



Technology in Teacher Planning from Universal Design for Learning: A Case Study on Inclusive Practices

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ENG Summary: Educational purposes are evident from the planning itself, so it must be the object of study, especially given its relevance in the generation of inclusive contexts. This paper aims to identify the use of technology in didactic planning developed under the Universal Design for Learning approach. A case study was carried out based on the analysis of nine didactic designs developed by active teachers and student teachers, who had received specific training in UDL. The content analysis revealed that technology is used to connect with the interests of the students, as well as to promote understanding through interaction with digital content, predominantly visual. However, its use is limited in facilitating action and expression of learning. The conclusions highlight the need to expand the use of technology through incorporating assistance tools and configuration options that adapt to the diversity of the student body; promoting multisensory support and decoding of information; to promote communication and the personal and collaborative construction of knowledge. Along with this, the development of learning strategies must be supported and the means to strengthen the emotional dimension and commitment must be diversified.

Keywords: Universal Design for Learning, teacher training, educational planning, educational technology, inclusive education.

ES La tecnología en la planificación docente desde el Diseño Universal para el Aprendizaje: un estudio de caso sobre prácticas inclusivas

Resumen: Las finalidades educativas se evidencian desde la propia planificación, por lo que esta debe ser objeto de estudio, especialmente dada su relevancia en la generación de contextos inclusivos. El presente trabajo pretende identificar el uso de la tecnología en las planificaciones didácticas elaboradas bajo el enfoque del Diseño Universal para el Aprendizaje. Se llevó a cabo un estudio de caso basado en el análisis de nueve diseños didácticos elaborados por docentes en activo y estudiantes de magisterio, que habían recibido formación específica en DUA. El análisis de contenido reveló que la tecnología se emplea para conectar con los intereses del alumnado, así como para favorecer la comprensión a través de la interacción con contenidos digitales, predominantemente visuales. Si embargo, su uso es limitado en la facilitación de la acción y expresión de los aprendizajes. Las conclusiones resaltan la necesidad de ampliar el uso de la tecnología a través de: incorporar herramientas de asistencia y opciones de configuración que se adapten a la diversidad del alumnado; promover el apoyo multisensorial y la decodificación de la información; fomentar la comunicación y la construcción personal y colaborativa del conocimiento. Junto a ello, se debe respaldar el desarrollo de estrategias de aprendizaje y diversificar los medios para fortalecer la dimensión emocional y el compromiso.

Palabras clave: Diseño Universal para el Aprendizaje, formación del profesorado, planificación educativa, tecnología de la educación, educación inclusiva.

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1. Introduction

Universal Design for Learning (UDL), initially considered an approach to support diverse learners (Meyer *et al.*, 2014), now convenient for all learners, has achieved great momentum on an international scale, at all levels of education (Deegan, 2021; Díez & Sánchez, 2015; Duck & Hernández-Ojeda, 2020; Fornauf & Erickson, 2020; Triana & Supena, 2023).

This conceptual framework, which aims to respond to the multiple modes of commitment, representation and action and expression of student learning, has recently been updated to version 3.0 (CAST, 2024). Aligned with the fourth goal set by the United Nations General Assembly (2015), which directs the 2030 Agenda for Sustainable Development through ensuring inclusive and equitable quality education, it contributes to promoting lifelong learning opportunities.

Present for decades in the educational legislation of numerous countries, it was incorporated into the Spanish educational context almost five years ago (LOMLOE 3/2020, of 29 December) considering that “students arrive at learning with different experiences and will approach their learning in different ways” (McCaughren, 2021, p. 139).

Therefore, it involves planning and implementing teaching action by overcoming ableist proposals based on labels and stereotypes, thus guaranteeing an inclusive education that respects diversity and promotes equal opportunities (Calderón *et al.*, 2022).

In this process, teacher training in UDL is crucial (Villoria & Fuentes, 2015; Campos-García & Canabal, 2023b), with the greatest challenge being the achievement of significant changes in the prevailing conceptions of inclusion and the practices that underpin it, which allow for a collective, deep, and sustained commitment of teachers at all levels of the education system (Calderón & Rascón, 2021).

On the other hand, the results of the UDL's contributions are sometimes inconsistent due to the heterogeneity with which it is interpreted by teachers (Rao *et al.*, 2017), which shows the methodological complexity involved in its research (Van Boxtel & Sugita, 2022). A structured observation system is required that, while leaving room for teaching experience and knowledge, allows for the investigation of the considerations that are actually implemented (King-Sears *et al.*, 2023; Rao *et al.*, 2020), as some research has begun to collect that incorporates tools such as self-assessments and teacher interviews (Craig *et al.*, 2022a).

Based on the approaches of the UDL implies doing so from educational planning, as a *sine qua non* starting point for equitable and quality educational care, an aspect on which this work focuses, paying special attention to didactic designs supported by technology.

2. Conceptual framework

2.1. Teaching planning

Planning in education is part of the fundamental activities of those who teach. It is a complex process, since it requires constant reflection and analysis on its practice, on how it organizes teaching around the challenges posed by its students, which is manifested in decision-making for problem solving (Gimeno, 1996) that involves the improvement of teaching-learning processes.

According to Monetti and Molina (2023, p. 264), planning “always requires building a coherent perspective on what, how, for what, for whom, and why what is being taught is taught.” It is a function that does not exempt from influences, explicit, from the pedagogical model on which it is built. Crystallizing these approaches into a design allows the teacher to make known what he or she thinks. Analyzing didactic planning, as representations that they are, involves identifying the conceptions it holds around teaching, learning, educational competences and contents, assessment and methodology with their respective resources and materials, among which digital resources stand out in this case.

For teachers to attend diversity from the initial phases, that is, from planning, considering the approaches of the UDL, a specific training process is necessary (Spooner *et al.*, 2007), as shown by various studies (Craig *et al.*, 2022a). Planning with all students in mind means formatively addressing the nuances and implications that each of the SAD options entail, confirming that what is planned does not put any student at a disadvantage and counting on the specific support of technology (Fleming, 2023; Zamora *et al.*, 2017).

2.2. Teachers' digital competence in terms of inclusion

For Vivanco (2015, p. 305), technologies “are characterized by their ability to modify the course and functioning of human relationships and activities. It is precisely this disruptive and systemic power that makes the process of integrating them into education complex, and at the same time decisive.” This purpose requires facing it by explicitly combining the pedagogical, social and cultural intention with which digitalization is incorporated into teaching-learning processes, to prevent the already existing exclusion gap in the educational field from widening. In turn, its use must not be exclusively transmissive, but rather promote interaction processes (Paz & Gisbert, 2024).

On the other hand, it is not enough for the teacher to have digital skills (García-Campos *et al.*, 2020), if they are not supported by competencies for inclusion, which requires a predisposition to integrate their technological capabilities and pedagogical knowledge for the sake of inclusion from their field of study (Parody *et al.*, 2022).

This is reflected in the update of the Reference Framework for Teaching Digital Competence (INTEF, 2022), specifically in area 5, understood as pedagogical competence for “the empowerment of students” and which involves the implementation of technologies at the service of individual differences, the

generation of digital contexts that activate the commitment and participation of all students, as well as the guarantee that digital resources are accessible, that is, “that they can be used by all recipients in a safe, autonomous, and efficient manner” (Rubio, 2022, p. 121).

Training proposals are required that strengthen the reflection and critical judgment of teachers, which allows them to go from being a mere consumer to a generator of valuable digital content for students (Buenestado *et al.*, 2023) while generating friendly learning contexts.

2.3. Technology in teacher training in UDL

Interest in the contributions of technology from UDL has a certain trajectory (Lee & Griffin, 2021). In the decade since these training processes began in the Spanish context, digital evolution has made it possible for the options it offers to gain in volume and accessibility (Canabal & García-Campos, 2020). Thus, collaborative work in small groups has come to be shared and visualized in large groups synchronously or it is possible to receive feedback simultaneously through different access channels.

3. Methodology

3.1. Objectives and methodological approach

The aim of this paper is to know the use made by teachers of technology from didactic designs based on the UDL, which is specified in the following specific objectives:

- Refer to the technologies present and the UDL principles they support.
- Identify both technologically reinforced guidelines and considerations, as well as those that are less so.

To this end, a qualitative methodology with an exploratory and descriptive approach is carried out through content analysis. A case study is developed around nine educational designs based on the UDL, using as a selection criterion the incorporation of technology as a resource that enriches the plans, making them more flexible and allowing them to increase their degree of adjustment to the diverse characteristics of all the students.

3.2. Fieldwork, participants and information collection

Regarding the research context, the training actions on UDL in which the teaching plans analyzed in this study are generated take place both in initial training, specifically in two subjects of the Degree in Early Childhood Education Teaching, and in permanent training, through various actions aimed at practicing education professionals, based on practice, collaborative inquiry, feedback and research of the teaching staff. Synchronous face-to-face sessions are developed, in which technological materials and resources are used, supported by asynchronous learning tasks, with a teaching load of between 8 and 14 hours, depending on the profiles of the participants. The objective of the training is to develop teaching skills through transformative practices through a didactic design based on the approaches of the UDL. The reasons for this decision are, on the one hand, that the day-to-day task of planning allows them to identify and organize aspects of improvement in their practice and, on the other, to reinforce the need to incorporate this conceptual framework from the design.

At the end of the training process, they prepare a proposal to address the classroom situation that they have decided to transform. Hence the diversity of the designs, which range from didactic material to the incorporation of UDL approaches in the learning assessment process itself, thus attending to curricular elements, although without proposing holistic proposals.

The 9 designs are made by women, who signed the informed consent, of which 8 are professionals in public education centers and one is a student. Their profiles are an early childhood education teacher and a primary school teacher, a pedagogical therapist, a hearing and language teacher, a community service teacher, a secondary school teacher, an adult education teacher, a university professor and a fourth-year student of the bachelor's degree in early childhood education.

3.3. Categories, instruments and data analysis

In the first phase, the 9 designs that incorporate technology are intentionally selected from the total number of teaching proposals developed and each technological resource is identified, as well as its purpose (see Table 1).

Table 1. Purpose of didactic designs.

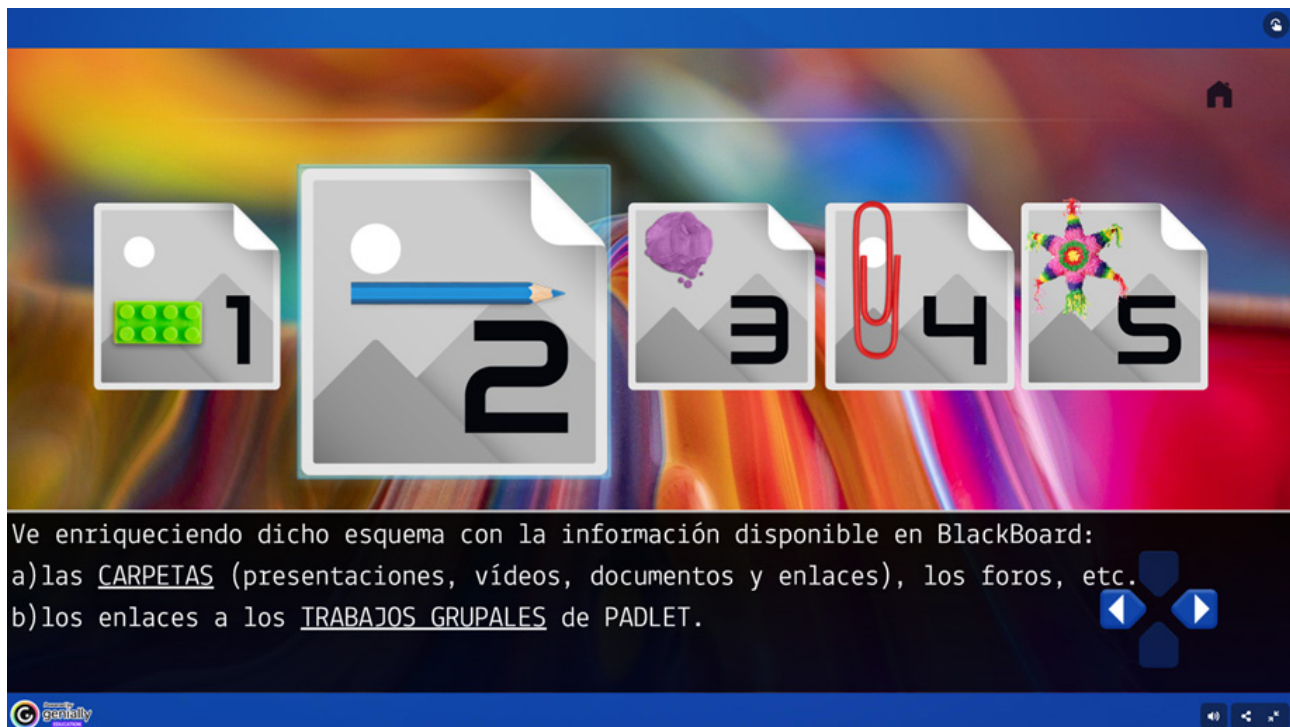
Technology Format	Purpose
1. Interactive Book	Promote formative assessment (assessment)
2. Interactive Book	Raising awareness of an unknown reality (sensitization)
3. Digital Presentation	Present the adapted methodology for complex content (explanation)
4. Digital Presentation	Working collaboratively (collaboration)

Technology Format	Purpose
5. Storytelling	Involve students in the subject (organization)
6. Digital gamification	Deepen the contents of the subject (extension)
7. Digital Wall	Visually organize the content of the subject (organization)
8. Photo-elicitation	To show other forms of construction and expression of knowledge (expression)
9. Digital Picture Album	Show inspiring examples to create proposals (analysis)

Note. Own elaboration.

In a second phase, the predefined categories of analysis are established, elaborated from the technological proposals indicated by Rubio (2022) in each principle of the UDL and its guidelines, to which those relating to the new dimensions of version 3.0 were added. (CAST, 2024). This gives rise to an *ad hoc* document with which the collection of data on each of the designs, arising within the framework of Grounded Theory (Kuckartz & Rädiker, 2023), is systematized, based on a deductive approach. Reliability is ensured through inter-judge agreement and peer review. The data is coded using the MaxQDA 2024 tool. These data are triangulated with those collected in the field diaries, the result of both observations made in the training sessions and feedback on the designs. In subsequent work, these data are contrasted with the reflections of the participants on their designs.

Figure 1. Image belonging to Design 1. Example of diversification with technology as a means of expression (subcategory Guideline 5) through digital presentation, text document, infographic, timeline, mind map and illustration. Own elaboration.



The data are coded into 3 categories (the principles of the UDL), 9 subcategories (the guidelines) and 62 slogans (technological proposals). Figures 1 and 2 show examples of part of the didactic designs (the written format prevents the interactivity and audio of the elements, among others). The content analysis of the data made it possible to identify the functionality of these tools, as well as to indicate which guidelines and considerations are most benefited by the technology (see Tables 2, 3 and 4). To this end, the respective principles alternated with the various levels of in-depth, following both the horizontal reading – level of access, support and executive functions – and vertical – 3 principles, 9 guidelines and 36 considerations – of this pedagogical framework (García-Campos & Canabal, 2023a).

Figure 2. Imagen belonging to Design 2. Example of inclusion of technological tools for the development of learning strategies (subcategory Guideline 6) through a planner. Own elaboration.



4. Results

4.1. Technological resources to design multiple means of engagement

Table 2 shows the records of the considerations provided with technology in each design, related to *why* we learn, focused on promoting interest and maintaining it until the student is involved in his/her learning processes.

Table 2. Technologies for designing multiple means of engagement: why we learn.

	Teaching designs								
	1	2	3	4	5	6	7	8	9
PAUTA 7. Technology to connect with interests and identities for learning	1	2	3	4	5	6	7	8	9
To raise awareness of the value and relevance of the proposal	+	+	+		+	+	+	+	+
To choose the path	+					+	+		
Incorporate playful elements						+			
To resume the process according to the individual rhythm	+	+			+	+	+		
Offers an intuitive support system	+				+	+	+		
Offer error as an opportunity to learn	+								
PAUTA 8. Technology to maintain the effort and perseverance to learn	1	2	3	4	5	6	7	8	9
Link the meaning of goals to levels of achievement	+								
Offers progressive challenges	+	+			+	+			
It proposes different levels of execution	+				+				+
Provide graduate support in an interactive activity	+								
Promotes collaboration structures	+	+		+	+	+			
Set up a feedback system that invites action	+				+				
PAUTA 9. Technology to diversify assessment to promote emotional capacity (emotional capacity: metacognition about learning)	1	2	3	4	5	6	7	8	9
They design learning paths on a digital platform	+				+				
They set up learning routines in these itineraries	+								
They incorporate a record of personal progress and with respect to the group									
Diversifying assessment instruments with ICT	+								+

Note. Adapted from Rubio (2022) and CAST (2024).

The analysis of the data indicates an important use of technology to, at the access level, connect learning with the interests of the students (guideline 7). All but one of the designs have technological resources to promote the level of access to *why* to learn, considering them a propitious means above all to explore the relevance and personal interests with which the student connects with the proposal (f8), give options to adjust to the individual rhythm (f5), use an intuitive support system (f4), provide options to choose the trajectory (F3) and, to a lesser extent, offer playful elements to involve or understand the error as an opportunity to learn (F1).

The use of technologies is reduced with respect to the level of support for learning, where it is crucial to support perseverance on the part of the student (guideline 8), expanding the offer of collaboration structures (f5), showing progressive challenges (f4), providing different levels of execution (f3), generating a feedback system that contributes to maintaining interest in learning (f2), giving graduated support or linking the objectives with the levels of achievement set (F1).

At the level of executive functions, in which it is proposed to promote the emotional capacity with which to be linked to learning (guideline 9) with the diversification of the assessment and through the promotion of awareness of the learning process carried out, the records are drastically reduced, being limited to three of the designs. Only one of them offers all the options except for the possibility of recording progress and personal situation with respect to the group.

4.2. Technological resources to promote multiple means of representation

Regarding the use of technology in didactic designs to encourage multiple means of representation, *what* we learn (see Table 3), the data indicate that there is a unanimous interest in promoting access to information (guideline 1) in designs through visual support, while auditory support is only registered in three of them and none offers a tactile alternative.

Table 3. Technologies to promote multiple means of representation: what we learn.

	Teaching designs								
	1	2	3	4	5	6	7	8	9
GUIDE 1. Technology as a support for the reception of information, providing:									
Hearing support	+	+				+			
Visual support	+	+	+	+	+	+	+	+	+
Touch support									
PAUTA 2. Technology as a support for the decoding of information, incorporating	1	2	3	4	5	6	7	8	9
Text-to-speech converters									
Translators									
Subtitling									
Dictionary									
Glossary						+	+		
Calculator									
Symbol Notation			+						
QR Codes									
GUIDE 3. Technology as a support for the development of knowledge, adding	1	2	3	4	5	6	7	8	9
a. Structuring resources:									
Graphic organizers	+	+					+		+
Syntax clarification	+		+						
Examples	+		+			+			+
b. Resources for manipulating information:									
Interactive digital content	+	+		+	+	+			+
Interactive guides that guide new knowledge (avatars)									
Using Simulators									
3D Models									
Virtual reality									

Note. Adapted from Rubio (2022) and CAST (2024).

The level of support (guideline 2) is the least enhanced by technology. The glossary and symbol notation are incorporated into only three designs without the use of specific technological tools for this purpose.

However, support for comprehension at the executive function level (guideline 3) is technologically reinforced. Specifically, the possibility of handling information with interactive digital content is the majority proposal,

followed by options to structure the information through graphic organizers and examples, as well as clarifying the syntax used. Despite this, there are no proposals in the designs that incorporate an interactive model that guides the generation of knowledge, the use of simulators, 3D models or virtual reality (guideline 3).

4.3. Technological resources to promote multiple means of action and expression

Regarding the use of technological resources to promote action and expression, *how we learn* (see Table 4), it highlights the fact that only four of the designs consider technologies to diversify how students' access, interact and manage their learning personally and collectively. Specifically, they reflect this interest in diversifying them (guideline 5) at the level of support, almost exclusively as *means of expression* through digital presentations (f3), text documents (f3), photographs (f3), infographics (f3), mind maps (f3), videos (f2), illustrations (f2), podcasts (f1), comics (f1) and timelines (f1). Only in one design is the forum registered as a *means of communication*.

Table 4. Technologies to promote multiple means of action and expression: how we learn.

	Teaching designs								
GUIDE 4. Guideline 4. Providing options for interaction with the digital resource, allowing:	1	2	3	4	5	6	7	8	9
Configure the interface									
Use as assistive technology									
PAUTA 5. Diversifying its use, understood as:	1	2	3	4	5	6	7	8	9
a. Media:									
Email									
Social Media									
Blogs									
Forums	+								
Chats									
Instant messaging									
Video conferencing									
b. Means of expression:									
Digital Presentations	+	+			+				
Podcast		+							
Videos		+			+				
Text documents	+	+			+				
Photographs		+			+			+	
Infographics	+	+			+				
Comics		+							
Timelines	+								
Animation									
Mind Maps	+	+			+				
Illustrations	+	+							
GUIDE 6. Including technological tools for the development of learning strategies:	1	2	3	4	5	6	7	8	9
Planners		+							
Digital agendas									
Time tracking tools		+							
Checklists	+								
Learning Journals	+	+							
Content Management Systems	+	+							
Improvement Mailbox									

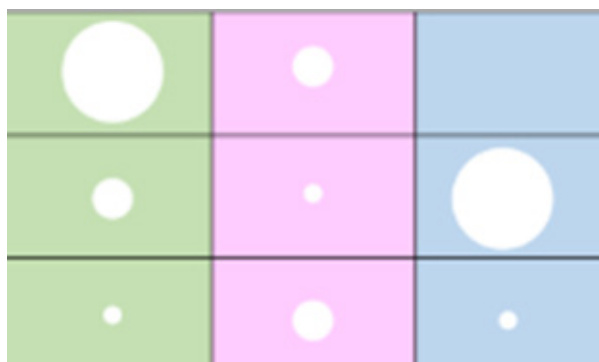
Note. Adapted from Rubio (2022) and CAST (2024).

It is noteworthy that only two of these four designs incorporate, for the level of executive functions, technology-reinforced measures for the personal and collective management of learning (guideline 6), but without resorting to specific technological applications to promote autonomy in management.

It is also important to note that none of the designs incorporates options for interaction with the digital resource (guideline 4), so no measures are proposed for this level of access in the action and expression of learning.

To sum up, while the dataset from the analyzed planning presents elements of the UDL reinforced by technology at all three levels - access (f34), support (f36) and executive functions (f31), an analysis of the data relating to the principles reflects a greater foresight to technologically strengthen the principle related to commitment (f42), followed far behind by the technological support provided for representation (F30) and for the action and expression of learning (F29). Figure 3 illustrates these results for further discussion.

Figure 3. Presence of technology in the SAD guidelines.



Note. Own elaboration. The size of the circles represents the frequency of technology-supported considerations in each UDL guideline (green -why learning-, pink -what learning-, blue -how learning-, small circles (frequency range between 1 and 10), medium (between 11 and 15) and large (between 16 and 22).

5. Discussion and conclusions

As already indicated, the objective of this work was to know, from a qualitative content analysis, how teachers integrate technology in their designs under the UDL framework.

First, the detailed analysis of the results related to engagement allows us to appreciate that technology is very present for the authors of the designs when it comes to promoting interest in student learning. However, this technological support declines when they plan to promote persistence and is even less present as an alternative to strengthening the ability to emotionally manage learning processes.

The use of technology is widespread to initially engage students, but there is less interest in using it to keep them connected to their learning process and its use as a diverse and flexible resource with which students can unravel their motivations, the image they have of themselves as a learner or generate strategies for reflection in collaborative contexts is even scarcer. Technology could thus contribute to students being able to face future learning with commitment and emotional capacity.

This link between increasing student engagement through technological resources is in line with the work of Fleming (2023), whose results point to an increase in students' commitment to participate fully in class discussion, by expanding the range of options for doing so. The fact that their results went beyond mere participation and showed a change in the way teachers and students relate to each other reflects the systemic and relational nature of technologies in education pointed out by Vivanco (2015) and also manifested by the UDL. The teaching attitude committed to technologically optimizing individual choices and minimizing threats shows interest in facilitating the conditions of access to learning for all students, which promotes connection and mutual trust, transforming the relationships established in the classroom. In this sense, Seymour (2023) highlights the relevance of professional skills and the promotion of a favorable school climate, relevant learning, as well as positive relationships (Buyse *et al.*, 2008). Spratt and Florian (2015) highlight the ability to support each student in the context of "everyone" as the most relevant competence of an inclusive teacher, for which he/she must have a positive belief in the abilities of his/her students and be committed to teaching everyone (Tjernberg & Heimdahl, 2014), achieving to be an educational designer as well as a reflective professional who develops his/her own work guided by inclusive values (Nielsen & Andreasen, 2013). Lakkala & Kyrö-Ammälä (2021) consider that student motivation and well-being are evidence of the teacher's "effectiveness", with student perceptions being indicators of the effectiveness of UDL implemented in classes.

Secondly, regarding the incorporation of the technologies planned to promote representation, the plans are limited to offering interactivity options so that students can manipulate the information while providing graphic organizers and examples with which to structure it at the support level, with the visual route being the most digitally promoted access. since the auditory pathway is barely reinforced and the tactile pathway is not at all beyond the possibility of interactivity.

The lack of foresight of tactile interactions recorded in this study is reinforced by the lack of audiovisual elements in the plans analyzed that, either in the form of environments, such as simulators or virtual reality or

in the form of objects, such as the 3D Model, could be connected to offer students an experience of interaction with these objects in three dimensions or simulate doing, for example, manipulative robotics activities in a virtual environment. These data coincide with those obtained by Fuentes *et al.* (2019) when they indicate that teachers require specific training to generate, manage and solve the possible technical incidents derived from this type of resources enriched with augmented reality, for which, according to the conclusions of their study, the relevant training is demanded and carried out, especially at primary education levels and from the public sector. Working in the classroom with these emerging technologies (Forero, 2022) would enrich the students' experience significantly as a support for understanding, for which it is necessary, in addition to specific teacher training, to provide schools with the necessary resources.

Thirdly, on this scale from highest to lowest frequency, the fact that technology is considered from planning to promote the expression of learning, but scarcely for communication in the principle of action and expression, stands out. This forecast is recorded in only four of the designs. The data related to the technological support to promote the development of strategies integrated in this principle denote an interest still very much directed by the teaching staff, with options only being registered in two of the designs to promote them, without incorporating technological tools with which the students can be more autonomous in the management of these strategies for their learning. No planning incorporates measures to adjust the interface so that students can feel more comfortable when accessing the proposal, nor assistive technology alternatives with which to improve their autonomy, remaining as a pending aspect in training that requires technical support for teaching.

It is concluded that the analysis of the plans denotes the teacher's interest in motivating students with technological resources to connect with the teaching proposals, to understand by interacting with fundamentally visual information and, in some cases, to express what they have learned through various technologies. However, it is still necessary to provide teachers, through training processes, with technological support guided by the UDL approaches to the teaching-learning processes, specifically with an emphasis on the following considerations:

- At the level of access to learning: a) use assistive technology and configuration of the interface of digital platforms, adapting them to the preferences of the students and b) promote auditory and tactile support aimed at receiving information through technological resources.
- At the level of learning support: a) to decode information – converters, translators, subtitling, dictionary, glossary, calculator, symbol notation, QR codes – and b) as a means of communication and expression.
- At the level of executive functions to a) promote strategies for action and expression of what has been learned, b) promote emotional capacity in learning processes for motivation while c) handle information and understand it better, using simulators, 3D models and virtual reality.

Teacher training in UDL continues to be very necessary and valuable, as indicated by studies such as that of Craig *et al.* (2022b) and that, as the contributions of this research show, it must go hand in hand with training in digitalization. Given the transformative capacity of both UDL and technology applied to education, the constant evolution they maintain and the systemic and relational nature they manifest, it is necessary to remember that training processes must be designed and developed on a relationship of subordination of technologies to the principles of UDL, with the main purpose of ensuring that technological contributions benefit all students.

Thus, the training processes to develop digital competence for teachers aimed at inclusion should include among their objectives the promotion of the use, adaptation and development of technological proposals, using open resources to a greater extent than until now (Mora *et al.*, 2022) to, as concluded in this work, accommodate the preferences of students, expand their possibilities of interacting with information, expressing it and understanding it to transform it into knowledge, expanding the options of reconstructing and enriching it.

Some guidelines for the design and development of these training processes are, on the one hand, to carry out educational innovation projects that, after a study of previously developed experiences and a design that adapts to the students and contextual conditions, incorporate emerging technology. As simple as the change may be, as Margalef (2011, p. 13) indicates, "it is when we innovate that we realize the meaning and purpose of the change in our practice, the learning process that underlies the whole situation and the possibility of improving educational practice".

On the other hand, adapting to the preferences that teachers also present as recipients of training using the SAD framework. Online training should be offered to strengthen digital competence. However, it is important not to forget the generational gap that persists in the digital competence of teachers, which makes it advisable to offer virtual and face-to-face training processes. The proposal of Mora *et al.* (2022, p. 36) for the training of digital skills with university teachers is "online training (MOOC-type training, online, massive and open), supported by micro-credentials, but with technical and pedagogical accompaniment, through accompaniment seminars that allow working on the different areas of competence and sharing teaching practices". Collaboration is a key issue in the training processes for the design and implementation of UDL (Palacios *et al.*, 2022; Moreno *et al.*, 2021) given that the conditions of shared accompaniment, reflection, and feedback promote educational changes towards inclusion (Craig *et al.* 2022a, 2022b). In turn, contextualization is presented as an unavoidable requirement (Sánchez & Duck, 2022).

Rescuing the words of Cabero and Ruiz (2018, p. 25), the incorporation of technology, from the point of view of teacher planning, is necessary to, on the one hand, "empower people and facilitate their social and

digital inclusion, both in education in particular and in society in general, and on the other, to promote the development of the person”.

Among the limitations of this work is the gender bias given by the feminization of teacher training studies. Another is not having considered the level of digital competence of the participants in accordance with the European Framework for the Digital Competence of Educators (Redecker & Punie, 2020), which would have made it possible to assess the levels of achievement achieved, while contrasting the results with those from other studies. As future lines of research, it is intended to analyze the implementation of educational designs together with the participating teachers. On the other hand, it would be valuable to systematize the educational use that teachers make of technologies, using an analysis model such as Technological Pedagogical and Content Knowledge (TPACK) to understand the combination of technological, pedagogical and disciplinary considerations that teachers put in place when planning in contexts of inclusion.

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References

- Buenestado, M., García, R., Vizcaíno, A. & Renés, P. (2023). Evaluación de una intervención sobre alfabetización mediática del profesorado de educación de adultos vinculado con la Agenda 2030 [Evaluation of an intervention on media literacy of adult education teachers linked to the 2030 Agenda]. *Aula Abierta*, 52(2), 251-259. <https://doi.org/10.17811/rifie.52.3.2023.251-259>
- Buyse, E., Verschueren, K., Doumen, S., Van Damme, J., & Maes, F. (2008). Classroom problem behavior and teacher-child relationships in kindergarten: The moderating role of classroom climate. *Journal of school psychology*, 46(4), 367-391. <https://doi.org/10.1016/j.jsp.2007.06.009>
- Cabero, J. y Ruiz, P. (2018). Las Tecnologías de la información y la comunicación para la inclusión reformulando la brecha digital [Information and Communication Technologies for Inclusion Reformulating the Digital Divide]. *IJERI. International Journal of Educational Research and Innovation*, 9, 16-30. <https://www.upo.es/revistas/index.php/IJERI/article/view/2665/2222>
- Calderón, I. y Rascón, M. T. (2021). Retóricas, posibilidades e infancias desgarradas. Sobre la educación inclusiva en la LOMLOE [Rhetorics, possibilities and torn childhoods. On inclusive education in the LOMLOE]. *Cuadernos de Pedagogía*, 526, 74-80.
- Calderón, I., Moreno, J. J. y Vila, E. S. (2022). Education, power, and segregation. The psychoeducational report as an obstacle to inclusive education. *Internacional Journal of Inclusive Education*, 1-14. <https://doi.org/10.1080/13603116.2022.2108512>
- Canabal, C. y García-Campos, M. D. (2020). Articulando la práctica docente: el DUA como eje de reflexión y de un aprendizaje para todas y todos [Articulating teaching practice: UDL as an axis of reflection and learning for all]. Paper presented at the *XVIII Jornadas FEAE: Respuesta educativa a un derecho*, Madrid, 10 y 12 de febrero. <https://feaemadrid.jimdofree.com/xviii-jornadas/>
- Center for Applied Special Technology (CAST) (2024). *Universal Design for Learning Guidelines version 3.0*. <https://udlguidelines.cast.org>
- Craig, S. L., Smith, S. J., & Frey, B. B. (2022a). Professional development with universal design for learning: supporting teachers as learners to increase the implementation of UDL. *Professional Development in Education*, 48(1), 22-37. <https://doi.org/10.1080/19415257.2019.1685563>
- Craig, S. L., Smith, S. J., & Frey, B. B. (2022b). Effects of coaching on Universal Design for Learning implementation. *International Journal of Mentoring and Coaching in Education*, 11(4), 414-433. <https://doi.org/10.1108/IJMCE-01-2022-0001>
- Deegan, C. (2021). Learning and teaching research methods by universal design a practical case study. In F. Fovet (ed.), *Handbook of Research on applying Universal Design for Learning Across Disciplines: Concepts, Case Studies, and practical implementation* (pp. 188-205). IGI Global.
- Díez, E., y Sánchez, S. (2015). Diseño universal para el aprendizaje como metodología docente para atender a la diversidad en la universidad [Universal design for learning as a teaching methodology to address diversity in the university]. *Aula Abierta*, 43(2), 87-93. <https://doi.org/10.1016/j.aula.2014.12.002>
- Duk, C., & Hernández-Ojeda, F. (2020). Mejorando la Respuesta a la Diversidad en el Aula a través del Estudio de Clases en Escuelas Chilenas [Improving the Response to Diversity in the Classroom through the Study of Classes in Chilean Schools]. *Revista Internacional de Educación para la Justicia Social*, 9(1), 99-123. <https://doi.org/10.15366/riejs2020.9.1.005>
- Fleming, E. C. (2023). UDL for Inclusive Teaching: Offering Choice to Increase Belonging Through Technology. *Journal of Teaching and Learning with Technology*, 12(1), 72-90. <https://doi.org/10.14434/jotlt.v12i1.36327>
- Forero, X. (2022). El papel de la interacción en la educación superior: hacia modelos pedagógicos más flexibles [The role of interaction in higher education: towards more flexible pedagogical models]. *EduTec. Ele Revista Electrónica De Tecnología Educativa*, 79, 134-148. <https://doi.org/10.21556/edutec.2022.79.2363>
- Fornauf, B. S., & Erickson, J. D. (2020). Toward an inclusive pedagogy through universal design for learning in higher education: A review of the literature. *Journal of Postsecondary Education and Disability*, 33(2), 183-199.
- Fuentes, A., López, J., & Pozo, S. (2019). Análisis de la competencia digital docente: Factor clave en el desempeño de pedagogías activas con Realidad Aumentada [Analysis of teachers' digital competence: A

- key factor in the performance of active pedagogies with Augmented Reality]. *REICE. Revista Iberoamericana sobre Calidad, eficacia y cambio en educación*, 17(2), 27-40. <https://doi.org/10.15366/reice2019.17.2.002>
- García-Campos, M. D. y Canabal, C. (2023a). Promover el compromiso de los/as estudiantes con su aprendizaje en una universidad generadora de inclusión y bienestar [Promote the commitment of students to their learning in a university that generates inclusion and well-being]. In M. Sandín (ed.), *Construyendo universidades promotoras de salud* (pp. 131-142). Universidad de Alcalá.
- García-Campos, M. D. y Canabal, C. (2023b). *Libro interactivo. ¿Cómo empezar a implementar el DUA en el aula?* [How to start implementing UDL in the classroom?] [Digital book]. <https://ebuah.uah.es/dspace/handle/10017/60481>
- García-Campos, M. D., Canabal, C., & Alba-Pastor, C. (2020). Executive functions in universal design for learning: Moving towards inclusive education. *International Journal of Inclusive Education*, 24(6), 660-674. <https://doi.org/10.1080/13603116.2018.1474955>
- Gimeno, J. (1996). Ámbitos de diseño [Design areas]. In J. Gimeno Sacristán & A.I. Pérez, *Comprender y transformar la enseñanza* (pp. 265-333). Morata.
- Instituto Nacional de Tecnologías Educativas y Formación del Profesorado (INTEF). (2022). *Marco de referencia de la competencia digital docente* [Framework of reference for digital teaching competence]. Ministerio de Educación y Formación Profesional y Administraciones educativas de las comunidades autónomas. https://intef.es/wp-content/uploads/2023/05/MRCDD_GTTA_2022.pdf
- Kuckartz, U. & Rädiker, S. (2023). *Qualitative content analysis: A guide to methods, practice and using software*. Sage.
- King-Sears, M. E., Stefanidis, A., Evmenova, A. S., Rao, K., Mergen, R. L., Owen, L. S., & Strimel, M. M. (2023). Achievement of learners receiving UDL instruction: A meta-analysis. *Teaching and Teacher Education*, 122, 103956. <https://doi.org/10.1016/j.tate.2022.103956>
- Lakkala, S., & Kyrö-Ämmälä, O. (2021). Teaching for Diversity with UDL: Analysing Teacher Competence. In A. Galkienė and O. Monkevičienė (eds.), *Improving Inclusive Education through Universal Design for Learning* (pp. 241-277). Springer. https://doi.org/10.1007/978-3-030-80658-3_10
- Lee, A. & Griffin, C. (2021). Exploring online learning modules for teaching universal design for learning (UDL): preservice teachers' lesson plan development and implementation. *Journal of Education for Teaching: International Research and Pedagogy*, 47(3), 411-425. <https://doi.org/10.1080/02607476.2021.1884494>
- Ley Orgánica 3/2020, de 29 de diciembre, por la que se modifica la Ley Orgánica 2/2006, de 3 de mayo, de Educación (LOMLOE). *Boletín Oficial del Estado*, 30 de diciembre de 2020, núm. 340, pp. 122868-122953. <https://www.boe.es/eli/es/lo/2020/12/29/3>
- Margalef, L. (2011). Los Encuentros de Innovación en Docencia Universitaria: un entorno para el aprendizaje colaborativo del profesorado y el alumnado [The Meetings of Innovation in University Teaching: an environment for the collaborative learning of teachers and students]. *Pulso*, 34, 11-28. <https://ebuah.uah.es/dspace/handle/10017/9386>
- McCaughren, S. (2021). Embracing new ways of learning and teaching: Sustaining student engagement in the learning and teaching of practice skills. In *Handbook of research on applying universal design for learning across disciplines: Concepts, case studies, and practical implementation* (pp. 137-148). IGI Global.
- Meyer, A., Rose, D., & Gordon, D. (2014). *Universal Design for Learning: Theory and Practice*. CAST.
- Monetti, E. y Molina, M. E. (2023). La planificación didáctica y su enseñanza en la formación docente: entramado de sentidos, representaciones y prácticas [Didactic planning and its teaching in teacher training: a network of meanings, representations and practices]. *Espacios en blanco*, 1(34), 259271. <https://doi.org/10.37177/UNICEN/EB34-387>
- Mora, M., Inamorato, A., Villalonga, C., Lacalle, J. R., Camarillo, J., Sota, J. M., Velasco, J. R., & Ruiz, P. M. (2022). *Competencias digitales del profesorado universitario en España: un estudio basado en los marcos europeos DigCompEdu y OpenEdu*. Oficina de Publicaciones de la Unión Europea.
- Moreno, K. C., Soto, R. I. y Oyarzún, C. J. (2021). Procesos argumentativos que conforman las reflexiones del profesorado chileno sobre sus experiencias de colaboración en el marco del Diseño Universal para el Aprendizaje [Argumentative processes that shape the reflections of Chilean teachers on their experiences of collaboration within the framework of Universal Design for Learning]. *Revista Educación*, 45(2), 1-16. <https://doi.org/10.15517/revedu.v45i1.43500>
- Naciones Unidas. (2015, 25 de septiembre). *Transformar nuestro mundo: la Agenda 2030 para el Desarrollo Sostenible*. https://unctad.org/meetings/es/SessionalDocuments/ares70d1_es.pdf
- Nielsen, J. L., & Andreasen, L. B. (2013). Educational designs supporting student engagement through networked project studies. In L. A. Wankel and P. Blessinger (eds.), *Increasing student engagement and retention using mobile applications: Smartphones, Skype and texting technologies* (pp. 19-46). Emerald Group Publishing.
- Palacios, M. L., Deroncele, A., Medina, P. y Goñi, F. F. (2022). Aprendizaje Profesional Colaborativo: Hacia la Sostenibilidad de la Formación Continua del Docente para una Educación de Calidad [Collaborative Professional Learning: Towards the Sustainability of Continuous Teacher Training for Quality Education]. *Revista Electrónica de Tecnología Educativa*, 82, 167-182. <https://doi.org/10.21556/edutec.2022.82.2569>
- Parody, L. M., Leyva, J. J. y Santos, M. J. (2022). El Diseño Universal para Aprendizaje en la Formación Digital del Profesorado desde una Mirada Pedagógica Inclusiva [Universal Design for Learning in Digital Teacher Training from an Inclusive Pedagogical Perspective]. *Revista latinoamericana de educación inclusiva*, 16(2), 109-123. <http://dx.doi.org/10.4067/S0718-73782022000200109>

- Paz, L. E., y Gisbert, M. (2024). Competencia digital docente y uso de tecnologías digitales en la educación universitaria [Digital teaching competence and use of digital technologies in university education]. *Revista Complutense de Educación*, 35(4), 809-821. <https://doi.org/10.5209/rced.90033>
- Rao, K., Ok, M. W., Smith, S. J., Evmenova, A., & Edyburn, D. (2020). Validation of the UDL reporting criteria with extant UDL research. *Remedial and Special Education*, 41(4), 219-230. <https://doi.org/10.1177/0741932519847755>
- Rao, K., Smith, S. J., & Lowrey, K. A. (2017). UDL and intellectual disability: What do we know and where do we go? *Intellectual and Developmental Disabilities*, 55(1), 37-47 <https://doi.org/10.1352/1934-9556-55.1.37>
- Redecker, C. & Punie, Y. (ed.) (2020). *Marco europeo para la competencia digital de los educadores: DigCompEdu*. INTEF. https://www.libreria.educacion.gob.es/libro/marco-europeo-para-la-competencia-digital-de-los-educadores-digcompedu_182024/
- Rubio, M. M. (2022). Las tecnologías digitales al servicio del diseño universal para el aprendizaje [Digital technologies at the service of universal design for learning]. *Journal of Neuroeducation*, 3(1), 119-124. <https://doi.org/10.1344/joned.v3i1.39658>
- Sánchez, S. y Duk, C. (2022). La importancia del entorno. Diseño universal para el aprendizaje contextualizado [The importance of the environment. Universal design for contextualized learning]. *Revista Latinoamericana de Educación Inclusiva*, 16(2), 21-31. <https://doi.org/10.4067/S0718-73782022000200021>
- Seymour, M. (2023). Enhancing the online student experience through the application of Universal Design for Learning (UDL) to research methods learning and teaching. *Education and Information Technologies*, 1-19. <https://doi.org/10.1007/s10639-023-11948-6>
- Spooner, F., Baker, J. N., Harris, A. A., 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>
- Spratt, J., & Florian, L. (2015). Inclusive pedagogy: From learning to action. Supporting each individual in the context of “everybody”. *Teaching and Teacher Education*, 49, 89-96. <https://doi.org/10.1016/j.tate.2015.03.006>
- Tjernberg, C., & Heimdahl, E. (2014). Inclusion in practice: A matter of school culture. *European Journal of Special Needs Education*, 29(2), 247-256. <https://doi.org/10.1080/08856257.2014.891336>
- Triana, H., & Supena, A. (2023). The Impact of Universal Design for Learning on Student Learning Effectiveness in Elementary Schools (Process and Outcomes). *Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*, 11(2), 596-611.
- Van Boxel, J. M., & Sugita, T. (2022). Exploring the implementation of lesson-level UDL principles through an observation protocol. *International Journal of Inclusive Education*, 26(4), 248-364. <https://doi.org/10.1080/13603116.2019.1655596>
- Villoria, E. D., y Fuentes, S. S. (2015). Diseño universal para el aprendizaje como metodología docente para atender a la diversidad en la universidad [Universal design for learning as a teaching methodology to address diversity in the university]. *Aula Abierta*, 43(2), 87-93. <https://doi.org/10.1016/j.aula.2014.12.002>
- Vivanco, G. (2015). Educación y tecnologías de la información y la comunicación ¿es posible valorar la diversidad en el marco de la tendencia homogeneizadora? [Education and information and communication technologies: is it possible to value diversity within the framework of the homogenizing trend?]. *Revista Brasileira de Educação*, 20(61), 297-315. <https://doi.org/10.1590/S1413-24782015206102>
- Zamora, R., Vélez, J., Paez, H., Coba, J., Cano, C., & Palmera, O. M. (2017). Implementation of an open educational resource through the model of universal design for learning taking into account competency-based assessment and the individual needs of students. *Spaces*, 38(5), 3-12. <https://www.revistaespacios.com/a17v38n05/17380503.html>