International Journal of Learning, Teaching and Educational Research
Vol. 24, No. 2, pp. 439-458, February 2025
https://doi.org/10.26803/ijlter.24.2.22
Received Dec 30, 2024; Revised Feb 13, 2025; Accepted Feb 19, 2025

Exploring the Awareness of Teacher-Educators Regarding Universal Design for Learning: A Study from Central Universities of India

Adya Shakti Rai
Faculty of Special Education
Dr. Shakuntala Misra National Rehabilitation University
Lucknow, Uttar Pradesh, India

Sweta Dvivedi*
Department of Education
Mizoram University
Aizawl, Mizoram, India

Abstract. The present study investigated the awareness of universal design for learning among teacher educators of central universities in India. Universal design for learning is an essential framework that reduces barriers to academic achievement, allowing students of all abilities to access the curriculum. In Indian classrooms, educators encounter challenges such as diverse students, large class sizes, rote learning practices, and limited resources, which complicate inclusive education efforts. The universal design for learning addresses these challenges by promoting flexible teaching methods, varied engagement strategies, and inclusive assessments. The success of curriculum implementation depends on teachers, highlighting the need to assess universal design for learning awareness among teacher educators who prepare future teachers. This study employed a descriptive research method and selected 62 teacher-educators from the teacher-education departments of five Indian universities as a sample by using a simple random sampling technique. A standardized awareness test developed by the researchers was administered to assess the awareness of teacher-educators regarding UDL. The participants were asked to complete the assessment test under the direct observation of the investigators. The dataset was thoroughly analyzed using descriptive statistics, such as the mean and standard deviation, to summarize its central tendency and variability. The results revealed that teacher educators from four universities had moderate awareness of universal design for learning, while teacher educators from one university exhibited high awareness. Furthermore, the study found that awareness levels were consistent across age, experience, and gender. This study highlights the importance of enhancing awareness of universal design for learning among teacher

*Corresponding author: Sweta Dvivedi, *dvisweta@gmail.com*

educators to foster inclusive education practices that can effectively meet the diverse needs of students in Indian classrooms.

Keywords: Universal design for learning; inclusive education; teachers' training programs; teacher educators; teacher-education institutions

1. Introduction

Inclusive education is often viewed as having several dimensions, encompassing the recognition and appreciation of individual differences and diversity, human rights considerations, social justice and equitable problems, social model of disability, and socio-political educational framework. Education has evolved from traditional methods to an inclusive model, allowing diverse learners to share the same classroom (Levey, 2023). The diverse classroom is an asset; however, it poses a significant challenge for teachers in managing the variability among learners. To promote the inclusion of students of all abilities in the classroom, all stakeholders in the education system advocate for universal design for learning (UDL) (Boothe et al., 2018; Cook & Rao, 2018; Meyer et al., 2014; Rose & Strangman, 2007) at different educational stages (Fovet, 2022; Jwad et al., 2022; Mackey, 2019).

This new approach to education has also been embraced by India so that traditionally excluded groups can access the education in the same institutions. However, Indian classrooms face several challenges including large class sizes, diverse student populations, rigid curricula, exam-centric approaches and rote learning, language barriers, limited resources, and inclusion of students with disabilities. These issues can be effectively addressed through UDL, which caters to diverse learning needs resulting from linguistic, cultural, and socio-economic differences. The UDL framework promotes inclusive education in line with the Indian National Education Policy (NEP) 2020 and shifts the focus from rote learning to critical thinking and creativity (Dvivedi et al., 2023; Meyer et al., 2014). The UDL framework focuses on providing a variety of goals, methods, resources, and evaluation techniques to address the needs of all learners. It also seeks to satisfy the demands of students with diverse needs through guiding principles of multiple means of engagement, representation, action, and expression, which are aligned with a brain network (Hall et al., 2003; Rose & Strangman, 2007).

In the successful application of the principles of UDL, teachers and the training they receive are significant factors that facilitate the entire process of inclusive education (Craig et al., 2019; Darling-Hammond et al., 2005; Horne & Timmons, 2009; Krishan & Sharma, 2023; Meyer et al., 2014). Bedir (2022) stated that UDL practices contribute to supporting individual differences in education, high-level efficiency, equality of opportunities in education, addressing everyone, versatile learning, facilitating learning, ensuring permanence, facilitating access to information, increasing the quality of education, and improving self-expression skills. Kelly et al. (2022) discovered that UDL has the potential for an integrated, connected, and inclusive curriculum through outdoor learning.

The results of UDL are largely positive in the teaching-learning process, but several factors hinder its implementation in the classroom. Teachers encounter challenges when trying to implement UDL in their classrooms, primarily due to a lack of appropriate policies, guidelines, tools, technologies, resources, physical and programmatic inaccessibility, ineffective management, lack of timeliness, equipment mismatches, high costs, and inadequate funding (Brown, 2018; Canter et al., 2017; Dalton et al., 2018; Dvivedi et al., 2023; Ebuenyi, 2018; Smith et al., 2019; Suja & Elamaran, 2023). Additionally, the main obstacle is a lack of awareness and training among teachers (Brown, 2018; Dalton et al., 2018; Ebuenyi, 2018; Markou & Díaz-Noguera, 2022; Krishan & Sharma, 2023; Suja & Elamaran, 2023). Poverty, inequality, and other social conditions are also some other hurdles in the implementation of UDL (Department of Education, 2001). Considering these factors, it is imperative to conduct a comprehensive investigation in order to effectively integrate UDL in the classroom, with the goal of providing support for the learning needs of all students.

Recent research on UDL clarified the importance of assessing the awareness of teacher educators regarding this framework. Research suggests that teachers typically possess a moderate grasp of UDL, highlighting a prevalent gap in their comprehensive understanding of its principles and applications (Almutairi & Alsuway, 2023; Dempsey et al., 2023; Dvivedi et al., 2023; Hills et al., 2022). Therefore, it is essential to determine how familiar teacher educators who are responsible for training future teachers are with UDL. This knowledge will enable them to raise awareness among their trainees during teacher training programs effectively. Within this framework, central university-affiliated teacher-educators play a crucial role, given their substantial responsibilities in the educational structure.

This study yields important theoretical and practical implications regarding teaching-learning environments, particularly in the context of higher education and pre-service teacher education. Theoretically, this study contributes to the growing body of knowledge on UDL by highlighting current awareness levels among teacher educators and reinforcing the importance of UDL in promoting inclusive educational frameworks. Practically, the findings of the study will help to give directions for curriculum development in teacher education programs, in-service teachers' training of teacher educators, and administrative support advocating the integration of UDL principles to enhance educational quality in higher education institutions. This research also yields valuable insights into the effectiveness of educators in successfully implementing inclusive education practices nationwide.

Within this scope, this study has focused on investigating the awareness level of teacher educators at central universities of India regarding the UDL so that inclusiveness can be established within the country. The research was centered on the following questions:

1. What is the level of awareness of universal design for learning among teacher-educators?

2. How do gender, age, and teaching experience influence teacher-educators' awareness of universal design for learning?

2. Literature Review

The concept of universal design started in architecture by Ronald Mace, focusing on accessible environments for people of all ages and abilities. Further, the concept was extended to education with the creation of the UDL framework, which was aimed at providing equal learning opportunities for all students (Almumen, 2020). The idea of UDL emerged in the late 1990s from David H. Rose and CAST, but the roots of UDL can be traced back to the theories of Piaget, Bruner, and Vygotsky. The essence of Vygotsky's theory (1978) emphasized the significance of social interaction and scaffolding in the learning process. The UDL framework supports this by providing diverse options for engagement through collaboration and culturally relevant instruction.

Sweller's cognitive load theory (1988) suggests that learners are constrained by limited working memory capacity, and UDL addresses this by providing different formats (visual, auditory, textual) to reduce cognitive overload. Gardner's multiple intelligences theory (1983) advocates for differing learning styles, which UDL supports through differing instructional strategies. Rose and Mayer (2002) elaborated on the UDL theories based on neuroscience, highlighting recognition (multiple means of representation), strategic (multiple means of action and expression), and affective (multiple means of engagement) as the three brain networks considered. Piaget (1952) and Bruner (1966) emphasized active learning and knowledge construction, values upheld by the UDL, through personal and experiential approaches. Though relatively new, with its foundations proposed by Rose and Meyer in the 1990s, research on UDL has grown significantly since 2000 because of its principles, which encompass flexible teaching methods and materials that help address diverse learners' needs, promoting engagement and achievement, particularly for students with disabilities (Bruyckere et al., 2020; Meyer et al., 2014; Sewell et al., 2022).

The research underscores the importance of UDL for students with diverse learning needs, such as students with learning difficulties (Melhem & Al-Rashid, 2023) and intellectual disabilities (AlRawi & AlKahtani, 2022; Browder et al., 2008; Coyne et al., 2012), to enhance their educational development (Delaney & Hata, 2020; Kennedy et al., 2014). Izzo (2012) highlighted UDL's positive impact on undergraduate students with disabilities, emphasizing the role of universally designed technology in improving academic performance. UDL also enhances teaching methods, promoting learner-centered education and flexibility, particularly for professors in science, technology, engineering, and mathematics disciplines. Roski et al. (2021) found positive effects of UDL on special education student participation, finding that UDL-based learning environments promote diversity. Moreover, UDL benefits all learners beyond students with disabilities. Through a meta-analysis, Capp (2017) showed that UDL positively affects the learning process in diverse classrooms. Almumen's (2020) study in Kuwaiti-inclusive classrooms revealed teachers' use of multisensory tools, recommending UDL's second principle to meet diverse needs and enhance

accessibility. Metzker (2021) described UDL as an approach inspired by architecture, focusing on creating inclusive learning environments for varied abilities. Similarly, Wells (2022) found UDL effective in supporting diverse student populations and improving academic outcomes in higher education.

Markou and Díaz-Noguera (2022) also noted its benefits in Greek secondary schools, particularly for students with special needs. The UDL framework supports different learning styles by providing equal access to learning without retrofitting (Edyburn, 2005), in which UDL empowered students to control their learning while teachers guided the process. This versatility led educationists to adopt UDL as a method to fulfil inclusive education objectives. Kurtts (2006) and Herrara et al. (2019) explored UDL's applications, with the later developing a massive open online course to promote inclusive virtual education. Frolli et al. (2022) emphasized the influence of UDL on the brain's affective, strategic, and recognition networks, benefiting students with severe intellectual disabilities. Kelly et al. (2022) extended UDL into outdoor learning, enhancing curriculum integration. A study by Chavarria et al. (2023) demonstrated UDL's role in fostering inclusivity in higher education. Hromalik et al. (2024) also found that the UDL framework enabled teachers to cultivate inclusive learning environments.

To implement UDL successfully in the teaching-learning process, teachers' preparation is crucial. A study by Izzo et al. (2008) found that faculty felt more confident in helping students with disabilities after using a UDL program, with their knowledge of UDL practices increasing significantly. Gavin (2017) found that UDL training increased teachers' use of UDL strategies, especially in visual modalities. Israel et al. (2014) evaluated UDL's integration into teacher preparation programs, emphasizing proactive approaches over behavior reduction strategies.

Research highlights varying awareness levels of UDL among teacher-educators, as shown by Rao et al. (2014), who found a general recognition of inclusivity's importance but limited familiarity with UDL frameworks. Mavrovic-Glaser (2017) discovered that only 55% of teachers claimed familiarity with UDL and many had not received any adequate training for its implementation. In this study, the researcher also found that special educators had more UDL training than general teachers. Laurian-Fitzgerald and Fitzgerald (2017) found that pre-service teachers had a limited understanding of UDL. Alquraini and Rao (2018) identified barriers to UDL implementation, including a lack of training and resources. More infrastructure and professional development are needed to enhance UDL practices, as highlighted by Bedir (2022).

Teacher-educators often struggle with limited UDL knowledge, as revealed in studies by Hills et al. (2022) and Almutairi and Alsuway (2023). Almutairi and Alsuwayl (2023) assessed Saudi elementary teachers' knowledge of UDL principles with 225 participants, including general and special education teachers. They found a medium overall knowledge level, with female teachers scoring notably higher than male teachers. However, teaching experience,

specialty, and highest degree showed no significant differences. The study highlighted gaps in understanding specific UDL aspects, especially in student assessment (Almutairi & Alsuwayl, 2023). Dvivedi et al. (2023) found limited awareness of teacher-educators about UDL and emphasized the need for policies and infrastructure to support UDL, while Krishan and Sharma (2023) found special education teachers more familiar with UDL than their general counterparts.

In a study by Dempsey et al. (2023), only 19 out of 61 anatomy educators were aware of UDL, and only 15 had applied it in their teaching. The majority of the respondents were not explicitly aware of UDL but many had unknowingly incorporated UDL principles in their curriculum design. The study suggests a gap in knowledge about UDL among anatomy educators in the Republic of Ireland and in the United Kingdom yet potential for further integration of UDL to enhance student motivation and engagement. Embedding UDL within teacher education programs is essential, as shown by Zerbato and Mendes (2021) and Hainline (2022), who demonstrated that UDL training increased student engagement and teacher confidence.

Although the majority of studies have highlighted positive results of UDL, it has not been successfully implemented in classrooms due to several factors, including barriers of time constraints, large class sizes, and insufficient training (Scott, 2018). Long (2018) identified systemic obstacles to UDL integration in schools, while Williams (2020) and Dacus-Hare (2023) found similar challenges in K-8 education. Lack of administrative support also plays a role (Scott, 2018), with institutional backing crucial for successful UDL integration.

With sufficient resources and adequate awareness or knowledge, teachers' perceptions also significantly influence UDL's application in classrooms. Cash et al. (2021) found that teachers with positive attitudes toward inclusion were more likely to apply UDL principles. Murphy (2021) also had similar findings, noting that while teachers appreciated UDL benefits, they encountered challenges such as resistance to change and limited career growth. Positive student perceptions of UDL have also been documented, as shown by Cloonan (2022), who reported student appreciation for UDL's flexibility and autonomy, and Boothe et al. (2020), who found that students valued UDL's impact on learning and expression.

While the potential of UDL to improve educational experiences for all learners is well-documented, more research is needed to understand teacher educators' awareness and application of UDL principles. As the field of education continues to evolve, teacher-educators must be equipped with the skills and knowledge necessary to implement UDL effectively. Addressing the barriers to UDL implementation—such as lack of knowledge, training, resources, and institutional support—will be critical for fostering truly inclusive learning environments.

3. Materials and Methods

In this specific research study, the researchers employed descriptive survey research design, a commonly used method for gathering information. This approach entails collecting data to gain a comprehensive understanding of the characteristics of the population under study which, in this instance, are teacher educators and their awareness of UDL.

A multistage sampling method was adopted to collect data in this study. This approach included the use of a simple random sampling technique for the selection of samples at each stage. The study's target population comprised all central universities in India. A total of 56 central universities in the country were categorized into five zones based on their geographical location of east, west, north, south, and central. This approach to the selection of the universities also aligned with the goal of representing a broad spectrum of cultural, linguistic, and educational contexts within the country. Among these universities, 45 had teacher-education departments. The selection process focused on universities offering a Bachelor of Education (B. Ed) program, resulting in a final sample frame of 35 universities with a 2-year B. Ed program.

In the first stage of sampling, one university from each zone was selected by using a simple random sampling technique to ensure representation of the entire target population. Further details of the selected universities are provided in Table 1.

Table 1: List of central universities selected as sample of the study

S.N.	Name of Central University	Zone
1	Visva-Bharati University, Kolkata.	East
2	Mahatma Gandhi Antarrashtriya Hindi Vishwa Vidyalaya, Wardha, Maharashtra.	West
3	Banaras Hindu University, Uttar Pradesh.	North
4	Maulana Azad National Urdu University, Hyderabad.	South
5	Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh.	Central

In the next stage, more than half of teacher educators were selected by using the same sampling technique from five chosen institutes to assess their awareness levels. A total of 62 teacher educators were ultimately selected for this study.

The study focused on employing a quantitative approach to assess the level of awareness among teacher-educators regarding UDL. Quantitative research, as defined by Creswell (1994), involves systematic analysis of social or human issues by quantifying variables using numerical data and utilizing statistical methods to test theoretical predictions. This method underscores the significance of numerical data and statistical analyses, as highlighted by Gall et al. (1999). Based on these principles, the researchers developed an awareness test titled "Teachers' Awareness Regarding Universal Design for Learning." This comprehensive assessment was designed to collect precise and relevant data across three levels of the cognitive domain: knowledge, comprehension, and application. The test was structured to evaluate awareness across various

dimensions of UDL, including multiple means of engagement, multiple means of representation and multiple means of actions and expression. The test was carefully constructed to extract meaningful insights into the awareness of UDL among teacher-educators, following guidelines provided by CAST. The reliability and validity coefficients of the test were determined to be 0.82 and 0.83, respectively.

To establish norms for the test, the UDL awareness test was administered to 106 teacher educators from various universities across the country. Following the initial data collection, researchers converted the obtained raw scores into Z-scores and T-scores, standardizing the results to facilitate comparison. This transformation was then further refined, resulting in the calculation of standard and stanine scores. These scores were analyzed to establish general norms for the UDL awareness test, which are presented in Table 2.

Table 2: Interpretation of the scores of universal designs for learning awareness test

Sl. No.	T- Score	Stanine Score	Interpretation
1	32-56	7 to 9	Very High
2	25-31	4 to 6	Average
3	0-24	1 to 3	Low

The study involved teacher educators from teacher education departments of central universities in different zones of India, teaching B. Ed classes. In order to proceed, initial authorization was sought from the heads of the respective departments of these institutions to gather necessary information. Subsequently, explicit consent was obtained from the teacher educators before the data collection process commenced. Teachers were clearly informed that the assessment tool was designed to assess their awareness of UDL, consisting of a total of 43 multiple-choice questions and 18 alternative-option questions. Some examples of these questions are as follows:

UDL is designed for:

A. Highly gifted students
B. Average students
C. Students with disabilities
D. All learners

UDL helps identify the instructional processes to be used for a particular classroom.

Yes
No

It was emphasized that the correctness of their responses was immaterial. Notably, all participating educators were associated with higher education and, therefore, expected to have proficiency in comprehending and responding in English. Consequently, to ensure effective communication, the questions were presented in English, and field investigators, who had already been sensitized to the nuances of operationalization, administered the tool. To accurately assess the awareness levels of the teacher-trainers, participants were requested to complete the assessment tests in the presence of the investigators. This approach facilitated direct observation and ensured the integrity of the data collected. To

get the awareness level of teacher educators, the data were analyzed using descriptive analysis such as mean and SD.

4. Results

The information in Table 3 presents a comprehensive overview of the levels of awareness regarding UDL. The data were collected through an awareness test conducted among educators in higher education institutions, including Banaras Hindu University (Varanasi), Maulana Azad National Urdu University (Hyderabad), Guru Ghasidas Vishwavidyalaya (Bilaspur), Mahatma Gandhi Antarrashtriya Hindi Vishwa Vidyalaya (Wardha), and Visva Bharti University (Shantiniketan).

The order of universities has been altered in Table 3 to ensure the confidentiality of the results, and they have been referred to as University 1 and University 2.

Table 3: Teacher-educators' awareness regarding universal design for learning

Sr. No.	Name of the Institution	N	Mean	SD
1	University 1	6	31.67	5.820
2	University 2	12	27.50	4.359
3	University 3	20	26.15	2.368
4	University 4	15	26.27	3.494
5	University 5	9	29.89	4.702
Total		**62**	**27.52**	**4.144**

Awareness is crucial for the successful implementation of UDL. Analyses reveal that only teacher educators from University 1 exhibited a high level of awareness regarding UDL. Conversely, teacher educators from other institutions showed only a medium or average level of awareness. Overall, the average level of awareness among all participants suggests that teacher educators possessed a limited understanding of UDL. This situation is particularly troubling for national-level institutions that lead teacher training. Teacher educators play a crucial role in preparing future teachers for the workforce. If these educators lack a solid understanding of UDL, it raises the important question of how they can effectively prepare their students to apply UDL principles in future classrooms.

This limited awareness among teacher educators across institutions underlines the critical need for targeted professional development programs. Such initiatives can cultivate a deeper understanding of UDL principles and practices, thereby enhancing the educational experiences of both educators and learners. Institutions must recognize the value of embedding UDL into refresher programs or other in-service teachers' training programs, as this approach not only caters to diverse learning needs but also fosters an inclusive educational environment.

Table 4: Teacher-educators' awareness regarding universal design for learning as per their gender

Sr. No.	Gender	N	Mean	SD
1	Female	18	27.44	5.032
2	Male	44	27.55	3.788

The data presented in Table 4 provides a comprehensive breakdown of teachers' awareness of UDL based on gender. The mean awareness values for female (N=18) and male (N=44) teacher-educators, which are 27.44 (SD=5.032) and 27.55 (SD=3.788) respectively, correspond to stanines 4, 5, and 6 and fall within the average range.

Furthermore, the data analysis demonstrates that both female and male educators exhibit a similar level of familiarity with the principles of UDL. This parity suggests the commonality in training or exposure to inclusive teaching strategies across genders. These findings also underscore the notion that, regardless of gender, teachers' awareness of the UDL remains consistent, indicating that gender may not be a determining factor in teachers' awareness levels.

Table 5 presents the data on the awareness of UDL among teacher-educators, segmented by age groups.

Table 5: Teacher-educators' awareness regarding universal design for learning as per their age

Sr. No.	Age Group	N	Mean	SD
1	35 and younger	6	27.50	5.577
2	36-50	47	27.74	4.141
3	51-65	9	26.33	3.317

The largest subset of the sample (47 individuals) belonged to the 36–50 age range. This group of teacher-educators achieved an average score of 27.74 in terms of UDL awareness, indicating a moderate level of awareness. The six teacher-educators aged under 35 obtained an average score of 27.50, which also reflects an average level of UDL awareness. Lastly, teacher-educators aged 51 and older had a mean score of 26.33, positioning them within the average category for UDL awareness.

The moderate level of awareness regarding UDL among teacher educators of all age groups indicates that UDL was likely never included in their pre-service training, even for those who completed their education in the 2000s or 2010s. Since the 2000s, there have been ongoing efforts to identify new strategies that effectively address the diverse learning needs of students in inclusive classrooms. Additionally, perhaps UDL and inclusive education were not part of in-service training, in the form of orientation or refresher courses, which would help educators understand how to manage inclusive classrooms and apply UDL in those settings.

In Table 6, the mean scores of the three categories based on the years of experience of teacher-educators are given.

Table 6: Teacher-educators' awareness regarding universal design for learning as per their experience

S. N	Experience	N	Mean	SD
1	0-10 years	30	27.60	3.519
2	11-20 years	23	27.74	5.216
3	21 years and older	9	26.67	3.202

Teachers' awareness of UDL was found to be at an average level across all three groups studied. This suggests that the amount of teaching experience—whether extensive or limited—does not significantly affect teachers' awareness of UDL. Additionally, it indicates that UDL may not be adequately covered in pre-service or in-service training programs in recent years. Even if it is included, there may not be a strong emphasis on ensuring that teachers are aware of it.

This finding contradicts the results from Krishna and Sharma (2023), which showed a significant variation in teachers' awareness based on their teaching experience. This discrepancy raises important questions about what factors actually influence teachers' awareness of UDL. While Krishna and Sharma's (2023) study suggests a connection between teaching experience and awareness, the current study implies that other elements could also be at play. A lack of familiarity with UDL might explain the absence of an observable effect of experience in this context.

To address this issue, teachers' understanding and implementation of UDL principles could be greatly enhanced through providing teachers with access to professional development opportunities, targeted training sessions focused on UDL, and support from their educational institutions.

5. Discussion

The primary objective of the current study was to assess the level of awareness of UDL among teacher-educators. It is widely acknowledged that awareness serves as the initial step in translating theory into practice. Being cognizant of UDL unquestionably enables educators to gain a deeper understanding of their approaches and techniques to ensure that all students have equal access to education. The initial move toward creating an inclusive educational system is to implement the pivotal and impactful UDL actively. Furthermore, NEP 2020 has also emphasized the urgent need for a shift from content-focused to personalized learning. The first crucial step in achieving this transformation is to enhance awareness of the available resources for tailoring learning experiences.

The UDL framework, which takes into account the needs of every student, facilitates access to education (Al-Azawei et al., 2016; Almeqdad et al., 2023; Priyadarsini & Mary, 2024; Trostle Brand et al., 2012). In an effort to support diverse learners, India has recently initiated efforts to integrate the UDL framework into its educational systems (National Council of Educational

Research and Training, 2021). This provides educators with valuable insights into how they can accommodate children with diverse needs in their lesson planning and design. The findings of the current study reveal that teachers' awareness of UDL was below average, a conclusion that was consistent with several other research findings (Almutairi & Alsuway, 2023; Alquraini & Rao, 2018; Dvivedi et al., 2023; Krishan & Sharma, 2023; Mavrovic-Glaser, 2017). Spooner et al. (2007) corroborated this conclusion by indicating that a number of general education teachers were unable to adapt their lessons for students with different abilities in the absence of training, a time limit, and effective classroom management. Educators need more expertise to apply UDL in inclusive environments.

Conversely, Dempsey et al. (2023) discovered that although a greater proportion of educators were not aware of UDL, they were able to identify the framework's checkpoints in their curriculum, which suggests that they had inadvertently included elements of UDL in the creation and delivery of their course material. However, this lack of awareness poses significant challenges to the effective implementation of UDL principles in classrooms. If teacher-educators are not fully informed about UDL and its strategies, they may struggle to create genuinely inclusive learning environments. This gap in knowledge can result in missed opportunities to engage all students, particularly those with varying abilities and learning styles.

Being aware of UDL undoubtedly helps educators better understand the attitudes and methods for ensuring that all students have access to education. Additionally, NEP (2020) made it clear that the shift from content-based to individual learning is urgently required. According to Paiva et al. (2019) and Qu and Cross (2024), UDL is a viable strategy for inclusive and accessible education (Priyadharsini & Mary, 2024). It is possible to expand UDL to develop a customized teaching strategy. The goal of teacher education programs should be to equip future educators with the knowledge, skills, attitudes, and behaviors necessary to perform their duties effectively in the classroom. UDL plays a pivotal role in empowering educators to develop lesson plans that cater to the diverse needs of all students rather than focusing exclusively on a limited group (Pisha & Coyne, 2001).

While it is clear from the discussion that teacher educators need to be aware of UDL, the results of this study show that, out of the five central universities, only one university's teacher educators (20%) had a high level of awareness of the UDL. In contrast, the other four (80%) universities had an average level of awareness. These are the conditions of central universities, which stand as ambassadors for society at large and for other institutions of learning in particular. The findings advocate putting UDL into practice by making it part of the curriculum in all universities where it is currently absent and also suggest designing curricula around it.

Additionally, the study reveals that a similar level of UDL awareness was found based on gender, age, and experience. Awareness levels were consistent across

all genders and age categories, suggesting that factors other than demographic characteristics may play a more critical role in shaping educators' familiarity with UDL.

The study reveals an overall average level of UDL awareness present throughout the institutions. However, the research did not investigate the underlying reasons for this phenomenon or the factors that may contribute to the limited dissemination of UDL knowledge within these institutions. Possible reasons for the restricted awareness of UDL could include a lack of policies supporting UDL practices, outdated curricula, insufficient training opportunities, or a lack of emphasis on UDL topics within teacher education programs. In addition, as has already been stated, the level of institutional support, resources, and administrative commitment towards inclusive education could significantly influence the awareness level of these teacher educators.

Comprehensive professional development programs that focus on UDL are imperative to address issues related to the average level of awareness regarding UDL. Such programs will not only educate teacher educators about the theoretical aspects of UDL but also provide practical applications and resources that can be easily integrated into their teaching practices. Workshops, seminars, and collaborative learning communities could serve as effective platforms for fostering a deeper understanding of UDL and its benefits.

Ultimately, raising awareness about UDL is not just about informing educators; it is about transforming educational practices to ensure that every student has the opportunity to thrive. As the educational landscape continues to evolve, teacher-educators must be equipped with the knowledge and skills necessary to meet the diverse needs of their own students, as well as prepare their students for the same, thereby fostering an inclusive and equitable educational system for all.

While this study provides quantitative results regarding the understanding of the UDL among teacher educators, it is limited by its lack of qualitative methods such as interviews or focus groups. If qualitative methods had been used, the study would have been able to portray more granulated perspectives regarding educators' experiences, attitudes, and the multifaceted challenges concerning UDL. These attitudes would provide insights into how UDL is understood and practiced in real classroom situations. Thus, future studies should be conducted using mixed methods in order to capture not just the level of UDL awareness but the context surrounding its effective application.

6. Conclusion

This study aimed to analyze the level of understanding of UDL, which is an essential aspect of inclusive education, by teacher educators in the central universities in India. The findings revealed that while the majority of teacher educators demonstrated a moderate level of UDL awareness, only a small proportion had a high level of awareness. These results highlight the urgent

need to strengthen UDL-focused training in teacher education programs to prepare educators for diverse and inclusive classrooms.

The study also disclosed that factors such as gender, age, and teaching experience do not significantly influence UDL awareness, indicating that the gaps are not individual but systemic. The lack of formal training on UDL, the absence of UDL in curricula, limited professional development opportunities, and the absence of governmental and institutional policies promoting inclusive practices likely contribute to these awareness gaps. These concerns not only require a single intervention but also need to be multi-faceted, such as the application of UDL principles in teacher education curricula, active and continuous educational training, and inclusive policy development. Although this study provided valuable quantitative insights, it acknowledges its limitations too, such as the absence of qualitative data that could offer deeper perspectives on the experiences of teacher educators along with institutional contexts.

Enhancing awareness among teacher educators regarding UDL is not just an academic requirement but also a practical necessity to promote equity, accessibility, and inclusivity in the Indian education system. By equipping educators with the required knowledge and skills to adopt and implement UDL effectively in the teaching-learning process, Indian teachers can move closer to actualizing the vision of inclusive education as outlined in the NEP 2020.

7. Recommendations

The findings of this study suggest that integrating UDL principles into pre-service and in-service teacher education curricula in India will help promote teacher educator awareness about implementation practices through dedicated modules, hands-on workshops, and practical training. Educational institutions should organize standard professional development courses, including seminars and refresher courses, to connect theoretical expertise with practical teaching skills. Additionally, policy-level support is also crucial, wherein educational institutions are encouraged to adopt policies in line with NEP 2020 that promote inclusive practices. An institutional culture of support needs leadership backing through resource allocation to develop UDL awareness further. Further research is needed on the systemic, cultural, and pedagogical elements which affect teacher educators' awareness of UDL. This combines an analysis of policies, the administrative level, the curricula, and the cultural attitudes towards diversity and its relational impact on educators' dispositions towards UDL. These aspects may be addressed using qualitative approaches, such as case studies, interviews or focus groups, which are vital for developing a deeper understanding of these phenomena with particular emphasis on the practices of education inclusion.

Institutional Review Board Statement: Ethical review and approval were waived for this study because the research does not deal with vulnerable groups or sensitive issues.

Funding: This study was funded by ICSSR, India, as a Major Project.
Acknowledgements: The authors thank all the field investigators and

participating teaching faculty from the sampled teacher education departments.
Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.
Data Availability Statement: The data presented in this study are available from the corresponding author on request. The data are not publicly available due to restrictions.
Conflicts of Interest: The authors declare no conflict of interest.

8. References

Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016). Universal design for learning (UDL): A content analysis of peer-reviewed journal papers from 2012 to 2015. *Journal of the Scholarship of Teaching & Learning*, *16*(3), 39–56. https://doi.org/10.14434/josotl.v16i3.19295

Almeqdad, Q. I., Alodat, A. M., Alquraan, M. F., Mohaidat, M. A., & Al-Makhzoomy, A. K. (2023). The effectiveness of universal design for learning: A systematic review of the literature and meta-analysis. *Cogent Education*, *10*(1). https://doi.org/10.1080/2331186X.2023.2218191

Almumen, H. A. (2020). Universal design for learning (UDL) across cultures: The application of UDL in Kuwaiti inclusive classrooms. *SAGE Open*, *10*(4). https://doi.org/10.1177/2158244020969674

Almutairi, N., & Alsuwayl, A. (2023). Assessing the knowledge of elementary school teachers on universal design for learning in Saudi Arabia. *Cogent Education*, *10*(2). https://doi.org/10.1080/2331186X.2023.2270295

Alquraini, T. A., & Rao, S. M. (2018). Assessing teachers' knowledge, readiness, and needs to implement universal design for learning in classrooms in Saudi Arabia. *International Journal of Inclusive Education*, *24*(1), 103–114. https://doi.org/10.1080/13603116.2018.1452298

AlRawi, J. M., & AlKahtani, M. A. (2022). Universal design for learning for educating students with intellectual disabilities: A systematic review. *International Journal of Developmental Disabilities*, *68*(6), 800–808. https://doi.org/10.1080/20473869.2021.1900505

Bedir, G. (2022). Teachers' view on the practices of universal design for learning. *International Journal of Curriculum and Instruction*, *14*(2), 1324–1342. https://files.eric.ed.gov/fulltext/EJ1340721.pdf

Boothe, K. A., Lohmann, M. J., & Owiny, R. (2020). Enhancing student learning in the online instructional environment through the use of universal design for learning. *Networks: An Online Journal for Teacher Research*, *22*(1). https://doi.org/10.4148/2470-6353.1310

Browder, D. M., Mims, P. J., Spooner, F., Ahlgrim-Delzell, L., & Lee, A. (2008). Teaching elementary students with multiple disabilities to participate in shared stories. *Research and Practice for Persons with Severe Disabilities*, *33*, 3–12. https://doi.org/10.2511/rpsd.33.1-2.3

Brown, S. (2018). *Inclusive education in Canada: Steps taken and the long road ahead*. Education International. https://www.ei-ie.org/en/item/22684:inclusive-education-in-canada-steps-taken-and-thelong-road-ahead

Bruner, J. (1966). *Toward a theory of instruction.* Harvard University Press

Bruyckere, P., Kirschner, P. A., & Hulshof, C. (2020). *More urban myths about learning and education: Challenging eduquacks, extraordinary claims, and alternative facts*. Routledge.

Canter, L., King, L., Williams, J., Metcalf, D., & Myrick-Potts, K. (2017). Evaluating pedagogy and practice of universal design for learning in public schools. *Exceptionality Education International*, *27*(1), 1–16. https://doi.org/10.5206/eei.v27i1.7743

Capp, M. J. (2017). The effectiveness of universal design for learning: A meta-analysis of literature between 2013 and 2016. *International Journal of Inclusive Education*, *21*(8), 791–807. https://doi.org/10.1080/13603116.2017.1325074

Cash, C., Cox, T., & Hahs-Vaughn, D. (2021). Distance educators' attitudes and actions towards inclusive teaching practices. *Journal of the Scholarship of Teaching and Learning*, *21*(2). https://doi.org/10.14434/josotl.v21i2.27949

Chavarria, R. E., Montesini, R. H. G., Lopez-Bastias, J. L., & Diaz-Vega M. (2023). Universal design for learning and instruction: effective strategies for inclusive higher education. *Education Sciences*, *13*(6), 620. https://doi.org/10.3390/educsci13060620

Cloonan, L. (2022). A critical evaluation of the integration of a universal design for learning approach into a module using an e-portfolio: A student perspective. *All Ireland Journal of Higher Education*, *14*(3), 1-27. https://ojs.aishe.org/index.php/aishe-j/article/view/679/1051

Cook, S. C., & Rao, K. (2018). Systematically applying UDL to effective practices for students with learning disabilities. *Learning Disability Quarterly, 41*(3), 179–191. https://doi.org/10.1177/0731948717749936

Coyne, P., Pisha, B., Dalton, B., Zeph, L. A., & Smith, N. C. (2012). Literacy by design: A universal design for learning approach for students with significant intellectual disabilities. *Remedial and Special Education*, *33*(3), 162–172. https://doi.org/10.1177/0741932510381651

Craig, S., Smith, S., & Frey, B. (2019). Professional development with universal design for learning: supporting teachers as learners to increase the implementation of UDL. *Professional Development in Education*, *48*, 1–16. https://doi.org/10.1080/19415257.2019.1685563

Creswell, J. W. (1994). *Research design: Qualitative and quantitative approaches*. Sage.

Dacus-Hare, D. (2023). *The barriers teachers face when implementing the universal design for learning framework* [Master of Science in Education thesis, Dominican University of California']. https://doi.org/10.33015/dominican.edu/2023.EDU.15

Dalton, E. M., Lyner-Cleophas, M., Ferguson, B. T., & McKenzie, J. (2019). Inclusion, universal design and universal design for learning in higher education: South Africa and the United States. *African Journal of Disability*, *8*, a519. https://doi.org/10.4102/ajod.v8i0.519

Darling-Hammond, L., Holtzman, D. J., Gatlin, S. J., & Heilig, J. V. (2005). Does teacher preparation matter? Evidence about teacher certification, teach for America, and teacher effectiveness. *Education Policy Analysis Archives*, *13*, 1–48. https://doi.org/10.14507/epaa.v13n42.2005

Delaney, T. A., & Hata, M. (2020). Universal Design for learning in assessment: Supporting ells with learning disabilities. *Latin American Journal of Content & Language Integrated Learning*, *13*(1), 79–91. https://doi.org/10.5294/laclil.2020.13.1

Dempsey, A. M., Hunt, E., Lone, M., & Nolan, Y. M. (2023). Awareness of universal design for learning among anatomy educators in higher-level institutions in the Republic of Ireland and United Kingdom. *Clinical Anatomy*, *36*(1), 137–150. https://doi.org/10.1002/ca.23947

Department of Education. (2001). *Education White Paper 6 on special needs education: Building an inclusive education and training system*. Government Printer.

Dvivedi, S., Rai, A. S., & Vanlalzuali, J. H. (2023). Effectiveness of universal design of learning at different levels of education: A meta-analysis of literature. *National Journal of Education*, *20*(2), 63–75.

Ebuenyi, I. D., Rottenburg, E. S., Bunders-Aelen, J. F. G., & Regeer, B. J. (2018). Challenges of inclusion: A qualitative study exploring barriers and pathways to inclusion of persons with mental disabilities in technical and vocational education and training programmes in East Africa. *Disability and Rehabilitation*, *42*(4), 536–544. https://doi.org/10.1080/09638288.2018.1503729

Edyburn D. L. (2005). Universal design for learning. *Special Education Technology Practice*, 7(5), 16-22. https://ocali.org/storage/ocali-ims-sites/ocali-ims-ocali/documents/UDL_SETP7.pdf

Fovet, F. (2022). *Review of the book creating inclusive learning opportunities in higher education: A universal design toolkit by Sheryl E Brugstahler*. Teachers College Record (ID Number: 23971). https://www.researchgate.net/publication/358262948_Fovet_F_2022_Review_of_Creating_Inclusive_Learning_Opportunities_in_Higher_Education_A_Universal_Design_Toolkit_by_Sheryl_E_Brugstahler_Teacher_College_Record_ID_Number_23971

Frolli, A., Cerciello, F., Esposito, C., & Sica, L. S. (2022). Universal design for learning: A new educational approach. *Proceedings of the International Day of Persons with Disabilities. Inclusion, Autonomy, Technology*, December 2–3, 2022, Rome, Italy. https://ceur-ws.org/Vol-3371/paper7.pdf

Gall, J. G., Gall, M. D., & Borg, W. R. (1999). *Applying educational research: A practical guide*. Longman.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences.* Basic Books.

Gavin, S. W. (2017). *Effectiveness of teacher training on the use of universal design learning strategies with special education students in middle school* [Master of Arts, Humboldt State University]. https://digitalcommons.humboldt.edu/etd/58

Hainline, A.D. (2022). *The effect of universal design for learning on student engagement and achievement in a southwest Missouri school district* [Doctor of Education dissertation, School of Education, Lindenwood University]. https://digitalcommons.lindenwood.edu/cgi/viewcontent.cgi?article=1732&context=dissertations

Hall, T., Strangman, N., & Meyer, A. (2003). *Differentiated Instruction and Implications for UDL Implementation.* National Center on Accessing the General Curriculum. https://sde.ok.gov/sites/ok.gov.sde/files/DI_UDL.pdf

Herrara, N. L., Crisol, M, E., & Montes, S. R. (2019). A MOOC on universal design for learning designed based on the UDL paradigm. *Australasian Journal of Educational Technology*, *35*(6), 30–47. https://doi.org/10.14742/ajet.5532

Hills, M., Overend, A., & Hildebrandt, S. (2022). Faculty perspectives on UDL: Exploring bridges and barriers for broader adoption in higher education. *The Canadian Journal for the Scholarship of Teaching and Learning*, *13*(1). https://doi.org/10.5206/cjsotlrcacea.2022.1.13588

Horne, P. E., & Timmons, V. (2009). Making it work: Teachers' perspectives on inclusion. *International Journal of Inclusive Education*, *13*(3), 273–286. https://doi.org/10.1080/13603110701433964

Hromalik, C. D., Myhill, W. N., Ohrazda, C. A., Carr, N. R., & Zumbuhl, S. A. (2024). Increasing universal design for learning knowledge and application at a community college: The universal design for learning academy. *International Journal of Inclusive Education*, *28*(3), 247-262. https://doi.org/10.1080/13603116.2021.1931719

Israel, M., Ribuffo, C., & Smith, S. (2014). *Universal design for learning: Recommendations for teacher preparation and professional development (Document No. IC-7)*. https://ceedar.education.ufl.edu/wp-content/uploads/2014/08/IC-7_FINAL_08-27-14.pdf

Izzo, M. V. (2012). Universal design for learning: Enhancing achievement of students with disabilities. *Procedia Computer Science*. *14*, 343–350. https://doi.org/10.1016/j.procs.2012.10.039

Izzo, M. V., Murray, A., & Novak, J. (2008). The faculty perspective on universal design for learning. *Journal of Postsecondary Education and Disability*, *21*(2), 60–72. https://files.eric.ed.gov/fulltext/EJ822094.pdf

Jwad, N., O'Donovan, M. A., Leif, E., Knight, E., Ford, E., & Buhne, J. (2022). *Universal design for learning in tertiary education: A scoping review and recommendations for implementation in Australia*. Australian Disability Clearinghouse on Education and Training. https://www.adcet.edu.au/resource/10814/universal-design-for-learning-in-tertiary-education-a-scoping-review-and-recommendations

Kelly, O., Buckley, K., Lieberman, L. J., & Arndt, J. (2022). Universal design for learning — A framework for inclusion in outdoor Learning. *Journal of Outdoor and Environmental Education*, *25*, 75–89. https://doi.org/10.1007/s42322-022-00096-z

Kennedy, M. J., Thomas, C. N., Meyer, J. P., Alves, K. D., & Lloyd, J. W. (2014). Using evidence-based multimedia to improve vocabulary performance of adolescents with LD: A UDL Approach. *Learning Disability Quarterly*, *37*(2), 71–86. https://doi.org/10.1177/0731948713507262

Krishan, S., & Sharma, N. (2023). Awareness of universal design for learning (UDL) among teachers in India. *Journal of Educational Technology Development and Exchange*, *16*(1), 108–125. https://aquila.usm.edu/jetde/vol16/iss1/6

Kurtts, S. A. (2006). Universal design for learning in inclusive classrooms. *Electronic Journal for Inclusive Education*, *1*(10). https://libres.uncg.edu/ir/uncg/f/S_Kurtts_Universal_2006.pdf

Laurian-Fitzgerald, S., & Fitzgerald, C. J. (2017). Universal design in education. In E. Soare, & C. Langa (Eds.), *Education Facing Contemporary World Issues*. European Proceedings of Social and Behavioural Sciences, 23, 389–399. https://doi.org/10.15405/epsbs.2017.05.02.48

Levey, S. (2023). Universal design for learning. *Journal of Education*, *203*(2), 479-487. https://doi.org/10.1177/00220574211031954

Long, M. (2018). *Supports and barriers to universal design for learning in schools implementing integrated comprehensive systems for equity* (Publication No. 1866) [Doctoral dissertation, University of Wisconsin-Milwaukee]. UWM Digital Commons. https://dc.uwm.edu/etd/1866

Mackey, M. (2019). Accessing middle school social studies content through universal design for learning. *Journal of Educational Research and Practice*, *9*(1). https://doi.org/10.5590/JERAP.2019.09.1.06

Markou, P., & Díaz-Noguera, M. D. (2022). Investigating the implementation of universal design for learning in Greek secondary and second chance schools through teachers' reflections on daily learning. *European Journal of Educational Research*, *11*(3), 1851-1863. https://doi.org/10.12973/eu-jer.11.3.1851

Mavrovic-Glaser, K. D. (2017). Teacher knowledge and use of universal design for learning [Master of Arts thesis, Governors State University]. https://opus.govst.edu/capstones/343

Melhem, T., & Al-Rashid, W. (2023). Teachers' perception towards implementation of principles of universal design for learning (UDL) in teaching students with

learning difficulties. *Educational Administration: Theory and Practice*, *29*(4). https://doi.org/10.52152/kuey.v29i4.772

Metzker, J. (2021). *Use universal design for learning (UDL) to remove barriers to learning*. Learning & Teaching Commons at The Washington Center. https://sites.evergreen.edu/ltc/2021/02/inclusive-teaching-tip-winter-2021-wk5/

Meyer, A., Rose, D. H., & Gordon, D. T. (2014). *Universal design for learning: Theory and practice*. CAST Professional Publishing.

Murphy, D. B. (2021). *Teacher perceptions of the effectiveness and barriers of universal design implementation for students with disabilities: An exploratory case study.* ProQuest LLC. https://www.proquest.com/docview/2641904173

National Council of Educational Research and Training. (2021). *National guidelines and implementation framework on equitable and inclusive education (NGIFEIE).* Department of Education of Groups with Special Needs, NCERT. https://dsel.education.gov.in/sites/default/files/guidelines/NGIFEIE_dosel.pdf

Paiva, A., van Munster, M., & Gonçalves, A. (2019). Universal design for learning and inclusive education: A systematic review in the international literature. *Revista Brasileira de Educação Especial*, *25*(4), 627–640. https://www.researchgate.net/publication/346087977_Universal_Design_for_Learning_and_Inclusive_Education_a_Systematic_Review_in_the_International_Literature/link/5fbade7fa6fdcc6cc65c75ea/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19

Piaget, J. (1952). *The origins of intelligence in children.* Norton.

Pisha, B., & Coyne, P. (2001). Smart from the start: The promise of universal design for learning. *Remedial and Special Education*, *22*(4), 197–203. https://doi.org/10.1177/074193250102200402

Priyadharsini, V., & Mary, R. (2024). Universal design for learning (UDL) in inclusive education: Accelerating learning for all. *Shanlax International Journal of Arts, Science and Humanities*, *11*(4), 145–150. https://doi.org/10.34293/sijash.v11i4.7489

Qu, X., & Cross, B. (2024). UDL for inclusive higher education—What makes group work effective for diverse international students in UK? *International Journal of Educational Research*, *123*, 102277. https://doi.org/10.1016/j.ijer.2023.102277

Rao, K., Ok, M. W., & Bryant, B. R. (2014). A review of research on universal design educational models. *Remedial and Special Education*, *35*(3), 153–166. https://doi.org/10.1177/0741932513518980

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

Rose, D. H., & Strangman, N. (2007). Universal design for learning: Meeting the challenge of individual learning differences through a neurocognitive perspective. *Univ Access Inf Soc*, *5*, 381–391. https://doi.org/10.1007/s10209-006-0062-8

Roski, M., Walkowiak, M., & Nehring, A. (2021). Universal design for learning: the more, the better? *Education Sciences*, *11*, 164, 1-25 https://doi.org/10.3390/educsci11040164

Scott, L. A. (2018). Barriers with implementing a universal design for learning framework. *Inclusion*, *6*(4), 274–286. https://doi.org/10.1352/2326-6988-6.4.274

Sewell, A., Kennett, A., & Pugh, V. (2022). Universal Design for Learning as a theory of inclusive practice for use by educational psychologists. *Educational Psychology in Practice*, *38*(4), 364-378. https://doi.org/10.1080/02667363.2022.2111677

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*(3), 174-185. https://doi.org/10.1177/1044207319826219

Spooner, F., Baker, J. N., Harris, A. A., Ahlgrim-Delzell, L., & Browder, D. M. (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

Suja, G. P., & Elamaran, S. (2023). Challenges of inclusive education in India. *Shanlax International Journal of Arts, Science and Humanities*, *11*(3), 98–104. https://doi.org/10.34293/sijash.v11i3.6905

Sweller, J. (1988). Cognitive load during problem-solving: Effects on learning. *Cognitive Science*, *12*(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4

Trostle Brand, S., Favazza, A. E., & Dalton, E. M. (2012). Universal Design for Learning: A Blueprint for Success for All Learners. *Kappa Delta Pi Record*, *48*(3), 134–139. https://doi.org/10.1080/00228958.2012.707506

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Harvard University Press.

Wells, M. B. (2022). Student perspectives on the use of universal design for learning in virtual formats in higher education. *Smart Learning Environments*, *9*(1). https://doi.org/10.1186/s40561-022-00218-6

Williams, A. (2020). *Teachers' perspectives on implementing universal design for learning* [Doctoral dissertation, California State University, Fresno]. https://scholarworks.calstate.edu/downloads/3f4628121

Zerbato, A. P., & Mendes, E. G. (2021). O desenho universal para a aprendizagem na formação de professores: da investigação às práticas inclusivas. *Educação E Pesquisa*, *47*, e233730. https://doi.org/10.1590/S1678-4634202147233730