UNIVERSAL DESIGN FOR LEARNING AND TEACHER TRAINING: a systematic literature review

O DESENHO UNIVERSAL PARA APRENDIZAGEM E A FORMAÇÃO DOCENTE: uma revisão sistemática de literatura

EL DISEÑO UNIVERSAL PARA EL APRENDIZAJE Y LA FORMACIÓN DOCENTE: una revisión sistemática de literatura

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ABSTRACT:
The article is a Systematic Literature Review, in accordance with the guidelines of the Prisma protocol. The objective was to investigate and analyze the studies published in some databases that dealt with UDL and teacher training, to actually understand how the approach has been implemented in different countries. The work is qualitative research, of a bibliographic nature. We used the sources: the Capes Periodical Portal, Scientific Electronic Library Online, Web of Science, National Library of Medicine and the National Institutes of Health and Erick, in a time frame from (2019 to 2024). The descriptors used were: "Teacher Training" AND "Universal Design for Learning", for Brazilian and international databases we used the descriptors "Teacher Training" AND "Universal Design for Learning". As results we had forty-five studies, which were analyzed according to Bardin's Content Analysis (2011). After applying the inclusion and exclusion criteria we were left with seventeen articles, however, after reading all the works in full we found that only five works answered our questions, two of which were Brazilian. It is a fact that the DUA promotes curricular accessibility, however, there are many questions that still need to be answered in relation to the approach so that we have it consolidated in education networks, providing inclusion.

PALAVRAS-CHAVE: Universal Design for Learning; Teacher training; Inclusion.

Introduction

Brazil is recognized worldwide for having a well-established inclusive policy. According to the Global Education Monitoring Report (Unesco, 2020, p. 15), "in Brazil, a change in public policies increased the proportion of students with disabilities in regular

schools from 23% in 2003 to 81%, in 2015". These legal advances guaranteed the enrollment of Special Education Target Audience (PAEE) students in regular classes; however, we cannot confirm the permanence and quality of this public's education.

Law No. 14,254, which provides for the comprehensive monitoring of students with dyslexia or Attention Deficit Hyperactivity Disorder (ADHD) or learning disorder, establishes in its Article 1 "The public authorities must develop and maintain a monitoring program full time for students with dyslexia, Attention Deficit Hyperactivity Disorder (ADHD) or other learning disorder" (Brazil, 2021, p. 1).

Bringing it to the context of our study, we need to work with pedagogical practices, which do not require adaptations for a specific audience, but which can be used by everyone, without depriving students of the common curriculum.

Furthermore, the Brazilian education scenario, as a result of COVID-19, has required us to modify the classroom model, to which we have been accustomed for years. We have made great progress in relation to the use of Information and Communication Technology (ICT) during the pandemic, however we have returned to the classroom in the traditional model, which has made the teacher/student relationship difficult. In this sense, Nóvoa (2019) tells us that in the face of so many changes occurring in society, we need to reformulate the 21st century school model. Nóvoa (2019, p. 2) tells us about the "Metamorphosis of the school", giving rise to the need for changes based on the "triangle joining the university, the teaching profession and network schools".

Pedagogical practices aim to improve teaching for everyone, starting from the action of teacher training and the school's conception of inclusion. It is not enough to live in the utopia of waiting for public policies to solve the problem. We need to outline strategies to implement practical actions, in favor of the problem we have in the face of school failure that Brazilian schools are currently experiencing. COVID-19 has shaken the school model in the present and in the future (Alcântara, 2022), so it is up to the "university, teacher training and network schools" to work together to change the current reality.

In this sense, law 13.146/15, Brazilian Inclusion Law/Statute of Persons with Disabilities (LBI), in its Article 28, holds public authorities responsible in relation to "research aimed at developing new methods and pedagogical techniques, teaching materials, equipment and assistive technology resources" (B razil, 2015, p. 7).

Starting from the perspective that educating in the face of diversity requires interacting with reality to seek viable solutions, we use Piaget's (2001) concept of reflective abstraction. According to the author, all knowledge is produced from the interaction of the subject on the object, from the interaction of knowledge that the

individual already has consolidated in the face of the destabilization generated by new knowledge, until they find a cognitive balance to produce new knowledge. In fact, the individual is affected through their interaction with the object. In view of the concept, Inhelder, Bovet and Sinclair (1977, p. 263) tell us that "Learning is carrying out an indefinitely renewed synthesis between continuity and novelty".

Universal Design for Learning was born from the concept of Universal Design, from architecture, in the United States. In the 1990s, some researchers in the field of education, such as Anne Meyer, David Rose and David Gordon, came together at the Center for Applied Special Technology (CAST) in the United States to propose teaching practices that could support the planning and pedagogical practice of inclusive way. The approach is called Universal Design for Learning (UDL), a term that was translated from English – Universal Design for Learning (UDL). The objective of DUA is to provide learning to a greater number of students through the didactic principles developed by researchers. (Correia, 2005).

DUA was based on studies of cognitive psychology and neuroscience, more precisely in the three areas: recognition, strategic and affective. Through these areas, the guiding principles of DUA were constructed, which are: the multiple forms of representation of content, multiple forms of action and representation and the multiple forms of engagement. Through the principles related to the areas of the brain we have "what", "how" and "why". These questions are directly related to new content presented to the student. (CAST, 2011).

Bringing it to the context of our study, the DUA represents a possibility of access to the common curriculum, designed in an inclusive way, suited to the individual's potential and abilities. It is clear that for this possibility to become effective it is necessary to remove barriers and reorganize teaching, making it truly inclusive, respecting and implementing all normative documents in favor of inclusion. Furthermore, the DUA is based on everyone's right to education, therefore it is up to the teacher, together with the entire school community, to provide didactic-pedagogical strategies that promote integral learning for students.

Given this context, this study aims to investigate and analyze the studies published in some databases that dealt with UDL and teacher training, so that we can actually understand how the approach has been implemented in different countries. Therefore, we seek answers for our analysis through a Systematic Literature Review (SR) to survey and understand the development of the topic at a global level. Therefore, the Systematic Literature Review aims to answer the following questions that will guide the specificities of our study through qualitative analysis.

1. What objectives, methodologies and results do we find in teacher training that uses the UDL approach?

2. What is the target audience and location of the study?

3. Has any training worked with DUA concepts aligned with Maker Culture knowledge?

2 Development

This research adopted the Systematic Review because it allows the use of a well-defined, precise methodology and with possible reapplication of the study. The protocol, an essential element for RS, Prisma 2020, was adopted, which according to Marcondes e Silva (2022, p. 15) provides a solid basis, consisting of three stages:

> a) **Identification**: where the aim is to find all the material available for analysis, which may be composed of studies from previous systematic reviews, a search for new studies through databases, or material coming from other data sources. Remembering that this stage must be thoroughly described regarding sources, dates, type of material, and all items contained in the Checklists;
> b) **Screening**: this stage is intended to refine the material found in the previous stage, with the specificity of indicating the reasons that led to the exclusion of a document. It should be noted that the items relating to this stage in the Checklists must also be met;
> c) **Inclusion**: this third stage of the review is intended to gather and present the studies included for the analysis of the systematic review. It should be noted that the use of software to assist in any processing of data must be presented and justified, as set out in the Checklists.

Regarding the Identification stage, the searches were carried out on January 5, 2024, in the databases, with the time period described in parentheses. We used the sources: the Capes Periodical Portal (2019 to 2024), Scientific Electronic Library Online (SciElo Brasil) (2019 to 2024), Web of Science (2019 to 2024), National Library of Medicine and the National Institutes of Health (PubMed) (2019 to 2024) and Erick (2019 to 2024).

Boolean combination between the descriptors was created: "Teacher Training" AND "Universal Design for Learning", for the databases - Portal Periódicos da Capes and Scientific Electronic Library Online (SciElo Brasil). In international databases we use the descriptors "Teacher Training" AND "Universal Design for Learning".

We adopted the following inclusion criteria: a) Open access studies; b) Studies such as complete articles in journals, scientific events, dissertations or thesis; c) Studies

that present the Universal Design for Learning approach or the acronym UDL in the title or abstract?

As exclusion criteria: a) Studies that were not open access; b) Duplicate articles; c) Reading the titles of studies found that are not related to the research theme; d) Reading of abstracts found that were not related to the research.

In the SciELO Brasil database, the search strategy was to type each set of keywords, between quotation marks, in different fields, using the Boolean operator AND. The search was used with terms in Portuguese. This research resulted in 8 (eight) works.
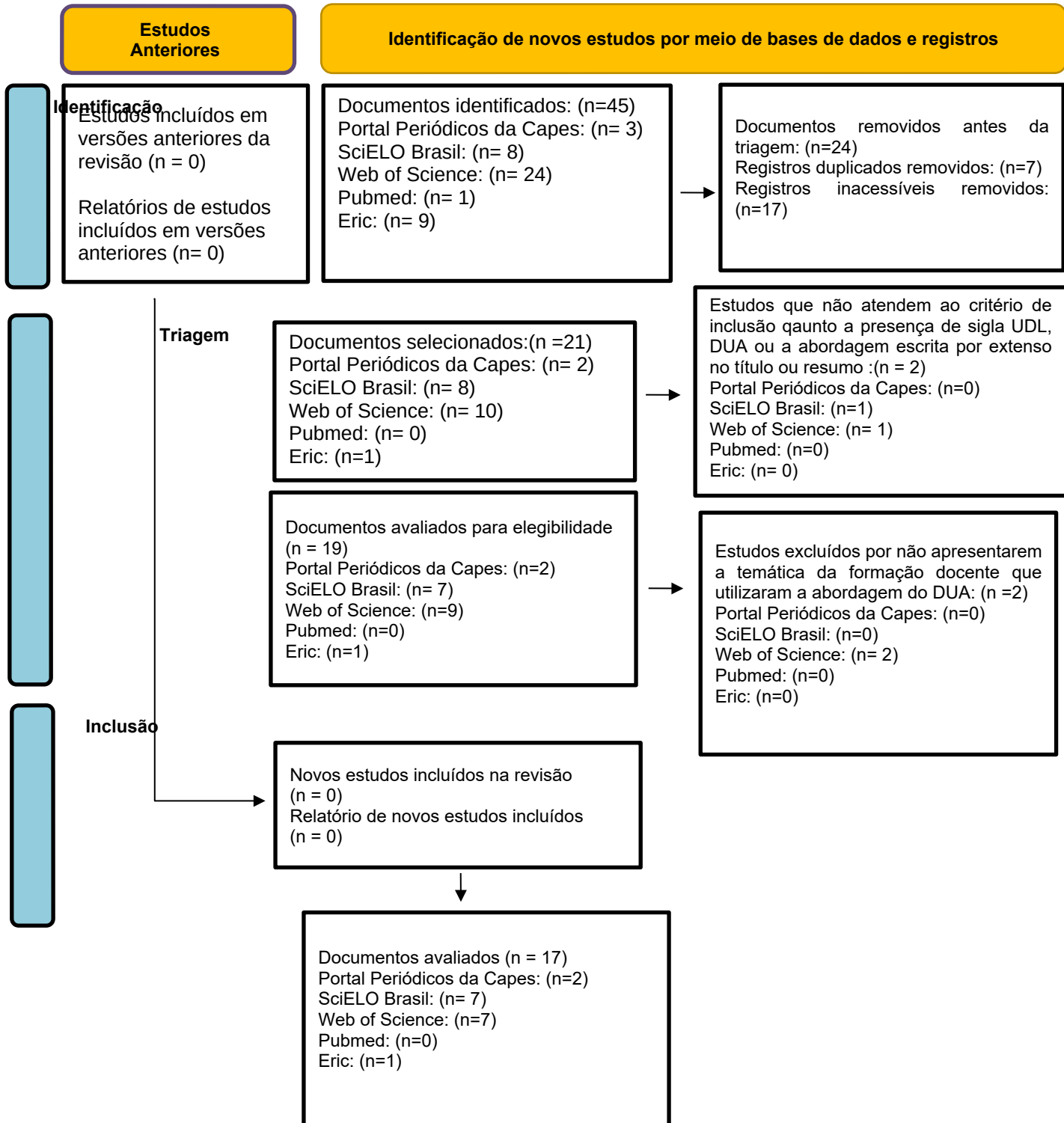
For the Capes Periodicals Portal database, the search was carried out in advanced mode, with the keywords in Portuguese, in quotation marks, using the Boolean operator AND, in advanced mode, in any language, in the specified time period of 2019 to 2024. The research resulted in 3 (three) works.

Web of Science database, the search was carried out using keywords in English, due to the nature of the database, in the time frame of the research. 24 (twenty-four) works were found, after applying the open works filter, we found 10 (ten) works.

National Library of Medicine and the National Institutes of Health (PubMed) database, we used the keywords in English, in quotation marks, using the Boolean operator AND, in the specified time period from 2019 to 2024. The search resulted in 01 (a job).

In the Eric database, we use the keywords in English, in quotation marks, using the Boolean operator AND, in the specified time period from 2019 to 2024, for open jobs. The research resulted in 09 (nine) works.

Figure 1 - Flow diagram of the Prisma 2020 Protocol

Estudos Anteriores	Identificação de novos estudos por meio de bases de dados e registros

Identificação

Estudos incluídos em versões anteriores da revisão (n = 0)

Relatórios de estudos incluídos em versões anteriores (n= 0)

Documentos identificados: (n=45)
Portal Periódicos da Capes: (n= 3)
SciELO Brasil: (n= 8)
Web of Science: (n= 24)
Pubmed: (n= 1)
Eric: (n= 9)

Documentos removidos antes da triagem: (n=24)
Registros duplicados removidos: (n=7)
Registros inacessíveis removidos: (n=17)

Triagem

Documentos selecionados:(n =21)
Portal Periódicos da Capes: (n= 2)
SciELO Brasil: (n= 8)
Web of Science: (n= 10)
Pubmed: (n= 0)
Eric: (n=1)

Estudos que não atendem ao critério de inclusão qaunto a presença de sigla UDL, DUA ou a abordagem escrita por extenso no título ou resumo :(n = 2)
Portal Periódicos da Capes: (n=0)
SciELO Brasil: (n=1)
Web of Science: (n= 1)
Pubmed: (n=0)
Eric: (n= 0)

Documentos avaliados para elegibilidade (n = 19)
Portal Periódicos da Capes: (n=2)
SciELO Brasil: (n= 7)
Web of Science: (n=9)
Pubmed: (n=0)
Eric: (n=1)

Estudos excluídos por não apresentarem a temática da formação docente que utilizaram a abordagem do DUA: (n =2)
Portal Periódicos da Capes: (n=0)
SciELO Brasil: (n=0)
Web of Science: (n= 2)
Pubmed: (n=0)
Eric: (n=0)

Inclusão

Novos estudos incluídos na revisão (n = 0)
Relatório de novos estudos incluídos (n = 0)

Documentos avaliados (n = 17)
Portal Periódicos da Capes: (n=2)
SciELO Brasil: (n= 7)
Web of Science: (n=7)
Pubmed: (n=0)
Eric: (n=1)

Source: Own elaboration: Adapted from Page et al. (2020)

As the study identification stage demonstrates, 45 (forty-five) studies were found in the databases established in this study. In compliance with the screening stage of this Systematic Literature Review, studies without open access were excluded, resulting in a total of 17 (seventeen) studies and subsequently duplicate studies in the databases used. Duplicate studies were excluded with the support of the ZOTERO program, totaling 7 (seven) studies.

Still in the screening phase, 2 (two) studies were excluded because they did not have the abbreviation of the approach, Universal Design for Learning, or even the full name in their title or summary. We were left with a total of 19 (nineteen) studies to be evaluated in full and then answer our questions established in this SR.

3 Results

To better understand the selected studies, we created a table describing the studies. The studies will be analyzed using Bardin's Content Analysis (2011) and grouped in order to answer the questions of this study: What objectives, methodologies and results do we find in teacher training that uses the UDL approach? What is the target audience and location of the study? Has any training worked with DUA concepts aligned with Maker Culture knowledge?

Table 1 - Description of the studies selected for analysis

Author (Year)	Title (original/translated)	Target audience and location	Goals	Method	Results
Guiérrez-Saldivia, Navarro and Díaz-Levicoy (2021)	Universal Design for Learning as a methodology for teaching mathematics in the training of future special education teachers.	Future teachers of Special Education, at the Catholic University of Temuco / Chile.	Publicize the implementation of DUA in initial training.	The DUA was implemented in the Tools for Access to Learning Language and Mathematics I course in the pedagogy career.	That the implementation of DUA strategies allowed greater involvement in learning and bringing students closer to their professional future. Fundamental aspects of Chile's educational policy, which requires schools to incorporate the DUA.
Herrera-	Collective reflection	Teachers and	Describe the	A conceptual	From the data

Seda et al. (2021)	among teachers in initial training continues as a space for the construction of an inclusive pedagogy.	future teachers/ Chile.	contributions of collective reflection on practice among teachers in initial and continuing training for the construction of an inclusive pedagogy, based on the principles of UDL.	model of teacher training for inclusion was developed, based on a qualitative research-training-action approach. The training was applied to 5 teams, consisting of 2 initial training teachers and 1 continuing training teacher.	collected, results were established about the convergences and divergences experienced by the participants. The conclusions corroborate the relevance of collective reflection among teachers for professional development to promote the transformation of classroom practices towards educational inclusion.
Navarro Montaño, Mª et al. (2022)	Participatory Methodologies in Teacher Training: Analysis of Active and Collaborative Didactic Strategies.	The sample was made up of 73 students enrolled in the 4th year of Elementary School in the Special Education category, in the subject "Teaching strategy and specific resources for attention to diversity" / Chile.	Develop participatory methodologies in the training of teachers from different disciplines, based on inclusive teaching strategies and the principles of UDL to support inclusive schools through the development of methodologies built by the teachers themselves.	Qualitative methodology was used, based on the principles of action research. Students discussed the principles of UDL and learned the guidelines collaboratively.	The conclusions reveal that participatory methodologies are developed through didactic strategies, with the management of skills and abilities being uneven, promoting the generation of knowledge itself, activating reflective learning and the management of different didactic strategies, which favor critical-reflective thinking, participation and shared knowledge.
Núñez-Ayala and Jacobo-García (2022)	Inclusive Professional Profile and Diversity: Implicit Theories of Beginning Teachers.	Training new teachers in the role. The sample consisted of 259 participants from the state of Sinola, Mexico.	Discover professional teaching thinking by exploring the dominant character of its inclusive	Qualitative methodological approach, which consisted of applying a dilemma questionnaire on educational	The results made it possible to identify the recurrent implicit theories about diversity, leaving evidence that there is a

			profile (inhibiting, facilitating and intermediary) as implicit theories about diversity.	inclusion processes with a sample of 259 participants.	predominant positive inclination towards the facilitating profile and a lesser inclination towards the inhibitory profile. This is a trend that validates the educator's professional knowledge about the notion of diversity, favoring Universal Design for Learning (UDL).
Parody, Leiva and Santos-Villalba (2022)	Universal Design for Learning in Digital Teacher Training from an Inclusive Pedagogical Perspective.	Spain	Present a bibliographical review of the main research carried out in the period between 2017 and 2021 on knowledge and training by teachers of inclusive and innovative didactic proposals based on the principles of this pedagogical model.	Literature review	The research results demonstrate the importance of UDL as an innovative and inclusive approach that, together with Information and Communication Technologies (ICT), promotes the transformation of teaching-learning processes aiming to offer effective responses to diverse needs, demands and particularities of students.
Sanchez Fluentes and Duk (2022)	The importance of the environment. Universal Design for Contextualized Learning.	Chile and Spain	Describe the concept of Universal Design for Contextualized Learning as a way to base programming and implement learning experiences	Literature review	It is concluded that there is a need to make more resources, spaces and time available for teacher training and professional development, in order to move towards contextualized educational

			that respond to students' realities, taking into account the diversity that characterizes each classroom.		practices, based on the principles of the UDL. Broaden the focus of inclusion to other groups at risk of exclusion due to their personal, social, cultural or ethnic situation. Put into practice the principles and strategies proposed by the DUA and, therefore, overcome the focus on students with special educational needs and/or disabilities.
Zerbato and Mendes (2021)	Universal design for learning in teacher training: from research to inclusive practices.	Ten basic education teachers and seven undergraduate students participated in the research. The teachers were from different backgrounds, some from the initial years and others from the final years. / Brazil	Investigate whether a teacher training program based on the UDL theme would result in practices that achieve greater participation and learning among the target student of Special Education in the regular classroom.	collaborative research to produce knowledge and promote teacher training. Ten basic education teachers and seven undergraduate students participated in the study. The program resulted in eleven meetings, involving various training tools, such as fictitious and real teaching cases, case discussion scripts and preparation of lesson plans based on the UDL.	The results showed that training strategies based on the assumptions of DUA and collaboration proved to be enhancing tools in the development of teaching actions consistent with diversity, as well as in the initial and continued training of participants.
Chavarria, Condoy and Montesino (2019)	Universal Design for Learning and inclusion in Basic Education	The final sample was made up of twenty-six teachers, who work with	Know the teaching methodologies and strategies	The methodology is quantitative and descriptive, for which a Likert	The results reflect limited knowledge about the DUA and its

		children between seven and twelve years old, from four educational establishments representing three of Ecuador's natural regions.	used by basic education teachers and whether they are based on the Universal Design for Learning.	scale questionnaire was used, with twenty-nine items. As a complement to the study, 4 qualitative open questions were also asked.	principles, highlighting that in public schools and those with a higher percentage of students with disabilities, only 29% of teachers know approximately what the DUA means. On the other hand, there are actions that affect the training process and equal opportunities for students with low hearing and vision.
Muzzio, Cassano and Góes (2022)	Universal Design for Learning in the practice of Mathematics teachers in Paraná.	The sample included 11 mathematics teachers in the state of Paraná. / Brazil	Analyze the knowledge of the participants, mathematics teachers, about special education, inclusive education and UDL.	The research is qualitative and interpretative, analyzing a questionnaire on the indicated themes.	It was found that the majority of participants, Mathematics teachers, are unaware of the UDL approach, which, as it is considered recent, is not widespread in teaching training that deals with school inclusion. Even so, it is possible to observe signs of UDL in the participants' reports of practices.
Agostini and Renders (2021)	Teacher training based on inclusive practices and Universal Design for Learning .	Six teachers working in the early years of elementary school in a public network in the ABCD region of São Paulo. /Brazil	Analyze how the principles of UDL, applied to teacher training, can contribute to inclusive practices at school.	A qualitative approach was used, using a method that combined narrative research and development research.	The results showed the importance of training based on teachers' daily practices, valuing their knowledge and practices in conjunction with new theoretical knowledge (in this case, the DUA) to support

					analyzes and reflections on teaching practices, in the context of special education from an inclusive perspective.
Garrad and Nolan (2023)	Rethinking higher education unit design: Embedding universal design for learning in online studies	There were seven undergraduate initial teacher education students enrolled in a four-year Bachelor of Education program at a regional Australian university.	online teaching and learning environment through the principles of UDL in higher education.	The study evaluated the development and satisfaction of students before using the DUA approach and after using it.	Applying UDL principles has resulted in higher levels of student engagement and lower rates of student attrition.
Chen, Evans and Luu (2023)	Moving towards inclusive education: Secondary school teacher attitudes towards universal design for learning in Australia. Towards Inclusive Education: Secondary school teachers' attitudes towards Universal Design for Learning in Australia.	One hundred and twenty secondary school teachers, regular class, in Sydney/Australia.	The aim of this study was to examine secondary school teachers' attitudes towards the DUA framework in Australia.	To collect demographic data, a questionnaire was used. Regarding the Framework Scale that assessed the attitudes of high school teachers towards inclusive education and the use of UDL, the Likert scale was used. The instrument consisted of eighteen questions. Data analysis was carried out using software.	They indicated that Australian secondary teachers' attitudes towards the DUA framework were generally positive, although they still had some practical concerns, such as having inflexible ideas about how to deliver instruction. The results provide useful insights for developing professional teacher training to promote inclusive education, where the UDL framework is a lens for interpreting inclusive education.
Rusconi and Squillaci	Effects of a Universal Design for Learning (UDL)	Switzerland	The objective of the study was to	Systematic review proposed by the Prisma	The results of the review highlighted three

(2023)	Training Course on the Development Teachers' Competencies: A Systematic Review		analyze the effects of a training course in Universal Design for Learning on the development of skills of teachers working in inclusive classrooms.	protocol, with extraction and analysis of twelve studies.	main findings: a training course had significant effects on students' diversity appreciation skills; The effectiveness of the course appears to be independent of its duration, mode of delivery and type of teachers targeted; UDL training promotes the implementation of accessible lesson planning and implementation skills. Still uncertain or unexplored, however, are the effects on teachers' areas of collaboration and reflective practice.
Leonardo and Cha (2021).	Filipino science teachers' assessment of the alignment of webinars with Universal Design for Learning and its relationship with self-efficacy amid the challenges of the COVID-19 pandemic.	There were three hundred and eighteen Science teachers from the Bulacan school division, in the central region of Luzon, in the Philippines.	To know the correlation of UDL-aligned webinars with science teachers' positive self-efficacy for teaching science in an online environment during the COVID-19 pandemic.	Research applied through data collection through a questionnaire answered via Google Survey. The criterion used to be part of the research was to have participated in training (webinars)	The results showed that the training was aligned with the principles of DUA and that the approach promoted accessibility and variability.
Diaz-Vega, Moreno-Rodrigues and Lopez-Batista (2020)	Educational inclusion through Universal Design for Learning: alternatives to teacher training.	Professors from the University of Rey Juan Carlos, from 2018 to 2019 in Spain.	Analyze the level of knowledge and implementation of Universal Design for Instruction principles	Application of a questionnaire to assess the sociodemographic profile of people who participated in the research and their level of knowledge	The results show a broad implementation of the principles of Universal Design for Instruction, despite the low level of prior knowledge of its

			and strategies by university teachers.	about the DUA and Universal Design for Instruction guidelines.	principles. This study concludes that there are practical alternatives to the lack of training and that teachers' self-perception of their own effectiveness and ability to deal with the inclusion of all students must be strengthened.
Valle-Flórez, et al. (2021)	Perception of education teachers on the inclusion of university students with disabilities.	We worked with a sample of 201 university professors from teacher training programs in Spain. The teachers were from the Faculties of Education of the University of León, in the Autonomous Community of Castile and León. The Complutense University of Madrid, in the Community of Madrid.	Analyze the barriers that hinder educational inclusion. Four factors are explored: student accessibility, facilities, resources and teacher availability to respond to students with disabilities and Special Educational Needs (SEN).	Non-experimental, descriptive research composed of the Likert scale.	The results show statistically significant differences in the indicated factors, according to gender, age group, teaching experience and experience with students who need educational support. According to the results of the study, a series of recommendations are included to improve the training necessary for university teachers to promote inclusive education.
Lintangsari and Emaliana (2020)	Inclusive Education Services for the blind: values, roles and challenges of university teachers teaching English as a Foreign Language	Indonesian university professors teaching English to visually impaired students in the first semester.	Find out what teachers did to facilitate the instructional effort to practice inclusive education for students with	Study with a qualitative approach, using interviews and observation.	The results highlighted the need to implement university policies for the practice of inclusive education, the use of UDL and Differentiated

			visual impairments in English classes, as well as the challenges encountered.		Instruction as key to a successful implementation of instructional teaching, adequate resources and teacher training.

After reading the studies in full, we created a table in order to categorize the studies and better understand the results, as we concluded that many studies did not answer our research questions, but contributed to this study, in order to understand the state of art in relation to the research that has currently been developed with the DUA approach.

With this categorization, we also seek to find the most efficient way to provide teacher training that addresses the UDL theme and also to verify whether the production of a Maker Pedagogical Architecture for teacher training based on the concepts of Maker Culture, in a synergistic way, in inclusive aspect would be unprecedented.

Table 2 - Description of studies selected for analysis

Category	Description	Number of studies	Authors/Year
1. Systematic Literature Review.	Studies that carried out a systematic literature review.	3	Parody; Leiva and Santos-Villalba (2022) Sánchez Fluentes and Duk (2022) Rusconi and Squillaci (2023)
2. Teacher training.	Studies that provided training for teachers on the topic of UDL and then collected data to verify the feasibility and barriers to applying UDL.	5	Guiérrez-Saldivia; Navarro and Díaz-Levicoy (2021) Herrera-Seda et al. (2021, p. 3) Zerbato and Mendes (2021) Agostini and Renders (2021) Navarro Montaño, Mª et al. (2022)
3. Perspective and applicability of UDL by teachers or future teachers.	Studies that did not provide training. They collected data on teachers' knowledge and perspectives on UDL.	9	Chavarria, Condoy and Montesino (2019) Diaz-Vega, Moreno-Rodrigues and Lopez-Batista (2020) Lintangsari and Emaliana (2020) Leonardo and Cha (2021) Valle-Flórez, et al. (2021)

			Núñez-Ayala and Jacobo-García (2022) Muzzio, Cassano and Góes (2022) According to Chen, Evans and Luu (2023) Garrad and Nolan (2023)

After categorization, we separated the studies according to the three categories listed in the study analysis.

3.1 Systematic Literature Review

Parody; Leiva and Santos-Villalba (2022) carried out a bibliographical review study, with a time frame between (2017 and 2021), to verify the state of the art in relation to Universal Design for Learning and teacher training in Information and Communication Technology (ICT). The justification for the study was the need for teacher training that includes the acquisition of digital skills to create inclusive and participatory environments, therefore, designing training using ICTs and UDL can provide enriching, innovative pedagogical praxis that respond to the diversity of students. In other words, DUA should be worked together with ICTs to build new paths for teacher training.

In the studies by Sánchez Fluentes and Duk (2022), it was said that countries such as the USA and Canada already have public policies in favor of educational inclusion. Policies regulate and guide how teachers should approach curricular flexibility. Chile also has public policies supported by decree number 83, of the law enacted in 2015 on curricular flexibility to diversify education. In this sense, several actions are promoted for teacher training, to prepare teachers for this purpose. In Spain there are also public policies that mention the application of the UDL approach in school curricula. Therefore, it is necessary for all teachers to take responsibility for the principles of inclusion and equity, therefore teacher training for the application of UDL is extremely relevant. We also need the Ministries of Education, that is, the responsibility of authorities for the development of public policies with actions and monitoring of them for teacher training considering the principles of the DUA.

According to Rusconi and Squillaci (2023), many governments in Europe concerned with the development of special education are implementing initial and continuing training programs for teachers. The project establishes the Profile of Inclusive Teachers, which guides the essential skills and knowledge for future teachers, regardless of the age group they will work in or even the specialty. The study brings up

the topic of neuroscience, in order to address its importance for studies in relation to student-centered learning. Although the study did not work with teacher training, it brought contributions in relation to some issues investigated in the systematic review, such as studies that valued the diversity of learners, those who planned accessible classes, those who implemented accessible classes, what were the effects on attitudes towards others, what are the attitudes towards personal and professional development and what characteristics define the effectiveness of a course with the UDL approach? The study brought valuable results to this study, including that neuroscientific knowledge on the part of teachers contributes to moving away from the fixed idea of human intelligence and allowing teachers to consider neuroscientific knowledge in their classroom practices. The results of the study also suggest the integration of contributions from neuroscience and evidence-based pedagogical practices in learning sciences and cognitive neuroscience.

3.2 Teacher Training

Guiérrez-Saldivia; Navarro and Díaz-Levicoy (2021) presented the practice of applying the UDL approach, in a Special Education course, in Pedagogy. Students at the Catholic University of Temuco, enrolled in the Special Education course, have on their CVs, in the third year of graduation, the course Tools for Access to Learning Language and Mathematics I. The course aimed to give participating students access to the language in Mathematics I, allowing the improvement of students' pedagogical practices. The objective was also to promote an inclusive environment in the classroom in relation to student learning. A virtual platform was used as a strategy, where students received materials to read in advance, in order to improve their understanding of what would be covered later in person. Audiovisual materials, physical manipulative materials, learning progress notes, a virtual forum and Wiki (both tools on the Moodle e-learning platform) were also used. As a result, students learned in practice how to apply more inclusive approaches. Even in the country there are public policies that are based on the principles of the DUA to diversify teaching in response to inclusive education.

Herrera-Seda et al. (2021, p. 3) outlined a training model that was based on four axes: "inclusive pedagogy, articulation between school and university, collective work and reflection on practice. According to the authors, research in Chile on the topic of inclusion reveals that teachers "tend to have a positive disposition to develop an inclusive approach", however they rarely diversify teaching. The training was in a theoretical-practical format, in a workshop format. Teachers learned to plan classes using DUA. The

research results showed that teachers share experiences (those who were working in practice) and teachers still in initial training (shared the desire and need to work as a team); in other words, there was an exchange of experiences during training.

Zerbato and Mendes (2021) carried out their studies during training with teachers and undergraduate students, with the aim of planning a class based on the principles of UDL throughout the program. The protocol for preparing the lesson plan should contain information about PAEE students, including in the context of a common class and the elaboration of the lesson plan with the principles of DUA. Ten lesson plans were created, which were put into practice, with the exception of one, as the teacher was in the role of pedagogical coordinator and was unable to apply the previously prepared plan.

Agostini and Renders (2021) carried out training for six teachers who expressed interest in participating. The training was conducted through a seminar, with the theme "Universal Design for Learning and School Inclusion", carried out by a research group, in 2020. The training included practices that used UDL through reading, circles of conversation and reflections on the participants' practices and the possibility of applying UDL in their classroom practices.

Navarro Montaño, Mª et al. (2022) addressed initial teacher training, which is justified by the need for inclusive and collaborative methodologies to minimize the distance between theory and practice. The technique used to collect data was focus groups, which involves asking questions about a topic to start dialogue. In this study, the questions were related to the principles and guidelines of the DUA to provide inclusive teaching. Students learned about the UDL approach collaboratively and with the help of active methodologies. The results showed that reflection on one's own practices becomes promising, as it encourages students to reflect and dialogue.

3.3 Perspective and applicability of UDL by teachers or future teachers

The study by Chavarria, Condoy and Montesino (2019) did not provide any teacher training, it assessed the knowledge of teachers participating in the research on UDL. There were twenty-eight participating teachers, with 2 (two) teachers not responding to the survey, leaving the valid sample with 26 (twenty-six) participants. The results showed little knowledge of UDL on the part of the participants. The study analyzed participants' knowledge and use of UDL principles. The teachers are from locations in Ecuador, on the border between Ecuador and Peru and on the border between Ecuador and Colombia.

According to Diaz-Vega, Moreno-Rodrigues and Lopez-Batista (2020), in Spain there is a decree number 1392/2007 that deals with the organization of higher education and establishes that higher education institutions must contribute to students' knowledge in relation to principles of accessibility and design for everyone, however only 16% (sixteen) of institutions introduced disciplines related to the context. The knowledge of UDL gave rise to the conception of Universal Design for Learning, which refers to the fact of anticipating and planning the learning process to ensure that all university students have access to the curriculum. This study did not provide training, it identified and analyzed the level of knowledge of university teachers about the UDL and the University Design for Instruction.

Lintangsari and Emaliana (2020) did not carry out teacher training, they investigated challenges and practices for inclusive education in higher education, in a course teaching English as a Foreign Language for students with visual impairments. The results highlighted the need for training programs for teachers regarding the use of Universal Design for Learning and Differentiated Instruction for teachers teaching English as a Foreign Language. Differentiated Instruction "offers teachers the planning of teaching strategies to reach and meet the needs of students with varied characteristics. Differentiated Instruction is well established as practices that can be well adapted to the three principles of the UDL" (Lintangsari and Emaliana, p. 442, 2020). According to the authors, both the DUA and Differentiated Instruction favor the learning process in favor of inclusion.

Leonardo and Cha (2021) assessed the self-efficacy of science teachers after participating in several online professional development trainings, with the aim of supporting teachers to teach in a new way. UDL principles were used as a tool to evaluate the webinar for application, variability, and inadequacy of a single curriculum. In the training, teachers learned how to use multimedia learning resources, development of e-books, Google Suite, development of Autodesk 3D models using Tinker CAD and Fusion360; Photoshop, Canva and Graphic Design, Microsoft Office 365, teaching and parenting under the new normal, and the introduction of open educational resources (OER). The DUA was used as an evaluation instrument through webinars considering the principles of the DUA. The results showed that although the trainings were not designed following the DUA approach, after the evaluations, teachers responded that the webinars were aligned with the DUA principles.

Valle-Flórez, et al. (2021) brings to discussion the issue of university curricula in Europe being restructured within the scope of the Bologna process, so the curricula underwent adjustments in relation to the variety of learning methods, in relation to the

skills of professional profiles and the expansion of the assessment system to make the curriculum more flexible and include students with disabilities or special educational needs within the university. The study did not provide training for university teachers, it applied research to analyze teachers' difficulties in working within the inclusion paradigm. UDL was cited in the research as a pedagogical approach that would help the teacher. The teachers mentioned the UDL relating it to the use of Information and Communication Technology. The results demonstrated that teachers know little about the UDL approach and that they have not received any training to work with the approach. The results also showed that women participating in the research are better prepared to meet the needs of students with disabilities or special educational needs; men have a better perception of accessibility in teaching resources

Núñez-Ayala and Jacobo-García (2022) carried out a study, which included 259 participants, teachers (with 1 to 3 years of experience in the role) to first identify the participants' profile between the way of thinking: barrier inhibitor, intermediate or barrier facilitator. The barrier-inhibiting profile is those who move away from the inclusive perspective. The intermediate profile are those who do not identify themselves as being for or against inclusive education. The facilitator profile is those who put into practice constructivist methodologies to remove barriers in favor of inclusion. Those who have the facilitator profile demonstrated that they are optimistic in relation to the DUA to work in the inclusion paradigm.

Muzzio, Cassano and Góes (2022) did not provide or even carry out any training, they assessed the participants' knowledge in relation to special education, inclusive education and AUD. They concluded that the mathematics teachers participating in the research showed interest in learning about new teaching methodologies, which provide better learning including a greater number of students. The research also demonstrated that the planning of these teachers is not designed and designed for everyone, however the participants recognized the importance of planning designed for all students.

According to Chen, Evans and Luu (2023), Australian authorities have recommended UDL to eliminate barriers so that all students can learn the same curriculum. The authors did not apply any training, they collected data on teachers' attitudes when applying the UDL. The study aimed to create public policies to support teachers in applying the UDL, as according to the authors, the approach eliminates barriers so that education becomes high quality for everyone.

Garrad and Nolan (2023) carried out a study to verify whether the principles of UDL applied in an undergraduate course, online, would be beneficial for students. The results demonstrated greater student engagement, a reduction in the dropout or evasion rate

and less student exhaustion in relation to learning. The study did not provide teacher training, it applied the UDL approach to an undergraduate course.

4 Discussion

The globalization of inclusive education over the two decades has boosted pedagogical practices that remove barriers and provide learning for all. In this context, the DUA approach eliminates barriers starting from planning (objectives, methods, subjects and assessments) through reasonable flexibility using the DUA principles, guidelines and checkpoints as a guidance document for building a flexible curriculum.

UDL is a teaching approach that has demonstrated success in achieving goal 4 of the 2030 agenda for sustainable development, therefore many countries have applied UDL in their public policies to provide inclusion in education.

The studies presented here, which carried out a Systematic Review, had as one of their objectives seeking information on the applicability of the DUA as a form of teacher training to provide access to the curriculum to a greater number of students; since many countries, mentioned here, address the issue of curricular flexibility (small or large adjustments in objectives, content, methodology, teaching-learning and assessment activities) in their public policies.

In relation to the studies that provided teacher training, it was possible to confirm that some worked in the face-to-face modality, others in the online modality, some worked in the workshop format, others in a theoretical or theoretical-practical format. Some studies worked only with teachers, while others worked with teachers and future teachers (undergraduate students). Some studies have explored only DUA, others have already related DUA to another approach, such as active methodologies. In all studies that worked with training, UDL was described as a possible and promising approach. Another important result is that only 3 (three) studies found were from Brazil. This data allows us to infer that there are few studies found in the databases used in this study that deal with the theme of this study in our country/Brazil. In total, there were 3 studies carried out in Brazil and two of them provided teaching training for teachers.

The studies covered in the third category contributed to this study in relation to the positive perspective of teachers in relation to UDL in all segments covered in this study. It was possible to detect that many studies related UDL with Differentiated Instruction, Communication and Information Technology, with the University Design for Instruction; that is, the DUA approach was not studied alone in some studies, it was related to other approaches to verify the applicability of DUA by teachers.

The study by Rusconi and Squillaci (2023) was very contributory to this study because it brought considerations regarding working with UDL in line with the contributions of neuroscience.

Some studies were removed from the research after reading them, as only after reading the studies in full was it possible to verify that they were illegible for the research, that is, they were not within the inclusion criteria. The study by Chavarria, Condoy and Montesino (2019) was removed as a text for reading from a database, as it is indexed in the Web of Science with an English title and in Scielo with a Spanish title, that is, repeated. The study by Yu et al. (2021) was removed, as after reading the text it was verified that it was an essay, a textual genre that does not form part of the inclusion criteria of this study.

The objective of this SR was to answer the three research questions listed above. After analyzing the studies above, it was possible to verify that not all studies provided teacher training to apply the UDL approach. Some used the approach in their work to verify the acceptability of teachers and some carried out a literature review. In this sense, this study highlights some work fronts in relation to Universal Design for Learning.

5 Conclusion

This work aimed to carry out a Systematic Review (SR) of Literature to survey and understand the development of teacher training using the Universal Design for Learning approach worldwide. The search resulted in a number of 17 (seventeen) articles, a considerable number, however, only 5 (five) studies addressed the answers to our study. These 5 (five) works carried out teacher training and subsequently collected data, thus we understand that it is necessary to carry out research that addresses this topic, mainly in Brazil, as we do not have in our federal legislation any document that guides in relation to the use of curricular flexibility with the DUA approach, as in the case of Chile.

It is a fact that the DUA promotes the inclusion of access to the curriculum, however we need to understand how the DUA is applied within the curricula of education networks or even universities? Which resources do teachers use? How much time is needed to plan a lesson using the UDL approach? Do teachers understand the specificities of students? Do teachers consider students' specificities when planning their classes?

There are many questions that still need to be answered regarding the approach to UDL at school or university levels. However, we hope that this study has contributed to thinking about research that applies UDL and that in the future it will be a consolidated approach in education networks providing inclusion.

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RESUMO:

O artigo trata-se de uma Revisão Sistemática de Literatura, de acordo com as orientações do protocolo Prisma. O objetivo foi investigar e analisar os estudos publicados em algumas bases de dados que trataram sobre o DUA e a formação docente, para de fato compreendermos como a abordagem tem sido implantada em diversos países. O trabalho trata-se de uma pesquisa qualitativa, de cunho bibliográfico. Utilizamos as fontes: o Portal de Periódicos da Capes, Scientific Electronic Library Online, Web of Science, National Library of Medicine and the National Institutes of Health e Erick, num recorte temporal de (2019 a 2024). Os descritores utilizados foram: "Formação Docente" AND "Desenho Universal para Aprendizagem", para as bases de dados de natureza brasileira e nas internacionais utilizamos os descritores "Teacher Training" AND "Universal Design for Learning". Como resultados tivemos quarenta e cinco estudos, que foram analisados segundo a Análise de Conteúdo de Bardin (2011). Após aplicarmos os critérios de inclusão e exclusão ficamos com dezessete artigos, entretanto, após a leitura de todos os trabalhos na íntegra verificamos que somente cinco trabalhos responderam as nossas perguntas, sendo dois deles brasileiros. É fato que o DUA promove a acessibilidade curricular, entretanto, são muitas questões que ainda necessitam serem respondidas em relação à abordagem para que tenhamos, a mesma, consolidada nas redes de ensino, proporcionando a inclusão.

KEYWORDS: Desenho Universal para Aprendizagem; Formação docente; Inclusão.

RESUMEN:

El artículo es una Revisión Sistemática de Literatura, de acuerdo con las directrices del protocolo Prisma. El objetivo fue investigar y analizar los estudios publicados en algunas bases de datos que trataron sobre el DUA y la formación docente, para comprender realmente cómo se ha implementado el enfoque en varios países. El trabajo es una investigación cualitativa, de naturaleza bibliográfica. Utilizamos las siguientes fuentes: el Portal de Periódicos de Capes, Scientific Electronic Library Online, Web of Science, National Library of Medicine and the National Institutes of Health y Eric, en un periodo de tiempo de 2019 a 2024. Los descriptores utilizados fueron: "Formación Docente" AND "Diseño Universal para el Aprendizaje" para las bases de datos de naturaleza brasileña y en las internacionales utilizamos los descriptores "Teacher Training" AND "Universal Design for Learning". Como resultados, obtuvimos cuarenta y cinco estudios, que fueron analizados según el Análisis de Contenido de Bardin (2011). Después de aplicar los criterios de inclusión y exclusión, nos quedamos con diecisiete artículos, sin embargo, después de leer todos los trabajos en su totalidad, verificamos que solo cinco trabajos respondieron a nuestras preguntas, siendo dos de ellos brasileños. Es un hecho que el DUA promueve la accesibilidad curricular, sin embargo, hay muchas cuestiones que aún necesitan ser respondidas en relación con el enfoque para que este se consolide en las redes de enseñanza, proporcionando inclusión.

PALABRAS CLAVE: Diseño Universal para el Aprendizaje; Formación docente; Inclusión.