

UDL-based interventions for Faculty Development in Higher Education: a Systematic Review

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Abstract: Universal Design for Learning is a theoretical approach aimed at ensuring full accessibility in education. Despite its global recognition and potential benefits for student engagement and teacher professionalism, the literature on its applications is still limited, especially when considering higher education. This systematic review offers a comprehensive overview of UDL-based interventions at the university level, focusing on their methodologies, structures, and impacts on students, faculty, and other university personnel. This review found a small number of studies on UDL in higher education, which nevertheless highlight the utility and benefits of UDL in higher education. These studies used various research designs, samples, and instruments, showing significant differences in the duration, frequency, and content of UDL interventions. These interventions primarily enhanced knowledge and skills of academic staff, while impacts on students' learning and participation or, more in general, faculty development was taken into consideration in a minority of cases. In conclusion, this review underscores that UDL implementation is essential to foster a more inclusive and effective learning environment in higher education, addressing the needs of all students and their heterogeneity. However, future research on UDL-based interventions would benefit from methodological rigor, fidelity in the

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implementation of the model, an accurate documentation of the interventions and assessment of their impacts.

Keywords: Universal Design for Learning; Higher Education; Faculty Development; Intervention; Systematic Review.

1. Introduction

Universal Design for Learning (UDL) is a framework aimed at enhancing teaching and learning for everyone, using scientific insights into learning mechanisms and differences (CAST, 2018). Initially created for students with disabilities, UDL has evolved to address the needs of all students, removing barriers in lesson design, teaching, and assessment.

UDL's three principles - representation, action and expression, and engagement - are based on neuroscience's identification of recognition, strategic, and affective networks. The UDL guidelines, structured around these principles, include detailed checkpoints with numerous examples (CAST, 2018). UDL shifts the focus from individual deficits to creating accessible contexts, proactively planning to meet all learners' needs. It aims to adapt the environment rather than the learner, ensuring meaningful engagement in learning.

While UDL is globally recognized, its implementation is more common in primary and secondary education than in higher education (Almeqdad et al., 2023). Research shows UDL benefits for both students' learning and teachers' professional development. Studies highlight improvements in student performance, awareness, confidence, motivation, and engagement (King-Sears et al., 2023; Ewe and Galvin, 2023; Marino et al., 2014). Positive outcomes are also noted for students with intellectual disabilities, particularly in literacy (Browder et al., 2008; Coyne et al., 2012; Dolan et al., 2005; Dymond et al., 2006).

In higher education, UDL enhances student learning and well-being, promoting interaction, self-determination, and reducing stress (Cumming and Rose, 2022; Ewe and Galvin, 2023; King-Sears et al., 2023; Marino et al., 2014). It benefits students from lower socio-economic backgrounds and minority groups and reduces the need for specific accommodations by planning inclusively from the start. For teachers, UDL increases awareness of accessibility and learning needs, fostering more inclusive educational environments (Coyne et al., 2012; Izzo, Murray & Novak, 2008; Rusconi & Squillaci, 2023).

This study reviews UDL-based interventions in higher education, focusing on their impact on academic staff and faculty development. The review represents the first phase of a broader project entitled "Design Accessibility Network to Enjoy University" (D.A.N.T.E.-U), financed at national level among those projects considered of relevant interest (PRIN). The project involves a network of Italian universities (University of Salento, the leading unit, with the collaboration of University of Roma 3, University of Perugia, University of Padova, and the Free University of Bozen-Bolzano) and promotes the design and implementation of an inclusive curriculum in higher education through the application of the principles of UDL.

2. Universal Design for Learning (UDL) in Higher Education

Designing accessible curricula using UDL is increasingly explored in tertiary education. Universities are responsible for educating students from various backgrounds, including non-traditional students (e.g., students working part-time or full-time, parents and caregivers) and students with disabilities. Incorporating UDL in the curriculum is, therefore, essential to meet the very diverse needs of university students (Sanger & Gleason, 2020; Rao et al., 2014).

UDL approach provides a way to accommodate diverse learning needs and abilities, enhancing engagement through multiple means of representation and expression (Marino et al., 2014). It promotes proactive inclusive design for university classrooms (Dalton et al., 2017), reducing the demand on accessibility services by accommodating most students' needs with inclusive strategies (Houghton & Fovet, 2013). UDL represents a significant shift towards greater inclusivity for all undergraduate and postgraduate students, thus, by focusing on flexible, inclusive study plans, universities can reduce dropout rates and the number of students taking extra time to complete their courses, thus securing funding. In addition, implementing UDL invests in improving teaching skills and diversifying educational methods. The goal of the UDL curriculum extends beyond mastering specific knowledge or skills; it aims to train expert learners and teachers. UDL aspires to create a university environment that is accessible, usable, and appealing to the widest range of students, thereby expanding the market reach. Addressing accessibility in both products and services is crucial for student recruitment and university rankings.

3. UDL-based Faculty Development in Higher Education

Change and transformation in learning and teaching rely on support and coordination from both the institution and the system (De Rossi & Fedeli, 2022). The term 'Faculty Development', coined forty years ago, was originally defined as a transformational process that renews teachers' focus on the needs of students, themselves, and the institution (Francis, 1975; De Rossi & Fedeli, 2022). Currently, there is a shift towards contextualizing formal and informal practices across three key areas: didactics, personal-professional growth, and organizational development (Lewis, 1996; De Rossi & Fedeli, 2022). These three areas, when well-integrated, form the foundation for implementing academic policies that enhance the interdependence of faculty roles, focusing on personal teaching skills, organizational development, integration of research and teaching, and active participation in institutional content management (De Rossi & Fedeli, 2022; Lotti & Lampugnani, 2020). Didactics is a challenging dimension for many academics, requiring them to rethink and organize their teaching to address student diversity in both school and university settings. Key transformative aspects of this element include flexibility in teaching, valuing differences, social sustainability of education, and global competition (De Rossi & Fedeli, 2022). Valuing differences involves enhancing and promoting diverse aspects of global societal development. Flexibility is crucial to meet the evolving needs of students and institutions (De Rossi & Fedeli, 2022). Integrating Universal Design for Learning (UDL) principles into professional development ensures training sessions are accessible, engaging, and effective for all learners.

Courses focused on UDL are vital for reflecting on teaching professionalism, methodologies, and the diversity of university classrooms. However, there are few training courses specifically aimed at professionals investing in UDL at universities. Most analyzed studies show that university training courses typically include only a small component of UDL within broader inclusive teaching programs. Incorporating

UDL principles into professional development helps create inclusive learning environments that support the diverse needs, preferences, and abilities of all participants, enhancing learning outcomes and promoting equity and accessibility.

4. Previous Reviews on UDL in Higher Education

In examining the application of Universal Design for Learning (UDL) in higher education, it is crucial to consider the existing literature reviews and meta-analyses that explore this framework. The current body of research on UDL within university settings is relatively sparse, with many reviews encompassing a wide educational spectrum from K-12 to higher education without a dedicated focus on the latter (Fornauf & Erickson, 2020; Seok et al., 2018). This broad approach often dilutes the specific insights needed for higher education contexts. Six prior reviews on the implementation of UDL in Higher Education have been identified (Table 1).

Table 1. Summary of UDL reviews (n= 6)

References		Purpose of review	Methods	Number of studies reviewed
Authors	Year			
Cumming & Rose	2022	Evidence for UDL efficacy in tertiary education	Rapid review	52
Dempsey et al.	2023	Use of UDL in anatomy curricula for healthcare programs, impact on student motivation	Scoping review	33
Fornauf et al.	2020	Literature on UDL in postsecondary settings, conceptualization by faculty and researchers	Literature review	38
Gawron et al.	2024	Identify gaps in UDL research in graduate-level allied health and medical education	Scoping review	6
Seok, DaCosta & Hodges	2018	Methods of UDL implementation for students with/without disabilities	Systematic review	17
Schreffler et al.	2019	UDL in postsecondary STEM education, synthesis and model development	Literature review	4

Notably, some studies have concentrated on particular areas within tertiary education. For instance, Schreffler et al. (2019) conducted a systematic literature review aimed at synthesizing the empirical literature on UDL in postsecondary STEM programs, highlighting its impact on these educational contexts. Similarly, scoping reviews by Gawron et al. (2024) and Dempsey et al. (2023) have been instrumental in identifying research gaps and assessing the efficacy of UDL in specialized fields such as graduate-level allied health, medical education, and anatomy curricula in healthcare programs.

However, research on UDL is often hindered by inconsistent definitions and objectives, leading to ambiguity in its application and outcomes. Many educators perceive UDL primarily as an intervention or program rather than as a comprehensive framework to be implemented with fidelity (Fornauf et al., 2020; Cumming & Rose, 2022). Addressing this conceptual ambiguity is essential to fully comprehend UDL's effectiveness in higher education and dispel associated misconceptions. A recurrent misconception in the reviews is the erroneous association of UDL solely with accommodations for students with disabilities (Schreffler et al., 2019; Seok et al., 2018; Fornauf et al., 2020; Cumming & Rose, 2022). This misinterpretation conflates UDL with special education, overlooking its broader applicability. While UDL may have historical ties to special education through CAST, its focus is on learner variability rather than disability. Thus, UDL should be viewed as an inclusive pedagogical approach designed to transform teaching and learning for all students at the postsecondary level, challenging traditional notions of normalcy (Fornauf et al., 2020; Gawron et al., 2024). In supporting inclusive pedagogy, UDL acknowledges learner variability as a fundamental educational principle, particularly relevant in higher education (Cumming & Rose, 2022; Dempsey et al., 2023). While it is often aligned with Disability Studies in Education, UDL serves as a potent tool for removing learning barriers, benefiting a diverse student body (Fornauf et al., 2020; Gawron et al., 2024).

Despite the importance of UDL, previous reviews have largely neglected non-traditional students. Fornauf et al. (2020) mention UDL's potential to address increased diversity, although without explicitly discussing its efficacy for non-traditional student groups. The literature predominantly derives from American studies and tends to be descriptive, focusing on anecdotal evidence of satisfaction from students and faculty after UDL implementation (Cumming & Rose, 2022; Gawron et al., 2024; Schreffler et al., 2019; Seok et al., 2018). The positive outcomes associated with UDL include enhanced student motivation, engagement, and the recognition of diverse needs. UDL also fosters a sense of support and reduces stress by providing accessible feedback from instructors (Cumming & Rose, 2022). However, the practical challenges in UDL implementation often stem from faculty attitudes towards students with disabilities, highlighting the need for appropriate staff training to foster an inclusive learning environment (Cumming & Rose, 2022; Gawron et al., 2024). Additionally, Gawron et al. (2024) identify student challenges in adapting to varied engagement methods as another barrier to UDL's successful implementation. Clarifying UDL's core objectives can help students understand their professors' pedagogical choices and recognize their unique learning styles.

In summary, while there is evidence suggesting that UDL can positively impact academic achievement, in particular for students with disabilities, the literature on its application in higher education is limited. Most studies emphasize student perspectives, with insufficient focus on the implications for faculty professional development and the broader effectiveness of UDL as an educational approach. Further research is needed to comprehensively evaluate UDL's benefits for both student outcomes and faculty competencies in postsecondary settings

5. Aims and Research Questions

The aim of this study to systematically review research on UDL-based interventions in tertiary education involving teaching/academic staff which were expected to generate an impact on faculty members, faculty development, and/or students.

Three main questions were formulated to guide the study:

- RQ1: which studies investigate the effect of UDL-based interventions for teaching/academic staff on their professionalism (e.g., teaching skills, attitudes, agency, etc.) in tertiary education?
- RQ2: which studies investigate the effect of UDL-based interventions for teaching/academic staff on faculty development in tertiary education (e.g., quality and accessibility of university courses and programmes, organisation, etc.)?
- RQ3: which studies investigate the effect of UDL-based interventions for teaching/academic staff on students' experience in tertiary education (e.g., learning, academic performance, well-being, attendance, participation, motivation, etc.)?

6. Method

6.1. Eligibility Criteria

The following eligibility criteria were adopted for the selection of relevant studies to be included in this systematic review:

- *Study design*: Studies could be qualitative (e.g., action-research, interpretative study, case study), quantitative (e.g., pre/post comparison, randomised controlled trial, quasi-experiment, correlational), mixed-method or multi-method.
- *Intervention*: Studies were required to explicitly refer to any kind of intervention (e.g. training course, participatory process, etc.) involving one or more dimensions of UDL. The UDL framework could have applied to all aspects of university institutions (e.g. course organization, faculty/university organization, teaching strategies, university policies, etc.) and could consider the needs of all students and/or of specific categories of students (e.g. students with disability, non-traditional students, etc.).
- *Setting*: Studies needed to be conducted in tertiary education (e.g., higher education, university, college, and other forms of post-secondary education) which were offered in presence, distance or blended learning.
- *Participants*: Interventions had to address the teaching and academic staff of a tertiary education institution; any field or subject of teaching could be included in the study.
- *Outcomes*: Interventions were expected to have an impact on academic staff (e.g., educators' attitudes and/or skills, agency), faculty development (e.g., teaching strategies, effective course organisation, accessibility, etc.) and/or on students (e.g. achievement/performance, regular attendance, motivation, etc.)
- *Timeframe*: Studies had to be published between January 2014 and December 2023; the year of commencement was defined in relation to the diffusion of the UDL model worldwide.
- *Language*: Studies could have been conducted in any country but had to be published in English.

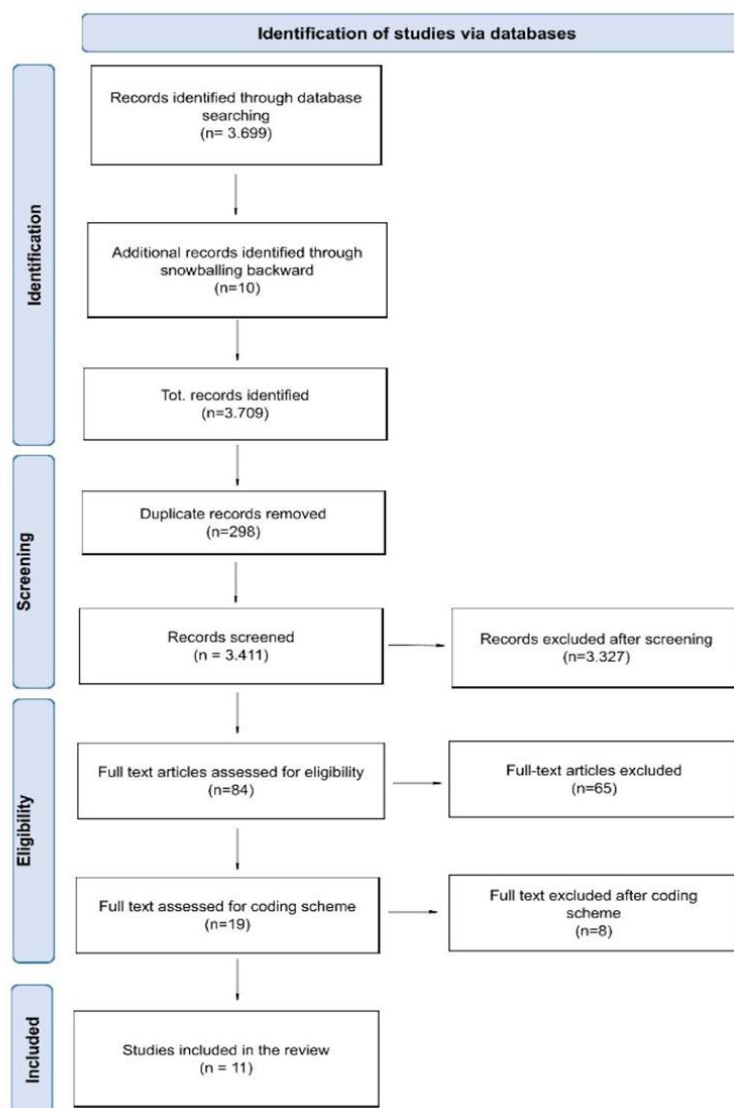
6.2. Information Source and Search Strategy

Relevant works were sought electronically through bibliographic databases, journal indexes, internet search engines in January 2024. General and educational databases were explored – Ovid Psycarticles, SCOPUS, Web of Science, ERIC, ProQuest Education Journal, JSTOR, Ebsco – using a combination of keywords. The database search involved a set of keywords related to the framework used for training (e.g. Universal Design for Learning, UDL, Inclusive Design, Design for all); the context (e.g. Post-Secondary/Postsecondary Education, Tertiary Education, College and University Education, Advanced Education, University); participants' outcomes (e.g. Faculty development, Professional Development, Teacher Training, Faculty Training, Staff Development, Academic Development) were identified and combined using logical Boolean operators. The search strategy was modified according to the specifications of each database, such as filters or strings. Additional hand-searches were conducted using Paper Fetcher, an online research engine, to find additional papers. Additionally, screening of tables of contents from the following international journals was performed: Journal of Diversity in Higher Education, Journal of Access Retention and Inclusion in Higher Education, European Journal of Special Needs Education, The Journal of Higher Education.

6.3. Study Selection Process

Studies were imported from databases into Rayyan to eliminate duplicates and to compile a comprehensive list of studies for screening. One of the authors screened the titles and abstracts of the studies using Active Learning for Systematic Reviews (ASReview), a software developed at Utrecht University that employs interactive machine learning to aid in the screening process of a systematic review. At this initial stage, only studies that did not investigate the impact of Universal Design for Learning (UDL) on faculty training were excluded. Subsequently, two authors executed an independent full-text review by two authors. Prior to the full-text review, reviewers underwent training aimed at establishing consensus on the application of eligibility criteria. Any disagreements were resolved through discussions among the three authors. 11 studies meeting the eligibility criteria were included in the review (Figure 1).

Figure 1. Selection process (Adapted from Page et al., 2020)



6.4. Data extraction

The studies selected were coded independently by two researchers, referring to a shared table containing a list of aspects related to the setting (country, type of university context, faculty, teaching area), to the type of training, intervention or programme implemented on the UDL (duration, intensity, content, etc.), to the participants in the study (university lecturers, administrative staff, etc.), to the beneficiaries of the interventions (students with disabilities, non-traditional students, all students), to the type of outcome measured or observed (e.g. improvement in teaching skills, strategies, motivation or learning outcomes) and to methodological aspects (research design, sample, information source, instruments, etc.). Before initiating the coding process, the reviewers conducted calibration exercises. After completing the independent review, authors resolved disagreements with the support of a third reviewer.

7. Results

7.1. Description of studies

In Table 2, the characteristics and individual effects of the studies included in our systematic review are summarized.

Table 2. Overview of the included studies

Study	Country	Type of tertiary education	Research design	Type of intervention	Academic staff involved	Outcome category
Altowairiki (2023)	Saudi Arabia	University	Case study	Interviews, document analysis	In-service training	University/Faculty development
Carballo, Morgado & Cortés-Vega (2021)	Spain	University	Qualitative evaluation	Questionnaire (open questionnaire), observation	In-service training	University educators' professionalism
Fornauf et al. (2023)	USA	Rural teacher residency program	Self-study	Self-study	Self-study as a situated inquiry into teaching practices	Not specified
Hromalik et al. (2021)	USA	Community college	Pre-post comparison	Questionnaire	In-service training	University educators' professionalism
Hromalik, Myhill & Carr (2020)	USA	Community college	Pre-post comparison	Questionnaire	In-service training	University/Faculty development
Hutson et al. (2015)	USA	College	Not specified	Assessment of FLC members	Faculty Learning Community (FLC)	University educators' professionalism

Kim, Kong & Tirota-Esposito (2023)	USA	University	Interpretative study	Questionnaire with qualitative feedback	In-service training	University educators' professionalism, University/ Faculty development
Leslie (2020)	USA	University	Not specified	Questionnaire, grades, group and individual assignments, self-reflection	In-service training	Impact on students
Moriña & Carballo (2017)	Spain	University	Qualitative evaluation	Questionnaire with open-ended questions	In-service training	University educators' professionalism, impact on students
Wynants & Dennis (2018)	USA	University (single faculty)	Interpretative study	Interviews	In-service training	University educators' professionalism
Xie & Rice (2021)	USA	(Liberal art) University	Multi-method	Questionnaire, focus group, workshop recordings	In-service training	University educators' professionalism

The majority of the studies considered were conducted in the United States (Kim et al., 2023; Leslie, 2020; Wynants & Dennis, 2018; Hromalik et al., 2020; Xie & Rice, 2021; Fornauf et al., 2023; Hromalik et al., 2021; Huston & Downs, 2015). Two studies originate in Spain (Moriña & Carballo, 2017; Carballo et al., 2021) and a third from Saudi Arabia (Altowairiki, 2023).

We also analysed the combination sample of the type of tertiary education in all studies included. In seven studies, the authors refer to university (Xie & Rice, 2021; Altowairiki, 2023; Wynants & Dennis, 2018; Leslie, 2020; Kim et al., 2023; Moriña and Carballo, 2017; Carballo et al., 2021), in one study they refer to college (Huston & Downs, 2015), in other two studies researchers refer to a community college (Hromalik et al., 2020) and in the last study, authors refer to a rural teacher residency program, as a partnership between University of New Hampshire, rural school districts, community-based

organisations and the New Hampshire State Department of Education (Fornauf et al., 2023).

Studies used different study designs, adopting different methods, with a variability in terms of the sample size and measures used. Of these 11 studies selected, two studies used a quantitative design (pre-post comparison), one used a multi-method approach, two - although combining different instruments - did not specify the method, whereas the remaining six studies used a qualitative design (qualitative evaluation, self-study, case study, interpretative study).

All studies included in our systematic review used different methods to search for information on UDL-based interventions for teaching and academic staff in tertiary education. Many studies used a questionnaire linked to qualitative written feedback or an open-ended questionnaire or an observation. Others preferred to use focus groups, workshops, recordings, self-study or interviews with their members. In nine of these studies, the interventions are aimed at in-service teaching; one is aimed at individual teaching practices (Fornauf et al., 2023) and one is aimed at the Faculty Learning Community (Huston & Downs, 2015).

During the coding phase, the outcomes were placed in three main categories: "University educators' professionalism", "University/Faculty development" and "Impact on students". Each category is created to answer our research question. Five studies place the results in the first category "University educators' professionalism", two studies place the outcomes in the second category "University/Faculty development" while only one study considers the "Impact on students". Finally, two studies collocate outcomes in two categories (University educators' professionalism and University/Faculty development; University educators' professionalism and Impact on students). Results from one of the studies are, instead, not specified.

8. Overall findings

8.1. UDL-based interventions for Faculty Development in Higher Education

The included studies presented different types of interventions. Nevertheless, not all studies provided extensive information on the type of intervention, contents and duration. The large majority described a type of in-service training for academic staff (e.g., Xie & Rice, 2021; Hromalik et al., 2021; Altowairiki, 2023). Only two studies applied other types of intervention, based on group or individual inquiry practices: Hutson and Downs (2015) resorted to a structured and intensive shared inquiry model entitled "Faculty Learning Community", which engaged faculty staff in a collaborative long-term program to improve the quality of learning and teaching, whereas Fornauf et al. (2023) fostered a self-study aimed to reflect on individual teaching practices through interaction with colleagues.

The training and participatory interventions varied significantly in terms of duration: several sessions or workshop meetings lasted between 2,5 and 18 hours (e.g., Xie & Rice, 2021; Wynants & Dennis, 2018), some days of training or meetings (Hromalik et al., 2020) or included more than 50 hours of training/meetings (e.g., Morina & Carballo, 2017; Carballo et al., 2021; Kim et al., 2023), spread over a variable timeframe ranging from six months to two years. The remaining studies did not report the number of hours, sessions or meetings, or the length of the period of intervention, generally describing the structure of the training (e.g., Hutson et al., 2015) or affirming that it was characterised by flexibility (e.g., Altowairiki, 2023).

All studies provided information on the contents of in-service training or professional experience, explicitly quoting Universal Design for Learning as the central focus (e.g., Xie & Rice, 2021; Fornauf et al., 2023) or as part of the contents covered (e.g., Carballo et al., 2021; Hromalik et al., 2020). Some interventions exclusively addressed aspects related to course design and implementation, such as teaching strategies, materials or contents (e.g., Xie & Rice, 2021; Fornauf et al., 2023; Hutson et al., 2015), while others combined these aspects with themes related to broader UDL implementation in tertiary education, such as support opportunities, institutional leadership and organisation (e.g., Moraña & Carballo, 2017; Hromalik et al., 2020; Altowairiki, 2023). Only a few interventions included topics related to specific categories or minorities of students, such as students with disability (e.g., Carballo et al., 2021; Hromalik et al., 2020) or with ADHD (Hutson & Downs, 2015). The remaining studies generically covered topics whose improvement might have been beneficial to all students (e.g., accessibility, variety of learning opportunities).

8.2. Outcome categories

The studies included in this research assess the impacts of UDL training across three main categories of outcomes: impact on teaching and academic staff, impact on faculty development, and impact on student outcomes. These impacts have often been assessed through qualitative measurements. There does not appear to be methodological rigor in assessing the impact of the training. Ten out of eleven studies declare the instrument used to assess the impact of UDL training. Of these studies, two measure the impact through a pre-post comparison research design. Two studies have assessed the impact through interviews, and four studies through open or closed-ended questionnaires. Three studies do not explicitly state which instruments they used to assess the impact.

Based on the findings from the examined studies on Universal Design for Learning (UDL), the implementation within higher education settings reveals a range of positive effects across various domains. Primarily, there is a notable enhancement in the competence and knowledge of teaching staff regarding the application of UDL principles for accessibility and course design (e.g., Xie & Rice, 2021; Fornauf et al., 2023; Hromalik et al., 2021; Hutson & Downs, 2015). This improvement signifies a positive impact on the professional skills and confidence of instructors. Moreover, there is a consistent trend towards increased satisfaction among faculty members regarding the utility and effectiveness of UDL principles in their teaching practices (e.g., Hromalik et al., 2020). This shift in attitudes towards inclusive pedagogy reflects a growing recognition of the value that UDL affords to educational settings. Structured training programs, such as intensive workshops and collaborative practice communities, are effective strategies for fostering faculty development and enhancing teaching practices in higher education. These programs provide educators with targeted training and support to integrate Universal Design for Learning (UDL) principles into their teaching methodologies. Through interactive sessions and peer collaboration, faculties gain valuable insights and skills to create more inclusive learning environments. The Community of Practice model further facilitates long-term shared inquiries among faculty members, promoting collaboration, innovation, and continuous improvement in teaching and learning quality. In summary, these approaches empower teaching and academic staff to address diverse student needs and enhance student engagement and success within higher education institutions.

In addition, UDL implementation also yields positive outcomes for target students. These outcomes include heightened motivation, engagement, and academic achieve-

ment, indicating the potential of UDL to create inclusive learning environments tailored to diverse student needs (Leslie, 2020; Moriña & Carballo, 2017). By offering diverse learning opportunities tailored to individual needs, UDL fosters a supportive environment conducive to student success. Although assessment methodologies varied across studies, the overall trend suggests UDL's efficacy in enhancing student outcomes. Furthermore, UDL promotes the development of inclusive learning environments by encouraging the creation of accessible curricula and diverse teaching approaches. This fosters a sense of belonging and respect among students, while also promoting collaboration and cooperation. Additionally, UDL ensures improved access and support for target students by addressing barriers to learning and providing tailored accommodations. This inclusive approach enables all students, including those with disabilities, to fully participate and succeed in higher education. Effectively, UDL plays a pivotal role in fostering equitable learning experiences and promoting student success in diverse educational settings.

Overall, the findings underline the significant positive effects of UDL implementation on teaching staff, faculty development, and target students within higher education. These effects not only promote inclusive teaching practices but also contribute to improved learning outcomes and the creation of supportive educational environments.

9. Limitations

This synthesis study, despite undergoing a rigorous process including the traditional steps of a systematic literature review, has limitations. A primary aspect to underline is the absence of a quality assessment of the studies. Therefore, we cannot ascertain the methodological rigour of the studies included in the review, nor can we attest to their quality. However, the authors' experience with the stages of study and coding leads us to believe that the studies have certain limitations, perhaps due to small sample sizes, for example.

A second limiting aspect of the study concerns the fact that, despite aiming to include and synthesize studies on Universal Design for Learning (UDL) in the context of tertiary education, both the theoretical approach and the training contexts are extremely heterogeneous. Specifically, the theoretical approach to UDL lacks shared formulations and definitions, often leading to different interpretations of the theoretical framework, indicating that UDL is a multifaceted and multidimensional approach. In addition, although united by academic teacher training, the delivery, and therefore the impact of contexts, vary greatly from online to in-person courses, to mixed training packages.

10. Discussion

The principal purpose of faculty development is to improve practice, to manage change and to develop strengths and skills. These improvements may include: the development of new didactic assessment skills; improvements in planning or implementing a curriculum or course, and thus improving institutional performance; new perspectives regarding the student-faculty relationship; a greater commitment to assessment, course feedback and educational research (De Rossi & Fedeli, 2022). The theoretical principles of Faculty Development are strictly in line with those of Universal Design for Learning. An effective FD program should aim at the improvement, dissemination and support of personal teaching, leadership and organizational skills and competences, the ability to engage synergistically between research-didactics-tertiary mission, active participation in work units and institutions for co-responsibility in managing contexts. With a specific

focus on the didactics, diversifying training offerings is an opportunity to enhance education for a larger number of students, and to respond to people's need for life-long and life-wide learning (De Rossi & Fedeli, 2022). Despite the relevance of the topic, our review highlights that the topic of UDL-based Faculty Development is still an under-explored, albeit growing, area of research.

Most studies included in our review were published between 2020 and 2023. Although the focus of our review is very circumscribed, this might indicate a growing interest in the subject. Nevertheless, apart from two studies conducted in Spain (Moriña & Carballo, 2017; Carballo et al., 2021) and one in Saudi Arabia (Altowairiki, 2023), the remaining involved tertiary education institutions in the USA. This distinct figure suggests a significant underrepresentation of this topic in other countries or may be due to a language bias, as other national publications in other languages have not been considered in this review. Another possible explanation for the limited publications identified in our search may be the general trends in research on Universal Design for Learning, which tend to revolve around teachers' and/or students' experience with this approach and tend to describe existing practices rather than implementing specific interventions (Ewe & Galvin, 2023; Cumming & Rose, 2021).

Regarding methodology, none of the studies resorted to experimental or quasi-experimental designs. On the contrary, purely qualitative approaches were applied in five out of eleven studies. The remaining studies chose pre-post comparison or mixed methods approaches. In general, even if our review did not foresee a quality assessment of the studies, the rigorousness of the methods appears to be one of the main weaknesses, as studies often rely on questionnaires, both qualitative and quantitative with regard to the choice of instruments. In some cases, the authors combine two or more instruments (e.g. Moriña & Carballo, 2017; Xie & Rice, 2021).

With reference to the type of intervention, the large majority of included studies resorted to the traditional training courses for in-service teachers of varying duration. Only two studies (Hutson & Downs, 2015; Fornauf et al., 2023) implemented other types of approaches, fostering participation and self-reflection, as well as collaboration within the academic community. Nevertheless, all studies addressed teachers' competences and professionalism, excluding all other relevant stakeholders playing a role in the university organisation from the discourse, such as administrative staff, ICT staff, or other non-academic staff. Furthermore, the variety of content covered in UDL, often combined with other topics, and the scarcity of information on the level of depth of the UDL model does not allow an accurate comparison between the different training models. Finally, most interventions appear to be confined in terms of both duration and people involved, a choice which risks not guaranteeing an enduring impact on university policies and practices.

According to the results of our review, UDL-based interventions have promising impacts on academic staff, students and faculty development. Training programs focusing on Universal Design for Learning (UDL) have enhanced the professionalism of teaching staff (Hutson & Downs, 2015). These programs often aim to improve teaching skills, increase awareness about accessibility issues, and develop strategies for inclusive education (Hinshaw & Gümüş, 2013). Studies show that participation in UDL training helps educators to gain a deeper understanding of diverse learning needs and equips them with the tools to create more inclusive learning environments (Hromalik et al., 2020). This professional development not only enhances teaching efficacy but also boosts teachers' confidence in implementing inclusive practices.

Faculty development through UDL training programs aligns closely with the principles of continuous improvement and adaptability in educational settings (Hromalik et al., 2020). Effective faculty development programs emphasize the importance of developing personal teaching skills, leadership capabilities, and organizational competencies. These programs often include intensive workshops, collaborative practice communities, and long-term shared inquiries that promote sustained professional growth. The goal is to foster an environment where educators continuously refine their teaching methods, engage in innovative practices, and contribute to the overall enhancement of institutional performance.

The implementation of UDL training has also shown positive impacts on student outcomes (Leslie, 2020; Moriña & Carballo, 2017). These include improved academic performance, increased engagement, and higher levels of motivation and satisfaction among students. UDL's focus on creating diverse and accessible learning opportunities helps in addressing the needs of all students, including those with different backgrounds and students with disabilities. By designing courses that accommodate various learning preferences and challenges, UDL training helps to reduce the need for individual accommodations and fosters a more inclusive and supportive educational environment.

Overall, UDL training programs play a critical role in enhancing the professionalism of educators, fostering faculty development, and improving student outcomes. The training programs implemented not only equip educators with the necessary skills and knowledge to implement inclusive practices but also contribute to a more equitable and effective educational system even if the evidence is quite reduced.

11. Conclusion

In this systematic review, we explored the impact of UDL-based interventions in higher education on faculty development and student outcomes. Our findings underscore the transformative potential of UDL in fostering an inclusive educational environment that benefits both academic staff and students.

The review reveals that while UDL's application in primary and secondary education is well-documented, its integration into higher education remains relatively nascent, especially in European contexts. The data indicate that UDL interventions enhance teaching skills, faculty awareness of diverse learning needs, and overall course accessibility. Academic staff who engage in UDL training report improved teaching efficacy, greater awareness of student diversity, and enhanced capability to create inclusive learning environments.

For students, the benefits of UDL are multifaceted. The framework helps reduce educational barriers and promotes a sense of belonging and engagement among students from various backgrounds, including those with disabilities and non-traditional students. This inclusive approach not only improves academic performance and retention rates but also supports students' well-being and motivation.

Despite these positive outcomes, the review identifies several barriers to the widespread adoption of UDL in higher education. These include a lack of comprehensive training programs specifically targeting university faculty, limited understanding of UDL's broader application beyond accommodations for disabilities, and resistance to change within institutional structures. Addressing these challenges requires a concerted effort to promote UDL awareness, integrate UDL principles into faculty development programs, and foster a culture of inclusivity at the institutional level.

In conclusion, the adoption of UDL in higher education is a critical step toward creating a more inclusive and effective learning environment. Future research should continue to explore the long-term impacts of UDL interventions on both faculty development and student outcomes, particularly in diverse educational contexts. Embracing UDL not only aligns with contemporary educational demands but also ensures that higher education institutions are well-equipped to support the diverse learning needs of all students.

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