percentage of White students in undergraduate enrollment has declined as Hispanic enrollment increased. In the two decades that spanned from 1996 to 2016, the percentage of all undergraduate students identified as being a race or ethnicity other than White grew from 29.6% to 45% (Espinosa et al., 2019). Concurrently, there has been an increase in the number of students with disabilities enrolling in higher education (McGuire & Scott, 2006; National Center for Education Statistics, 2019b; Scott, McGuire & Shaw, 2003).

Unlike most higher education counterparts, community colleges reduced admission barriers for students in an attempt to increase access to higher education for students from underrepresented groups (Kerr & Pannoni, 2020; Vaughan, 2004). In Fall 2019 community colleges enrolled 37% of all undergraduate students nationally (National Center for Education Statistics, 2021b), with the majority of their students enrolled part-time (65%) (American Association of Community Colleges, 2021).

California community colleges are diverse across all demographics, including re-entry students who are older than traditional college students (Foundation for California Community Colleges, 2019). According to the California Community College Chancellor's Office (2021g), in 2019-2020, the community college system served predominately Hispanic/Latinx (46.04%), White Non-Hispanic (23.60%), Asian (11.38%), and African American (5.58%) students. In the same year, 118,273 (4.78%) students identified as having educationally-related disabilities in the following categories: learning disability (25.80%), psychological disability (21.03%), attention deficit hyperactivity disorder (8.46%), autism spectrum (9.06%), mobility (6.60%), developmental delay (5.62%), hearing impairment (3.57%), brain injury (3.24%), visual impairment (2.76%), speech/language impairment (0.01%), and other disabilities (13.86%) (California Community Colleges Chancellor's Office, 2020). Postsecondary diversity, such as socioeconomic status, educational backgrounds, first-time college students, working students, students with families, and students with various learning needs, poses unique challenges for college instructors (Pliner & Johnson, 2004; Polanska, 2013) and warrants an expansion of inclusive pedagogical practices to meet the needs of a wide variety of learners and support students' upward mobility (Scott, McGuire, & Shaw, 2003).

Design for Inclusion

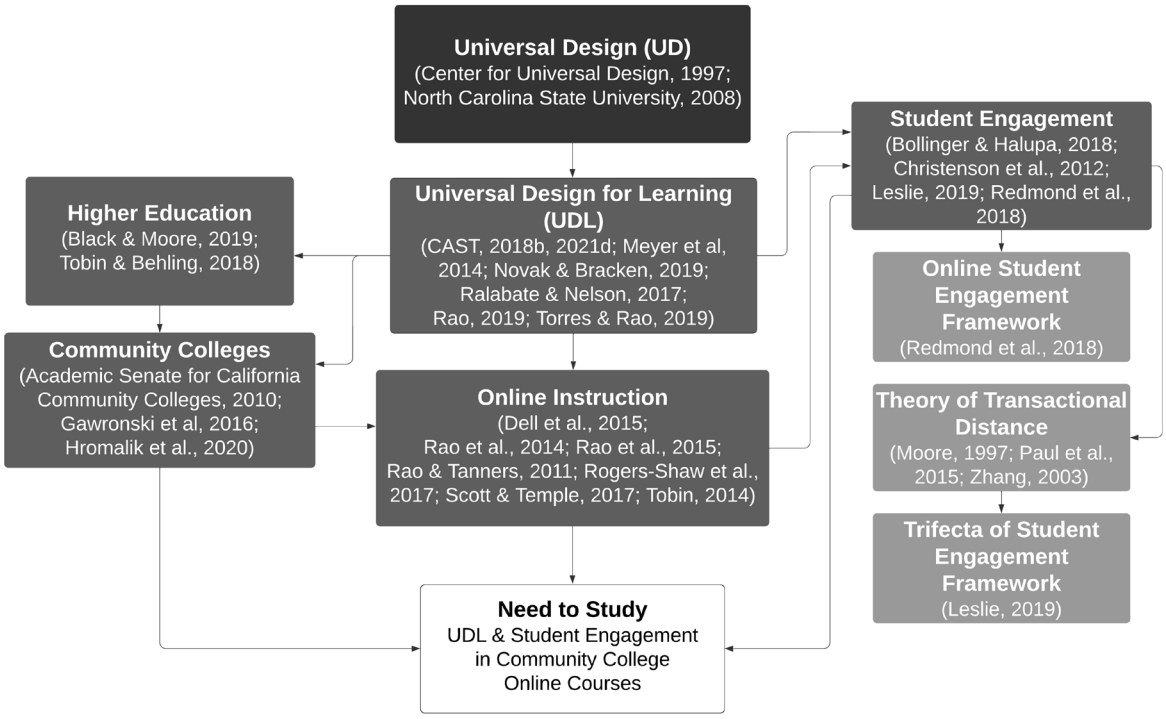
Universal Design (UD) is a concept built on variability and inclusivity. The concept was created by Ron Mace, an architect with a disability, during the 1970s (Center for Universal Design, 1997). Over time, the idea of building things to proactively plan for access for the greatest amount of people spread to other industries, such as education. A decade later, in the 1980s, the Center for Applied Special Technology (CAST, 2020a) introduced the Universal Design for Learning (UDL) framework as a scientifically based framework to influence instructional design in ways that meet the needs of diverse learners (Black & Moore, 2019; Meyer, Rose, & Gordon, 2014; Tobin & Behling, 2018). Originally developed for students with disabilities, UDL is now seen as an instructional strategy that provides better teaching strategies for all students (Black & Moore, 2019; Tobin & Behling, 2018), as it reduces barriers and increases access while maximizing learning for all students. There is already significant UDL research on K-12 education but UDL research in higher education is still limited. Higher education differs significantly from K-12 in student characteristics, pedagogical practices, and course modalities, hence the UDL approach for higher education must be differentiated (Black & Moore, 2019; Tobin & Behling, 2018). Figure 1 maps ideas, arguments, and concepts from the UDL literature.

Universal Design (UD)

In the mid-twentieth century demand for physically accessible environments increased in the U.S., as World War II veterans returned home, many with disabilities. The paramount Servicemen's Readjustment Act of 1944, also known as the GI Bill, prioritized federal funding for physically accessible facilities, including higher education spaces.

In 1968, the Architectural Barriers Act required buildings and facilities that utilized federal funds to meet specific physical accessibility requirements (U.S. Department of Justice, 2020). Expensive retrofitting caused architects to rethink and change initial building designs for new structures. One such architect, Ron Mace, had a unique perspective as a person who used a wheelchair. His insight created new barrier-free environments for people of all abilities, thus creating Universal Design (UD) in 1988 (CAST, 2021e; Tobin & Behling, 2018). Automatic electric doors and sidewalk ramps are examples of UD concepts in physical environments, while video closed captioning and listening options for online news articles are examples in digital environments.

Figure 1. *Literature Review Map*



In 1997, North Carolina State University created a working group of UD advocates to establish the Principles of Universal Design (North Carolina State University, 2008). Members included architects, product designers, engineers, and environmental design researchers. The group defined UD as creating products and environments that all people could use to the greatest extent possible without adaptation or specialized design and created the seven principles shown in Table 1 (Center for Universal Design, 1997).

Table 1. *Universal Design (UD) Principles*

Principles	Description
Equitable use	The design is useful and marketable to people with diverse abilities.
Flexibility in use	The design accommodates a wide range of individual preferences and abilities.
Simple and intuitive use	Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
Perceptible information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
Tolerance for error	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
Low physical effort	The design can be used efficiently and comfortably and with minimal fatigue.

Size and space for approach and use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Note. Adapted from Principles of Universal Design 2.0 (Center for Universal Design, 1997)

The germination of UD in education reduced barriers to the physical environment, a practice that eventually led to the development of Universal Design for Learning.

Universal Design for Learning (UDL)

The prominent UD model in education is the UDL framework. In 1984, Anne Meyer and David Rose founded the Center for Applied Special Technology, near Boston, Massachusetts (CAST, 2020a). CAST initially focused on assistive technology for students with disabilities through a grant from Microsoft (CAST, 2021e). To provide students equal access to the curriculum, CAST shifted focus from the disability of the student to the disability of the curriculum (CAST, 2021e; Rogers-Shaw et al., 2017; Tobin & Behling, 2018). In 1998, Meyer and Rose designed the UDL framework based on neuroscience and educational research to create accessible, inclusive, and effective learning environments (Griful-Freixenet et al., 2020; Meyer et al., 2014). A core part of neuroscience research revealed that each human brain is as unique as our fingerprints (Meyer et al., 2014). This revelation supports the concept of learner variability, which stipulates that genetic and environmental factors create unique brains in each individual (CAST, 2018a). UDL allows educators to address learner variability in their classrooms.

The framework focuses on three networks for learning: the affective network, the recognition network, and the strategic network. There are further three principles that transpose on these networks: multiple means of (a) engagement, (b) representation, and (c) action and expression (CAST, 2018b). The purpose of each principle is to support students to become expert learners who are (a) purposeful and motivated, (b) resourceful and knowledgeable, (c) strategic and goal-orientated (CAST, 2018b; Meyer et al., 2014).

Each principle includes a series of guidelines. For instance, under the first principle of providing multiple means of representation, there are three guidelines: (1) provide options for perception, (2) provide options for language and symbols, and (3) provide options for comprehension (Table 2). CAST dissects each guideline further into checkpoints. For instance, guideline one (provide options for perception) consists of three checkpoints: (1.1) offer ways of customizing the display of information, (1.2) offer alternatives for auditory information, and (1.3) offer alternatives for visual information (Table 2).

These checkpoints provide clarity and detail that guide instructors to best practice. For example, checkpoint 1.2 details the high importance of sound in instruction and indicates that educators must provide alternatives to sound not just for students with hearing disabilities but also for students with memory difficulties and English Language Learners (CAST, 2021b; Meyer et al., 2014; Ralabate & Nelson, 2017; Torres & Rao, 2019). Higher education continues to serve many adult

learners who greatly appreciate the ability to use captioning for videos when studying in a noisy environment or at night when family members are sleeping.

Table 2. *Universal Design for Learning (UDL) Guidelines*

Principles	Guidelines	Checkpoints
Provide multiple means of representation	1: Provide options for perception	1.1: Offer ways of customizing the display of information 1.2: Offer alternatives for auditory information 1.3: Offer alternatives for visual information
	2: Provide options for language and symbols	2.1: Clarify vocabulary and symbols 2.2: Clarify syntax and structure 2.3: Support decoding of text, mathematical notation, and symbols 2.4: Promote understanding across languages 2.5: Illustrate through multiple media
	3: Provide options for comprehension	3.1: Activate or supply background knowledge 3.2: Highlight patterns, critical features, big ideas, and relationships 3.3: Guide information processing and visualization 3.4: Maximize transfer and generalization
Provide multiple means of action and expression	4: Provide options for physical action	4.1: Vary the methods for response and navigation 4.2: Optimize access to tools and assistive technologies
	5: Provide options for expression and communication	5.1: Use multiple media for communication 5.2: Use multiple tools for construction and composition 5.3: Build fluencies with graduated levels of support for practice and performance
	6: Provide options for executive functions	6.1: Guide appropriate goal setting 6.2: Support planning and strategy development 6.3: Facilitate managing information and resources 6.4: Enhance capacity for monitoring progress

Principles	Guidelines	Checkpoints
Provide multiple means of engagement	7: Provide options for recruiting interest	7.1: Optimize individual choice and autonomy 7.2: Optimize relevance, value, and authenticity 7.3: Minimize threats and distractions
	8: Provide options for sustaining effort and persistence	8.1: Heighten salience of goals and objectives 8.2: Vary demands and resources to optimize challenge 8.3: Foster collaboration and community 8.4: Increase mastery-oriented feedback
	9: Provide options for self-regulation	9.1: Promote expectations and beliefs that optimize motivation 9.2: Facilitate personal coping skills and strategies 9.3: Develop self-assessment and reflection

Note. Adopted from UDL guidelines version 2.2 (CAST, 2018b)

UDL is grounded in research of more than eight hundred peer-reviewed scholarly articles (Novak & Bracken, 2019), with each checkpoint mapping to extensive evidence. For instance, checkpoint 1.2 connects to numerous experimental and quantitative evidence (18 scholarly articles), scholarly reviews, and expert opinions (11 publications) (CAST, 2021c). This foundation in neurological research supports UDL as a substantive pedagogical intervention in education.

K-12 educators were the first to adopt the UDL framework in the 1990s (Meyer et al., 2014; Tobin & Behling, 2018). Because of their pedagogical training they are more likely to implement UDL than their higher education counterparts (Davies et al., 2013; McGuire & Scott, 2006; Smith, 2012; Tobin & Behling, 2018).

Benefits of UDL

Supporting Hidden Students

Individualized Education Program teams extrinsically support students with disabilities in high school but upon transitioning to higher education, college students must proactively manage and intrinsically self-advocate for support with only supplemental assistance from the Disability Services Office (DSO).

After initial admission to a college, students with disabilities may become 'hidden' should they refuse to apply for disability-related services and accommodation. For example, in the 2015-2016 academic year, 19.4% of undergraduate students reported a disability (National Center for Education Statistics, 2019b). However, research has shown that only 20% of students with

disabilities register in the DSO (Schelly et al., 2011), as the process is perceived as cumbersome and time-intensive (Silver et al., 1998; Stentiford & Koutsouris, 2020).

Even community colleges within the same district may have different processes, requiring students with disabilities to submit separate applications for each college. Each time a student applies to a DSO, they must provide medical documentation of their disability, such as a previous Individualized Education Plan, a Section (504) plan, a psycho-educational evaluation report, or other documentation verifying the student's diagnosis from a qualified health professional (Cañada College Disability Resource Center, 2021). Students may find it difficult to produce documentation if they have inconsistent health insurance or insufficient support for diagnosing the disability during childhood. Some DSOs provide testing services for disabilities depending on funding availability.

This cumbersome process can delay access to resources, such as Letters of Accommodations (LOAs), specialized counseling services, and early registration. LOAs can include testing accommodations, such as additional test-taking time, using notes during an exam, or access to a quiet test environment. Some students may need physical accommodations, such as accessible desks, recordings of lectures, or frequent breaks from classes. Other students may utilize notetaking or sign language interpreting services during class.

Once the DSO approves academic supports, it is incumbent upon the student to inform each individual instructor of their LOA to access disability supports (Silver, Bourke, and Strehorn, 1998); higher education faculty are not automatically notified of students with LOAs. While students with disabilities are protected by layers of legislation, such as the Americans with Disabilities Act, the Rehabilitation Act, and state laws, many students hesitate to request accommodations from faculty members (Shaw & Van Leuven, 2019; U.S. Department of Justice, 2020) due to fear of faculty's negative attitudes towards accommodations or because they do not believe their accommodations will help them succeed in the course (Iowa State Center for Excellence in Learning and Teaching, 2015; Schelly et al., 2011). Some college students wait until they are underperforming in a course to disclose their LOAs to their instructors. Implementing the UDL framework can remove access barriers for students with disabilities (Rao, 2019; Stentiford & Koutsouris, 2020).

Reducing Requests for Individual Disability Accommodations

Incorporating UDL into the curriculum reduces the need for individual disability accommodations (Tobin & Behling, 2018). For example, a science professor could provide options for all students to consume course content through text or auditory information by posting multiple sources of information in the Learning Management System (guidelines 1.2 and 1.3 in Table 2). Faculty could automatically record all online lectures and use automatic transcription services to create an initial transcript of the recording, such as with Otter.ai integration within Zoom video conferencing (guideline 1.2 in Table 2). While faculty would still need to edit the transcription, the artificial intelligence feature would reduce the overall workload for the instructor. In synchronous online video sessions, instructors could encourage students to participate in discussions through the chat feature, which provides students additional time for formulating their answers and can be especially helpful

for students with learning disabilities, English language learners, and timid students (guideline 5.1 in Table 2). Faculty can also enable automatic live captioning in video conferencing software, so English Language Learners can read the text as people speak (guideline 1.2 in Table 2).

Inclusive Access to Learning

The COVID-19 pandemic highlighted the need for inclusive access to education. UDL is recognized as inclusive practice for young and adult learners, locally and abroad (Academic Senate for California Community Colleges, 2010; Scott & McGuire, 2017; Tobin & Behling, 2018). The UDL framework is a blueprint for educators to create multiple pathways for diverse learners to access curricula, diminish barriers, and empower students (Gawronski et al., 2016; Ralabate & Nelson, 2017; Scott & McGuire, 2017). For instance, educators can use UDL to develop scaffolded vocabulary support for native language learners (Torres & Rao, 2019). They can also provide a culturally relevant experience by customizing curricula with a variety of individualistic and collectivistic assignments that meet the varying cultural comfort level of students (Ralabate & Nelson, 2017; guideline 7.2 in Table 2).

Fostering Student Engagement and Community

Rao et al. (2014) conducted a descriptive review of UD implementation across all levels, including higher education. They found that students perceived courses with UD to be more effective and reported increased levels of engagement, including more frequent communication and interactions.

Criticisms of UDL

Overwhelming Implementation

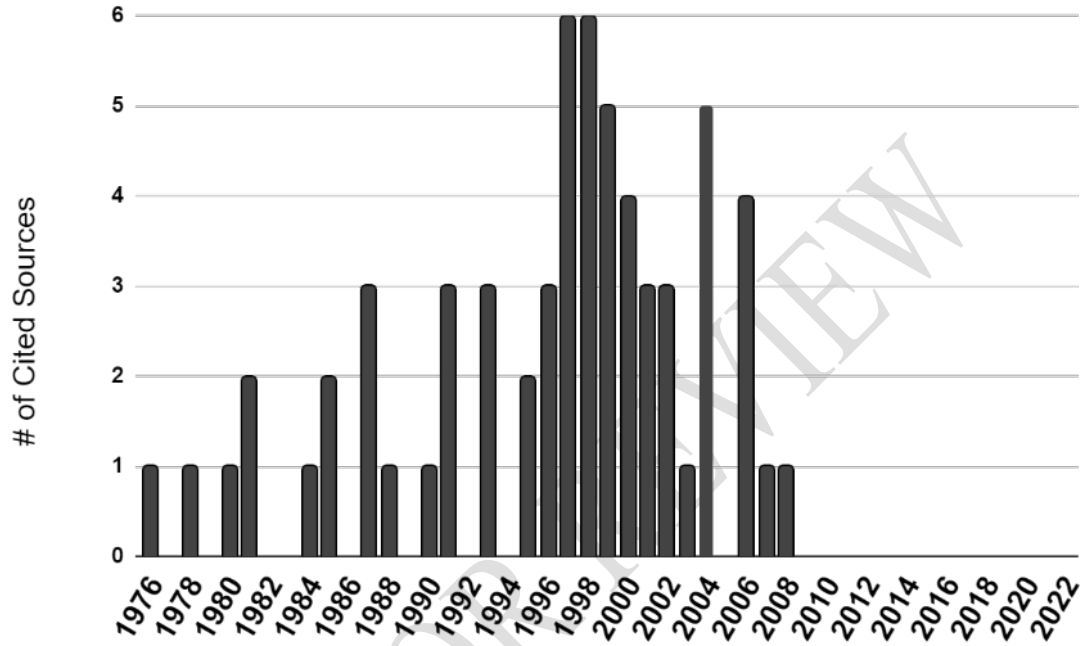
More than two decades following the creation of the UDL framework (Griful-Freixenet et al., 2020), UDL struggles to transition from the advocacy phase to the accommodation phase (Edyburn, 2010). Faculty hesitate to use the UDL framework and frequently criticize the depth of the UDL heuristic (Hromalik et al., 2020; Meyer et al., 2014). They struggle to progress from the initial stage of awareness to actual implementation (Scott & McGuire, 2017; Tobin, 2013), as they become overwhelmed with the number of possibilities in course design execution (Meyer et al., 2014); they are even confused about what it means to incorporate UDL in their teaching (Rao et al., 2014; Tobin, 2013). The many available choices complicate instructional design decisions, particularly for faculty who are ill-equipped in pedagogical training (Hromalik et al., 2020). Many also find the UDL reflection process labor-intensive and lacking sufficient evidence of students' benefits (Rao et al., 2015; Tobin, 2013; Tobin & Behling, 2018).

Outdated Checkpoint Research

While CAST has mapped over eight-hundred research studies behind the UDL checkpoints (Novak & Bracken, 2019), this evidence is now dated. For example, checkpoint 7.1 cites research from 1916 to 2008 (CAST, 2021d). No references

have been cited since 2008; CAST is missing fourteen years of the latest neurological research. Figure 2 illustrates the lack of research for UDL checkpoint 7.1 from 2008 to 2021, missing thus the adoption of educational technology and its impact on learners.

Figure 2. *Number of Cited Research Evidence per Year for UDL Checkpoint 7.1*



Note. The chart excludes one cited source from 1916.

Insufficient Student Outcomes Data

There are significant shortcomings in UDL research, such as:

(a) UDL guidelines research does not investigate implementation or student outcomes (Rao et al., 2020).

(b) The short supply of outcome data in the literature requires empirical validation of the UDL framework (Rao et al., 2014) but Kember (2003) argues that there are practical difficulties in using experimental designs to evaluate teaching innovations, such as UDL in higher education. He recommends instead triangulation of data through a mixed-methods study.

(c) Most UDL research in higher education does not disaggregate data by student characteristics such as race, ethnicity, linguistic background, or disability status. As a result, educators cannot know which interventions are effective for their student populations (Rao et al., 2020).

Lacking Data on Students with Disabilities

Existing literature sparsely includes data on students with disabilities in higher education. Several factors constrain the collection and reporting of this data, such as the requirement for students in higher education to opt-in to disclosing their disability status with professors as well as limiting factors on how many students

with disabilities have been verified through the local Disability Service Office to authenticate their disability accommodations in class.

Culturally Unresponsive

Initially, CAST and other UDL-proponents claimed that cultural responsiveness was inherently embedded within the UDL guidelines but the fact that cultural responsiveness was not explicitly mentioned drew criticism. In a recent whitepaper titled Cracks in the Foundation, David Rose, the co-founder of CAST, reflected on the UDL guidelines, explicitly addressing systemic barriers to equitable learning and outcomes in education (Rose, 2021). While CAST proponents have finally admitted their unconscious bias regarding culturally responsive materials in the UDL framework, they are still planning to update the framework to include culturally responsive pedagogy, lagging other social justice and inclusion movements.

UDL in Community Colleges

In general, there is significantly less research on pedagogy performed at community colleges than on universities (Alicea et al., 2016; Hromalik et al., 2020). As a result, there are gaps in the UDL literature concerning the community college environment.

In 2010, the Academic Senate for California Community Colleges (ASCCC) recognized UDL as a practice to promote equity in basic skills courses. The report claimed UDL increased success for all students and supported the learning of all students if given the proper access, support, and opportunity. The ASCCC viewed UDL through a cultural competency lens and encouraged faculty to be aware of their own cultural biases in considering students' cultural and ethnic values. The ASCCC issued a formal recommendation that statewide faculty development efforts should focus on equity-based practices, including incorporating UDL for equitable outcomes in the classroom (Academic Senate for California Community Colleges, 2010). A decade later, however, UDL still resides in a black hole outside the reach of many faculty.

In 2016, Gawronski, Kuk, and Lombardi examined community college faculty and students' perceptions toward inclusive teaching practices. However, their research focused on UD, not UDL. The researchers recognized that few empirical studies had measured perceptions of college students towards inclusive instruction (Gawronski, Kuk, & Lombardi, 2016, p. 333) and designed two online qualitative instruments: (a) the Inclusive Teaching Strategies Inventory (ITSI) for faculty; and (b) the Inclusive Teaching Strategies Inventory-Student (ITSI-S) for students. Responses included 179 faculty ITSI submissions and 449 student ITSI-S submissions, which were analyzed using a Multivariate Analyses of Variance. They discovered that the age and ethnicity of a faculty member impacted their self-reported action on inclusive teaching. In particular, they found that European participants between 35-44 years old had higher action scores than faculty of color. While faculty reported favorable attitudes toward inclusive design, the authors hypothesize that a lack of knowledge and practical skills in implementing inclusive teaching may be prohibiting changes in their classrooms. Faculty and students

agreed that inclusive education was necessary, but they rarely saw it implemented in a classroom. One of the strong criticisms was the absence of psychometric properties in the design of a quantitative instrument. The study did not address online education.

Hromalik et al. (2020) studied UDL training for community college faculty and organized a UDL Academy as a two-phase professional development program. Their research uncovered that faculty found UDL challenging to put into practice and asserted that UDL training would provide community college instructors the competence and confidence to succeed in course design, but they soon realized that one-time workshops would not be sufficient to produce significant results, without a framework for effective professional development practice that includes active learning, modeling, coaching, feedback, and reflection during professional development (Darling-Hammond, Hyler, & Gardner, 2017).

Clearly, to implement UDL effectively, faculty need post-workshop support. Hromalik et al. (2020) summarized the design, development, and implementation of the UDL Academy at the Onondaga Community College over a two-year timeframe. They included detailed tables of sample agendas, events, learning objectives, and content presented, as well as a detailed top-level summary of the schedule for both years of the UDL Academy. It was clear that funding to support faculty summer work helped incentivize faculty participation. However, it must be noted that a $4.5 million U.S. Department of Labor grant funded this study. Many community colleges lack access to such substantial resources and smaller colleges may not have the bandwidth or the number of faculty to support a comprehensive two-year UDL Academy. The community college in their study resided in upstate New York, where over half of the population was White, starkly different from the rich diversity in the California community colleges.

UDL in Distance Learning

Faculty today spend significantly more time teaching virtually. Rao and Tanners (2011) published a case study on UDL and Universal Instructional Design (UID) implementation in an online graduate course. The study was conducted in three phases: course design, implementation, and evaluation. The authors created a table for practitioners that mapped UDL and UID principles to specific course elements, such as course materials, instructional strategies, synchronous, and asynchronous activities. Student surveys and interviews identified valuable UD components in the course. Students reported an appreciation for multiple modalities in both the presentation of information and the representation of their work in the class. Additionally, Rao & Tanners found that students appreciated brief weekly assignments less stressful than high-stakes ones. A primary limitation of this case study was the small sample size of twenty-five students.

Rao et al. (2014) conducted a systematic review of empirically based intervention studies using three UD education models, including UDL. Research findings were organized into two elaborate tables, one for K-12 articles and one for higher education articles. The authors recommended creating reporting standards

that would serve as a precursor to creating the UDL reporting criteria (Rao et al., 2020).

Tobin (2014) documented tactical ways to increase student retention online through the application of UDL principles. He advocated for learners who are increasingly using mobile devices to access information, noting that online students can experience variability and uncertainty in Internet service and an increase in the dependence on mobile devices over laptops or computers. He proposed five strategies for incorporating UDL into online college courses:

a. Start by building course learning pathways strategically on textual information. Some of this text can be used to succinctly script content for video or audio formats.
b. Create two pathway versions: text-only and video versions; focus on content that traditionally confuses students.
c. Let students define the method and medium for the instructor's course learning objectives. For example, students write an essay, record a podcast, or make a video in special assignments. Be aware, however, that specific assignments, such as creating a business memo, should only allow one medium since it is unsuitable for other media.
d. Break topics into smaller chunks by creating short text-based or video content to accompany the most important topics in the course. Scaffold course content into brief segments of five minutes or less for manageable consumption by the student and manageable creation and updating by the faculty member.
e. Be selective and intentional in the type and amount of software required in a course.

His article was a predecessor to Tobin and Behling's (2018) seminal book, 'Reach Everyone, Teach Everyone: Universal Design for Learning in Higher Education'.

Rao et al. (2015) studied the implementation of Universal Instructional Design (UID), a UD model like UDL, in three online courses in a post-baccalaureate teacher certification program in special education. The purpose of this study was to document instructional practices that supported an inclusive environment for all learners while incorporating learner variability and adult learning theories into the research. The research provided a detailed description of how the instructor designed an inclusive online course. The authors included a table with course components mapped to UID and UDL principles. However, when mapping content areas to UDL principles, the authors did not specify which checkpoints were used under each variable or why and their research did measure student outcomes. Furthermore, while they promoted interaction between faculty and students, they did not emphasize interaction between students, a primary focus of today's online education for community colleges (California Education Code, 2007/2019).

Scott and Temple (2017) published a study that converted a face-to-face graduate-level special education course into an online course. The study detailed technology use and content delivery methods while including a comprehensive table

outlining the UDL design. While the article walks the reader through the authors' steps to convert the course to an online format, it primarily focuses on descriptive accounts of UDL instructional design without quantitative data on student outcomes and does not include student or faculty perspectives.

Rogers-Shaw et al. (2017) published a study on UDL for adult learners in online instruction summarizing the history of UDL and described how to redesign an online course. Implementation decisions included diversifying the ways students could access text-based content in the course, simplifying the syllabus, creating visuals for assessment values, modifying previous instructor-created exams to student-created exams, and increasing communication frequency within the course and directly to students. The authors advocated for UDL as an epistemological shift supporting social justice but did not adhere to the UDL reporting criteria. Their study did not include student outcome data or student perceptions.

Student Engagement

Frequently described as a meta-construct that is difficult to define and decode, many scholars under-theorize student engagement research and fail to explicitly define the term within their research (Christenson et al., 2012; Leslie, 2019; Redmond et al., 2018). Challenges in agreeing on a predominant definition of student engagement are compounded by differences in student engagement research, which evolves primarily within the classroom within K-12 but is studied both inside and outside the classroom within higher education. Postsecondary engagement research tends to focus more on engagement at the campus level, rather than the classroom level (Gunuc & Kuzu, 2014; Alicea et al., 2016). One example of measuring campus-level student engagement is the National Survey of Student Engagement.

With the exponential growth in online learning accelerated by the COVID-19 pandemic, researchers and practitioners alike must focus on providing equitable experiences and resources to online students to avoid educational segregation, since online students have fewer options for institutional engagement (Redmond et al., 2018). Needless to say, student engagement is key to online student retention and graduation persistence (Bolliger & Halupa, 2018).

Online Student Engagement Framework

Redmond et al. (2018) analyzed extant student engagement literature and developed a multidimensional student engagement construct for online education. They published an engagement framework specifically tailored to the virtual classroom, which consists of the following elements: behavioral engagement, cognitive engagement, collaborative engagement, emotional engagement, and social engagement. The five elements are interrelated in how they impact student engagement.

Behavioral Engagement

There are three aspects to behavioral engagement: (a) following rules and norms, (b) active academic participation, and (c) active participation in non-academic activities through the academic institution. When behaviorally engaged, students seek help and aid other students as needed; they display interest in learning, find content relevant to their personal lives, and develop academic skills such as reading, writing, time management, and goal setting. Illustrative indicators of behavioral engagement include adhering to online learning norms, developing agency and academic skills, and supporting peers (Redmond et al., 2018).

Cognitive Engagement

While cognitive engagement is the most fundamental form of engagement, it is not definitively defined in the literature. Generally, there are two levels of cognition. Deep cognitive engagement – when students justify or compare their ideas to others' ideas or incorporate new supporting information – and surface cognitive engagement – when students state ideas without justification or agree with other students without explaining. Course design impacts the level of cognitive engagement. Illustrative indicators of cognitive engagement in an online classroom include activating metacognition, critical thinking, integrating ideas, and justifying decisions (Redmond et al., 2018). Engaging self-regulation and metacognition directly align with UDL's focus on executive functioning and creating expert learners.

Collaborative Engagement

Students benefit academically, socially, and emotionally when connecting with others. Collaborative engagement develops relationships that support academic learning. Students can form relationships with other students, faculty, and professionals in the industry. Collaborative engagement with students includes group work, study groups, and tutoring. Faculty can collaboratively engage with students by providing a supportive learning environment, including small group activities and assessments. Externally, students can engage with industry professionals through professional networks. Although students can proactively develop their own networks, faculty may aid this process by creating informational interview assignments and campus career centers may help by organizing networking events. Illustrative indicators of collaborative engagement include developing professional networks, learning with peers, and relating to faculty members (Redmond et al., 2018).

Emotional Engagement

Emotional engagement is a student's attitude toward learning and is commonly referred to as the affective component of engagement. A student's attitude, whether anxiety or enthusiasm, indicates emotional engagement. Academic discipline may also play a role in emotional engagement; for example, courses in mathematics, suffer from inherent student anxiety that directly impacts student emotional engagement. Illustrative indicators of emotional engagement include articulating

assumptions, commitment to learning, managing expectations, and student motivation (Redmond et al., 2018).

Social Engagement

Social engagement refers to student participation in academic activities within the virtual classroom and extracurricular activities outside of class. Illustrative indicators of social engagement include building community, relationships, and trust (Redmond et al., 2018). A social engagement subconstruct creates a sense of belonging or the feeling of acceptance and inclusion within a group of people. Sense of belonging is conceptually distinct from social engagement, and thus, should be defined and measured separately in academic research (Anh & Davis, 2020). It supports diversity and inclusion while impacting performance and retention (Cornell University, 2021).

Theory of Transactional Distance

The theory of transactional distance dates to 1972, when the first definition of distance education was recorded in the English language (Moore, 1997). Decades later, Moore (1997) wrote a seminal essay on the theory of transactional distance in which he described three clusters of transactional variables: (a) dialogue, (b) structure, and (c) learner autonomy.

The concept of instructional dialogue is differentiated from mere interactions and defined as meaningful and valuable interactions between two or more people. The speed of the interaction is moderated by the type of technology utilized in the course. Other environmental factors also influence instructional dialogue, such as the number of students in a course, the frequency of communication, and the emotional environment of both teachers and students. Multiple influencers exist for dialogue, such as content, learner personality, and teacher personality (Moore, 1997).

Program structure relates to instructional design components. Moore argues that overstructured interactive online programs produce a learning environment more synonymous with one-way communication modalities, such as video. Thus, specific online education components with less structure are a welcoming environment to create meaningful dialogue. The skills and attitudes of the learners are imperative to the program structure. Students must have the confidence to participate in course activities and the skills to monitor autonomous learning (Moore, 1997).

Learner autonomy is present when a student is emotionally independent of the instructor and self-directed. The greater the student's autonomy, the more comfortable he/she is with less dialogue and structure in a course. The opposite is true for students with less autonomy. Adult learning theories naturally support an autonomous environment for learners (Moore, 1997).

One criticism of Moore's theory on transactional distance is his reliance on university institutions to provide robust instructional design resources for faculty. He cites that online learning is a team endeavor, with multiple staff contributing to the faculty's efforts, such as instructional designers, media specialists, and tutors.

California community college faculty do not have access to that level of instructional design support; rather, they rely on their own efforts to design and deliver courses.

Revised Scale of Transactional Distance (RSTD)

Distance education has transformed itself through new technologies. Similarly, the theory of transactional distance research has also evolved. Moore's theory of transactional design now identifies three types of interaction: student-to-student, student-to-teacher, and student-to-content (Zhang, 2003). Zhang (2003) extended Moore's theory to include more complex components related to online learning environments and developed an instrument to measure four dimensions of transactional distance that encourage active student engagement and learning:

1. Transactional distance between student and student (TDSS)
2. Transactional distance between student and teacher (TDST)
3. Transactional distance between student and content (TDSC)
4. Transactional distance between student and interface (TDSI).

Zhang's scale of transactional distance was later updated to become the revised scale of transactional distance (RSTD), which eliminated the TDSI construct in response to the changing needs of online students as technology continues to develop. The researchers recognized that unique obstacles to students' engagement in class are continuously adapting to changes in social, economic, and technological advances in society (Paul et al., 2015).

Trifecta of Student Engagement Framework

Leslie (2019) at the National University in California, designed the Trifecta of Student Engagement framework based on Moore's theory of transactional distance. The framework posits that students are engaged in a class, if they regularly interact with course content, student peers, and their instructor (Leslie, 2019, p. 151). The framework orients the student-centered theory into a pragmatic visual for application in faculty professional development programs.

Challenges with the Extant UDL Literature

While the breadth of UDL academic research seems vast and expansive, the overwhelming focus has been on K-12 education (Rao, 2019; Scott & McGuire, 2017; Tobin & Behling, 2018). There is a lack of UDL implementation studies in college classrooms (Gawronski et al., 2016; Rao et al., 2014; Samuels-Peretz & Powers, 2014; Silver et al., 1998; Stes et al., 2010). Furthermore, the research does not sufficiently describe which implementations benefit students with unique characteristics, such as disability or language ability status (Rao et al., 2014). There is clearly a need to further UDL research within community colleges and document implementation techniques and student outcomes.

Conclusion

While extant literature thoroughly discusses UDL as an excellent pedagogical practice, several studies have identified a lack of UDL implementation in the community college segment of higher education. These studies also point to a lack of documenting improvements in student outcomes facilitated by UDL, especially for students with specific characteristics.

Due to circumstantial reasons, researched-based evidence for UDL stops after 2008. CAST must update UDL guidelines based on new discoveries in educational neuroscience and revise the UDL framework to include cultural responsiveness.

In conclusion, there is a clear need for additional research on UDL implementation in higher education in general and community colleges in particular. UDL can be viewed as an investment in faculty variability, which has become necessary to effectively address the growing learner variability, especially in the California community college system. New research must include authentic assessment tools to measure UDL-induced improvements in student outcomes and explore how UDL can meet the needs of students with disabilities. Lastly, the effectiveness of UDL as an instructional design philosophy must be established and measured in various course modalities, such as in-person, hybrid, asynchronous online, and synchronous online.

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