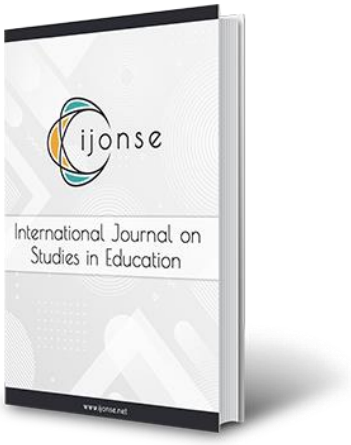

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Experience-Based Universal Design for Learning (UDL) Applications: Building Bridges to Overcome Barriers

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Abstract

The purpose of this phenomenological study was to examine the autobiographical memory narrative through which graduate teacher candidates (TCs) identified (1) barriers to learning, (2) Universal Design for Learning (UDL) checkpoints to remove these barriers, and (3) strategies for addressing the UDL checkpoints to remove the barriers. This study explored lived experiences among graduate TCs in relation to (a) UDL training in the graduate teacher preparation programs, (b) barriers to learning among their past experience, and (c) UDL checkpoints' applications to removing the self-identified barriers to learning. Emerging themes and subthemes indicated that the participants used specific UDL checkpoints to overcoming specific types of barriers to learning in the past experience in K-16 education. This indicates their recognitions of specific types of barriers to learning, identifications of specific UDL checkpoints for overcoming the barriers, and considerations of specific strategies based on the identified UDL checkpoints. Implications for the future study includes having autobiographical memory narratives as a practical learning tool for graduate TCs to put themselves into perspectives of (A) students experiencing barriers to learning and (B) teachers applying UDL checkpoints to removing the barriers to learning.

Introduction

Inclusive education has been central foci in educational laws in the United States as evident by *Individuals with Disabilities Education Improvement Act (IDEIA) of 2004, Higher Education Opportunity Act (HEOA) of 2008,* and *Every Student Succeeds Act (ESSA) of 2015.* These educational laws ensure (a) inclusive education, (b) access to standard-based education, and (c) educational rights for all learners. Creating an inclusive classroom requires various elements of planning and collaboration with general education teachers (GETs), special education teachers (SETs), related service providers, school counselors, administrators, and school staff.

Inclusive education is providing an environment, where all feels welcomed and safe, that is facilitated consistently and over time (Friend & Bursuck, 2019; Kozleski et al., 2015). In this practice, access to general education needs to be ensured for all learners (ESSA, 2015; IDEA, 2004). To ensure all learners have access to general education, teachers can remove preexisting barriers to learning in curriculum by applying the UDL framework (Rao & Meo, 2016).

Inclusive Education and UDL

The UDL Guidelines are developed to reach all learners across ages for inclusive learning more than three decades ago (CAST, 2023c). ESSA (2015) and HEOA (2008) provide definitions of UDL as a cognitive neuroscience research-based framework. Furthermore, they endorse UDL applications to inclusive educational practices (ESSA, 2015; HEOA, 2008). For instance, ESSA (2015) endorses UDL for quality instruction and assessments. Also, HEOA (2008) endorses UDL incorporation into inclusive higher education including teacher training and TC preparation. Research shows that teachers' UDL implementations support learner variability while reducing barriers to learning from the outset (Griful-Freixenet et al., 2020). Thus ESSA (2015) and HEOA (2008) ensures an ecological cycle of UDL-based learning in K-16 education.

UDL Guidelines

UDL is an element of the core educational foundation thorough which teachers support students to become expert learners by embedding built-in natural supports from the onset (CAST, 2023a). The UDL Guidelines includes multiple means of (a) engagement in the learning process, (b) representation of information processing, and (c) action and expression of learning outcomes (CAST, 2018). Rose and Meyer (2002) introduce three UDL application features including (i) removing preexisting barriers within the curriculum, (ii) intentionally building-in natural support for learners, and (iii) bridging interactions among their learning process (2002). For these reasons, both teachers and TCs need to be trained for UDL applications to K-12 education and to bring the educational laws endorsing UDL into practice (ESSA 2015; Spooner et al., 2007). TCs to understand and apply the UDL framework in teacher preparation programs before stepping into the K-12 classrooms is more proactive, efficient, and cost-effective approach and reduces in-service teacher training on UDL (Spooner et al., 2007).

The UDL Guidelines is organized vertically and horizontally with specific purposes (CAST, 2018). Vertical columns include three UDL principles including multiple means of engagement activating affective brain networks targeting the *why* of learning, multiple means of representation activating recognition brain networks targeting the *what* of learning, and multiple means of action & expression activating strategic brain networks targeting the *how* of learning. Multiple means of engagement include providing options for *recruiting interest* (guideline 7), *sustaining effort & persistence* (guideline 8), and *self-regulation* (guideline 9). Multiple means of representation include providing options for *perception* (guideline 1), *language & symbols* (guideline 2), and *comprehension* (guideline 3). Multiple means of action & expression include providing options for *physical action* (guideline 4), *expression & communication* (guideline 5), and *executive functions* (guideline 6).

Horizontal rows are organized to target access to learning through *recruiting interest* (guideline 7), *perception* (guideline 1), and *physical action* (guideline 4); building learning processes through *sustaining effort & persistence* (guideline 8), *language & symbols* (guideline 2), and *expression & communication* (guideline 5); and internalizing learning through *self-regulation* (guideline 9), *comprehension* (guideline 3), and *executive functions* (guideline 6). Purposefully implementing the UDL Guidelines through vertical and horizontal intentions, educators can support individuals becoming expert learners who are *purposeful & motivated, resourceful &*

knowledgeable, and *strategic & goal-directed* (CAST, 2018). Thus, all learners can have access and engage in meaningful and challenging opportunities to learn (CAST, 2018).

UDL Implementations

To apply UDL, planning is tailored, and barriers are proactively identified and reduced - thus it is not a one size fits all framework. The idea is that with time and practice, all children are supported throughout a process of becoming expert learners. This takes time, trial, and error with implementation. To eliminate barriers to learning, it is completely up to educators to see identify barriers to learning among students. To have successful applications which will in turn enhance inclusive educational practices, curriculum, and materials to be learned by students need to be accessible for the individual students. Accessible in this context refers to how the information is presented, used, and operated. Examples include but are not limited to providing multisensory approaches to learning (i.e., hands on, visual, auditory) and customized how the information is shared with the student (i.e., paper copy textbook, text read aloud, technology). It is crucial that ample data are taken prior to the distribution of the curriculum to determine the best plan of delivering the information to the student. By customizing curriculum delivery, educators can make materials that are accessible to the student. Once the information is accessible to the student, then the educator can determine the best ways to help the student understand the material. Using the frameworks as a guideline, instead of a set-in stone system, it allows fluidity throughout the teaching practices, which is necessary for ever-changing students' external and internal conditions. It is also equally important to have the student feel in control of their learning.

UDL can be a great resource for a teacher if that teacher also includes the student in the decision-making. Examples of having the student feel in control of their learning are, giving the student options for submission (i.e. digital or in hard copy), providing the student with reasonable extensions on work, making the assignments and guidelines extremely student-friendly, and allowing the student to decide what works best for where they complete their work (CAST, 2018). By having the student feel in control of their learning, they can feel more apt to ask questions, immerse themselves in the material, and better use the UDL framework. While allowing the student to feel in control of their learning, the student can hold on to different strategies that were presented to them and use them across all content areas as well as remember these strategies throughout their lives. This is a reason UDL is so important and crucial to education. By altering learning strategies and making the curriculum more accessible, while pertaining to each student's strengths, preferences, and interests, each student can carry these techniques with them throughout their schooling and into adulthood, as they become expert learners.

UDL and Research

Learning to understand and apply UDL is equally important for educators as it is for students who will be using them to learn materials. It is without question that there has been a shift in teacher preparation programs when it comes to introducing UDL into the curriculum. UDL is both explicitly and inexplicitly taught in teacher preparation programs, however the extent to which these programs are preparing teachers to use UDL in K-12 settings is still in progress. UDL has been existing for more than three decades (CAST, 2023c) while some school

districts might have been proactively implementing UDL for a long time and some other school districts might have been getting started for their UDL implementations.

Lowrey et al. (2017) examined at the overall implementation of UDL in general education classrooms with a narrative inquiry for obtaining data. The data was collected from teachers from the US and Canada who were in a general education classroom. The findings indicated that teachers were better equipped to manage intentional planning and ensure that the quality of their teaching was high. Many of the teachers interviewed attributed their appreciations towards UDL attributions to the amount of professional development that was offered. When professional development is offered to teachers, their comfortability as well as their competency in teaching increases. Determining how much professional development a school needs can really be dependent on how much those teachers learned when they were merely TCs.

A more recent study was conducted where researchers went into a school district to see if the reporting criteria for the UDL guidelines was accurately and widely used throughout all the classrooms. This study was conducted in a K-12 setting with the overall purpose of the study being to determine if the reporting criteria that is used in UDL is useful or not. The results of the study indicated that when used in a fluid way, the reporting criteria can be useful (Rao et al., 2020). This study, along with others, have continuously concluded that UDL is not meant to be a set-in stone way of teaching, but more along the way of guidelines that need to be adapted to the specific classroom they are being used in. In this study it was discussed how certain classrooms were using more reporting criteria than others. Thus, UDL implementations vary due to the learner variability in the classroom. While there has been a shift in teacher preparation programs to include UDL guidelines, the next study suggests that these shifts need to occur further down the line in education.

While teacher preparation programs thrive to prepare their TCs to implement UDL, each individual TC's unique conditions affect their learning. Just like with UDL how students learn differently, TCs learn differently as well. So, to really measure the extent that existing teacher preparation approaches support TCs' competencies in UDL applications to K-12 education, it is necessary to assess learning that is occurring throughout the classroom. Mental images and the idea of taking a picture of something with one's mind was discussed by Clark et al. (2015). The researchers examined the importance of creating strategies that help individuals remember items. When individuals recall autobiographical memories, they have specific physiological responses that naturally occur. By creating strategies to help determine how teacher will react when those memories occur, it might be easier to remember (or forget that is an intention) specific parts of those memories. With UDL if teacher is trying to remember something specific that teacher learned so that teacher can teach it to teacher students it might be important to attach a physiological reaction to that memory so that when teacher recall that memory teacher know how teacher felt and what teacher did in the moment it first occurred. Another researcher who informally examined parts of memory and strategy was David Lewkowich (2016). He examined teacher education as a whole and came to the very realistic conclusion that forgetting events was a very natural occurrence in teaching; especially with the sole fact of how much teachers are expected to remember daily as it is. He, along with Clark and his team of researchers all concluded that when teacher focus on strategies and teaching those strategies teacher can individualize how people learn. Coincidentally this is exactly what UDL proclaims. When teacher create strategies

to help people learn information, and even further adapt those strategies to truly create individualization, teacher is creating a system of learners that thrive in all situations.

Along with ensuring the quality strategies that are taught to teacher candidates alone to excel in the competencies of UDL, it is essential to consider what degree of UDL is being taught in the classroom(s). Basham et al. (2020) examined just this. When teacher has such a great tool it is equally as important to measure the amount that the tool is being implemented. Determining the level of UDL that is implemented in classrooms can provide insights on how well TCs are being prepared in their undergraduate and graduate level programs. Basham and his research team studied 11 classrooms in the mid-west region of the United States and found varied levels all the way from pre-emergent to observed were found in the classrooms. A second interesting finding was that for this study, some of the researchers had extensive prior knowledge of UDL while others had little knowledge of UDL. This is important because the interrater reliability could be affected due to how much the observers already knew about the tool. It is difficult to determine if some of these classrooms had that much of a discrepancy or if the researchers were just looking for different elements. Thus, the UDL Reporting Criteria (Rao et al., 2020) is essential to be used in observing UDL implementations.

Autobiographical Memory Study

Walls et al. (2001) suggests that what TCs can recall from their own elementary school days can play a huge role in how their learning develops in their undergraduate years. He and his fellow researchers conducted a study in which they conducted a study with 252 undergraduate students through focus groups to examine what memories they could recall about their younger school days. The memories that were recalled the most were not academic related and were dependent on the gender being interviewed. Most memories focused on sports, awards, injuries, or boy-girl relationships. This is noteworthy as it demonstrates that what is taught in undergraduate classes relate to how these candidates are teaching, and what mnemonic strategies they are using to get their students to learn the information.

Greenberg and Knowlton (2014) reviewed the role of visual imagery, but more so in autobiographical memories. They conducted their research with a focus group of 101 undergraduate students with a mean age of 19.3. They examined the role of these mental images and how important (or not) they were in memories as they got older. They found that out of all the subjects, those with strong visual memories tended to relive their memories more than someone with a weak visual memory. These individuals also tended to believe their memories more than someone with a weak visual memory. Just as was previously stated in the research of Lewkowich (2016) and Clark et al. (2015), these images provide a vivid recall of something that was learned potentially many years prior. How well they can recall on these images almost gives the assumption of a photographic memory. Greenberg and Knowlton (2014) discussed that differences in what was remembered was dependent on the type of cue that was given. For example, if a student was asked what their favorite book was when they were younger, they might come up with a different example as opposed to if they asked them what their favorite 9th grade English book was. When these students are asked to remember certain events, it focuses on the type of memory they have and what strategies they use to recall their memories. When expecting a high level of competency in K-12 teachings

of UDL by respective TCs, it is important to remember that there may be discrepancies in what those TCs remember and to what extent they teach what they remember.

In addition to these studies on autobiographical memory narratives, there are applications to teacher preparation programs. These memories are all brought about by different social interactions. Depending on the social interactions as well as the type of communication and language that is occurring, various parts of that memory will be recalled. Bartoli and Smorti (2018) conducted a study in which they wanted to see the role of communication and self-narratives in autobiographical memories. They conducted a focus group study on a group of undergraduate students who were mostly neurotypical in their function with a few exceptions. They found that individual narratives are produced for memories and that this is important to language because narration involves a speaker and a listener. When they think of this logistically as a teacher or a teacher candidate, it is important to immediately think of how they communicate with their students. TCs need to be taught to communicate with their students in a very meaty way, with a lot of opportunity for questions and comments. Communication should be educational and engaging for all students. When they foster that communication, they are setting the student up for success in remembering these conversations. Teacher preparation programs should focus on techniques to enhance communication between teachers and their students.

In addition to having these communication skills to enhance the narratives that students have, the type of environment that is being fostered in the classroom is equally as important. The environment and how the teacher interacts with the students helps determine what type of memory recall students will have (de Lima et al. 2014). This study was conducted with 129 student teachers with most of them being female. The purpose was to analyze the relationship of autobiographical narratives through school, adulthood, and teaching these narratives. The findings indicated that the more positive the classroom environment and the more positive the teacher interaction in elementary school led to a more positive impact on the memory recall of these students. Another finding was that the more nurturing the teacher, the more information that student will recall. Teacher preparation programs should also focus on the environment that the teachers have in their classrooms and what type(s) of interactions they want to occur between themselves and their respective students.

For these reasons, our study focuses on autobiographical narratives among TCs for recalling their past learning experience in terms of barriers to their learning and taking a role as a teacher to removing these barriers. This supports their learning to understand UDL and apply its framework to removing the barriers to learning. Thus, the TCs took dual roles as a student who experienced barriers to learning and as a teacher who proactively applied UDL to removing these barriers based on their autobiographical narratives. Thus, they can add this experience to envision and experience UDL applications.

Method

A phenomenological approach was applied for studying TCs' lived experiences and shared phenomenon through which they learned to identify barriers to learning, apply UDL to remove these barriers, and describe ways to incorporate specific UDL-based strategies for removing the barriers (Creswell & Poth, 2018). The researchers

used the phenomenological approach to explore universally experienced phenomena among TCs' (a) UDL training in the graduate teacher preparation programs, (b) barriers to learning in their experience at any point of time in K-16 education, and (c) UDL applications using specific strategies for removing the self-identified barriers to learning (Creswell & Poth, 2018). The participants developed a composite description including (1) their past experiences as a student who experienced barriers to learning and (2) their present experiences as a teacher who applied UDL with specific strategies to remove self-identified barriers to learning (Creswell & Poth, 2018). Thus, they took dual roles as a student and their own teacher in this process. Narrative research poses challenges including understanding individuals' context of life as well as capturing their experiences among stories (Creswell & Poth, 2018). To overcome these challenges, this study employed trifold prompts that focus on individuals' context of life and capturing their experiences of barriers to learning in a specific period in K-15, details in this specific experience, and strategies for removing these barriers to learning based on the UDL framework. To systematically analyze the data, the data were analyzed to describe *what* and *how* participants experienced the phenomena by identifying significant statements and meanings of clustered emerging themes (Creswell & Poth, 2018; Moustakas, 1994). Based on the data analysis, the essence of experience addressing *what* and *how* the participants experienced the shared phenomena are discussed (Creswell & Poth, 2018).

Participants

Purposeful sampling (Creswell & Poth, 2018) was employed to identify participants who shared memberships in the teacher preparation graduate programs as well as engaged in a structured graduate course that incorporated a UDL training using an autobiographical memory narrative. Having a purposeful criterion sampling at the site level, this study explored central phenomenon among the participants including 63 graduate TCs in teacher certification programs at a comprehensive university in the northeastern region in the United States. The participants enrolled in an asynchronous online introductory special education course across three academic years. Thus, the participants represent three different cohorts across years. There were 27 TCs who identified as male and 36 TCs who identified as female. The average age among the male TCs was 31.00 years old and among the female TCs was 29.47 years old. Their subject areas of focuses are varied and from the most common included Special Education, History/Social Studies, English, Mathematics, Spanish, and Science.

Materials

The materials in this study included the Overcoming Learning Barriers course assignment template, course content files of electronic presentations, multimedia presentation recordings by the instructor, and assignment templates. All materials were available for reviews by the participants throughout a semester. The TCs asynchronously engaged in the instructor's course content design and delivery through a Learning Management System. The multimedia presentations included slides as well as a video of the instructor's content delivery.

The Overcoming Learning Barriers assignment provided a template that contained three questions and explicit response length examples (e.g., a number of paragraphs). The template also included response formatting directions. For instance, each question included what specific type of information should appear in responses. As

an example, the second question on the assignment asked to identify learning barriers they had personally experienced in the past. The template contained the guidance such as "4 paragraphs, 1 paragraph per experience-only describe the situation and the barrier." The template included the same set of questions and guidance for all the three cohorts across three years.

Procedure

The same course instructor covered myriad content in the asynchronous fully online course in all the three years. This course was one credit introductory special education course. In the course, the following topics were learned by the TCs: UDL definition, history of key terms, UDL relevance to curriculum, 12 barriers to learning, explanations of the brain networks including affective, recognition, and strategic networks, and explicit instruction in ways to complete the Overcoming Learning Barriers assignment. The TCs engaged in a shared discussion forum focusing on (1) unpacking barriers to learning in instructional design, (2) asking them to identify experiences they had or observed where barriers to learning came in to play, and (3) sharing ways to overcome them. Twelve well-known instructional barriers to learning were discussed and re-discussed throughout the content engagement. These instructional barriers to learning were initially identified and derived from ways learning occur, instructional design features (National Research Council, 2000; Schunk, 2012), and the UDL principles, guidelines, and checkpoints (CAST, 2018). The 12 instructional barriers to learning to be removed through UDL by TCs included abstractedness, organization, relevance, interest, skills, strategies, background information, complexity, quantity, activities, outcomes, and response options (Table 1). In addition to these 12 barriers to learning, TCs identified two additional categories including other academic factors such as academic, psychological, or emotional disability or disorder or depression, as well as situational life stressor such as factors contributing to financial strain, family issues, and transportation problems. The instructor facilitated the shared discussion and explicit instruction as a model. Also, the instructor guided practice before TCs independently completed the assignment. The Overcoming Learning Barriers assignment completion required TCs to independently answer all the three questions using the autobiographical narrative.

Data Analysis

Data analysis was conducted using four data sources: (a) descriptive data, (b) perceived definition of their learning barriers, (c) four scenarios describing their experienced barriers to learning, and (d) strategies for overcoming identified barriers using UDL checkpoints. The data analysis revealed the phenomenon, UDL applications to removing self-identified barriers to learning that are experienced in any point of K-16 education among TCs. The substantive validation was ensured through the descriptive and reflective field note reviews (Bogdan & Biken, 1998; Creswell & Poth, 2018). The researchers employed coding, categorizing, and identifying themes and subthemes (Chenail, 2012). The interrater agreement and content analysis were conducted to increase the reliability of the study (Creswell & Poth, 2018; Nardi, 2006). An interrater reliability demonstrated 96% among 726 instances of strategies identified by the participants. After emerging themes and subthemes were agreed, the researchers identified UDL checkpoints (CAST, 2018) by matching keywords in the strategy themes and subthemes, if not explicitly mentioned by the participants.

Results

Table 1 shows different barriers to learning that were noted by participants in this study. The barriers were strategies, situational life stressors, skills, responses, relevance, quantity, outcomes, organization, other academic, interest, complexity, background information, activities, abstractedness, and ecological factors. The specific barriers were identified in terms in frequencies from most to least. Table 1 also shows emerging themes in these barriers as well as subthemes. They were identified by frequency counts from most to least. It is notable that emerging subthemes are identified based on their strategy identifications to overcome their self-identified barriers to learning using specific UDL checkpoints.

Table 1. Alignment of Barriers, UDL, Subthemes, and Strategies

Barriers	Barrier Freq	UDL Principles	Emerging Themes in Strategies	Emerging Subthemes	Strategy Freq	Strategy Total
Strategies	211	E, R, AE	Variation	Action Expression Responses Teaching strategies Learning strategies Pacing	93	106
			Memory	Aids Strategies Posters Games	13	
Situational life stressor	205	E, AE	Support	Related support Seek for help After school programs	49	65
			Personal coping skill	Stress reductions Motivation Plan for success	16	
Skills	189	E, R, AE	Review	Previous content Memory Refresher Keys	26	86
			Scaffolding	Build fluencies Building upon	20	
			Feedback	Rubrics Types Structures	20	

Barriers	Barrier Freq	UDL Principles	Emerging Themes in Strategies	Emerging Subthemes	Strategy Freq	Strategy Total
				Mastery oriented		
			ZPD	Flexibility Current skills/needs Adjustments	20	
Responses	178	E, AE	Assessment	Formative Instructional adjustments Creative	31	47
			Assignment	Group Models Expectations	16	
Relevance	173	E, R, AE	Relevance	Cultural Linguistic Native speaker	13	13
Quantity	153	E, R, AE	Quantity	Chunking Adjusting Smaller steps	51	51
Outcomes	137	E, R, AE	Communication	Guidance	94	94
Organization	130	R, AE	Organization	Examples Faculty models Notetaking	88	88
Other academic	108	E, R, AE	Individualization	Needs Preference	27	27
Interest	78	E	Recruiting interest	Interesting Options Relevance	135	135
Complexity	53	E, R	Complexity	Simplify Reduce Concrete	17	17
Background information	21	E, R	Background knowledge	Pre-assessment Prior knowledge Confidence building	81	81
Activities	15	E, AE	Activity	Ample opportunities, repetitions, practices Interactive	40	40

Barriers	Barrier Freq	UDL Principles	Emerging Themes in Strategies	Emerging Subthemes	Strategy Freq	Strategy Total
				Fun Creative		
Abstractedness	12	E, R, AE	Alternative	Auditory Visual Option for comprehension	17	17
Ecological Factor	NA	E	Community	Learning environment Relationship building Collaboration	57	67
			Quality	Enthusiasm Caring Understanding Being interested in students Making students feel important	10	

*Freq = Frequency, E = Engagement, R = Representation, and AE = Action and Expression

Table 2 shows ways UDL checkpoints are used to remove these identified barriers to learning.

Table 2. Alignment of Barriers, UDL, Themes, and Strategies

Barriers	UDL Principles	Emerging Themes in Strategies	Specific Strategies (checkpoints)
Strategies	E, R, AE	Variation Memory	• Provide a variety of student actions, expressions, and response types (3.4, 5.1, 6.2) • Allow for different paced activities, assessments, and varied pacing (5.3, 6.1) • Teach strategies that correspond with student learning strategies (6.2, 5.1) • Provide enough time to represent with cues, questions, etc. (6.4, 3.3) • Provide resources and strategies that are tangible to the student (3.1, 5.1, 9.2) • Provide students with a multitude of aids, strategies, and classroom posters highlighting

Barriers	UDL Principles	Emerging Themes in Strategies	Specific Strategies (checkpoints)
			key concepts (5.1, 3.3)
Situational life stressor	E, AE	Support Personal coping skill	• Provide students with different avenues of related academic support including after school and extra-curricular • Focus on their academic, emotional, and mental health • Provide access to tangibles such as glasses • Teach the student how to ask for help to reduce stress,
Skills	E, R, AE	Review Scaffolding Feedback ZPD	• Incorporate students' background knowledge by slowly re-teaching strategies and giving refreshers (9.2, 5.3) • Use assessments and providing materials for exams (8.2) • Use key details from previous contents and materials (5.3) • Build upon students' prior knowledge to provide amount of support necessary (8.3, 9.2, 5.3) • Provide information back to the student with different types and structures so they understand the information (8.3, 6.1) • Provide mastery oriented with formative and extensive feedback (8.3, 6.1)
Responses	E, AE	Assessment Assignment	• Provide different means of assessments based on needs of students with self-assessments & formative assessments to guide instructional practices (7.1, 7.2, 8.1, 9.1, 9.2, 9.3) • Maintain interest by gauging how well the class is engaging (6.4) • Allow for creative projects dependent upon the needs of the students (4.1, 5.2) • Provide models and set expectations for group projects (6.4)
Relevance	E, R, AE	Relevance	• Make the content interesting to the students by applying cultural and linguistic concepts (7.2, 8.1, 3.1, 5.3)

Barriers	UDL Principles	Emerging Themes in Strategies	Specific Strategies (checkpoints)
			• Provide a native speaker (8.4, 6.3)
Quantity	E, R, AE	Quantity	• Adjust the curriculum to the less is more technique and dive deep into a few themes rather than making sure to cover lots of themes (7.3, 8.2, 3.3, 6.3)
Outcomes	E, R, AE	Communication	• Set clear expectations and goals with teacher provided examples and models (9.1, 8.1, 6.1, 6.2) • Provide set due dates and assignment outlines with clear grades (6.2) • Use rubrics for grading expectations and provide ahead of time (6.2) • Use student feedback to alter/guide future assignments (3.3) • Provide assessment criteria in the beginning of the topic/course (5.3, 6.1, 6.2, 9.1) • Foster a resilient community by using purposeful grouping/pairing (7.1, 7.2, 8.3, 4.2, 5.1)
Organization	R, AE	Organization	• Provide a student-friendly syllabus with a course outline, structure, timeline of assignments/assessments, goals/objectives of course, and the content that will be covered/ what materials are necessary (3.3, 6.3) • Demonstrate different organizers/show students how they can structure their assignments (3.3, 6.3) • Provide students with study skills/learning strategies and model the expectations for assessments (3.3, 6.3) • Provide template and use an agenda that highlights importance of content, state goals/objectives (3.3, 6.3) • Use of notetaking support, materials, approach, and routine (3.3, 6.3)
Other	E, R, AE	Individualization	• Accommodate all students by individualizing

Barriers	UDL Principles	Emerging Themes in Strategies	Specific Strategies (checkpoints)
academic			assignments, rubrics, assessments, and grading criteria • Provide more time for students when necessary • Personalize and modify documents as necessary
Interest	E	Recruiting interest	• Highlight student interests and experiences to make learning interesting (8.3) • Provide choice, options, additional challenges, and autonomy to students (7.2, 8.3) • Build motivation through modeling and providing support/assistance when necessary (8.1, 8.3) • Use hands-on approaches with relatable materials and tools • Allow opportunities to share and for feedback (8.1, 8.3) • Make content taught relevant, relatable, authentic, and provide real-life applications (7.2, 8.3)
Complexity	E, R	Complexity	• Use concrete examples and models to simplify content taught (1.2, 1.3, 7.2) • Encourage questions and the use of manipulatives to enhance learning (8.2, 7.2) • Make content less abstract and more concrete (1.2, 1.3, 2.1, 7.2) • Use tangible objects, including handouts (1.2, 1.3, 2.1)
Background information	E, R	Background knowledge	• Create a relevance for learning by supplying and using prior knowledge to build upon (3.1, 8.1) • Use placement tests to assess present levels of performance (1.1, 2.1) • Build confidence by using students' strengths and ensuring they are matched with the level of the course registration (1.1, 7.3) • Provide a relevance for learning with connections to students' current lives/past personal experiences (3.1, 1.1, 8.1)

Barriers	UDL Principles	Emerging Themes in Strategies	Specific Strategies (checkpoints)
Activities	E, AE	Activity	• Encourage active participation by making activities interactive and fun with ample practice opportunities and repetitions (7.1, 7.2, 8.3) • Ensure that the classroom is student-centered and allows students to be creative (9.3, 4.1, 8.3 9.1, 7.1) • Help students build confidence by providing them practice with ample opportunities and repetitions (7.2, 7.3) • Use multimodal instruction to maintain focus (7.2, 7.3) • Open-dialogue classroom that is interdisciplinary and allows for group discussions (4.1, 7.1, 7.2, 7.3)
Abstractedness	E, R, AE	Alternative	• Use different options for comprehension such as auditory and visual (7.2, 8.3, 1.1, 1.2, 1.3, 2.4, 2.5, 3.1, 3.2, 3.3, 6.4)
Ecological Factor	E	Community Quality	• Create a positive learning environment to lessen bullying and increase a safe/non-threatening space • Allow opportunities for structured group work in addition to individual assignments • Get to know the students to build relationships, provide support, and gain rapport • Use guided practice, and accept diversity to show inclusion • Adjust learning environment based on student needs and use guided practice to create a common learning experience • Use high-quality teaching with enthusiasm, appropriate voice volume, and showing interest in students • Understand students and their needs • Avoid making assumptions on student knowledge and skills

In Table 2, "strategies" was the first barrier with a 211 frequency note that had the themes of variation and

memory. Variation had subthemes of action, expression, responses, teaching strategies, learning strategies, and pacing, with a strategy frequency of 93. Memory had subthemes of aids, strategies, posters, and games and only had a strategy frequency of 13. The UDL principles that were aligned with the overall barrier of strategies were engagement, representation, and action and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Facilitate personal coping skills and strategies (9.2), Activate or supply background knowledge (3.1), Guide information processing and visualization (3.3), Maximize transfer and generalization (3.4), Use multiple media for communication (5.1), 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), Enhance capacity for monitoring progress (6.4). To remove barriers to strategies using variation and memory, the participants noted as necessary to:

- Provide a variety of student actions, expressions, and response types (3.4, 5.1, 6.2)
- Allow for different paced activities, assessments, and varied pacing (5.3, 6.1)
- Teach strategies that correspond with student learning strategies (6.2, 5.1)
- Provide enough time to represent with cues, questions, etc. (6.4, 3.3)
- Provide resources and strategies that are tangible to the student (3.1, 5.1, 9.2)
- Provide students with a multitude of aids, strategies, and classroom posters making sure to highlight key concepts (5.1, 3.3)

The next barrier was "situational life stressor" with a 205-frequency rating that had the themes of support and personal coping skill. Support had subthemes of related support, seek for help, and after school programs with a strategy frequency of 49. Personal coping skill had subthemes of stress reduction, motivation, and plan for success with a strategy frequency of 16. The UDL principles that were aligned with the overall barrier of strategies were engagement, action, and expression. To remove barriers to situational life stressor using strategies including support and personal coping skills, the participants noted as necessary to:

- Provide students with different avenues of related academic support including after school and extra-curricular
- Focus on their academic, emotional, and mental health
- Provide access to tangibles such as glasses
- Teach the student how to ask for help to reduce stress, anxiety, and formulate a plan for success

The next barrier was "skills" with a 189-frequency rating that had the themes of review, scaffolding, feedback, and zone of proximal development (ZPD) (Vygotsky, 1978). Review had subthemes of previous content, memory, refresher, keys, and build fluencies with a strategy frequency of 26. Scaffolding had subthemes of building upon, rubrics, and types with a strategy frequency of 20. Feedback had subthemes of structures, mastery oriented, and flexibility with a strategy frequency of 20. ZPD (Vygotsky, 1978) had subthemes of current skills/needs, and adjustments with a strategy frequency of 20. The UDL principles that were aligned with the overall barrier of skills were engagement, representation, and action and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Vary demands and resources to optimize challenge (8.2), Foster collaboration and community (8.3), Facilitate personal coping skills and strategies (9.2), Guide information processing and visualization (3.3), Build fluencies with graduated levels of support for practice and performance (5.3), Guide appropriate goal setting

(6.1). To remove barriers to skills using strategies including review, scaffolding, feedback, and ZPD (Vygotsky, 1978), the participants noted as necessary to:

- Incorporate students' background knowledge by slowly re-teaching strategies and giving refreshers (9.2, 5.3)
- Use assessments and providing materials for exams (8.2)
- Use key details from previous contents and materials (5.3)
- Build upon students' prior knowledge to provide amount of support necessary (8.3, 9.2, 5.3)
- Provide information back to the student with different types and structures so they understand the information (8.3, 6.1)
- Provide mastery oriented with formative and extensive feedback (8.3, 6.1)

The next barrier was "responses" with a 178-frequency rating that had the themes of assessment and assignment. Assessment had subthemes of formative, instructional adjustments, creative, and group with a strategy frequency of 31. Assignment had subthemes of models and expectations with a strategy frequency of 16. The UDL principles that were aligned with the overall barrier of responses were engagement, action, and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Optimize individual choice and autonomy (7.1), Optimize relevance, value, and authenticity (7.2), Heighten salience of goals and objectives (8.1), Promote expectations and beliefs that optimize motivation (9.1), Facilitate personal coping skills and strategies (9.2), Develop self-assessment and reflection (9.3), Vary the methods for response and navigation (4.1), Use multiple tools for construction and composition (5.2), Enhance capacity for monitoring progress (6.4) To remove barriers to responses using strategies including assessment and assignment, the participants noted as necessary to:

- Provide means of assessments based on needs of students with self-assessments & formative assessments to guide instructional practices (7.1, 7.2, 8.1, 9.1, 9.2, 9.3)
- Maintain interest by gauging how well the class is engaging (6.4)
- Allow for creative projects dependent upon the needs of the students (4.1, 5.2)
- Provide models and set expectations for group projects (6.4)

The next barrier was "relevance" with a 173-frequency rating that had the theme of relevance. The subthemes were cultural, linguistic, and native speaker all with a strategy frequency of 13. The UDL principles that were aligned with the overall barrier of relevance were engagement, representation, and action and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Optimize relevance, value, and authenticity (7.2), Heighten salience of goals and objectives (8.1), Increase mastery-oriented feedback (8.4), Activate or supply background knowledge (3.1), Build fluencies with graduated levels of support for practice and performance (5.3), Facilitate managing information and resources (6.3). To remove barriers to relevance, the participants noted as necessary to:

- Make the content interesting to the students by applying cultural and linguistic concepts (7.2, 8.1, 3.1, 5.3)
- Provide a native speaker (8.4, 6.3)

The next barrier was "quantity" with a 153-frequency rating that had the theme of quantity. The subthemes were

chunking, adjusting, and smaller steps all with a strategy frequency of 51. The UDL principles that were aligned with the overall barrier of quantity were engagement, representation, and action and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Minimize threats and distractions (7.3), Vary demands and resources to optimize challenge (8.2), Guide information processing and visualization (3.3), Facilitate managing information and resources (6.3). To remove barriers to quantity, the participants noted as necessary to:
Adjust the curriculum to the less is more technique and dive deep into a few themes rather than making sure to cover lots of themes (7.3, 8.2, 3.3, 6.3)

The next barrier was "outcomes" with a 137-frequency rating that had the theme of communication. The subtheme was guidance with a strategy frequency of 94. The UDL principles that were aligned with the overall barrier of outcomes were engagement, representation, and action and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Optimize individual choice and autonomy (7.1), Optimize relevance, value, and authenticity (7.2), Heighten salience of goals and objectives (8.1), Foster collaboration and community (8.3), Promote expectations and beliefs that optimize motivation (9.1), Guide information processing and visualization (3.3), Optimize access to tools and assistive technologies (4.2), Use multiple media for communication (5.1), 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). To remove barriers to outcomes by facilitating communication, the participants noted as necessary to:

- Set clear expectations and goals with teacher provided examples and models (9.1, 8.1, 6.1, 6.2)
- Provide set due dates and assignment outlines with clear grades (6.2)
- Use rubrics for grading expectations and provide ahead of time (6.2)
- Use student feedback to alter/guide future assignments (3.3)
- Provide assessment criteria in the beginning of the topic/course (5.3, 6.1, 6.2, 9.1)
- Foster a resilient community by using purposeful grouping/pairing (7.1, 7.2, 8.3, 4.2, 5.1)

The next barrier was "organization" with a 130-frequency rating that had the theme of organization. The subthemes are examples, faculty models, and notetaking all with a strategy frequency of 88. The UDL principles that were aligned with the overall barrier of organization were representation, action, and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Guide information processing and visualization (3.3), Facilitate managing information and resources (6.3). To remove barriers to organization, the participants noted as necessary to:

- Provide a student-friendly syllabus with a course outline, structure, timeline of assignments/assessments, goals/objectives of course, and the content that will be covered/ what materials are necessary (3.3, 6.3)
- Demonstrate different organizers/show students how they can structure their assignments (3.3, 6.3)
- Provide students with study skills/learning strategies and model the expectations for assessments (3.3, 6.3)
- Provide template and use an agenda that highlights importance of content, state goals/objectives (3.3, 6.3)
- Use of notetaking support, materials, approach, and routine (3.3, 6.3)

The next barrier was "other academic" with a 108-frequency rating that had the theme of individualization. The subthemes are needs and preference all with a strategy frequency of 27. The UDL principles that were aligned with the overall barrier of other academic were representation, action, and expression. To remove barriers to other academic by facilitating individualization, the participants noted as necessary to:

- Accommodate all students by individualizing assignments, rubrics, assessments, and grading criteria
- Provide more time for students when necessary
- Personalize and modify documents as necessary

The next barrier was "interest" with a 78-frequency rating that had the theme of recruiting interest. The subthemes are interesting, options, and relevance all with a strategy frequency of 135. The UDL principle that was aligned with the overall barrier of interest was engagement. Table 2 shows the UDL checkpoints that would remove this barrier: Optimize relevance, value, and authenticity (7.2), Heighten salience of goals and objectives (8.1), Foster collaboration and community (8.3). To remove barriers to interest by recruiting interest, the participants noted as necessary to:

- Highlight student interests and experiences to make learning interesting (8.3)
- Provide choice, options, additional challenges, and autonomy to students (7.2, 8.3)
- Build motivation through modeling and providing support/assistance when necessary (8.1, 8.3)
- Use hands-on approaches with relatable materials and tools
- Allow opportunities to share and for feedback (8.1, 8.3)
- Make content taught relevant, relatable, authentic, and provide real-life applications (7.2, 8.3)

The next barrier was "complexity" with a 53-frequency rating that had the theme of complexity. The subthemes are simplified, reduce, and concrete all with a strategy frequency of 17. The UDL principles that were aligned with the overall barrier of complexity was engagement and representation. Table 2 shows the UDL checkpoints that would remove this barrier: Optimize relevance, value, and authenticity (7.2), Vary demands and resources to optimize challenge (8.2), Offer alternatives for auditory information (1.2), Offer alternatives for visual information (1.3), Clarify vocabulary and symbols (2.1). To remove barriers to complexity, the participants noted as necessary to:

- Use concrete examples and models to simplify content taught (1.2, 1.3, 7.2)
- Encourage questions and the use of manipulatives to enhance learning (8.2, 7.2)
- Make content less abstract and more concrete (1.2, 1.3, 2.1, 7.2)
- Use tangible objects, including handouts (1.2, 1.3, 2.1)

The next barrier was "background information" with a 21-frequency rating that had the theme of background knowledge. The subthemes are pre-assessment, prior knowledge, and confidence building all with a strategy frequency of 81. The UDL principles that were aligned with the overall barrier of background information was engagement and representation. Table 2 shows the UDL checkpoints that would remove this barrier: Minimize threats and distractions (7.3), Heighten salience of goals and objectives (8.1), Offer ways of customizing the display of information (1.1), Clarify syntax and structure (2.1), Activate or supply background knowledge (3.1). To remove barriers to background information, the participants noted as necessary to:

- Create a relevance for learning by supplying and using prior knowledge to build upon (3.1, 8.1)
- Use placement tests to assess present levels of performance (1.1, 2.1)
- Build confidence by using students' strengths and ensuring they are matched with the level of the course registration (1.1, 7.3)
- Provide a relevance for learning with connections to students' current lives/past personal experiences (3.1, 1.1, 8.1)

The next barrier was "activities" with a 15-frequency rating that had the theme of activity. The subthemes were ample opportunities, repetitions, practices, interactive, fun, and creative all with a strategy frequency of 40. The UDL principles that were aligned with the overall barrier of activities were engagement, action, and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Optimize individual choice and autonomy (7.1), Optimize relevance, value, and authenticity (7.2), Minimize threats and distractions (7.3), Vary demands and resources to optimize challenge (8.2), Foster collaboration and community (8.3), Promote expectations and beliefs that optimize motivation (9.1), Develop self-assessment and reflection (9.3), Vary the methods for response and navigation (4.1 To remove barriers to activities, the participants noted as necessary to:

- Encourage active participation by making activities interactive and fun with ample practice opportunities and repetitions (7.1, 7.2, 8.3)
- Ensure that the classroom is student-centered and allows students to be creative (9.3, 4.1, 8.3 9.1, 7.1)
- Help students build confidence by providing them practice with ample opportunities and repetitions (7.2, 7.3)
- Use multimodal instruction to maintain focus (7.2, 7.3)
- Open-dialogue classroom that is interdisciplinary and allows for group discussions (4.1, 7.1, 7.2, 7.3)

The next barrier was "abstractedness" with a 12-frequency rating that had the theme of alternative. The subthemes were auditory, visual, and option for comprehension all with a strategy frequency of 40. The UDL principles that were aligned with the overall barrier of abstractedness were representation, engagement, and action and expression. Table 2 shows the UDL checkpoints that would remove this barrier: Optimize relevance, value, and authenticity (7.2), Foster collaboration and community (8.3) Offer ways of customizing the display of information (1.1), Offer alternatives for auditory information (1.2), Offer alternatives for visual information (1.3), Promote understanding across languages (2.4), Illustrate through multiple media (2.5), Activate or supply background knowledge (3.1), Highlight patterns, critical features, big ideas, and relationships (3.2), Guide information processing and visualization (3.3), Enhance capacity for monitoring progress (6.4). To remove barriers to abstractedness by providing alternatives, the participants noted as necessary to:

- Use different options for comprehension such as auditory, visual, and sensory inputs (7.2, 8.3, 1.1, 1.2, 1.3, 2.4, 2.5, 3.1, 3.2, 3.3, 6.4).

The last barrier was "ecological factor" which had a frequency rating of NA and a theme of community and quality. The subthemes for community were learning environment, relationship building, and collaboration all with a strategy frequency of 57. The subthemes for quality were enthusiasm, caring, understanding, being interested in students, and making students feel important all with a strategy frequency of 10. The UDL principle

that was aligned with the overall barrier of ecological factor was engagement. To remove barriers to ecological factor, the participants noted as necessary to:

- Create a positive learning environment to lessen bullying and increase a safe/non-threatening space
- Allow opportunities for structured group work in addition to individual assignments
- Get to know the students to build relationships, provide support, and gain rapport
- Use guided practice, and accept diversity to show inclusion
- Adjust learning environment based on student needs and use guided practice to create a common learning experience
- Use high-quality teaching with enthusiasm, appropriate voice volume, and showing interest in students
- Understand students and their needs
- Avoid making assumptions on student knowledge and skills

Conclusion

This phenomenological study examined autobiographical memory narratives among TCs as a way for them to learn to identify (1) barriers to learning, (2) UDL checkpoints to remove these barriers, and (3) strategies for addressing the UDL checkpoints to remove the barriers. This study explored these TCs lived experience in terms of their (a) UDL training in the graduate teacher preparation programs, (b) barriers to learning among their past experience, and (c) UDL checkpoints' applications to removing the self-identified barriers to learning. Specifically, this study focused on their strategies to remove the barriers to learning among their past experience through UDL checkpoints' applications. Therefore, they dually took roles as a student, who identified barriers to their learning among their past experience, and as a teacher, who identified and applied specific UDL checkpoints to removing the self-identified barriers to learning. Data analysis was conducted to identify specific strategies based on UDL checkpoints' applications to removing these barriers among participants. Discussion highlighted strategies for addressing the UDL checkpoints to remove the barriers. This includes specific UDL checkpoints and their strategy applications.

Emerging themes indicated that the participants used specific UDL checkpoints to overcoming specific types of barriers to learning in the past experience in K-16 education. This shows that graduate TCs demonstrated their recognitions of specific types of barriers to learning, identifications of specific UDL checkpoints for overcoming the barriers, and considerations of specific strategies based on the identified UDL checkpoints. Therefore, using the autobiographical narrative, TCs can identify barriers to learning from their past experience, apply specific UDL checkpoints to remove these barriers, and discuss specific strategies based on the UDL checkpoints to be implemented in an instructional environment while dually taking roles as a student as well as their own teacher. Thus autobiographical memory narratives can be part of a practical learning tool 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 to remove the barriers. Also, they can learn to put themselves into perspectives of (A) students who experience barriers to learning as well as (B) teachers who apply UDL checkpoints to removing the barriers to learning. We continuously seek ways to support TCs to learn to implement UDL so that they can support their students in becoming expert learners.

Recommendations

This study explored the TC's UDL applications using specific strategies to removing barriers to learning among their own autobiographical narratives. The results indicated that TCs identified specific strategies for removing barriers to their own learning at any time of point in K-16 education. In other words, TCs identified ways the UDL Guidelines can be applied to removing barriers to learning in K-12 education as well as higher education. Barriers to learning are identified and include from most frequently mentioned such as strategies, situational life stressor, skills, responses, relevance, quantity, outcomes, organization, other academic, interest, complexity, background information, activities, abstractedness, and ecological factor. UDL principles identified to remove these barriers include engagement, representation, and action & expression.

More specifically, all the three UDL principles were applied to remove barriers among strategies, skills, responses, relevance, quantity, outcomes, other academic, and abstractedness. Engagement and representation were applied to remove barriers among complexity and background information. Engagement and action & expression were applied to remove barriers among situational life stressor, responses, and activities. Representation and action & expression were applied to remove barriers among organization. Engagement was applied to remove barriers among interest and ecological factors. Engagement was most frequently applied to remove identified barriers to learning.

Among emerging themes in strategies, subthemes were emerged. For instance, the top five most frequently identified strategies target (1) variation (action, expression, responses, teaching strategies, learning strategies, pacing), (2) memory (aids, strategies, posters, games), (3) support (related support, seeking for help, after school programs), (4) personal coping skill (stress reductions, motivation, plan for success), and (5) review (previous content, memory, refresher, keys). It is noteworthy that (1) variation specifically learning strategies and (4) personal coping skills are addressed by the participants as being willing to learn to use them for removing barriers to learning as students. Next top fiver though 10 frequently identified strategies included (5) scaffolding (build fluencies, building upon previously learned contents and skills), (6) feedback (rubrics, types, structures, mastery oriented), (7) ZPD (flexibility, current skills/needs, adjustments), (8) assessment (formative, instructional adjustments, creative), (9) assignment (group, models, expectations), and (10) relevance (cultural, linguistic, native speaker). Reviewing these strategies inform educators of strategies that learners would like to try, use, and have for removing their self-identified barriers to learning. Furthermore, a list of specific strategies with corresponding UDL checkpoints indicate what educators can do to reduce learning barriers in K-16 education.

By reviewing the TCs' responses addressing specific strategies, educators can be informed of ways to bridge learning and their interactions with their learning process by (i) removing preexisting barriers within the curriculum and (ii) intentionally building-in natural support (Rose & Meyer, 2002). Also, TCs demonstrating their understanding and application of the UDL framework in the autobiographical narrative is one step forward learning to incorporate UDL into their K-12 teaching practices. Therefore, this would contribute to more proactive, efficient, and cost-effective UDL training approach that might reduce an initial in-service teacher training on UDL (Spooner et al., 2007).

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