International Journal of Instruction
e-ISSN: 1308-1470 ● www.e-iji.net

July 2023 ● Vol.16, No.3
p-ISSN: 1694-609X
pp. 1127-1146

Article submission code: 20220708042927
Received: 08/07/2022
Revision: 01/03/2022
Accepted: 24/03/2022
OnlineFirst: 10/06/2023

Experience-Based UDL Applications: Overcoming Barriers to Learning

Megan Mackey
Central Connecticut State University, USA, *mackey@ccsu.edu*

Natsuko Takemae
Central Connecticut State University, USA, *takemae.n@ccsu.edu*

John Foshay
Central Connecticut State University, USA, *foshayj@ccsu.edu*

Allison Montesano
Central Connecticut State University, USA, *montesantoa@my.ccsu.edu*

The overall purpose of this study was to examine the autobiographical memory narrative as a way for graduate teacher candidates (TCs) to learn to identify (1) barriers to learning, (2) Universal Design for Learning (UDL) checkpoints to remove these barriers, and (3) strategies for addressing the UDL checkpoints and removing these barriers. This phenomenological study explored lived experiences of (a) UDL training in the graduate teacher preparation programs, (b) barriers to learning in the past experience, and (c) application of UDL principles to removing the self-identified barriers to learning among graduate TCs. Having a purposeful criterion sample at a site level to explore central phenomena in the study (Creswell & Poth, 2018), participants in the study included 63 graduate TCs in a teacher certification program at a university in the north eastern region of the United States. The participants dually took roles as a student, who identified barriers to their learning from the past experience, and as a teacher, who applied UDL principles to removing those self-identified barriers. Data were collected through each participant's autobiographical narrative about (i) their past learning experience at any point in K-16 education, (ii) barrier to their own learning experience in the past, and (iii) UDL application to removing the identified learning barriers. Data were analyzed to identify frequency of barriers and types of strategies to remove these barriers across participants. Discussion includes identified (1) barriers to learning, (2) UDL checkpoints, and (3) strategies to apply the identified UDL checkpoints to removing these barriers. Emerging themes were aligned with the UDL guidelines (2018).

Keywords: universal design for learning, UDL, teacher preparation, overcoming barriers, learning

Citation: Mackey, M., Takemae, N., Foshay, J., & Montesano, A. (2023). Experience-based UDL applications: Overcoming barriers to learning. *International Journal of Instruction*, *16*(3), 1127-1146. https://doi.org/10.29333/iji.2023.16360a

INTRODUCTION

Self-reflection is a foundation of teaching practices and addressed by teacher preparation programs, professional educational organizations, and state educational agencies (CAEP, 2022; McLeskey et al., 2017; NEA, 2018). Based on the reflection theory of knowledge development, knowledge is built upon (a) self-reflection of past experiences, (b) meaning creations for the new information, and (c) knowledge construction based on the new information (Dewey, 1933). This means activating reflections of prior experiences is essential for creating meaning and knowledge of the new information. Reflective practices help teachers review, evaluate, and share their perceptions toward past experiences (Burhan-Horasanli & Ortaçtepe, 2016). This impacts one's beliefs about teaching and motivation, pedagogical preferences, and teaching competence (Burhan-Horasanli & Ortaçtepe, 2016; Ismail & Jarrah, 2019; Lo, 2021). Thus self-reflection is a powerful tool and essential part of teacher preparation programs.

Self-Reflection through Autobiographical Memory

Self-reflection consists of autobiographical memories in one's past experiences and actions. The context of memories in human development and culture have been analyzed by researchers (Walls et al., 2001). Careful examination of one's own autobiography, including memories, self-characterizations, and perspectives in relation to education and teaching, is critical in teacher preparation (Lima et al., 2014). Memory narratives reveal the extent of ways certain events impacted one's past experiences and be altered based on individuals' developmental stage of life (Thorne, 1995). Recollections likely include pleasant and challenging experiences at school (Lo, 2021; Walls et al., 2001). Thus autobiographical memories are researched to find perceived experiences among one's relationship to school and how those memories effected their feelings towards school (Walls et al., 2001).

For instance, both (a) success oriented pleasant experiences and (b) unpleasant misfortunate experiences are identified based on most recent memories (Walls et al., 2001). When learning about how memories of school relate to reasons individuals decide to enter the education field, *event specific knowledge* memories related to school are focused (Walls et al., 2001). Balli (2014) discusses *event specific knowledge* memories (Walls et al., 2001) as factors contributing to one's decision on becoming an educators The participants in the Balli's study on autobiographical memories about school demonstrates that students with teachers, who utilize specific teaching and learning strategies, have more positive than negative memories from their school age years. It is notable that teachers who use specific teaching and learning strategies play a key role that contributes to positive memories from school among students (Balli, 2014).

Memorable and Positive Learning Experience Imprinted by Dynamic Teachers

Students remember specific experiences within their school career where their teachers actively engage with them. For instance, Latterell and Wilson (2016) report that participants studying to become educators in the field of mathematics recall that when they were held to higher expectations it made them feel proud of themselves and that

feeling was something they wanted to pass onto their future students. Balli (2014) discusses that students with teachers who incorporate higher levels of thinking, debate topics in a different way, and allow the students to become more engaged in learning have a bigger impact on their learning than teachers who lecture about facts. When students feel respected and are involved in the lessons rather than passively lectured, they have a positive school experience that they want to pass along when teaching in their future classrooms (Balli, 2014). In addition, teachers that take the time and effort to ensure students understanding of the content make a lasting impression on university students studying to become educators themselves (Balli, 2014).

University students enrolled in teacher preparation programs have reported factors that they believe led to a person becoming an effective teacher. Studies conducted by Catling et al. (2010), Balli (2014), as well as Latterell and Wilson (2016), all suggests that teachers who are engaging, hold high standards for their students, and demonstrate flexible teaching styles, have a major influence on students becoming teachers. Further, Catling et al. (2010) discuss that students enrolled in geography education programs have reported that being actively engaged in the learning process made an impact on their enjoyment of the subject and increased their interest in becoming geography teachers. These learning experiences connect to the UDL guidelines (CAST, 2018) and are discussed later in this section.

UDL and Inclusive Teacher Preparation

The UDL guidelines are developed by CAST, originally known as Center for Applied Special Technology, for teachers to design teaching and learning in ways that will reach all learners in inclusive education more than three decades ago (CAST, 2022c). Educational laws such as *Individuals with Disabilities Education Act (IDEA) of 2004*, *Higher Education Opportunity Act (HEOA) of 2008*, and *Every Student Succeeds Act (ESSA) of 2015* mandate inclusive education for all learners. These educational laws ensure (a) inclusive education, (b) access to standard-based education, and (c) educational rights for all students including students with disabilities and limited English proficiency in K-12 and higher education. To ensure these priorities in field practices, ESSA (2015) and HEOA (2008) define UDL as a cognitive neuroscience research-based framework and endorses UDL applications to educational practices. ESSA (2015) ensures quality instruction and assessments through UDL. Research has shown that teachers who implement UDL in their classroom support learner variability by reducing learning barriers from the outset (Griful-Freixenet et al., 2020). HEOA (2008) ensures TC preparation, teacher training, and postsecondary education by an incorporation of UDL into setting the stage for inclusive education among all postsecondary learners including TCs and teachers. Both ESSA (2015) and HEOA (2008) create an ecological cycle of UDL-based learning in K-12 and higher education.

UDL is one of the core educational foundations through which teachers intentionally embed built-in natural supports for students to become expert learners (CAST, 2022a). The UDL framework encompasses three critical elements of learning including multiple means of (a) engagement in the learning process, (b) representations of conceptual processing, and (c) actions and expressions of learning outcomes (CAST, 2018). Three

UDL application features are (i) removing preexisting barriers in the curriculum, (ii) intentionally building-in natural support for learners, and (iii) bridging student interactions with their learning process (Rose & Meyer, 2002). Therefore, both teachers and TCs need to be trained for UDL applications to K-12 classrooms and to align with the educational laws endorsing these practices (ESSA 2015; Spooner et al. 2007). It is noteworthy that preparing TCs in teacher preparation programs to understand and apply the UDL framework prior to stepping into the K-12 classrooms is a more proactive, efficient, and cost-effective approach than training in-service teachers.

The UDL guidelines are organized vertically where they contain three guiding principles: engagement, representation, and action & expression (CAST, 2018). The UDL guidelines are also organized horizontally to help students *access*, *build*, and *internalize* content that is being taught in the classroom (CAST, 2018). The goal is to support students to become expert learners, who are *purposeful & motivated*, *resourceful & knowledgeable*, and *strategic & goal-oriented* (CAST, 2018). Each guideline has specific checkpoints on ways to reduce barriers to learning and maximize learning opportunities (CAST, 2020a). Teachers who implement UDL guidelines in their instruction can purposefully and proactively design goals, assessments, methods, and materials to reach learners with variability (CAST, 2022b). This is because applications of UDL to designing a learning environment and expertise call for addressing learner variability (Basham et al., 2020). The UDL guidelines (CAST, 2018) help understand and consider learner variability in this design process (Basham et al., 2020).

Effective Teachers in Autobiographical Memory and UDL

TCs pursuing a career in teaching have vivid memories of their time as students in classrooms (Balli, 2014). This experience can shape their desire to pursue teaching and their philosophy on what it means to be an effective educator (Balli, 2014). Balli (2014) shows the effective teaching among these teachers' instruction. For example, students remember teachers who used a wide range of reading methods for teaching and multiple different ways of presenting information (Balli, 2014). If these past teachers were to plan their instructions proactively and intentionally with applications of UDL checkpoints using these strategies, they could be aligned with the UDL checkpoint 1.1 (offer ways of customizing the display of information, CAST, 2018). Another example would be to have students take responsibilities and be in charge of their own learning (Balli, 2014). If these teachers were to actively plan for a UDL-based instruction with these strategies, they would apply the UDL checkpoint 9.2 (facilitate personal coping skills and strategies, CAST 2018). Likewise, having students interact via discussions or debates in their classrooms that were referred as memorable learning experiences among TCs (Balli, 2014), these teachers would apply the UDL checkpoint 7.2 (optimize relevance, value, and authenticity, CAST, 2018). Through these connections, past teachers among TCs can serve as teacher role models (Balli, 2014).

Teacher Candidates' UDL Application

The UDL guidelines give teachers a framework on how to plan curriculum, assessments, and implement instruction (Basham et al., 2020). Proactively implementing UDL-based supports, teachers can make the curriculum and instruction to reach all learners. However, issues affecting teacher instruction and student learning in a classroom are inevitable as the following: a lack of research in an area of UDL (Edyburn, 2010), the challenges to adopt and apply UDL principles among teachers (Koutering et al., 2005), and the misconceptions of UDL and evidence-based practices among teachers (Basham & Marino, 2013; Meo, 2008). To overcome these issues, it is essential for TCs and classroom teachers to understand and apply UDL principles to making the instruction and curriculum accessible to learners with variability. For these reasons, more research on effective teacher training on the UDL principles and applications are essential (Smith et al., 2019; Spooner et al., 2007). Thus, this research humbly contributes to the field of teacher preparation with UDL.

To learn to remove preexisting barriers for learning (Rose & Meyer 2002), TCs can apply UDL checkpoints to removing their own identified barriers to learning by using or making changes in teaching strategies used by their past teachers (Balli, 2014). Through this process, TCs can learn to become teachers by considering how their teachers would have applied UDL checkpoints through specific strategies. Takemae et al. (2018) suggest that a self-reflective learning cycle in addition to UDL training in a course provides additional opportunities for TCs to learn to apply the UDL framework to inclusive teaching practices. For these reasons, the UDL application procedure identified in this study included an autobiographical narrative as self-reflection while TCs systematically learned to apply the UDL framework to K-12 educational settings.

The overall purpose of this study was to examine the autobiographical memory narrative as a way for graduate TCs to learn to identify (1) barriers to learning, (2) UDL checkpoints to remove these barriers, and (3) strategies for addressing the UDL checkpoints for removing these barriers. This phenomenological study explored TCs' lived experiences in learning to identify (a) UDL training in the graduate teacher preparation programs, (b) barriers to learning in the past experience, and (c) application of UDL principles to removing the self-identified barriers to learning among graduate TCs. Thus, our research focused on TCs to (A) engage in systematic knowledge acquisition through the UDL training and (B) practice UDL applications to K-16 autobiographical memory scenarios. In this process, TCs took dual roles as a learner and their own teacher. Simultaneously they engaged in (1) their autobiographical narratives as a learner and (2) UDL applications to their learning design as a teacher.

METHOD

A phenomenological approach was applied to study lived learning experiences among participants and the shared phenomenon through which they learned to apply UDL to removing barriers to their past learning experiences (Creswell & Poth 2018). Phenomenological study allowed the researchers to explore universally experienced phenomena, (a) UDL training in the graduate teacher preparation programs, (b) barriers

to learning in the past experience, and (c) application of UDL principles to removing the self-identified barriers to learning among graduate TCs (Creswell & Poth 2018). A composite description developed by participants included their experiences as (1) a student experiencing barriers to learning and (2) a teacher applying UDL to removing self-identified barriers to learning (Creswell & Poth, 2018). In other words, TCs recognized barriers to their own past learning and applied the UDL framework to identifying changes they would make in learning strategies and environment. Challenges to narrative research include understanding individuals' context of life and capturing their experiences through particular stories (Creswell & Poth, 2018). Thus this study incorporated trifold prompts focusing on individuals' context of life through which they experienced barriers to learning in a specific period of time in K-16, details in this specific experience, and ways they could remove these barriers to learning using the UDL framework. Systematic procedures from identifications of significant statements and meanings of clustered emerging themes were analyzed to describe *what* and *how* participants experienced the phenomena (Creswell & Poth, 2018; Moustakas, 1994). This essence of experience focusing on *what* and *how* participants experienced the shared phenomena, were discussed based on the data analysis (Creswell & Poth, 2018).

Participants

This study employed purposeful sampling (Creswell & Poth, 2018) to identify participants who shared memberships in the teacher preparation graduate programs and who engaged in a structured course that provided a training on autobiographical memory-based UDL applications. Having a purposeful criterion sample at the site level to explore central phenomenon in the study, the participants in the study included 63 graduate TCs in a teacher certification program at a university in the north eastern region in the United States. All participants were enrolled in an asynchronous online introductory special education course in 2017, 2018, or 2019. Thus, the participants represent three different cohorts. There were 36 TCs who identified as female and 27 students who identified as male. The female TCs' average age was 29.47 years and the male TCs' average age was 31.00 years. Within their graduate program the students had various focus areas or subject majors from the most common being Special Education, History/Social Studies, English, Mathematics, Spanish, and Science. Cohorts from 2020 through the present were not included in this study in order to separate possible influences of the COVID-19 Pandemic on the nature of data representation. For instance, including the data from 2020-present might yield ways TCs' learning barriers were influenced by various aspects of the COVID-19 Pandemic that were different from the data representation from 2017-2019. Thus, the participants in this study included cohorts prior to the COVID-19 Pandemic.

Materials

The materials utilized in this study were the Overcoming Learning Barriers course assignment template and course content files of electronic presentations in Microsoft PowerPoint, multimedia presentations recorded by the instructor, and assignment templates. All these materials were available for download by the participants. The instructor designed and delivered course content through an online multimedia (audio,

video, slide presentation) format that TCs attended to through a course management software system. The multimedia consisted of a slide presentation and a video of the instructor presenting the slide content.

The Overcoming Learning Barriers assignment template was a Microsoft Word file that contained three questions and explicit response lengths in paragraphs. The template also included specific directions for formatting the response by providing instructions for what type of information should appear in each question. For example, relative to the second question on the assignment, which asked the TCs to identify learning barriers they had personally experienced, the template contained the guidance, "4 paragraphs; 1 paragraph per experience-only describe the situation and the barrier." In this process, the participants dually took roles as a student who identified barriers to their learning from the past experience and as a teacher who applied UDL principles to removing those self-identified barriers.

Procedure

The instructor covered myriad content in the asynchronous fully online, 1 credit, introductory special education course. Taught within the course was a definition of UDL, the history of the term, the relationship of UDL to curriculum, 12 barriers to learning, an explanation of the recognition, affective, and strategic networks, and explicit instruction in how to complete the Overcoming Learning Barriers assignment. The instructor used a shared discussion format focusing on (1) unpacking what barriers to learning were in instructional design, (2) asking students to identify experiences they had or observed where those barriers came in to play, and (3) sharing how to overcome them. The shared discussion and explicit instruction served as a model and guided practice prior to independently completing the assignment. The TCs independently completed the Overcoming Learning Barriers assignment including the autobiographical narrative.

All the above UDL content was within one class session. Twelve well-known instructional barriers to learning were included in the course and repeatedly referenced directly in the content presentation. These instructional barriers to leaning were initially identified and derived from how learning occur, instructional design features, (National Research Council, 2000; Schunk, 2012) as well as the UDL principles, guidelines, and checkpoints (CAST, 2018). The identified barriers to be removed through UDL were abstractness, organization, relevance, interest, skills, strategies, background information, complexity, quantity, activities, outcomes, and response options (see Table 1). During the presentation, the instructor listed the name of the barrier and provided a brief explanation. For example, the word ***abstractness*** would appear on a slide followed by the bullet point "content too conceptual." Next, the instructor provided an example of the barrier using a personal K-12 or college experience as an example. Then, the instructor asked the TCs to think about potential approaches or solutions an educator could use to overcome the named barrier, provided wait time, then suggested one to three approaches. For example, with the design problem of ***abstractness*** the suggested solution was "more concreteness needed." The suggested solution appeared as a bullet point directly under the brief explanation. The instructor then provided an example of

what an educator could have done to use the solution in the context of the previously given barrier example. For illustration, the instructor described their learning experience in an applied electronics course lab where an experiment required the use of a multimeter to measure resistance in a circuit. The electronics professor assumed prior understanding of the multimeter tool, however, for the learner the principles and practices were too abstract. In the illustration the instructor proceeded to explain that as a learner, they would have benefitted from more concrete step-by-step guidelines for how to use the multimeter to measure resistances in a circuit. This process of naming the barrier, explaining the barrier, providing examples, and identifying ways to overcome the barrier were repeated for the remaining 11 barriers. Based on this instructor model, the TCs identified their own learning barriers based on their autobiographical memory narratives and the shared discussion. Then they identified ways to remove these barriers through UDL applications.

Table 1
Barrier definitions

Barrier Category	Definition
Abstractness	Content too conceptual
Activities	Do not help students achieve understanding or mastery
Background information	Students lack the background knowledge needed to be successful
Complexity	Information has too many parts or layers
Interest	Students perceive content as boring
Organization	Too unstructured or students unclear on nature of organization used
Outcomes	Information provided is insufficient to help students to reach desired outcome or know what finished product should look like
Quantity	A lot of difficult, complex material
Relevance	No relationship to students' lives
Responses	Response options do not allow students to demonstrate competencies
Skills	Lesson lacking prerequisite skills or written at inappropriate skill level
Strategies	Presented in ways that learners approach task ineffectively or inefficiently

Explicit instruction, model assignment, and structured template were provided for students to learn to complete the Overcoming Learning Barriers assignment. The instructor reviewed the syllabus description of the assignment by referring to the text of the syllabus directly. Together in class, the instructor and TCs reviewed the Overcoming Learning Barriers assignment guidelines and model assignment completion. The TCs completed the assignment by downloading the structured template with three prompts, typing directly into the file, saving the file, and uploading the file to the course management software system. All three prompts on the Overcoming Learning Barriers template appeared in the multimedia presentation and the instructor directly referenced several of the known UDL barriers and gave specific examples of how to compose responses to each of the three prompts on the template. The Overcoming Learning Barriers assignment was used for all three sections of the course, one course each year,

for three years, and did not change from year to year. The instructional content covering UDL barriers did not change across the three years. Therefore, each participant's autobiographical narrative included (1) their past learning experience at any point in K-16, (2) barrier to their own learning experience in the past, and (3) UDL application to removing the identified learning barriers. learning barriers.

Data Analysis

Qualitative data was analyzed after the data collection was performed through four data sources: (a) descriptive data, (b) perceived definition of learning barriers, (c) four scenarios describing experienced barriers to learning, and (d) strategies for overcoming identified barriers through UDL. Data analysis focused on the phenomenon, applying UDL to removing self-identified barriers to learning experienced in the past. The substantive validation was ensured through reviews of the descriptive and reflective field notes (Bogdan & Biken, 1998; Creswell & Poth, 2018). The interrater agreement and content analysis increased the reliability of this study (Creswell & Poth, 2018; Nardi, 2006). This process included coding, categorizing, and identifying themes (Chenail, 2012).

Data analysis consisted of identifying frequency of barriers and types of strategies to remove these barriers among the participants. The TCs' responses to the assignment requirement of naming the barrier, explaining the barrier, providing examples, and identifying the four barriers to learning were individually analyzed and coded by each researcher. The researchers met to compare codes. This meeting yielded two major outcomes: (1) Interrater reliability was determined to be 77% with 194 out of a possible 252 agreements and (2) extensive discussion about the coding of responses that did not identify one of the 12 provided barriers. The team determined that responses that included a self-reported reference to any type of academic, psychological, or emotional disability or disorder such as a learning disability (LD), Attention-Deficit/Hyperactivity Disorder (ADHD), depression, or similar, should be categorized as "Other Academic" (see Table 2). Further, the team coded factors such as financial strain, family issues, transportation problems and similar as "Situational Life Stressors." Researchers individually recoded the responses that had not fallen into the 12 original barrier categories before they reconvened. The second meeting for code comparison yielded an interrater reliability of 84% with 211 out of 252 agreements.

Table 2
Additional barriers & definitions

Barrier Category	Definition
Other academic	Any type of academic, psychological, or emotional disability or disorder, depression, or similar
Situational life stressor	Factors such as financial strain, family issues, transportation problems and similar

Researchers then turned their attention to analysis of the strategies that the TCs listed for overcoming each of their four identified learning barriers. Per the assignment requirements, the TCs were expected to provide three different strategies they

implemented through UDL applications to overcome their learning barriers. The qualitative data analysis was conducted for the three different strategies and rationales that each TC identified for removing their perceived learning barriers. First, each researcher used open coding to identify the three different strategies per barrier that the TCs described. Second, the researchers met to discuss their coding. At that time, researchers agreed upon keywords to use to label strategies. Third, the researchers reexamined their coding and named the strategies using agreed upon descriptors. Finally, the coded strategy items were analyzed to identify emerging themes and subthemes. The researchers conducted the interrater agreements for each theme among these strategies. There were 726 possible instances of strategies offered by participants. Only 575 were provided and coded by all three researchers. Of those 575 occurrences, at least two of the researchers coded 552 the same way, for an interrater reliability of 96%. After these emerging themes and subthemes are agreed, they identified UDL checkpoints (CAST 2018) that mentioned keywords in these strategy themes and subthemes.

FINDINGS

The Overcoming Learning Barriers assignment highlighted lived learning experiences among participants with the shared phenomenon for learning to apply UDL to removing barriers to past learning experiences. Results of the data analysis on (a) identified barriers to learning from experience as a learner and (b) strategies to remove these barriers through UDL applications were identified with clusters of meanings to highlight and categorize them into themes (Creswell & Poth, 2018). Emerging themes from the data analysis were aligned with the UDL principles and checkpoints (CAST, 2018). The emerging themes among identified (1) barriers to learning, (2) UDL checkpoints to remove these barriers, and (3) strategies to apply the identified UDL checkpoints for removing these barriers were consistent. This implicates the participants' demonstration of intentional UDL applications to overcoming identified barriers to learning.

Barriers to Learning

Barriers to leaning are initially derived from how learning occurs and instructional design features (National Research Council, 2020; Schunk, 2012) as well as the UDL principles, guidelines, and checkpoints (CAST, 2018). Based on the descriptions by the participants and UDL principles, guidelines, and checkpoints, these barriers to learning serve as key factors contributing to ensuring learners to *access, build,* and *internalize* target contents and skills. To *access, build,* and *internalize* target contents and skills are the horizontal alignments in the UDL guidelines (CAST, 2018). Analysis of the barriers revealed that ***strategies*** were the barrier that participants identified most often with 211 occurrences (see Table 3). These data indicate that participants felt that strategies used by the teacher posed challenges to learning efficiently or effectively. The barriers to learning among ***strategies*** affected all UDL principles: engagement, representation, and action & expression. According to the UDL guidelines, engagement is *the why of learning* and includes checkpoints about recruiting interest, sustaining effort & persistence, and self-regulation. Representation is *the what of learning* and consists of the checkpoints of perception, language & symbols, and comprehension. Action &

expression is *the how of learning* and contains the checkpoints addressing physical action, expression & communication, and executive functions (CAST 2018).

Table 3
Barrier categories, frequencies, and applied UDL principles and checkpoints

Rank	Barrier Category	Frequency	Engagement	Representation	Action & Expression
1	Strategies	211	9.2	3.1, 3.3, 3.4	5.1, 5.3, 6,1, 6.2, 6.4
2	Situational life stressor	205	7, 8, 9		4, 5, 6
3	Skills	189	8.2, 8.3, 9.2	3.3	5.3, 6.1
4	Responses	178	7.1, 7.2, 8.1, 9.1, 9.2, 9.3,		4.1, 5.2, 6.4
5	Relevance	173	7.2, 8.1, 8.4	3.1	5.3, 6.3
6	Quantity	153	7.3, 8.2	3.3	6.3
7	Outcomes	137	7.1, 7.2, 8.1, 8.3, 9.1	3.3	4.2, 5.1, 5.3, 6.1, 6.2
8	Organization	130		3.3	6.3
9	Other academic	108	7, 8, 9	1, 2, 3	4, 5, 6
10	Interest	78	7.2, 8.1, 8.3		
11	Complexity	53	7.2, 8.2	1.2, 1.3, 2.1	
12	Background information	21	7.3, 8.1	1.1, 2.1, 3.1	
13	Activities	15	7.1, 7.2, 7.3, 8.2, 8.3, 9.1, 9.3		4.1
14	Abstractness	12	7.2, 8.3	1.1, 1.2, 1.3, 2.4, 2.5, 3.1, 3.2, 3.3,	6.4

Note. This table demonstrates elements of barriers, frequency, as well as applied UDL principles and their checkpoints. The barriers serve as key factors of ensuring the UDL principles and their checkpoints.

Five other barriers that hindered all three UDL principles were mentioned more than 100 times. ***Skills***, meaning the lesson was not matching for students' present skill level, was the third highest with a total of 189 occurrences. ***Relevance*** was the fifth highest barrier identified with a total of 173 references. This means that there were insufficient or unclear connections between the content and the students' lives. ***Quantity***, which referred to instruction containing a large quantity of difficult and complex material, was noted 153 times. The seventh highest, ***outcomes***, appeared on 137 occasions. These indicate that course, lesson, and assignment outcomes addressed by the instructor were insufficient in helping students achieve the learning objective or know what was expected of them. ***Other academic***, a category borne from analysis, showed up on 108 occasions. This included any type of academic, psychological, or emotional disability or disorder, depression, or similar.

Two barriers to learning that affected the UDL principles of engagement as well as action & expression and with frequency counts over 100, were identified during

analysis. One of the new categories yielded during analysis, ***situational life stressors***, had a frequency of 205 instances and was the second most frequently referred barrier. These point to factors beyond the classroom, such as family issues, medical conditions, and other things having a significant impact on the candidates' ability to be successful. Life stressors impact the UDL principles of engagement and action & expression, which both require extensive student participation to achieve success. ***Responses***, which pointed to limitations in response options to demonstrate competencies, was fourth highest with 178 mentions.

Organization was referenced in 130 instances, which is the eighth highest and only remaining barrier with over 100 mentions. Disorganization in courses, lessons, and assignments hindered the UDL principles of representation as well as action & expression. One of the five remaining barriers with less than 100 references affected all three UDL principles: engagement, representation, and action & expression. It was ***abstractness*** (12) meaning that abstract concepts were provided without concrete examples and clear explanations. Two barriers in the category of less than 100 references signaled challenges to two UDL principles of engagement and representation. They are ***Complexity*** (53), meaning the information had too many parts or layers, and ***background information*** (21), showing that the TCs believed they lacked and were not supplied with the necessary background knowledge to be successful. ***Activities*** (15), meaning the activities used in the lesson were identified as unhelpful for students to endure understanding affected two UDL principles of engagement and action & expression. ***Interest*** was referenced on 78 occasions and indicated that the students were not hooked with the content and skills taught and experienced boredom. Lack of interest impacted the UDL principle of engagement.

UDL Applications to Overcome the Barriers

Analysis of the strategies the TCs identified to overcome the barriers yielded several themes. The theme that occurred most frequently was ***recruiting interest*** for a lesson or activity, with 135 references. The primary focus of this theme is the "why" of learning, or the UDL principle of engagement. Recruiting interest includes providing meaningful learning opportunities, relevant and relatable topics, and options for content exploration as emerging subthemes among strategies. The strategies yielded themes and subthemes targeted UDL checkpoints and are mentioned in these UDL checkpoints. These UDL checkpoints included to *optimize individual choice and autonomy* (7.1), *optimize relevance, value, and strategy* (7.2), and *minimize threats and distractions* (7.3). The TCs addressed these UDL checkpoints in their narratives. Keywords emerged in the strategy themes and subthemes are addressed in these UDL checkpoints.

The sixth most frequent theme also consisted of the "why" of learning. That theme was ***community*** with a total of 57 references. Subthemes of community consisted of relationship building, collaboration, developing a safe and inclusive learning environment, and incorporating group work. The TCs discussed the UDL checkpoint to *foster collaboration and community* (8.3). This UDL checkpoint includes keywords appeared in the emerging strategy theme and subthemes in this area.

The next three highest ranked themes cut across the UDL principles of engagement, representation, and action & expression which means they encompassed the "what, why, and how" of learning. ***Communication*** (94) involves the instructor's effectiveness in conveying expectations, providing models or examples, and offering guidance to students. Also, with facilitating communication with the classroom and between home and school. The TCs emphasized the value of ***variation*** (93) in all aspects of classroom instruction and student learning. This includes changing the pacing of lessons, offering additional time for completion of activities, changing teaching strategies, altering ways students demonstrating understanding, and incorporating wide-ranging resources. An instructor's ***organization*** (88) was also deemed vital to student success. This involved things such as well-developed lesson plans, incorporating various instructional approaches, utilizing different materials, and even maintaining a structured classroom environment. The target UDL checkpoints, which include keywords for the emerging strategy themes and subthemes, identified by the TCs include as followed: *heighten salience of goals and objectives* (8.1), *vary demands and resources to optimize challenge* (8.2), *foster collaboration and community* (8.3), *increase mastery-oriented feedback* (8.4), *promote expectations and beliefs that optimize motivation* (9.1), and *develop self-assessment and reflection* (9.3) in engagement. Under representation, the following eight UDL checkpoints were included: *clarify vocabulary and symbols* (2.1), *clarify syntax and structure* (2.2), *support decoding of text, mathematical notation, and symbols* (2.3), *promote understanding across languages* (2.4), *activate or supply background knowledge* (3.1), *highlight patterns, critical features, big ideas, and relationships* (3.2), *guide information processing and visualization* (3.3), and *maximize transfer and generalization* (3.4). The following six UDL checkpoints in action & expression were recurrently identified by the TCs: *use multiple tools for construction and composition* (5.2), *build fluencies with graduated levels of support for practice and performance* (5.3), *guide appropriate goal-setting* (6.1), *support planning and strategy development* (6.2), *facilitate managing information and resources* (6.3), and *enhance capacity for monitoring progress* (6.4).

Background knowledge was a theme that appeared in 81 instances. This consisted of ways to activate, connect to, review, and build upon previously learned information. The TCs also noted the need to assess for prerequisite knowledge skills and to fill any gaps prior to moving on with instruction. Background knowledge speaks to the emphasis on the "what" of learning, which is the UDL principle of representation. The target UDL checkpoints addressed by these strategies are included as followed: *offer ways of customizing the display of information* (1.1), *clarify vocabulary and symbols* (2.1), *clarify syntax and structure* (2.2), *promote understanding across languages* (2.4), and *activate or supply background knowledge* (3.1) in representation. These UDL checkpoints include keywords describing the emerging strategy theme and subthemes for background knowledge.

The next most mentioned theme was ***quantity*** with a count of 51 instances. The focus here is on breaking down steps, assignments, and materials into easily digestible parts. This could take the form of chunking material, adjusting expectations, or sacrifice amount for quality. The UDL checkpoints targeted by these strategies that include

keywords appeared in the emerging strategy theme and subthemes. These UDL checkpoints include as followed: *guide information processing and visualization* (3.3) in representation and *facilitate managing information and resources* (6.3) in action & expression.

The next two themes again addressed all UDL principles: engagement, representation and action & expression, and the "what, why, and how" of learning. ***Support*** had a frequency count of 49. Instructors making themselves available outside of class, students seeking help, and the provision of related supports such as tutoring, paraprofessionals, or counseling were all identified within this theme. ***Activity*** was mentioned 40 times and consisted of having myriad learning opportunities, repetition of content, and ample practice. It also referred to use of activities that were fun, creative, or interactive. These strategies recurrently focused especially on the UDL guideline 8, *sustaining effort & persistent,* guideline 9, *self-regulation,* checkpoint 3.4, to *maximize transfer and generalization,* and checkpoint 5.3, to *build fluencies with graduated levels of support for practice and performance.* These UDL guidelines and checkpoints address support for students to be embedded in their learning environment and process.

Rounding out the top 10 themes was ***assessment*** with a count of 31. The main element of this theme was effectively using assessment to inform instruction. The UDL principle of action & expression or the "how" of learning, respectively, were evident in this theme. The examples included as followed: using the results of formative assessment to check for understanding and adjust lessons as needed, student self-assessment to cultivate autonomy and reduce anxiety, and developing creative projects to demonstrate mastery. The UDL checkpoint 6.4 to *enhance capacity for monitoring progress* was recurrently targeted when students designed these strategies. Keywords that emerged from the assessment theme and subthemes were mentioned by the UDL checkpoint as well.

DISCUSSION

The conceptual foundation for UDL has existed for more than three decades (CAST 2022c). As ESSA (2015) and HEOA (2008) define and endorse UDL applications for all learners throughout their educational experiences, these educational laws re-envision designs and implementations of instructional environments and support addressing learner variability. This implicates the priority for TCs and teachers to be trained to proactively identify learner variability and flexibly design learning environment and support for these learners (CAST, 2018; CAST, 2022b). Thus, when these TCs and teachers are trained and prepared for the UDL applications, it is also important for teacher educators in higher education and district leaders in K-12 education flexibly identify effective and efficient ways of the UDL training and preparation. Identifying effective models through which TCs and teachers can learn to implement UDL would inform teacher educators and district leaders of meaningful professional development and teacher preparation designs (Smith et al., 2019).

Smith et al. (2019) suggest teacher preparation programs to document ways they prepare future teachers to implement UDL. To contribute to the suggested action, this study

examined the autobiographical memory narrative as a way for graduate TCs to learn to apply UDL. The TCs (A) engaged in systematic knowledge acquisition in the UDL training and (B) practiced UDL applications to their identified barriers to learning in their K-16 autobiographical memory scenarios. This documents a possible UDL training design that can be replicated based on the Methods section. This also contributes as a UDL resource to the field of education.

Self-reflection is part of central foci in teacher preparation programs, professional organizations' standards, and professional development and training (CAEP, 2022; McLeskey et al., 2017; NEA, 2018). Through self-reflection of one's own past experiences, meaningful connections to the new information can be made for the knowledge construction (Dewey, 1933). Reflective practices activate TCs' demonstration of reviewing, evaluating, and sharing perceptions toward past learning experiences (Burhan-Horasanli & Ortaçtepe, 2016). Therefore, TCs can engage in opportunities for acquisition and application of UDL through a self-reflective learning cycle (Takemae et al., 2018). In the self-reflective learning cycle (Takemae et al., 2018) using their own autobiographical narratives of past school experiences (Walls et al., 2001), the TCs' past teachers can serve as teacher role models (Balli, 2014). For these reasons, TCs can learn to become teachers while analyzing how their teachers would have applied UDL checkpoints through specific strategies to remove TCs' own barriers to learning. In learning to remove preexisting barriers to learning in the environment (Rose and Meyer, 2002), TCs can intentionally apply UDL checkpoints to remove their own experienced barriers in the past by using or designing strategies that their past teachers implemented.

This study explored the TCs' UDL applications to their own autobiographical narratives by taking dual roles as a learner and teacher on their own. The data informed (1) barriers to the TCs' own past learning based on the autobiographical narratives, (2) UDL applications to remove these barriers by identifying UDL checkpoints, and (3) specific strategies to address identified UDL checkpoints for removing the barriers to learning. The results showed that the participants were able to identify learning barriers they have experienced in their K-16 experiences as students as well as to produce strategies that overcome those barriers. The most frequently identified barriers included situational life stressors, skills, responses, and relevance. The barrier identified as situational life stressors was not specifically listed in the course content, presentations, nor included as a known instructional design barrier. While the study procedures specifically asked participants to identify known design barriers from course content, the data showed 205 instances of situational life stressors. These data showed that the participants perceived socio-economic, medical, personal, and other situational life stressors as barriers to learning.

The emerging themes among identified (1) barriers to learning, (2) UDL checkpoints to remove these barriers, and (3) strategies to apply the identified UDL Checkpoints for removing these barriers were aligned with the UDL guidelines (2018). The most frequently identified strategy themes included recruiting interest, communication, variation, organization, and background knowledge. Taken collectively the identified

strategies target implementations of the UDL principles of engagement, representation, and action & expression. Ways to implement these identified strategies included critical patterns that formed emerging themes and subthemes. These themes and subthemes connected to ways for students to ***access*** content through (a) recruiting interest, (b) perception, and (c) physical action; ***build*** understanding by (d) sustaining effort & persistence, (e) language & symbols, and (f) expression & communication; and ***internalize*** information via (g) self-regulation, (h) comprehension, and (i) executive functions (CAST, 2018). This indicates intentional UDL-based strategy identifications for removing specific barriers to learning among participants.

Because designing learning environments by removing barriers through UDL should be proactive and intentional (CAST, 2022b), horizontal and vertical alignments among the barriers, strategies, strategy themes and subthemes, and UDL principles, guidelines, and checkpoints should be addressed in future research to provide insightful perspectives for TCs' learning to design an instruction. This alignment can show a clearer relationship between identified barriers, target UDL checkpoints to remove these specific barriers, and specific strategies corresponding to the target UDL checkpoints and barrier removals. This alignment can be used as a model and example for TCs to refer to when they learn to design instructional environment and support for learners with variability. By aggregating a large sample data on identified and/or experienced barriers to their own past learning, research can also inform the educational field of commonly experienced learning obstacles among them. It will also be insightful to analyze possible relationships among their own identified barriers, ways to overcome these barriers through UDL, and actual UDL applications to their K-12 teaching practices. In addition, future studies could investigate the nature and frequency of learning barriers based on variables such as K-12 grade level, university programs, subject matter, gender, age, or other factors. Also, future studies could investigate the effects of autobiographical reflection on the ability of TCs to plan lessons that proactively address the frequently identified barriers. Additionally, future studies could also investigate the effects of autobiographical reflection on the ability of TC to plan lessons that include the frequently identified UDL-based strategies in the instructional design. Furthermore, future research could investigate the effects of UDL in higher education on overcoming the situational life stressors or to what extent university faculty and staff can help students overcome those stressors to remain engaged in their education.

CONCLUSION

This study examined the autobiographical memory narrative as a way for TCs among graduate teacher preparation programs to learn to identify (1) barriers to learning, (2) UDL checkpoints to remove these barriers, and (3) strategies to address the UDL checkpoints that overcome these barriers. The TCs (A) engaged in the systematic knowledge acquisition through the UDL training and (B) practiced UDL applications to their K-16 autobiographical memory scenarios. In this process, the participants took dual roles in this study. As a student, they identified barriers to their learning from the past experience at any point in K-16 education. As a teacher, they applied UDL checkpoints to removing those self-identified barriers from the past experience.

Emerging themes and subthemes indicated that the participants' identified specific types of learning barriers they have experienced in their K-16 experiences as students as well as to applied UDL to overcoming those barriers as if they were their own teacher. Thus using the autobiographical memory narrative, TCs can identify barriers to learning from their past learning experience, specific UDL checkpoints to remove these barriers, and UDL-based strategies to implement in an instructional environment as if they were their own teacher. We continuously seeking effective and efficient ways for TCs to learn to implement UDL for designing learning environments that are accessible, challenging, meaningful, and rigorous for all learners across ages (CAST, 2022b). Together, we continue our UDL journeys.

REFERENCES

Balli, S. J. (2014). Pre-service teachers' juxtaposed memories: Implications for teacher education. *Teacher Education Quarterly, 41*(3), 105-120.

Basham, J. D., Gardner, J. E., & Smith, S. J. (2020). Measuring the implementation of UDL in classrooms and schools: Initial field test results. *Remedial and Special Education, 41(*4), 231–243. https://doi.org/10.1177/0741932520908015

Basham, J. D., & Marino, M. T. (2013). Understanding STEM education and supporting students through Universal Design for Learning. *TEACHING Exceptional Children, 45*(4), 8-15.

Bogdan, R. C., & Biklen, S. K. (1998). *Qualitative research in education: An introduction to theory and methods* (3rd ed.). Allyn & Bacon.

Burhan-Horasanli, E., & Ortactepe, D. (2016). Reflective practice-oriented online discussions: A study on EFL teachers' reflection-on, in and for-action. *Teaching and Teacher Education, 59,* 372-382. https://doi.org/10.1016/j.tate.2016.07.002

Council for the Accreditation of Educator Preparation (CAEP). (2022). CAEP Standards for accreditation at the advanced-level. https://caepnet.org/standards/2022-adv

CAST. (2022a). *About Universal Design for Learning.* http://udloncampus.cast.org/page/udl_about

CAST. (2022b). *Frequently asked questions*. https://udlguidelines.cast.org/more/frequently-asked-questions

CAST. (2022c). *Timeline of innovation UDL.* https://www.cast.org/impact/timeline-innovation

CAST. (2018). *Universal design for learning guidelines version 2.2.* https://udlguidelines.cast.org

Catling, S., Greenwood, R., Martin, F., & Owens, P. (2010). Formative experiences of primary geography educators. *International Research in Geographical and Environmental Education*, *19*(4) 341–350. https://doi.org/10.1080/10382046.2010.519153

Chenail, R. J. (2012). Conducting qualitative data analysis: Qualitative data analysis as a metaphoric process. *The Qualitative Report*, *17*(1), 248-253. https://doi.org/10.46743/2160-3715/2012.1818

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry & research design* (4th ed.). SAGE Publications, Inc.

Dewey, J. (1933) *How we think: A restatement of the relation of reflective thinking to the educative process.* Heath and Company.

Edyburn, D. L. (2010). Would you recognize universal design for learning if you saw it? Ten propositions for new directions for the second decade of UDL. *Learning Disability Quarterly, 33,* 33-41. https://doi.org/ 10.1177/073194871003300103

Every Student Succeeds Act (ESSA) of 2015, Pub. L. No. 114-95, § 4104 (2015).

Griful-Freixenet, J., Struyven, K., Vantieghem, W., & Gheyssens, E. (2020). Exploring the interrelationship between Universal Design for Learning (UDL) and Differentiated Instruction (DI): A systematic review. *Educational Research Review, 29,* 1-23. https://doi.org/10.1016/j.edurev.2019.100306

Higher Education Opportunity Act (HEOA) of 2008, P.L. 110-315, § 103 (2008).

Individuals with Disabilities Education Improvement Act (IDEIA), P.L.108-446, § 611 (2004).

Ismail, S. A. A., & Jarrah, A. M. (2019). Exploring pre-service teachers' perceptions of their pedagogical preferences, teaching competence and motivation. *International Journal of Instruction, 12*(1), 493-510.

Koutering, L., McClannon, T., & Braziel, P. (2005). What algebra and biology students have to say about universal design for learning? *National Center on Secondary Education and Transition, 4*(2), 1-6.

Latterell, C., & Wilson, J. (2016). Stories about math: An analysis of students' math autobiographies. *International Journal of Research in Education and Science*, *2*(2), 279-285. https://www.ijres.net/index.php/ijres/article/view/107

Lima, M. P., Rebelo, P. V., & Barreira, C. (2014). Teacher development: Contributions of educational biography and personality. *Journal of Adult Development, 21*, 216-224. https://doi.org/10.1007/s10804-014-9193-y.

Lo, W. Y. (2021). Pre-Service teachers' prior learning experiences of mathematics and the influence on their beliefs about mathematics teaching. *International Journal of Instruction, 14*(1), 795-812.

Meo, G. (2008). Curriculum planning for all learners: Applying universal design for learning (UDL) to a high school reading comprehension program. *Preventing School Failure, 52*(2), 21-30.

McLeskey, J., Barringer, M-D., Billingsley, B., Brownell, M., Jackson, D., Kennedy, M., Lewis, T., Maheady, L., Rodriguez, J., Scheeler, M. C., Winn, J., & Ziegler, D. (2017, January). *High-leverage practices in special education.* Council for Exceptional Children & CEEDAR Center.

Moustakas, C. (1994). *Phenomenological research methods.* Sage.

National Education Association (NEA). (2018). *Reflective practice: How becoming a National Board Certified Teacher helps profession.* https://www.nea.org/professional-excellence/student-engagement/tools-tips/reflective-practice-how-becoming-national

National Research Council. (2000). *How people learn: Brain, mind, experience, and school* (expanded edition). The National Academy Press. https://doi.org/10.17226/9853

Nardi, P. M. (2006). *Doing survey research: A guide to quantitative methods* (2nd ed.). Pearson Education, Inc.

Rose, D. H., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning.* Association for Supervision and Curriculum Development.

Schunk, D. H. (2012). *Learning theories: An educational perspective* (6th ed.). Pearson.

Smith, S. J., Rao, K., Lowrey, K. A., Gardner, J. E., Moore, E., Coy, K., Marino, M., & Wojcik, B. (2019). Recommendations for a national research agenda in UDL: Outcomes from the UDL-IRN preconference on research. *Journal of Disability Policy Studies, 30*, 174–185. https://doi.org/10.1177/1044207319826219

Spooner, F., Baker, J. N., Harris, A. A., Ahlgrim-Delzell, L., & Browder, D. (2007). Effects of training in universal design for learning on lesson plan development. *Remedial and Special Education, 28*(2), 108-116. https://doi.org/10.1177/07419325070280020101

Takemae, N., Dobbins, N., & Kurtts, S. (2018). Preparation and experiences for implementation: Teacher candidates' perceptions and Understanding of Universal Design for Learning. *Issues in Teacher Education, 27*(1), 73-93. https://www.itejournal.org/issues/spring-2018/09takemaeetal.pdf

Thorne, A. (1995). Developmental truths in memories of childhood and adolescence. *Journal of Personality, 63*(2), 139-163.

Walls, R. T, Sperling, R. A., & Weber, K. D. (2001) Autobiographical memory of schools. *Journal of Educational Research, 95*(2), 116-127. https://doi.org/10.1080/00220670109596580