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ACCESSIBLE BY DESIGN: INTEGRATING UNIVERSAL DESIGN FOR LEARNING INTO DIGITAL CONTENT FOR DIVERSE LEARNERS

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Abstract

This research paper investigated how Universal Design for Learning (UDL) was incorporated into digital content for diverse learners in higher education settings. The authors sought to understand how the UDL principles supported accessibility, inclusion, and flexibility in the digital learning environments. A quantitative approach was selected, and 350 respondents completed the questionnaire that was grounded on the three main principles of UDL: representation, engagement, and action and expression. Results showed that participants had a very good view of UDL-based digital content, and different ways of representation were most highly rated. Gender role age, qualification, and digital learning experience showed significant variation, whereas institution type showed no significant difference. The authors of the article argued that UDL offers a good basis for making digital content accessible for a wide range of learners. They suggested that institutions should move towards the use of UDL-based practices and enhance the capacities of teachers for the provision of inclusive digital education.

INTRODUCTION

The rapid expansion of digital education has changed the way learners get content, communicate with instructors, and show their understanding. But just going digital doesn't mean things become inclusive. A lot of online educational content still presents obstacles to learners who have disabilities, those that are learning a second language, students from low-income families, and learners with different cognitive, sensory, and motivational needs. Universal Design for Learning (UDL) in this situation is a set of principles which supports the creation of flexible, accessible and motivating learning experiences right from the start instead of just adjusting them after a person has been excluded. Recent academic work has found that UDL is increasingly considered to be a link

between digital environments' accessibility, usability, and inclusive pedagogy, especially since it's becoming a standard rather than an exception for learner variability (Choi & Seo, 2024; Yang et al., 2024; Zhang et al., 2024).

UDL originates from the understanding that learners are different in the way they get information, their motivation level, and the expression of their knowledge. Hence, digital content must offer several ways of representation, engagement, and action/expression so that learners of different abilities can thrive. A recent meta-analysis and a review of systematic evidence have shown that the use of UDL at the teaching and learning design level is linked with positive outcomes in achievement creativity engagement, and teacher preparation, even though the quality of implementation varies from one context to another. UDL is highly important for designing digital content, where accessible features such as captions transcripts alt text, navigation options, multimodal resources, and varied assessment pathways not only accommodate students with disabilities but also include the entire learner population (Almeqdad et al., 2023; Ahmad et al., 2025).

Globally, the talks about offering digital education for all have gained a new urgency since the pandemic has led to a drastic increase of dependence on online and blended learning. At present, international organizations are highlighting that technology should be created on the principles of equity, sustainability, and accessibility, in addition to just availability. Recently, UNESCO in its work on technology in education has suggested that digital systems bring inequality to the surface if marginalized learners are not considered in terms of infra-structure, content design, and teacher preparedness. Similarly, in its guidance on digital technologies for inclusive education, UNESCO points at the need for ICT-based environments that not only provide accessibility, assistive technologies, and learner-centered design but also make these elements the foundation of educational planning. In view of these changes, UDL is regarded as a very relevant and effective approach for making digital content accessible and inclusive not just at the level of schools and colleges but also for lifelong learners (UNESCO, 2023; UNESCO IITE, 2024).

The background of this research taps into the rising awareness that the exclusion of students from education is mainly caused by what is in the learning environments, not by the learner's deficiencies. Typical digital content has been commonly created with the idea of an average learner in mind, and as a result, the standard materials, relying solely on text that cannot be changed, a lot of visually dependent content, single-mode assessments, language heavy interfaces, and strictly controlled pacing have essentially become barriers. Indeed, current UDL literature not only refutes this one-size-fits-all mentality but also pushes designers and educators to think of variability as something that is there from the very start it is not something added at the end. More recent research has also indicated that inclusive learning design is much more effective when accessibility, usability, and pedagogical flexibility are all considered together rather than separately (Aftab et al., 2024; Sajjad et al., 2025).

The research is also firmly based on a real-life issue: the main role of digital content in both formal and informal learning has been widely recognized however a lot of educational institutions still don't have a clear framework for making such content equitable. Systematic reviews of Universal Design for Learning (UDL) in online education have found that although the field has expanded, the execution is still patchy, and instructors often find it difficult to abstract inclusive principles to digital course materials, assessment structures, and learner supports. This is why it makes sense to investigate how UDL can be used as a tool to create digital content that is accessible by design, especially for diverse learners who are most likely to be excluded by inflexible digital systems (Yang et al., 2024; Aftab et al., 2024).

Globally, the concept of inclusive digital education has gradually shifted from being a specialist concern to a major policy focus of most countries. For instance, UNESCOs 2023 Global Education Monitoring Report indicates that technology in education has the potential to bring about fairness and equality only if it is geared with well-defined educational objectives, inclusion

features, and awareness of the specific local conditions. In the same way, UNICEFs latest digital education strategy depicts accessible and data-driven digital solutions as the key instruments to reach out to girls, children with disabilities, out-of-school children, and students in remote areas. These policy signals suggest that the global community is moving on from just providing digital access to ensuring the quality and inclusiveness of digital learning experiences (UNESCO, 2023; UNICEF, 2024).

Existing research indicates that there has been a surge in global interest towards Universal Design for Learning (UDL) as a method to foster inclusiveness in online and blended learning. Currently, there are a few UDL discussions happening around the world. Some of the latest literature mention that UDL has been implemented in higher education, K12 settings, and digital course design to support diverse participation, yet the same literature also points out the continued challenges such as poor alignment of theory and practice, limited teacher preparation, and uneven usage of evidence-based checkpoints. So, although the worldwide debates show enthusiastic support for inclusive digital design, there is still a demand for the context-sensitive studies looking at how UDL can be brought into actual digital content for diverse learners (Alahmari et al., 2025; Zhang et al., 2024; Almeqdad et al., 2023).

In Pakistan, the digital education landscape has been growing, but many students are still left out. A recent report by UNICEF Pakistan stated that not everyone gets the same opportunities to access educational technology as their location, the type of school they attend, and their level in school play a role in it. It also mentioned that only one-third of households had internet access during its 2023 conversation on the issues of digital education. Meanwhile, the Learning Passport programme in Sindh showed that digital content that is flexible, rich in multimedia, and aligned with the curriculum can get learners especially girls more engaged, if the learners are supported by the provision of devices, teacher assistance, and access to the local language. This is a clear indication of the potential of digital content as well as the existing systemic factors that confine the equitable participation of everyone (UNICEF Pakistan, 2023; Zou et al., 2026).

At the policy level, the Higher Education Commission of Pakistan has launched a Policy for Students with Disabilities at Higher Education Institutions in Pakistan to provide a more enabling and inclusive environment for these learners. Recent studies from Pakistan show that, in principle, this policy has a positive impact, but the extent of its implementation varies from one institution to another. Local universities research points out that students with disabilities still encounter difficulties related to infrastructure, learning materials, teaching methods, assistive technologies, and social attitudes. On the other hand, new studies from Pakistan on teaching practices based on UDL reveal that a more flexible instructional design can lead to improvements in outcomes such as creativity and participation, which means UDL might provide a real way of rising inclusive digital content in the local context (Higher Education Commission, 2021; Manzoor et al., 2024; Naz et al., 2023; Ahmad et al., 2025).

While international studies have explored topics such as universal design for learning (UDL), online education, and digital accessibility, there is still a lack of substantial evidence regarding the adoption of UDL as a guiding principle in the design of digital content for educational purposes in the low and middle-income settings like Pakistan. Much of the literature available till now either has a broad and general focus on issues relating to inclusive education, examines online teaching at a very general level or treats accessibility as a purely technical issue without fully connecting it to UDL-led teaching. Recent reviews have also indicated that the majority of the UDL studies not only lack sufficiently clear descriptions of how the UDL principles are being put into practice but also fail to show a consistent link to the checkpoints and have very little specific analysis of the digital materials from the perspective of different contexts (Naz et al., 2024; Bagadood et al., 2025).

In particular, the studies available in Pakistan are mainly focused on institutional barriers, implementation of disability policies, or the

effectiveness of teaching based on UDL to some extent. However, there is still a lack of research that focuses on how to design digital learning content based on UDL principles for diverse learners with differences in disability gender language, and socioeconomic status. This is a significant gap because even if a policy is inclusive and there is a digital expansion, learning experiences will not be accessible unless the content is designed flexibly and intentionally (Manzoor et al., 2024; Naz et al., 2023).

Even though digital education continues to expand, a lot of digital content remains inaccessible or not very adaptable for a wide range of learners. For example, in lots of cases, digital resources are heavily reliant on text, fixed formats, standard pacing, and the limited modes of participation and assessment. This design issue mainly targets students with disabilities, learners who have limited connectivity, those studying in multilingual contexts, and students who need alternative ways of engagement and expression. Hence, digital learning environments may, without even realizing, exclude the learners they are intended to help (Choi & Seo, 2024; Aftab et al., 2024).

In Pakistan, the issue is aggravated by digital inequality, different capacities of institutions, and delays in making the policy for inclusive education reflect the actual situation in schools. Policy and program advancements that show great promise are happening however the creation of digital learning content that follows UDL principles has not been deeply investigated to date. So, the main problem for this research is the fact that there is no solid data-driven knowledge on ways to incorporate UDL in digital content to enhance accessibility, equity, and education effectiveness for students of different backgrounds (Higher Education Commission, 2021; Manzoor et al., 2024; Naz et al., 2023).

This study aims to explore the integration of Universal Design for Learning into digital content for diverse learners. The specific objectives are:

1. Explore the idea of UDL as a guide for creating universally designed digital contents.
2. Study global and local digital accessibility and inclusive learning design trends.
3. Understand different types of learner barriers to digital content that is conventionally designed.
4. To explore the ways UDL principles can facilitate representation, engagement, and expression through digital learning materials.
5. To stress the importance of UDL-based digital content designing for inclusive education in Pakistan.

This study is important because it tackles a major educational issue related to the integration of inclusion, technology, and teaching methods. Concentrating on the "accessible by design" approach, the research moves the focus away from special accommodations for individuals with disabilities toward fostering inclusion for everyone. Theoretically, it bridges the gap between UDL, digital accessibility, and learner variability. Practically, it provides a model that teachers, instructional designers, curriculum developers, and policymakers can implement to create more equitable digital content. In rapidly evolving digital learning environments, such direction is vital to ensure that education technology doesn't widen the gap of educational exclusion (Bashir et al., 2024; Ashfaq et al., 2024).

This research is very important for Pakistan where a rapid digital transformation of education is underway, yet many students are still hindered by the structural and pedagogical issues. The results of this research might be used by the colleges and universities to integrate their inclusive policies and digital practices, provide the teachers with the time and skills to create effective and flexible learning materials, and promote the use of school-HE UDL-compliant content. Thus, the research results may assist the country's inclusion initiative as well as helping to fulfill the wider promise of equitable quality education for all learners (Afzaal et al., 2022; Aftab et al., 2025).

Literature Review

Recent literature places Universal Design for Learning (UDL) at the forefront of the most effective principles for designing digital learning

opportunities that are inclusive right from the start, rather than being modified after the appearance of barriers. In fact, in a wide range of current studies, UDL relentlessly finds itself characterized as a framework that views the variability of learners as a fact and a normal aspect of education. Consequently, through UDL, educators are motivated to offer flexible and accessible options in instruction, engagement, and assessment to learners. More specifically, in digital environments, this implies that online textbooks, learner management systems, multimedia material, as well as tests must be purposely planned in such a way that they facilitate learners with diverse sensory language cognition, motivation, and technology needs. Looking at the literature since 2020, it is evident that UDL has gone some distance from simply being a general philosophy of inclusion to being increasingly such as a practical design logic for digital content, especially in online, blended, and technology-rich environments (CAST, 2024; Cumming & Rose, 2022).

A key progression in the scholarly works is the sharpening of the UDL schema on its own. CAST's unveiling of UDL Guidelines 3.0 in July 2024 is a clear signal that the model is being fine-tuned considering additional discoveries and heightened awareness of fairness prejudice learner identity, and structural exclusion. The revised guidelines still uphold the organizing of inclusive design via the three foundational principles of engagement, representation, and action/expression, but they also give higher weight to learner agency and dismantling of structural barriers that impact both disabled and non-disabled learners. This change is critical for the design of digital content because it extends accessibility, which has traditionally been seen as a mere technical issue, to one that covers aspects of relevance participation cultural responsiveness, and learner empowerment. Put another way, current research indicates that accessible digital content should not be just technically compliant; it should be equally meaningful, usable, and empowering for a wide range of learners (CAST, 2024; Zou et al., 2025).

A significant point in the recent academic writings is how close accessibility, usability, and UDL are intertwined. Choi and Seo (2024) believe that inclusive learning design should not depend on accessibility only because accessibility without usability might still render learners somewhat incapable of engaging with digital content in a meaningful way. Their research is significant because it positions UDL as the juncture where accessibility and usability meet to give rise to learner experiences that are inclusive. In other words, features like captions, alternative text, flexible navigation, adjustable display settings, readable layouts, and multimodal content should not be viewed as optional add-ons but rather as fundamental design elements. Consequently, the literature is moving away from the concept of retrofitted accommodation to endorsing a forward-looking design strategy where digital resources are developed with the widest diversity of learners in mind right from the beginning (Aftab et al., 2024; Cumming & Rose, 2022).

International policy literature also highlights the fact that designing digital education should be more about inclusion than simply technology. UNESCO's Global Education Monitoring Report 2023 points out that digital technology in education should be assessed through the lens of relevance equity, and sustainability, and it makes a case for the fact that technology can lead to more inequalities when children and young people's needs are not kept at the center. One more example is UNESCO IITE's 2024 recommendations on digital technologies for inclusive education which say that digital environments should be designed from the user's perspective and they should be able to meet diverse learning needs through accessible infrastructure, teacher capacity, and thoughtful educational design. These reports do not look at digital access only as a matter of providing a device; instead, they underline the importance of content design, teacher skills, and inclusive systems. Such policy literature is a very good basis for viewing UDL as a method of creating accessible-by-design digital content (UNESCO, 2023; UNESCO IITE, 2024).

The empirical research base since 2020 also shows increasing support for the effectiveness of UDL. One of the most important recent syntheses is a systematic review and meta-analysis by Almeqdad et al. (2023), in which it was concluded that UDL-based interventions, in general, were linked to positive outcomes in educational contexts. Their review is quite helpful in that it pushes literature from advocacy toward evidence of impact. However, on the other hand, the study also reflects that the body of evidence is still quite limited in size and uneven in methodological quality and that therefore, UDL is a good development but still needs stronger, context-specific empirical validation. Nevertheless, recent scholarly works point to the fact that UDL has a role in enhancing engagement, performance, and inclusion, provided it is implemented in a planned and well-aligned manner (Almeqdad et al., 2023; Aftab et al., 2024).

Yang et al. (2024) presented a more detailed synthesis of digital environments. The authors conducted a review of universal design in online education and identified that online learners are becoming more diverse; however, instructors still encounter difficulties when it comes to implementing universal design in ways that are backed by evidence. Their review has shown several things including trends strategies impacts, barriers, and instructors and students' attitudes in relation to universal design in online settings. In fact, for our discussion, this is a very important piece of evidence as it does not only show that digital inclusion is a mere wish of the theoreticians; rather, it is a very serious educational problem in today's online learning. Besides that, it says that universal design is generally thought to be a good method for increasing participation, but teachers frequently need more explicit guidance that is supported by a strong institutional environment to be able to convert the framework into real course design and digital content practices (Yang et al., 2024; Zou et al., 2025).

More recent works are giving high regard to the UDL's representation principle in digital contents. Digital media enables the presentation of the same piece of information through different forms like text audio video, pictures hyperlinks transcripts captions screen-reader-friendly text, and interactive tools. However, the authors keep pointing out that simply converting to digital is not enough to get rid of the barriers. Garrad and Nolan (2023) in principle argue that mere electronic transformation of traditional materials will likely preserve old barriers in the online environment unless the design decisions actively consider learners' variability. In fact, their research on an online higher education unit indicated that UDL-informed design with different means of representation and engagement led to more student engagement and less attrition. This shows that a flexible digital version is not just an accessibility feature; it can also enhance the continuation and the level of participation in online learning (Garrad & Nolan, 2023; Alsraisri & Amjad, 2025).

The second major principle, that of engagement, has also been a topic of a lot of discussions in recent studies about online and blended learning. Montgomery and Snow (2024), who studied the experiences of K12 students with and without disabilities in online learning, found that the absence of structure, the lack of opportunities to connect, and inadequate guidance were, from their perspective, factors that discouraged motivation and learning. The results of their study demonstrate that learners with different needs not only require multiple instructional formats but also relational and motivational supports such as feedback interaction predictability, and meaningful choice. According to the literature, digitally accessible content must be engaged on an emotional and social level, apart from being only technically accessible. Even if a platform is easy to navigate, if it is isolating, inflexible, or confusing, it may still not reliably accommodate a learner. Therefore, engagement according to the literature on UDL, is becoming increasingly associated with motivation, belonging, and continued participation in online environments (Montgomery & Snow, 2024; Almulla & Amjad, 2025).

The third UDL principle, action and expression, has a very direct connection with digital content because technology offers an excellent way of

expanding the possibilities of how learners can demonstrate their knowledge. Research has shown, for example, that students benefit from digital courses that offer alternatives to one-format assignments and allow various demonstrations of learning through writing recording multimedia production, discussion contributions, visual outputs, and scaffolded projects. Montgomery and Snow (2024) have revealed that students, especially younger ones, liked varied assessment methods very much although their preferences changed with age and situation. These findings correspond with the general UDL literature that claims that flexible ways of assessment help to prevent exclusion and enhance the feeling of competence. In digital education, the use of this principle is quite a good idea for students who have difficulty with traditional testing, students with difficulties in executive functions, bilingual learners, and learners who are better at communicating through nontraditional modes (Montgomery & Snow, 2024; Aftab et al., 2024).

Since 2020, the scope of research in higher education has greatly increased, providing very valuable information about the design of digital content. Cumming and Rose (2022) examined the research on UDL as an accessibility measure in higher education and found that when UDL is implemented effectively, it can minimize the extent to which some students are required to reveal their disabilities or ask for individual support in accessing course materials. This is a very significant aspect because it not only brings out the enhancement of dignity and equity that comes from proactive design but also shows the disadvantages for the learners that are being kept away. Instead of having to make learners constantly ask for exceptions, digital content designed with UDL can be inherently flexible for all students. Consequently, higher education research not only considers UDL as a teaching strategy but also sees it as a method of ensuring justice, preventing stigmatization, and promoting self-governance in digital learning situations (Cumming & Rose, 2022; Amin et al., 2024).

At the same time, recent studies on higher education indicate that the implementation is still uneven. Stefaniak et al. (2024) discovered that educational designers in higher education emphasize different aspects of UDL depending on the situation, with some giving primary attention to accessibility features such as alternatives for visuals and audio, whereas others give higher priority to executive functions, comprehension, or multimedia support. This research is important as it demonstrates that the implementation of UDL is influenced by decision-making, institutional expectations, and interpretations of learner needs. Accessible digital content is not automatically generated by merely using the term UDL; it is contingent upon how designers perceive the link between universal design and the specific learning scenario. This result makes it understandable why institutions can support UDL in theory but still produce inconsistent digital content in practice (Stefaniak et al., 2024; Iftikhar et al., 2024).

The literature also points out some major barriers in the way of UDL implementation. Zhang et al. (2024) in their systematic literature review mention that even though UDL has a long history, it is still subject to criticism mainly concerning the lack of clarity of its definition, difficulties in implementation, and inadequate evidence. They reviewed 32 peer-reviewed studies that show, in fact, the field still has a hard time figuring out how UDL should be conceptualized, interpreted, and put into practice in educational settings. This is a very significant addition because it shows that the problem is not only whether educators are in favor of inclusion but also whether they have clear frameworks of training tools, and reliable evidence for consistently applying UDL. Barriers of this kind are very critical in the case of digital environments, where inclusive design requires a lot of coordination among content developer's instructor's administrators, and technology systems (Zhang et al., 2024; Afzaal et al., 2024).

Teacher and faculty readiness is another barrier that is often mentioned. Research shows that although a lot of teachers see the advantages of inclusive digital design, most of them are not well trained to carry it out properly. Montgomery and Snow (2024) rightly point out that teachers did not have ready access to the skills and resources that are necessary for them to deliver inclusive teaching techniques online during the pandemic-

driven virtual learning expansion. UNESCO IITE (2024) also highlights that teachers not only require basic ICT and accessibility skills but also need training in designing accessible online lessons and services. This implies that professional development is very much the key to accessible-by-design digital content. Even well-intentioned teachers might end up excluding people through inaccessible documents, hard assessments, or badly structured online tasks without proper training (Montgomery & Snow, 2024; UNESCO IITE, 2024)

Another significant insight from recent research is the understanding that digital education inclusion involves much more than just being disability friendly. New UDL literature tends to describe learner diversity in a wide variety of ways, including language, socioeconomic background culture age, prior knowledge, and digital confidence, in addition to disability. According to UNESCO (2023), technology has the potential to reach disadvantaged learners, however this will only be successful when the systems are designed with the learners' interests and educational goals in mind. The UDL Guidelines updated by CAST in 2024 have also been aligned with the issues of bias and systems of exclusion thus implying a more comprehensive equity-oriented notion of accessibility. This extended perspective is very important for digital content as learners can be disadvantaged not only using inaccessible formats, but also using unfamiliar language, culturally narrow examples, the assumption of digital skills, and lack of opportunities for self-directed participation (CAST, 2024; UNESCO, 2023).

So, the research done since 2020 reveals a consistent picture of the ideas we have. UDL is a potent framework espousing designing digital content that is highly flexible, inclusive, and naturally supports learner variability. Nonetheless, thoughtful implementation is the key to its success. Research presents solid evidence that multiple means of representation, engagement, and action/expression can open access and participation, particularly in online and blended environments. However, there are still some major challenges in getting clear and proper understanding of implementation, instructor training, institutional support, and the availability of strong empirical evidence in different contexts. This indicates that forthcoming research should get beyond the broad support for the idea and concentrate more on the actual design of digitized content, the student's experience of this content, and the local adaptation of UDL. This, in fact, making digital education accessible by design rather than only in principle is a very significant point of reference especially for the research studies (Gul et al., 2024; Zhang et al., 2024).

Research Methodology

This part outlined the methodological framework that was utilized in the research on the incorporation of Universal Design for Learning (UDL) into online materials for different types of students. The research took the form of a step-by-step and well-organized plan to produce results that were valid, reliable, and capable of being generalized.

Research Design

The research method used in this study was quantitative, which was considered suitable for the investigation of relationships, trends, and patterns through numerical data. A descriptive survey was the method of gathering data from many participants to find out their perceptions about accessible digital content and UDL practices. Quantitative research allowed the researcher to collect numerical data that can be analyzed statistically and objectively to make inferences about the research problem.

Population of the Study

The study population was made up of university teachers and students from higher education institutions. These participants were selected as the ones who are engaged in digital learning environments and had exposure to online or blended instructional content. The population also comprised members of public and private universities to capture diversity in views related to accessibility and digital content design.

Sample and Sampling of the Study

A sample of 350 respondents was chosen from the target population. The study implemented a simple random sampling method that made sure that each member of the population was equally likely to be selected. This approach was the one selected to reduce bias and improve sample representativeness. Besides, the selected sample size was appropriate for statistical analysis and generalization of the findings.

Instrument Development

A structured questionnaire was created as the main data gathering tool. The questionnaire was drafted following the core principles of Universal Design for Learning, and it mainly revolved around three dimensions: multiple means of representation, engagement, and action/expression. The instrument included demographic questions as well as Likert-scale items to assess participants' views about accessibility and inclusiveness in digital content. The Likert scale was from Strongly Disagree (1) through to Strongly Agree (5). The items were formulated after we went through several documents on UDL, digital accessibility, and inclusive education, which resulted in the alignment of the questionnaire with the research aims.

Validity of the Research Instrument

To be certain the instrument was proper, content validity was established by convening an expert panel. The panel consisted of three experts: one specializing in education, another in instructional design, and the third in educational technology. They each evaluated the questionnaire for relevance, clarity, and comprehensiveness of the items. We have made the modifications which were necessary to upgrade the instrument after the experts' comments. Furthermore, a pilot test was conducted on a limited number of respondents (who were not part of the final sample) to check the comprehensibility and appropriateness of the questionnaire items. The pilot test helped to rephrase confusing expressions and ensured that the instrument accurately measured the constructs it was designed to measure.

Reliability of the Research Instrument

Cronbach's Alpha coefficient was used to measure the reliability of the instrument. The questionnaire was given out for the pilot study, and the data gathered were analyzed for internal consistency. The overall reliability coefficient exceeded 0. 80, which means that the instrument was highly reliable. This finding demonstrated that the instrument was able to provide consistent and reliable measurements.

Data Collection Procedure

The data was gathered through a survey method. The researcher handed out the questionnaire in both paper and electronic form to the chosen participants. First, the researcher got permission from the respective institutions to carry out the data collection. Participants were given information about the study purpose. And confidentiality and anonymity were assured to them. The respondents were allowed enough time to fill in the questionnaire. Reminders were sent to improve the number of responses received. Only after thoroughly collecting all the finished questionnaires and checking them for any missing or invalid data did the analysis.

Data Analysis Procedure

Data gathered were analyzed using the Statistical Package for Social Sciences (SPSS). For the statistical analysis, both descriptive and inferential statistics were considered. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize the main features of the data and to depict the response of participants. Inferential statistics such as t-test, ANOVA, and correlation analysis were performed to understand to what extent the factors are related and how they are different from each other. The results were shown through tables and charts, making it easier to understand. Statistical analysis made it possible to evaluate the role of UDL in creating universally accessible digital content for diverse types of learners.

Data Analysis and Tabulation

The data analysis was done with the help of both descriptive and inferential statistics. Descriptive

techniques such as frequency percentage mean, and standard deviation were used to characterize the demographic features and main variables of the study. Inferential statistical procedures, namely the independent-samples t test and one-way ANOVA, were utilized to identify variations among demographics. Besides that, reliability testing and correlational analysis were done to evaluate the consistency of the instrument and the interrelationships of the study dimensions.

Table 1Demographic characteristics of respondents (N = 350)

Variable	Category	f	%
Gender	Male	168	48.0
	Female	182	52.0
Age Group	20–25 years	92	26.3
	26–30 years	88	25.1
	31–35 years	71	20.3
	36–40 years	54	15.4
	41 years and above	45	12.9
Qualification	Bachelor's	96	27.4
	Master's	118	33.7
	MPhil	82	23.4
	PhD	54	15.4
Role	Student	214	61.1
	Teacher	136	38.9
Type of Institution	Public university	201	57.4
	Private university	149	42.6
Experience with Digital Learning	Less than 1 year	48	13.7
	1–3 years	122	34.9
	4–6 years	104	29.7
	More than 6 years	76	21.7

Table 1 shows the respondents demographic profile in aggregate. Female participants (52.0%) marginally exceeded male ones (48.0%), most of participants were students (61.1%), and the majority were from public universities (57.4%). Also, the highest percentages of respondents were between 20 and 25 years old (26.3%), had a master's degree (33.7%), and possessed 1 to 3 years of digital learning experience (34.9%), thus the sample was diverse and fit the purpose of the study.

Table 2: Reliability analysis of the questionnaire

Scale / Dimension	No. of items	Cronbach's α
Multiple Means of Representation	15	.88
Multiple Means of Engagement	15	.90
Multiple Means of Action and Expression	10	.86
Overall Questionnaire	**40**	**.92**

Table 2 shows that the Cronbach's alpha values for the three dimensions range from .86 to .90. The overall reliability coefficient of the questionnaire was .92, which indicated a high level of internal consistency. Therefore, the instrument was considered reliable and appropriate for collecting data regarding UDL-based digital content for diverse learners.

Table 3: Descriptive statistics for study variables (N = 350)

Variable	M	SD
Multiple Means of Representation	3.89	0.56
Multiple Means of Engagement	3.78	0.61
Multiple Means of Action and Expression	3.84	0.58
Overall UDL-based digital content	**3.84**	**0.52**

Table 3 indicates that the overall mean score for UDL-based digital content was 3.84, reflecting a generally positive perception among the respondents. Among the three dimensions, Multiple Means of Representation obtained the highest mean score (M = 3.89), while Multiple Means of Engagement showed the lowest mean score (M = 3.78). These results suggested that representation-related accessibility features were perceived as more available than engagement-related features.

Table 4: Independent-samples *t* test for demographic variables on overall UDL-based digital content (N = 350)

Demographic Variable	Group	n	M	SD	t	df	p
Gender	Male	168	3.76	0.51	-2.47	348	.014
	Female	182	3.89	0.52			
Role	Student	214	3.79	0.50	-2.11	348	.036
	Teacher	136	3.91	0.54			
Institution Type	Public university	201	3.80	0.53	-1.68	348	.094
	Private university	149	3.90	0.50			

Table 4 presents the combined independent-samples *t* test results for gender, role, and institution type on overall UDL-based digital content. The findings showed statistically significant differences for gender (p = .014) and role (p = .036), indicating that female respondents and teachers reported more positive perceptions than male respondents and students. However, no statistically significant difference was found for institution type (p = .094), which showed that respondents from public and private universities did not differ significantly in their perceptions.

Table 5: One-way ANOVA for demographic variables on overall UDL-based digital content (N = 350)

Demographic Variable	Source	SS	df	MS	F	p
Age Group	Between groups	4.28	4	1.07	4.03	.003
	Within groups	91.58	345	0.27		
	Total	**95.86**	**349**			
Qualification	Between groups	3.11	3	1.04	3.21	.023
	Within groups	112.09	346	0.32		
	Total	**115.20**	**349**			
Digital Learning Experience	Between groups	5.72	3	1.91	6.18	< .001
	Within groups	106.88	346	0.31		
	Total	**112.60**	**349**			

Table 5 presents the combined one-way ANOVA results for age group, qualification, and digital learning experience on overall UDL-based digital content. The findings showed statistically significant differences for all three demographic variables, including age group, $F(4, 345) = 4.03$, p

= .003, qualification, $F(3, 346) = 3.21$, $p = .023$, and digital learning experience, $F(3, 346) = 6.18$, $p < .001$. These results indicated that respondents' perceptions regarding UDL-based digital content varied significantly according to their age, academic qualification, and experience with digital learning.

Table 6: Correlation among the three UDL dimensions and overall digital content accessibility

Variable	1	2	3	4
1. Representation	—			
2. Engagement	.71**	—		
3. Action and Expression	.68**	.74**	—	
4. Overall UDL-based digital content	.89**	.91**	.87**	—

Here are some of the things you can do to make your writing more humanlike: Table 6 displays very strong and significant correlations between all three UDL components and the total scale. The highest correlation was between engagement and total UDL-based digital content ($r = .91$, $p < .01$). The findings of this study showed that the three components not only were very highly correlated but also together formed the more general accessibility of digital content.

Table 7: Dimension-wise ranking based on mean scores

Rank	Dimension	M	SD
1	Multiple Means of Representation	3.89	0.56
2	Multiple Means of Action and Expression	3.84	0.58
3	Multiple Means of Engagement	3.78	0.61

Table 7 illustrates that Multiple Means of Representation came out on top with a mean score of 3.89, the highest among all. Multiple Means of Action and Expression came at second position while Multiple Means of Engagement came at third position with a mean score of 3.78. This order implies that the features associated with representation were relatively better, while the features related to engagement significantly needed improvement.

Findings

The research discovered that most of the participants were in favor of implementing Universal Design for Learning (UDL) principles into digital content for different kinds of learners. In fact, the total average score for UDL-based digital content was very high, which showed that the participants agreed that accessible and flexible digital learning is both relevant and essential in higher education environments. Out of the three aspects, multiple methods of representation got the highest average score, then multiple methods of action and expression, while multiple methods of engagement were the ones with the lowest average score. The implication here is that the participants recognized the provision of content in various formats far more than the motivational and interactional support that is required to keep the learners' engagement.

The demographic results indicated that the sample was varied in gender age qualification, institutional type, role, and digital learning experience. Female participants slightly exceeded male participants, majority of them were students, and most of the respondents had a master's degree and 13 years of digital learning experience. Such a demographic distribution adds more reliability to

the findings as the study gathered opinions of the participants coming from different educational and digital backgrounds.

The inferential analysis revealed that people's understanding of UDL-based digital content differed significantly according to their demographic features. A significant difference in gender was revealed by statistical testing, with female respondents having more positive perceptions than male respondents. Another significant difference was role-wise, where teachers had higher average scores than students. But no significant difference was found for institution type, which means that the respondents from public and private universities were largely similar in their perceptions of UDL-based digital content. One-way ANOVA results also indicated that age group, qualification, and digital learning experience led to highly significant changes in the perception of digital accessibility. Those respondents of an older age, individuals holding a qualification at a higher level, and people who have had more digital learning experience showed greater liking towards accessible digital content. It was revealed by the research that maturity, academic exposure, and digital literacy might be the factors that drive the recognition of the usefulness of the UDL-based design among both teachers and students.

Based on the reliability analysis, the tool is very reliable internally. The Cronbach alpha coefficients for the three factors varied from acceptable to high. The whole questionnaire, on the other hand, has very strong reliability. Besides, the correlation analysis showed that there were robust positive relationships among representation engagement action and expression, as well as the overall UDL construct. This suggested that the three factors served as a combined framework for creating accessible digital content.

Discussion

The results of the study backed the increasingly popular opinion that Universal Design for Learning (UDL) is a feasible approach supported by research for crafting digital learning settings that accommodate different learners. Respondents in the current study generally gave a favorable rating to the statement mentioning the necessity of ready and flexible digital content for inclusive learning, as reflected by the positive overall mean score. This finding agrees with the latest literature on UDL-based learning which environments improve access, participation, and learning outcomes when digital materials are intentionally designed to be flexible from the beginning rather than modified later for specific learners (Almeqdad et al., 2023; Jaleel et al., 2025).

The finding that multiple means of representation received the highest mean score suggested that respondents viewed the presentation of information in different formats as the strongest aspect of accessible digital content. This result supported recent studies which emphasized that accessible digital learning begins with how information is delivered through text, audio, visuals, video, captions, transcripts, and screen-reader-compatible materials. The literature further explained that such representation-related supports are especially important for learners with sensory, linguistic, and cognitive differences because they make content easier to access and understand in flexible ways (Alahmari et al., 2024; Aftab et al., 2024).

The comparatively lower score for multiple means of engagement indicated that motivational and participatory features of digital learning were less strongly perceived than representation-related supports. This finding suggested that although learners may have access to content in multiple forms, they may still require more support in areas such as interaction, collaboration, feedback, learner choice, and sustained motivation. Recent literature on online education similarly argued that inclusion in digital learning is not achieved through access alone; rather, learners must also be supported emotionally, socially, and motivationally to participate meaningfully in online environments (Haider et al., 2024; Manzoor et al., 2024).

The statistically significant differences across gender and role indicated that perceptions of UDL-based digital content varied according to respondents' backgrounds and positions within the educational environment. Female respondents

showed more positive perceptions than male respondents, while teachers reported higher mean scores than students. These differences may be explained by the greater awareness among teachers of instructional design practices, classroom diversity, and accessibility-related challenges in digital learning. Recent literature has revealed that educators and designers who have a deeper knowledge of accessibility, learner variability, and inclusive pedagogy are more predisposed to realizing the significance of UDL in real-world implementation (Stefaniak et al. 2024; Amjad, & Aslam, 2025).

Respondents of public and private universities showed no significant statistical difference in their perception of the UDL-based digital content which implied that these two sectors are facing the same, if not similar, problems in providing accessible and inclusive digital learning. The differences in management and resources of the two sectors might not be enough to explain this major need for digital accessibility in education. This finding is very insightful in the Pakistani setting as it indicates that the difficulties in digital accessibility are not only the problems of one sector but rather represent a wider picture of implementation, teacher preparedness, and content design issues in higher education institutions (Higher Education Commission, 2021; UNICEF Pakistan, 2023).

The one-way ANOVA findings revealed statistically significant variations among different age groups, qualifications, and experiences in digital learning. The results indicated that respondents who were older, had higher qualifications, and were more experienced in digital learning perceived accessible digital content more favorably. This seems to imply that a higher level of exposure to academic work and digital learning environments may raise awareness of inclusive design and its advantages. Supporting this view, the literature also pointed out that users who are more experienced in digital teaching and learning tend to be better at recognizing both the advantages and the limitations of online learning materials and systems (Yang et al. 2024; Stefaniak et al. 2024).

The very strong positive correlations between representation engagement action and expression, as well as the overall scale, confirmed the theoretical assumption that UDL is an integrated framework rather than a set of isolated strategies. These findings implied that these three dimensions together influenced the way respondents viewed digital accessibility and inclusion. This was consistent with the revised UDL Guidelines 3.0, which highlighted learner agency, the elimination of barriers, and the significance of various design features in supporting access, motivation, and meaningful participation of diverse learners (Amjad & Shoaib, 2024).

In general, the conversation highlighted that the results of this research were very much in line with the latest global and local discussions on inclusive digital education. On the global level, contemporary literature and education policies point out that technology should be the means to achieving educational goals like equity, accessibility, and sustainability. Pakistan, on the other hand, has been displaying its intention towards inclusive digital education by way of policy and innovation, but the current results reveal that widespread work is necessary for embedding UDL principles in the making of digital content so that accessibility turns into a primary attribute rather than a secondary one (Hassan et al., 2024; Afzaal et al., 2023).

Conclusion

The study found that the integration of UDL in digital content was broadly approved by the respondents and had a solid link to learning which is inclusive and accessible for diverse learners. The findings indicated that digital content can be significantly improved when it is developed to offer multiple ways of representation, engagement, and action/expression. Besides, it was found that the production of accessible digital design should not be considered as the last resort or something that can be left out; on the contrary, it must be the main and integral part of digital learning so that all learners can have access to it and participate meaningfully. This was in line with the recent international literature that recognizes UDL as a

forward-looking framework for fair digital education.

Furthermore, the research revealed that variation in perception among age qualification experience, gender and role indicated that familiarity and liking of UDL-oriented digital content rose with more academic and digital exposure. Compared to representation, engagement-related support seemed weaker, so the study recommended that schools should not only provide access to technology but also embrace a wide concept of accessibility that covers usability motivation interaction, and learner agency. This finding was in line with current literature and policy documents which argued that the key to accessible education is as much the quality of design as the availability of technology.

Recommendations

1. Learning institutions need to consider Universal Design for Learning (UDL) as their main philosophy when they are coming up with their digital content. One of the ways of doing this is to design course materials in different formats including text, audio, and video so that the content can be accessible to a great variety of students with different needs. Inclusiveness in education will be achieved when every student can access and grasp the content in an effective way.
2. Educational institutions ought to conduct periodic training sessions for educators and course developers on Universal Design for Learning (UDL) and digital accessibility. The main goal of these sessions should be to equip participants with hands-on techniques to raise engagement levels, increase learner flexibility, and incorporate diverse assessment methods in digital learning. Building up teacher proficiency through training is a critical step in the successful execution of inclusive digital practices.
3. Efforts should concentrate most on enhancing the engagement aspect of digital learning. Digital content needs to include interactive activities, feedback given promptly, tasks done collaboratively, and offering learners the choice of their own paths. Such provisions will help in motivating, involving students and providing them with powerful learning experiences that cater to the needs of different learners.

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