

PRESCHOOL EDUCATION FOR CHILDREN WITH AUTISM SPECTRUM DISORDER ALONG UNIVERSAL DESIGN FOR LEARNING: A THEORETICAL ASPECTS

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ABSTRACT

Background. In the context of inclusive education children with autism spectrum disorder have the right to attend an educational institution that best suits their needs; however, this right is restricted by a number of factors, including the special education programs that the educational institution offers and the level of competence of the teachers. Furthermore, an early diagnosis offers significant benefits because it determines the medical and special education programs that the kid is eligible for. But, a child's needs might not be satisfied if his unique requirements are not recognized. Use of an appropriate strategy that guarantees inclusion in school for all children – not only those with a diagnosis and special education support measures – is therefore imperative. *Method* The field of inclusive education research is developing quite rapidly, highlighting the importance of this approach and providing new insights on the most effective way to put it into practice. However, certain theories are not supported by scientific findings, which furthers fragmentation. A systematic literature review of the literature makes it easier to evaluate concepts and frameworks objectively. EBSCOhost, CambridgeCore, ScienceDirect, and SageJournals are popular online bibliographic databases in the social sciences that were used in a systematic literature review.

Results. The research demonstrates how the universal design for learning framework complies with contemporary inclusive education trends through qualitative research, providing support to all children regardless of whether a diagnosis is made or whether a specific form of assistance has been determined upon.

Keywords: *autism spectrum disorder; inclusive education; preschool; universal design for learning, teacher competence, learning strategies.*

Introduction

Preschool inclusive education is associated with the idea of “engagement” which is defined as active participation in everyday activities in the environment (EASI, 2017b). The “engagement” is closely related to learning and the child's interaction with the social

and physical environment, highlighting one of the key ideas in inclusive education: inclusion of children, not integration in preschool. According to Rose and Meyer (2002), to achieve goals in inclusive environment it is important to determine the teaching and support strategies that will help children in the learning process. Using a suitable and scientifically proved approach is required to guarantee that each child is satisfied.

In Latvia, inclusive education is mandated by the Education Law (Latvijas Republika, 1998), which requires education for all children starting at age three (EASI, 2017a) and promotes quality education for all residents throughout their lives (Ministru kabinets, 2021). The aim of preschool education is to foster a curious, creative, and happy child who lives a healthy, safe, and active lifestyle while acquiring knowledge about themselves, their peers, and the world around them and highlights the provision of the required assistance in order to get prepared for the basic education stage (Ministru kabinets, 2018). The objectives and assignments outlined in the educational policy planning documents center on different subject areas and highlight the provision of the required assistance in order to get prepared for the basic education stage.

The implementation of inclusive education faces barriers, particularly the lack of relevant strategies. “Universal Design for Learning” (UDL) is identified as a promising strategy to ensure access to education for all students (Chambers, Varoglu, & Kasinskaitė-Buddeberg, 2016; Agarwal, 2020; International Disability Alliance, 2021). UDL’s increasing recognition highlights its importance in inclusive education (Ewe & Galvin, 2023), and its adaptable framework can be applied across all educational levels, accommodating children’s unique developmental needs.

Although the use of the UDL framework has a long history (CAST), in the last decades it has gained wide attention and the need for its use is indicated in the globally recognized special and inclusive education guidelines (No Child Left Behind Act of 2001; IDEA, 2004). Initially, the UDL framework was developed to adapt the physical environment for persons with mobility impairments, but was gradually improved for different persons, such as pregnant women and seniors (Scott et al., 2003). Over time, the UDL framework developed from an educational perspective to address exclusion of the children in education (CAST). Although practical examples of the use of different strategies and teaching methods vary in different areas of education, for example, for children with hearing or visual impairments may be useful for all children with and without different established diagnosis.

First, previous systematic literature reviews and exploratory main results were examined to compare key findings over a 20-year period. From 2006 to 2023, six further systematic literature studies were conducted on the topic of UDL framework (Twyman & Tindal, 2006; Coyne et al., 2012; Kennedy et al. 2014., King-Sears et al., 2015; King-Sears & Johnson, 2020; King-Sears, 2023). Among these reviews, only one includes the preschool stage (Coyne et al., 2012). The analysis of the articles focuses on three main conclusions: 1) UDL is an effective framework for promoting inclusive education not only for children with special needs, but for every child; 2) In order to implement and effectively use the principles of the UDL framework, professional training of teachers is

required; 3) The current research of the UDL framework across various age groups and subject areas fails to provide sufficient empirical evidence.

This study examines the UDL three principles for inclusion of children with ASD in preschool education, by analyzing current trends, advantages and disadvantages for UDL implementation. The objective of this research is to present a comprehensive overview of the UDL framework's applicability to inclusive preschool education by specifying two research questions:

- 1) what are the core principles of the UDL framework, and 2) what specific strategies within UDL are most effective in fostering inclusive learning environment for children with ASD?

Literature review

Using contemporary theories and ideas to promote inclusive education requires the use of evidence-based practices (Lohmann, Hovey, & Gauvreau, 2023). The UDL framework is a scientifically proven educational framework that is not focused on the special needs in specific cultures, although most of the research was conducted in the United States (Almumen, 2020; King-Sears, et al., 2023). The UDL framework can be used in different countries,

The UDL framework offers guidelines for the various teaching strategies and assessment tools, which enhances the professional competence of teachers for a wide range of students (Almumen, 2020; Taylor, Neild, & Fitzpatrick, 2023). Teacher professional development needs to include learning the principles of UDL and to benefit its use in practice (Almumen, 2020; Takemae, Nicoll-Senft, & Tyler, 2022). Teachers who have learned UDL principles and put it into practice report a greater understanding of meeting the needs of diverse groups of children (King-Sears et al., 2023). At the same time, it is recommended to implement UDL principles gradually, not all at once. For example, when learning about different insects, you can go out into nature and do practical research at the beginning, gradually adding different visual, aural and tactile materials (Lohmann, Hovey, & Gauvreau, 2023). It is easier for teachers and students to adopt new techniques when teaching materials and support techniques are used one after the other.

Certainly, teachers who are unaware of various teaching strategies can not include every child in preschool education environment (Fundelius, et al., 2023). In addition, teachers recognize that the development of professional competence is mostly an individual initiative of each educator (Takemae, Nicoll-Senft, & Tyler, 2022). Anyway, the use of the UDL principles is increasing in a growing number of studies, although there is a worldwide lack of qualitative and quantitative research about efficacy of UDL framework (Almumen, 2020). The most crucial conclusion involve an acute lack of research on the effects of the UDL framework in the preschool stage (Chen, & Dote-Kwan, 2021).

Method

The systemic literature analysis of this article is focused on the preschool stage. The research method involves identification of evidence, synthesis and PRISMA flow diagram, which is described below.

Identification of the Evidence

A systematic literature review of the literature makes it easier to evaluate concepts and frameworks objectively. Although it was originally planned to search for scientific articles on the use of UDL principles in preschool education in the EBSCO, CambridgeCore, ScienceDirect, and SageJournals databases, the ScienceDirect database was removed from the list by adding the Google Scholar database. Scientific articles about UDL implementation in a preschool between December 2023 and February 2024 were found in two of the selected databases, Google Scholar and Ebsco.

Keywords associated with preschool education ('preschool' OR 'kindergarten' OR 'early childhood') and universal design for learning ('universal design for learning' OR 'UDL') were included in the search cluster. All databases' scans for scientific papers were arranged using the same set of criteria (See Table 1).

Table 1 Article inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none">• English language• Free access• Universal design for learning is included in the title of the article or mentioned in the keywords• School stage included: preschool• The articles were published in the period from 2019 to 2024	<ul style="list-style-type: none">• Other languages• Partial or no availability• Universal design for learning is not included in the title of the article or mentioned in the keywords• The school stage represents secondary school, university or professional education

The articles obtained as a result of the search were selected based on the selection criteria: articles in English with the possibility of free access and inclusion of keywords in the title of the articles. Of the 80 ($N = 80$) identified articles published in the respective phase and remove two duplicates, the study analyzes 13 articles ($N = 13$), as the remaining 65 articles were dropped for the following reasons: 1) UDL was not the focus of the article or was indirectly mentioned; 2) preschool age was not the focus of the article or was indirectly mentioned.

Of the 13 articles identified, 8 articles required an additional search for access, using access credentials with a university username and password or following the links provided. Scientific articles on the use of UDL in preschool education were selected regardless of the country of origin in order to not reduce the already sparse number of articles.

This systematic literature review focuses on the implementation of the principles of the UDL framework at the preschool stage during the last five years, which explains the limited number of papers included in the review ($N = 13$).

Synthesis

Of the selected number of articles, 10 ($N = 10$) articles were qualitative, two articles ($N = 2$) quantitative studies, while one ($N = 1$) used mixed research methods.

Initially, it was planned to conduct a quality assessment of the selected articles based on Ewe, & Galvin, (2023) and King-Sears et. al. (2023), since the quality assessment of the articles allows for the accurate selection of only qualitatively developed articles. However, the majority of articles are not of high quality due to the lack of available empirical evaluations of studies and the use of case-control groups in case analyses, lack of use of recent literature, or lack of clear study categories. Only two articles Almumen (2020) and King-Sears et al. (2023) were high quality research. Therefore, in order to cover the widest possible range of UDL framework in theory and practice, this study analyzes all 13 included articles.

PRISMA

The PRISMA method in the analysis of systematic literature is widely used by the scientific community around the world and provides objective data acquisition also in the study of the UDL framework (Sohrabi et al., 2021; Ewe, & Galvin, 2023). By implementing the criteria specified in the PRISMA method, articles in the Sage Journals, Ebsco, Cambridge Core and Google Scholar databases were searched for in the period from 2019 to 2024 (See picture 1). The process of research selection is described below.

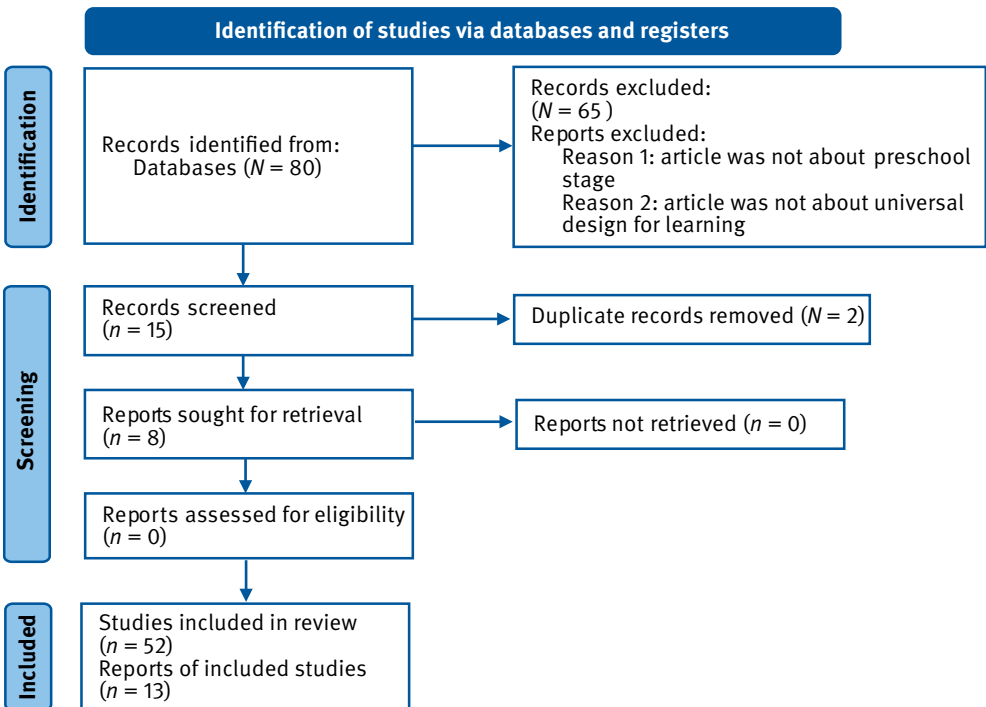


Figure 1 Prisma flow diagram Universal Design for Learning in preschool

The Sage Journals database searches for articles related to universal design for learning, preschool, kindergarten, or early childhood. However, no articles were found. The field of Special Education is selected, but 26 articles don't align with the research direction.

The Ebsco database is searched using advanced search options for articles related to universal design for learning, preschool, kindergarten, or early childhood. 43 articles are offered, with nine aligning with the research direction.

The Cambridge Core database does not return any articles when searching for the same keywords.

Finally, Google Scholar database opens one article, of which one is given open access. Changing keyword from "preschool" to "kindergarten" opens two articles, none of which has free access. By changing keyword kindergarten to "early childhood" database opens six articles, of which free access is provided to five articles.

After selecting 15 articles, two are identified as duplicates, thus removed from the total number of articles. As a result, 13 ($N = 13$) articles are obtained. For selected articles, see Table 2.

Table 2 Included articles (Ewe, & Galvin, 2023)

No	Article	Country	Aim	Sample	Methods	Measures	The field of autism is represented	Results
1.	Almumen (2020)	Kuwait	To investigate the role of UDL in inclusive settings	5 teachers	qualitative	3 semi-structured interviews	–	UDL is effective in engaging all students and although teachers may have basic knowledge of UDL, they need more training and practice
2.	Ayuso-del Puerto & Gutiérrez-Esteban (2022)	Spain	To investigate the accessibility of OERs' design for early stages in education	28 indicators	quantitative	Assessment Tool and an analysis indicator	–	OERs do not meet the needs of all users because they do not consider several of the indicators contained in the guide designed for their evaluation

No	Article	Country	Aim	Sample	Methods	Measures	The field of autism is represented	Results
3.	Chen & Dote-Kwan (2021)	USA	To investigate how UDL and DI promote an inclusive educational environment for preschool children	2 children with special needs	qualitative	Assessment of child development	–	By using both UDL and DI, children with various special needs can have a maximum positive experience in an inclusive preschool environment
4.	Fundelius et al. (2023)	USA	To investigate ways to increase accessibility by designing multisensory learning activities using the principles of UDL	4 children with special needs	qualitative	Case study	–	UDL is a research framework that focuses on goals, methods, materials and assessments for all children's needs
5.	Gauvreau, Lohmann, & Hovey (2019)	USA	To investigate multiple means of representation in the early childhood classroom	35 articles and sources	qualitative	Case study	+/-	UDL provides a useful framework when planning for ways that all learners can participate, access, and be included in education
6.	Gauvreau, Lohmann, & Hovey (2021)	USA	To investigate ways to create active learning opportunities	8 strategies	qualitative	Case study	only in references	Through using UDL principles teachers no longer need to create individualized interventions to help each child succeed
7.	Hovey, Gauvreau, & Lohmann, (2022)	USA	To investigate multiple means of action and expression in the early childhood classroom	4 strategies	qualitative	Case study	+	Providing multiple means of action and expression are useful tools to assist with assessment of both academic and behavioral goals and objectives

No	Article	Country	Aim	Sample	Methods	Measures	The field of autism is represented	Results
8.	King-Sears et al. (2023)	USA	To investigate UDL's emergence as a research-based practice for diverse learners	20 articles	quantitative	Meta-analysis	–	All learners benefit when instructional and curricular barriers are proactively and thoughtfully reduced by applying UDL
9.	Lohmann, Hovey, & Gauvreau (2023)	USA	To investigate science learning concepts through UDL framework	52 articles and sources	qualitative	Case study	–	The use of the UDL framework reduces barriers to learning for all young children
10.	Moffat (2022)	New Zealand	To investigate UDL principles in practice in early childhood environments	13 articles and sources	qualitative	Literature review	only in references	Using UDL principles and reflecting on practice will support early childhood to achieve world class inclusive practice
11.	Rosati (2021)	Italy	To investigate features of the Montessori method and on the principles of UDL	18 references	qualitative	Literature review	It is indicated that M. Montessori also worked with autistic children	Montessori methods are compatible with UDL principles of multiple means of representation, expression and engagement
12.	Takemae, Nicoll-Senft, & Tyler (2022)	USA	To provide UDL guidelines in teacher preparation programs	41 articles and sources	Mixed methods	Literature review and Design-Based Research	–	This article advocates for the integration of UDL and CRT by emphasizing the critical role of strong school-university partnerships
13.	Taylor, Neild, & Fitzpatrick (2023)	USA	To investigate principles of UDL in preschool environments to support deaf and hard of hearing children	40 articles and sources	qualitative	Literature review	–	All teachers need to remove barriers that hinder DHH student access to the general education curriculum

Results

Creating an inclusive learning environment for all students has received increasing emphasis in recent decades. Despite these efforts, progress in inclusive education around the world remains slow and uneven in different contexts and regions (Nilholm, 2021), particularly in include ASD into educational settings (Barnard et al., 2002; Brede et al., 2017).

The study's questions is addressed in each of the two sections that comprise the results. The core principles of the UDL framework are discussed in the first section, while the effective UDL strategies for fostering inclusive learning environments for children along ASD are described in the second.

The Core Principles of the UDL Framework

The first principle of UDL, **multiple means of engagement**, is rooted in the brain's affective network, which is crucial for motivation and emotional responses to learning. Research indicates various ways for students to actively participate in their education, fostering interest in the learning process (Rosati, 2021; Fundelius et al., 2023). This principle emphasizes the need for an engaging classroom environment where students feel a sense of belonging and inspiration to learn. Teachers can observe if a child is making effort towards learning goals, showing interest in the material, and self-regulating their learning (Takemae, Nicoll-Senft, & Tyler, 2022). Effective strategies for engagement include aligning with children's diverse interests, offering choices in engagement methods, and incorporating hands-on activities for active participation.

The second principle, **multiple means of representation**, corresponds to the recognition network of the brain and embodies the idea that learners should have the opportunity to access and interpret information in various ways. This refers to the provision of several forms for delivering information, therefore catering to diverse learning strategies (CAST, 2020). For instance, employing different materials for children with ASD has proven to effectively enhance communication skills (Hanney, 2012; Martin & Wilkins, 2022). The same applies to the use of digital technologies and alternative communication systems.

The third principle, **multiple means of action and expression**, aligns with the strategic network of the brain. This principle emphasizes the necessity for learners to have various avenues for expressing the knowledge they have acquired and for navigating the learning environment to demonstrate their understanding, whether through traditional assessments, creative projects, or verbal presentations (CAST, 2020). Providing opportunities for students to express themselves – be it through art, music, or technology – helps validate their individual ways of action and expression (Takemae, Nicoll-Senft, & Tyler, 2022). Teachers can facilitate this by offering choices in how assignments are completed and allowing for varied formats that align with each child's strengths.

Effective UDL Strategies for Fostering Inclusive Learning Environments for Children with ASD

Only one paper addresses ASD specifically (Hovey, Gauvreau, & Lohmann, 2022), but the UDL framework does not prioritize specific disabilities, focusing instead on diverse learning needs for all children, and the majority of the strategies suggested in articles can be applied to children with ASD.

Multiple means of Engagement

Preschool children, including children with ASD, are most engaged in learning when the content aligns with their interests and when choices is provided (Harrop et al., 2019; Rosati, 2021). Choices not only boosts interest and motivation but also reduces challenging behaviors. For instance, encouraging children to select their seating and engage in activities like singing or motor exercises during the “Morning Circle” promotes participation (Gauvreau, Lohmann, & Hovey, 2021). Routine is crucial for children with ASD, making choice and practical engagement essential for effective learning.

Practical engagement is crucial for early development, as it promotes skill acquisition through play and everyday activities. For instance, learning hiking skills entails setting up a tent and using multisensory props (Taylor, Neild & Fitzpatrick, 2023), which is especially important for children with ASD (Dickie et al., 2009). Activities can include walks in classrooms or outdoors, where children assume various roles and encounter different scenarios (Almumen, 2020). However, sensory overload can make it difficult for children with ASD to complete practical tasks. To facilitate participation, children can use gardening gloves or sound-canceling headphones when handling materials (Hovey, Gauvreau, & Lohmann, 2022).

The environment, encompassing play, object manipulation, motor activities, and interactive materials, is vital for fostering an inclusive setting (Taylor, Neild, & Fitzpatrick, 2023). Visual daily and weekly schedules, along with annual calendars, are essential tools that should be manipulated through movement, voice, or visual representation (Fundelius et al., 2023; Moffat, 2022). Additionally, materials employing UDL principles, initially designed for children with hearing impairments, can support children with ASD by modifying acoustics, using sound-generating devices, and reducing background noise.

Multiple means of Representation

Since preschoolers learn differently, it is vital to use various materials in the classroom to enhance understanding of curriculum concepts (Takemae, Nicoll-Senft, & Tyler, 2022). An inclusive environment utilizing diverse visual, auditory, and tactile resources benefits both children with and without developmental disabilities (Almumen, 2020; Chen & Dote-Kwan, 2021). Literacy lessons, for instance, should incorporate various strategies and materials to represent story content (Moffat, 2022), and sandpaper letters in Montessori methods promote tactile engagement (Rosati, 2021).

While practical materials are vital for acquiring new skills, digital technology is increasingly important in education. It includes a variety of resources, such as Braille

systems and digital books, which support children with visual impairments (Fundelius et al., 2023). Digital tools encourage curiosity and provide varying levels of difficulty (Ayuso-del Puerto & Gutiérrez-Esteban, 2022). Integrating these tools into the “Morning Circle” can address diverse needs for information access, motivation, and interest (Gauvreau, Lohmann, & Hovey, 2021).

Alternative communication systems are crucial for children with ASD in processing information (Iacono, Trembath, & Erickson, 2016). It is recommended that these methods be integrated into all preschool activities, including play and social interactions (Gauvreau, Lohmann, & Hovey, 2019). Approaches designed for children with hearing impairments or alternative languages can also benefit children with ASD (Ayuso-del Puerto & Gutiérrez-Esteban, 2022).

Multiple means of Action and Expression

Evaluating the knowledge children acquire is essential to identify their learning strengths and difficulties. Various assessment tools not only evaluate children’s knowledge but also the effectiveness of teaching strategies. Assessing competencies across learning areas is facilitated by systems that utilize digital technologies (Hovey, Gauvreau, & Lohmann, 2022). Digital technologies are crucial in today’s educational environment and can effectively assess children’s development in multiple subject areas.

Participation in the “Morning Circle” helps assess learned skills of children (Gauvreau, Lohmann, & Hovey, 2021). Literacy assessment is enhanced through digital and physical tools, including sensory books, real objects, and sound-generating devices (Fundelius et al., 2023), as well as dance, music, and art (Moffat, 2022). It is better to use a variety of assessment techniques rather than relying on just one. Assessing children’s skills is significantly affected by their ability to express what they have learned, making alternative communication methods vital for children with ASD.

The use of various visual supports facilitates social interaction and comprehension of instructions (Gauvreau, Lohmann, & Hovey, 2021). Children should engage not only verbally but also through alternative communication methods (Chen & Dote-Kwan, 2021), ranging from sign language and symbols to speech-generating devices and audio recordings. For children with ASD, alternative communication systems is crucial for assessing acquired skills.

Discussion

Activating all brain networks is crucial for applying UDL principles, which facilitate multiple means of engagement, representation, action, and expression (King-Sears et al., 2023). However, practices from each study are applicable to specific cases and may vary (Lohmann, Hovey, & Gauvreau, 2023). While teachers can draw inspiration from the provided instructions, the necessary strategies and methods can differ by classroom. The strategies discussed in this research enhance teachers awareness of opportunities to improve learning using UDL principles.

In response to the first research question about the core principles of the UDL framework, the three main principles are designed to enhance accessibility and engagement in learning. The first principle, multiple means of engagement, focuses on creating an engaging classroom environment that fosters motivation and emotional responses, allowing students to participate actively in their education. The second principle, multiple means of representation, emphasizes providing information in various formats – auditory, visual, and tactile – catering to diverse learning styles. The third principle, multiple means of action and expression, highlights the importance of offering learners various avenues to demonstrate their understanding, whether through traditional assessments, creative projects, or other formats.

In response to the second research question about effective UDL strategies for fostering inclusive learning environments for children with ASD, the UDL framework provides key strategies that enhance educational experiences. Multiple means of engagement encourages aligning learning content with children’s interests and providing choices to promote participation and reduce challenging behaviors, especially in structured activities like the “Morning Circle”. Multiple means of representation utilizes diverse auditory, visual, and tactile resources to ensure all students access the curriculum. The strategy of multiple means of action and expression empowers children to demonstrate their knowledge in various ways, which is crucial for assessment. Furthermore, alternative communication methods facilitate social interactions and comprehension for children with ASD, allowing them to engage meaningfully and express their understanding. Together, these strategies highlight the importance of a flexible educational framework that supports the diverse needs of preschool children, including children with ASD.

Due to a lack of data on respondent characteristics and pre- and post-intervention results in most articles, accurately assessing the efficacy of UDL principles was not possible. The study authors intend to conduct future empirical research to evaluate the effects of UDL on inclusive preschool education. Further research on the suitability of UDL for diverse preschool children may provide objective insights into the framework’s effectiveness and contribute significantly to future studies.

Limitations

The studies included in the systematic literature analysis reveal a lack of research on the UDL framework across various education levels, particularly in preschool (Almumen, 2020; Chen & Dote-Kwan, 2021). While the studies offer practical examples of UDL implementation, they often lack participant information and assessment results before and after interventions (Almumen, 2020; Takemae, Nicoll-Senft, & Tyler, 2022). Finally, while different strategies rely on teachers’ professional competence (Takemae, Nicoll-Senft, & Tyler, 2022), there is a lack of research assessing teachers’ professional skills and acquired competencies before and after UDL implementation in preschool settings (Fundelius et al., 2023).

Suggestions for future research

In order to assess the effectiveness of the UDL framework in the context of inclusive education for preschool children with ASD, it is necessary to conduct research with more diverse children in preschool settings in different learning areas (Almumen, 2020). When conducting empirical studies to evaluate the use of the UDL framework, it is necessary to specifically describe the participants, the course and the duration of the study by describing the educational environment and compare the data using specific assessment tools (King-Sears et al., 2023).

Conclusions

The UDL is an effective learning framework for promoting inclusive education. UDL framework represents three principles based on theoretical and neuroscientific evidence. Although the use of UDL principles has been proven to be effective, the use of the framework to promote inclusive education requires the improvement of the professional competence of teachers and empirical research on the use of the UDL framework in the preschool education environment.

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