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Role of Design Attributes to Determine the Intention to Use Online Learning via Cognitive Beliefs

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ABSTRACT Online learning is the most widely used application in educational institutions, particularly during the pandemic (COVID-19). However, shortcomings in online learning systems negatively impact learner's attitudes and intention to use. Especially poor interface design can increase the cognitive load that ultimately affects the learner's intention to use. The design aspects that could be convenient, useful, and trustworthy in an online learning context are an emerging challenge and the primary purpose behind this study. So, in current research, the effect of different design aspects or attributes (i.e., interactivity, information, navigation, and visual) have been examined on learners' cognitive beliefs (i.e., ease of use and usefulness), trust, and ultimately intention to use. The proposed model was used to determine the learner's intention to use via trust, cognitive beliefs, and design aspects. Data was collected from the students at different Universities in Punjab, Pakistan, using a questionnaire embedded in an online learning prototype. PLS-SEM method was employed for analysis using the SmartPLS tool. The findings show that among the used design attributes, interaction, information, and visual design significantly influence the learner's cognitive beliefs, where navigation partially influences the cognitive beliefs. Furthermore, both cognitive beliefs (i.e., ease of use and usefulness) were observed to be strong determinants of trust. This study importantly contributes to the e-learning domain by providing a comprehensive understanding of learners' perceptions and experiences related to interface design that leads to intention to use.

INDEX TERMS Cognitive beliefs, ease of use, intention to use, online-learning, trust, usefulness, user interface.

I. INTRODUCTION

The instant technological development has produced numerous web/software based applications likewise e-commerce, e-health, e-banking, and online learning [1]–[4]. Individuals use these technologies to achieve their required goals. Therefore, determining the aspects that may influence the utilization behavior and continued intension to use these technologies is important to retain the users. In the online learning context, intention to use refers to the learner's intent to utilize the online learning platform. Accordingly, interface design plays an important role in heightening the individual's engagement with online learning. As online learning is the most widely used application in educational institutions. It provides efficient ways of learning for the students to acquire knowledge from anywhere and anytime without the obligation to go to the classroom [4]. Also, the epidemic of COVID 19 has its footsteps on education. Dangerous virus worldwide has compelled educational institutions to shut down to control the spread of this virus. Thus, it pushes towards the usage of online learning applications. Therefore, appropriate design strategies are important for online learning applications to heighten involvement and reduce mental efforts. Likewise, Hsu *et al.* [5] argue that a good interface includes all the cues used to design it and affects users' internal state. In recent research, Faisal *et al.* [6] discussed the importance of design to enhance learning experiences. Christine *et al.* [7] argue that ease of navigation and relevant information influence user's trust. Otherwise, they might quit if they feel it problematic when exploring required

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information. It is because a system with a bad design leads to confusion and misunderstanding [8].

A well-designed interface makes a system easy to use and useful. It involves information with precise organization and visual support to increase instant recognition and reduce the cognitive burden. Thus, design and usability problems become crucial facets considering the fulfillment of individual beliefs and trust in learning applications. Thus, poor interaction style, irrelevant information, inappropriate navigational scheme, and graphics may irritate the individuals [9]. Consequently, they may stop using online resources after having annoying experiences, leading to low retention rates. Increasing users' retention and motivate them to use online learning resources is critical for the sustainability of online learning. Academic institutions heavily invest in developing trustworthy digital resources to increase students' satisfaction. Especially during the pandemic, the educational institutions adopted online learning platforms to continue the academic activities. In recent research, Akbaria *et al.* [10] observed trust as a strong mediator between cognitive beliefs (i.e., ease of use and usefulness) and intention to use. Besides design and usability, environmental and instant consumer usage behavior changes also force institutions to research the individuals' behavioral intention continuously.

Moreover, several studies employed various cognitive and affective motives to determine the intention to use [6]. Among these aspects, trust is considered an important determinant of utilization behavior and intention to use. This is because an online application's success solely depends upon its acceptance and trust in the services it provides [11]. Trust is a user's belief about functional reliability and confidence in the system's services. Tams *et al.* [12] identified trust as a critical determinant of technological behavior. The abilities, benevolence, and honesty boost users' desire to depend on new technologies and create long-term relationships with services. As in recent studies of Akbari *et al.* [10] the intention to accept 5G technology strongly depends on user's trust through perceived ease of use and perceived usefulness. Following TABLE 1 discussed trust used in previous studies. In a study, Faisal *et al.* [13] determine the influential role of trust in the e-commerce context. They further emphasized the need to explore the role of trust in the online context.

Individuals depend on the web for information, where interface design acts as a medium of communication between the users and the web. Design quality is a key part of communication and is considered important in building trust. Therefore, the elements that constitute the interface design for communication can be considered essential components to improve the learning experience through attractiveness, convenience, and trustworthiness. Hall and Hanna, [14] also considered usability an important factor in determining the website usage via ease of use and utility. Accordingly, to our knowledge, our research is may the first that used categorical aspects of design to determine the intention to use via cognitive beliefs (i.e., ease of use and usefulness) and trust in the online learning context as trust was considered a strong moderator of intention to use in the prior studies.

This research makes two contributions: first, to determine the impact of design aspects such as interactivity (i.e., user control, connectedness, personalization, and responsiveness), information, navigation, and visuals design on users' cognitive beliefs. Second, determine the mediating role of trust between design aspects and intention to use via cognitive beliefs in the online learning environment. Lastly, this research provides valuable guidelines to the designer to clearly understand the important design elements for developing online learning applications to heighten the intention.

This paper is organized as follows: Section II highlights related studies about trust, cognitive belief, design artifacts, and intention to use. Section III presents the research model along-with hypotheses. Section IV describes the details about the adopted methodology, experimental procedures, and data gathering techniques. Section V describes the statistical analysis and results, while section VI is related to discussions. Section VII covered conclusions followed by limitations of this study and possible future directions.

II. LITERATURE REVIEW

Many learners stop using online learning after the first experience that leads to low retention rates. Retaining learner continuation is critical for online learning sustainability. Thus, online learning drags attention to design operative online learning paradigms by ensuring that the learners' pre-adoption beliefs are fulfilled. Their learning capabilities are improved through the interface design of online learning applications [15]. Thus, it is really important to identify and investigate which design factors could affect learners' intention to use these learning environments continuously. In the context of online learning, Intention to use refers to the learners' intent to utilize an online learning system. It engages continual use from the present to the future [16], [17]. As Agarwal and Venkatesh [18] argued, not all design criteria are equally important to diverse groups of users. Moreover, users of different countries demonstrated different acceptance behavior towards design, including trust regarding e-application adoption. Following Hofstede's cultural index, Pakistani culture is considered as a low-trust culture [19]. Therefore, it is important to identify these design attributes to identify user continuance intention through trustworthy content. As we [13] have investigated different design attributes across different cultures to strongly identify user loyalty through mediating the role of trust and satisfaction. As well as the developing countries have fully or partially failed to deploy online learning systems successfully [17]. Thus, ''it is essential to examine the most influential design principles that affect Pakistani students when they utilize the online learning system for learning.''

Thus, this paper will address the gap in prior studies and examine students' preferences for the interface design of the online learning environment in Pakistan's higher education institutions. The design factors that could be significant

TABLE 1. Trust related studies.

Sr. No.	Relationship between variables	Reference
1	Discussed detailed review of trust (T) antecedents in electronic services, specifically in e-commerce. Perceived Ease of Use (PEOU), Information Quality, Graphical Characteristics, Social Presence Cues, Personalization and Customization Capacity, Privacy Assurances and Security Features, Third Party Guarantees all on Trust	Beldad et al. [11]
2	Trusting Stance on Situational Normality and on Structural Assurance, Faith in General Technology on Structural Assurance and on Trusting Beliefs in Specific Technology, Trusting Beliefs in Specific Technology on Intention to Explore, Deep Structure Use	Mcknight et al. [20]
3	Perceived Usefulness(PU) on Attitudes Towards Adoption (ATA), PEOU on ATA, Need for Interaction on ATA, Perceived Performance Risk on ATA, ATA on Intention Towards Adoption (ITA), PU on ITA, Subjective Norm (SN) on ITA, Ton ITA	Kaushik et al. [21]
4	Effort Expectancy on Performance Expectancy, Structural Assurance on Initial Trust (IT), Performance Expectancy on Intention and Use, Performance Expectancy on Attitude, Attitude on Intention, IT on Intention, Perceived Risk on Intention, Intention on Intention to Use.	Baptista & Oliveira [22]
5	Disposition, Perceived (e.g, risk, security, privacy, reputation, PU, system quality, information quality, service quality, and design quality), satisfaction, attitude, intention, and loyalty	Kim & Peterson [23]
6	Effort and performance expectancy, social influence, PU, attitude ease of use, trust, intention to use.	Zolotov et al. [24]
7	Trust in Technology on Computer Self Efficacy, Computer Self Efficacy on Post Adoptive Use	Stefan et al. [12]
8	Consumer Characteristics, Firm Characteristics, Website Infrastructure and Interaction on Trust, Trust on Intention to Use	Oliveiraet al. [25]
9	Involvement, Trust, Self-Efficacy, Technology Readiness on Privacy Risks, Privacy Risks on Internal Conflicts and Continued Use Intention	Lee & Rha [26]
10	Consumer Characteristics on Online Trust, Online Trust on Behavioral Intent	Bart et al. [27]
11	Agency Made of People on Trust in the Agency, PEOU on Trust in the Agency, Trust in the Agency on PU, Agency Made of People on PEOU, PEOU on PU, PU on Behavioral Intention to Use, Agency Made of People on Behavioral Intention to Use,	Warkentinet al. [28]
12	Emotional Intelligence on Trust and Satisfaction , Trust and Satisfaction on Project Success	Rezvani et al. [29]
13	PEOU, PU on Trust and Concentration, Trust and Concentration on Intention to Use 5GTechnology	Akbari et al. [10]

in the learning paradigm are emerging challenges and the primary purpose of conducting this research. Identifying design-related variables for developing an online learning environment should be designed to look trustworthy and needless cognitive efforts to use; besides, misunderstanding could dispose of the users to close it. Additionally, online learning applications should ensure clarity, consistency, and information on suitable areas of the website, which are easily accessible and useful, and trustworthy, is the main objective of this research. Following is the detailed description of variables trust, cognitive beliefs, and design artifacts.

A. TRUST

Any online application's success depends upon its acceptance based on the services it provides, and this also includes the level of users' trust built during the system's usage [11]. Mcknight *et al.* [20] defined trust in technology as users' belief based on the experience and judgment about the functionality, reliability, and helpfulness while performing a task or transaction in an environment. The importance of trust has been widely explored in earlier research studies [21]–[24]. For example, Tams *et al.* [12] dispute that trust produced a huge effect in driving e-use. Similarly, customers with high trust showed a higher intention of online purchases [25].

The shortfall of trust was quite possibly the most well-known purpose behind not purchasing from Internet vendors [25], [26]. In the context of online, trust in technology has been derived through the user's interactivity with an online information system [27]. Furthermore, trust has been discovered to be a significant factor in driving behavioral intention [21], [28] and success [29]. For example, Kaushik *et al.* [21] argue that trust essentially affects travelers' attitudes. Thus, determining user behavior via cognitive beliefs and trust in the online learning context still needs to be explored. To address this gap, we have evaluated the effect of trust by placing it between the user's cognitive beliefs and behavioral intention.

B. COGNITIVE BELIEFS

Cognitive beliefs represent the specific properties of an individual that influence performance as well as learning. These beliefs serve up to improve or reduce performance. Cognitive beliefs entail cognitive actions like attention, memory, and reasoning [30]. Every individual possesses cognitive beliefs that assist and amending his behavior and behavioral reactions to outside stimuli. Individual performance for several daily routine tasks depends on these cognitive beliefs [31]. Cognitive beliefs such as ease of use and usefulness have been successfully applied in the Web portal in predicting user

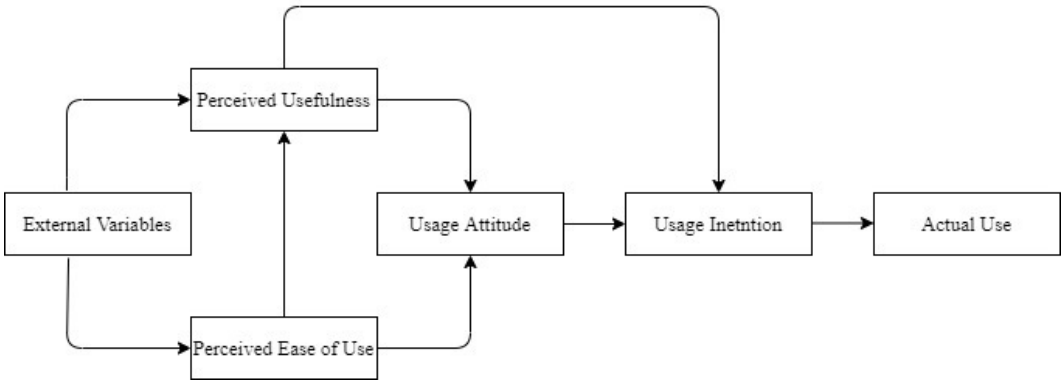

FIGURE 1. Technology acceptance model (TAM) [33].

intention to return [32]. Persons' judgment towards IT acceptance is strongly predicted through these cognitive beliefs comprised on usefulness and ease of use [32]. These cognitive beliefs are the fundamental part of TAM that is the most extensively deployed model [33]. TAM proved basic drivers for the acceptance of new technology through behavioral intention in recent studies [34]–[39]. In the TAM, attitude plays a mediating role between usefulness and perceived ease of use and usage intention on the other side. Perceived Ease of Use (PEOU) can be described as the degree to which a person believes that using a particular system would be free from effort [33]. Usefulness has been defined as the degree to which a person believes that using a particular system will enhance his performance [33]. Usage intention is described as the degree to which a person has prepared his cognitive actions to execute or not execute specific particular behavior in the future [40]. Both factors' ease of use and usefulness affect users' satisfaction towards a software tool and further affect individuals' beliefs and behaviors when adopting any online tool [41], [42].

Earlier several researchers employed different theories such as Theory of Reasoned Actions (TRA) [43], Theory of Planned Behavior (TPB) [44] and Technology Acceptance Model (TAM) [33] to determine the individuals' utilization behavior and technological adoption. TAM model is shown in FIGURE 1. Among these theories, TAM was the most adopted theory to research the individuals' utilization behavior [45], [46]. As Sandhu and Arora [3] derived the 5G technology acceptance through trust in TAM. Likewise, Heijden [47] extended the TAM by introducing visual aspects and exploring their influence on ease of use and usefulness. Similarly, Saadé and Bahli [48] also used the TAM to predict the impact of the website environment on intention to use.

By applying TAM to online learning, Sun *et al.* [41] proposed that more a learners' perceived usefulness and ease of use on education transferring technology, accordingly improved learning skills and satisfaction that ultimately enhanced possibilities towards using online learning environment. As no proper presentation of content on the Web and least navigational facility affects cognitive complexity leads to reduce learners' attention towards the online learning system [49]. Ease of findings and retrieving information can drag learners' attention through learners' overall insight about the Information System that resultantly might enhance the learner's ability to manage a piece of given information conveniently [50]. In this research, we examined students 'perception of how the online learning environment interface design is easy to access, use and learn and to what extent the online learning interface design improves their performance and effectiveness during learning activities. As well as how interface design attributes help to understand the learners' trust and behavioral intention towards the usage of an online learning environment through cognitive beliefs. Following TABLE 2 highlighted the details about cognitive beliefs constructs used in previous studies.

C. DESIGN ARTIFATS

The user interface could be defined as the extent to which a person feels that a system is well designed. These design features are information, navigation, visual appearance, and the system's functionality to facilitate users [51]. Alshehri *et al.* [52] distinguished the different design features to assess online learning systems' usability as interactivity, visual design, navigation design, and learnability. This has been identified that the effect of design quality (i.e., appearance, navigation, information, and interactivity) on cognitive and affective involvement forces the user to use online learning application continuously [6]. In this way, a good quality site includes all the factors utilized to design and influence clients' inner condition. It includes a blend of appropriate information perspectives with an exact association of contents. Other than association, visual appearance likewise contributes by starting positive perspectives towards the framework interface, which, eventually, prompts increased involvement [6], [53]. Volery and Lord [54] described that the success factors of an online learning system comprised of interface design, level of interaction, navigation, and accessibility. Hong *et al.* [55] recommended that the design of course content and interface design both could affect the entire efficiency of game-based learning. As Cyr [56] distin-

TABLE 2. Cognitive beliefs and related studies.

Sr. No.	Relationship between variables	Reference
1	Attitude Towards Act /Behavior, SN and Perceived Behavioral Control (PBC) on Behavioral Intention (BI), BI on Behavior, PCB on BI and Behavior	Ajzen [34]
2	Inhibition, Task-Switching, Updating on Self Report (SR) and Performance, Performance on SR, SR on Performance	Vaughan & Giovanello [35]
3	Information Personalization, Navigation Personalization, Presentation Personalization on PEOU, PU, Enjoyment and on Control, PEOU, PU, Enjoyment, and Control on Intention to Continue to Use (ICU)	Wang & Yen [36]
4	Apply System Characteristics (System Quality, Content Quality, Information Quality, Computer Self Efficacy (CSE), SN, Enjoyment , Accessibility, Computer Playfulness) on TAM	Salloum & Shaalan [37]
5	Social Norms, User Interface Design, CSE, on PEOU, PU, BI Use, Actual System Use	Yalcin & Kutlu [38]
6	Relative Advantage, Ease of Use, Social Influence And User Satisfaction on BI, BI on Adoption of Cloud-Based E-Learning	Kayali & Alaaraj [39]
7	Course Contents, Teacher Subject Knowledge, Technology Integration, And Interactivity on ICU. (Integrate TAM and Task Technology Fit (TTF) Model)	Tawafak et al. [40]
8	Individual Level (CSE, Individual Innovativeness (II), Computer Anxiety, Perceived Enjoyment, Experience), Social Level (SN) and System Level (Content Quality, Facilitating Condition), on PEOU and PU, PEOU and PU on Attitudes Towards Using, Attitudes Towards Using on BI to Use, Proposed FARMER 4.0	Jimenez et al. [41]
9	Assist Theories TAM, TPB, and UTAUT for Modeling Advanced Driver Assistance Systems (ADAS).	Rahman et al. [42]
10	Multimedia Instruction, Interactivity on LMS, LMS Self Efficacy on PEOU, PU and Perceived Satisfaction (PS), PEOU, PU And Perceived Satisfaction on BI to Use	Cigdem & Ozturk [49]
11	Learner Dimension (LD),Course Dimension (CD), Design Dimension (DD), Instructor Dimension (ID), Technology Dimension (TD), Environment Dimension (ED) on PS	Sun et al. [50]
12	LD, CD, DD, ID, TD, ED and University Support and Services on PS	Asoodar et al. [51]
13	Organization, Consistency and Structure On Perceived Readability and PEOU, Memorability, Perceived Readability, and Perceived Memorability on Preference for E-Learning System	Al-Samarraie et al. [52]
14	Personal Information Management, (Finding, Retrieving, Keeping), Information Fragmentation, Remember Where to Look, Visualizing Information Structure (Hierarchal, Flat Linear, Spatial, Network)	Lee & Shin [53]

guished design into three constructs: visual design, information design, and navigation design. Visual design is about how much an application is attractive; navigation is concerned with easy-to-use applications, and information design helps sense its availability and clearance.

Various researchers call attention to the need to search the role of interface design to use an application. Consequently, retaining the users and continuously using a system can only be made possible with significant interactivity support and engaging-design artifacts [57]. While discussing interactivity, there is still a lack of research that considered interactivity a multidimensional construct in the online learning environment to evaluate their effect on cognitive beliefs, especially where both learners and teachers communicate through an interface. In this research, interactivity is considered a multidimensional construct [58], [59] comprises of four constructs: user control, connectedness, personalization, and responsiveness to evaluate its effects on users' cognitive beliefs. As in the online learning context, these interactivity features have not been studied in detail. Especially user control is not discussed in detail. Faisal *et al.* [6] considered interactivity with three constructs user control, responsiveness, and communication, evaluating these on user affective and cognitive involvement and finally on continuous intention to use. The most discussed elements of interactivity in different domains in literature are user control [60], personalization/customization, responsiveness, connectedness, and playfulness. Cyr *et al.* [58] used perceived interactivity with three constructs: user control, connectedness, and responsiveness in the model and tested it in a new context of e-loyalty. Lee *et al.* [61] defined perceived interactivity based on four dimensions as perceived control, perceived responsiveness, perceived personalization, and perceived nonverbal information in the context of mobile usability. User control is described as the user's capability to operate and control the information and contents available [6], [62]. Connectedness is represented as the user's perception of being connected to other individuals in an online context [62] to share their experiences through conversation portals, chat, and hyperlinks-based characteristics. It may also be defined as public signs and the ability of interpersonal communication [6].

Cheng *et al.* [63], in their work, modulated that in a collaborative learning environment, sharing of information

and different ideas with peers significantly affects employees' intention to utilize the learning system. Similar results have been found from the research of [64], who elaborated on the significance of collaboration and communication for learner's satisfaction and motivation for the usage of the learning environment. Personalization echoes the degree to which information or content is customized to assemble the user's requirements [59]. Responsiveness is described as the quickness of response towards the user's queries. Responsiveness is a joint communication, the relatedness of response to prior queries, or the degree to which correspondence reactions are seen to be suitable and relevant [61]. Therefore, it is the capability to quick reply to user questions, and the user perception of how proficient a website behaves by providing their wanted content [6], [62]. In a study, Lee [59] discussed the influential role of interactivity, and he observed the strong impact of interactivity on individuals' trust and on transaction-related intention in the mobile commerce (m-commerce) context. The results from his study indicate that interactivity aspects in the m-commerce context (i.e., perceived contextual offer and perceived ubiquitous connectivity) heightens the purchase intention. Moreover, the individuals' perception of control over the interaction, connectedness, connectivity, responsiveness, and appropriate offers significantly influences trust and, ultimately, purchase intention.

There is a robust empirical indication about information quality and system use at the individual level of analysis through how a system participates in users' success. Content quality is the pillar of an online course. The online content should be readable text form accompanied by visuals, videos, podcasts, e-books, and research guides. Materials should be up-to-date, well-structured, and coherent and must provide learner-content interaction [65]. The crucial target should convey clear, useful, and relevant information to build positive attitudes and intentions. It influences the user perceptions about the contents [55] and arouses their commitment and involvement [66]. Poor, incomplete, and inconsistent information organization may prompt usability [67] and understanding issues for the intended users. A learner perceives a complex content presentation as a burden on its intellectual capabilities and concludes that paying extra attention and cognitive efforts will be useless.

The content presentation with extra sensory stimulation (proper color, screen configuration, interface) will produce productive learning environments. As when the contents are simple and clear, the learning procedures will also be convenient. The additional effects of cues, visuals, animations, attractive images embedded with materials enhance the user learning procedure. Besides proper placement of content clearly and suitably so that a learner can navigate, connect with other learners will ultimately improve the user learning capabilities [68].

Navigation also aids the users while conveniently exploring a website [69]. While discussing any online learning environment, multiple visual elements can be categorized as text style, attractive image, and color scheme. This delivers the overall appearance and sense of design [70]. According to Cyr [56], different visual design aspects can be treated with a sense of balance, emotional appeal, aesthetics, and consistency of the Website interface's overall graphical look. This can be defined as pictures, shapes, colors, or text styles. Grant-Smith *et al.* [71] emphasized the visual design for the learning management system. Their findings concluded that student engagement could be enhanced through visual design, functional utility, aesthetic appeal, and transactional access for LMS. Bader and Lowenthal [72] defined visual design as composed of two essential elements, such as functionality and the aesthetic of any application or product, and described the guidelines for improving a learning platform's visual design by creating a design studio at colleges and universities level. The visual design has a significant impact on how users perceive information and learn, evaluate reliability and usability, and in the end, consign significance to an online experience.

In online learning, there are numerous visual artifacts included. These artifacts can be arranged into text, picture, shape, and shading. These elements can give sway on the look and feel of design [70]. As indicated by past research [70], a poor user interface design with unattractive visuals appearance caused many intelligent courses has never been utilized. So, symmetry of contents, color scheme, typography, layout consistency, presenting information effectively, aesthetics, and credibility are important visual design elements in developing online learning applications [73]. Yet, to date, there has not been any research that evaluates the effect of visual design on well-known antecedents of TAM, such as cognitive beliefs, ease to use, and usefulness in the context of the online learning environment. However, in the research of [74], visual complexity has a potential effect on perceived ease of use and perceived usefulness. Before they researched to evaluate the visual design and subjective evaluations of the design, aesthetics should be considered key variables on antecedents to the TAM that may explain an individual's willingness to adopt a technology or behavior [75]. Following TABLE 3 listed the details about design artifacts conducted in previous studies.

They discussed literature that emphasizes classifying appropriate design attributes of user interfaces that correspond to various systems and contexts. This research, therefore, attempts to elicit students' perceptions of the most important design characteristics and prioritize them according to their influence on learner behavioral intention. This research's main point is to identify and prioritize design factors closely tied to the online learning system's actual users. So, this research fills the research gap by addressing the effects of web design attributes for online learning environment comprising of interaction, information, navigation, visual escorted with the intermediate role of cognitive beliefs such as ease of use, usefulness on trust, and trust on user behavioral intention towards the usage of an online learning environment. Based on the research findings, online learning

TABLE 3. Design related studies.

Sr. No.	Relationship between variables	Reference
1	System Navigation, System Learn-ability, Visual Design, Information Quality (IQ), Instructional Assessment and System Interactivity on Usability of E-Learning System	Alshehriet al. [44]
2	Appearance (Font Quality, Aesthetic), Navigation, Information and Interactivity (R, UC, Communication) on Cognitive and Affective Involvement leading to CIU the Online Learning Application	Faisal et al. [33]
3	Ease of Access and Navigation, Interface, Interaction, Attitudes Towards Students, Instructor Technical Competence, Classroom Interaction on Success of Online Education	Volery & Lord [46]
4	Navigation Design (ND), Visual Design (VD) and Information Design (ID) on Sand T, T and S on E-Loyalty	Cyr [48]
5	Perceived Interactivity Comprised (User Control (UC), Connectedness (C), Responsiveness (R)) on Cognitive Beliefs (Efficacy, Effectiveness,) Enjoyment, Trust, on E-Loyalty, Efficacy, Effectiveness, Enjoyment, Trust, on E-Loyalty	Cyret al. [15]
6	UC, C, R, Personalization (P), Ubiquitous Connectivity, Contextual Offer on Trust on Attitudes Towards Using MC and on BI use MC	Lee [16]
7	Interactivity (PBC, Non Verbal Information, Perceived Personalization), Simplicity (Reduction, Organization, Integration, Prioritization), Simplicity on Interactivity, Interactivity on Usability, Usability on Satisfaction, Usability on Trust, Satisfaction on Trust, Usability on Loyalty, Satisfaction on Loyalty, Trust on Loyalty	Leeet al. [18]
8	Interactivity(UC, Communication, R) on Engagement and Satisfaction, Engagement and Satisfaction on Technology Dependence	Fan et al. [19]
9	Content, Personalization, Navigation, Structure and Design, Appearance and Multimedia on User Satisfaction	Grigoroudis et al. [26]
10	Visual Elements of Interface Design (Text, Graphic, Shape, and Color) on Navigation Button and Structure Text, Graphic, Shape, and Color Make Interface Attractive And Enhance Usability of E-Learning	Adnanet al. [27]
11	Visual Design Principles (Functional Utility, Visual Identity, Aesthetic Appeal) and Transactional Access to Enhancing Student Engagement and User Experience in a Virtual Learning Environment	Grant-Smithet al. [28]
12	Visual Design (Functionality, Aesthetic), Information Design on Reliability and Usability of Online Learning Platforms/Interfaces. Enlist Different Design Principles by deploying Graphic Design Theory And Media Theory	Bader & Lowenthal [29]
13	Visual Design(Proper Color Scheme, Typography), Information Architecture(Layout Consistency, Presenting Information Effectively, Aesthetic and Credibility on Usability of Online Learning Environment	Reyna [30]
14	Feature Complexity, Design Complexity on Aesthetic Evaluation (AE), AEon PEOU , PU on Usability Assessment of E-Health	Lazard & King [31]

system designers can draw upon specific design characteristics to improve the system.

III. RESEARCH MODEL AND HYPOTHESIS

Design aspects and quality of interface design may influence cognitive beliefs (e.g., ease of use, usefulness, and trust), leading to continuous intention to use. These design features, i.e., interactivity, information, navigation, and visuals aspects, are essential for interface quality [6]. Figure 2 shows our proposed model named Design Cognitive beliefs Trust and Intention to use (DCTI), attributes, and relationships.

A. INTERACTIVITY DESIGN

Website interactivity defines how presented information is handled through users, such as customization and content management [76]. Interactivity concerns the online learning system collaborative tools that facilitate students' interactivity and between students and instructors [52]. Kim and Chang [77] have extended the TAM model using some antecedent variables associated with health information websites' design attributes. Results concluded that usage support and customization are two significant useful features in the expanded TAM skeleton in the paradigm of health-related websites that help build health websites more operative for improving user satisfaction where ease of use and usefulness played a mediating role. Cyr *et al.* [58] defined interactivity as a multidimensional construct comprised of user control, connectedness, and responsiveness. To evaluate this concept, she proposed a model in which both user cognitive and affective responses are examined concerning interactivity. Specifically, perceived interactivity that includes user control, connectedness, and responsiveness potentially influences users' cognitive beliefs [58].

Hence, the details of all interactivity aspects considered in this research are adopted from the concepts of elegant work of Lee [59], who identified user control, responsiveness, personalization, and connectedness as essential components of interactivity in mobile commerce settings. User control is defined as the user's confidence while performing required tasks. Connectedness: whether learners can share experiences about courses and certificates offered in the online learning environment with other learners to the outside world. Personalization has been defined as the personalization offered by this online learning environment to the concerned user. For example, when a learner enrolled in a course, the environment automatically creates a learner profile where he kept his data about courses, certificates personally or can share publicly. Finally, responsiveness is defined as the learning

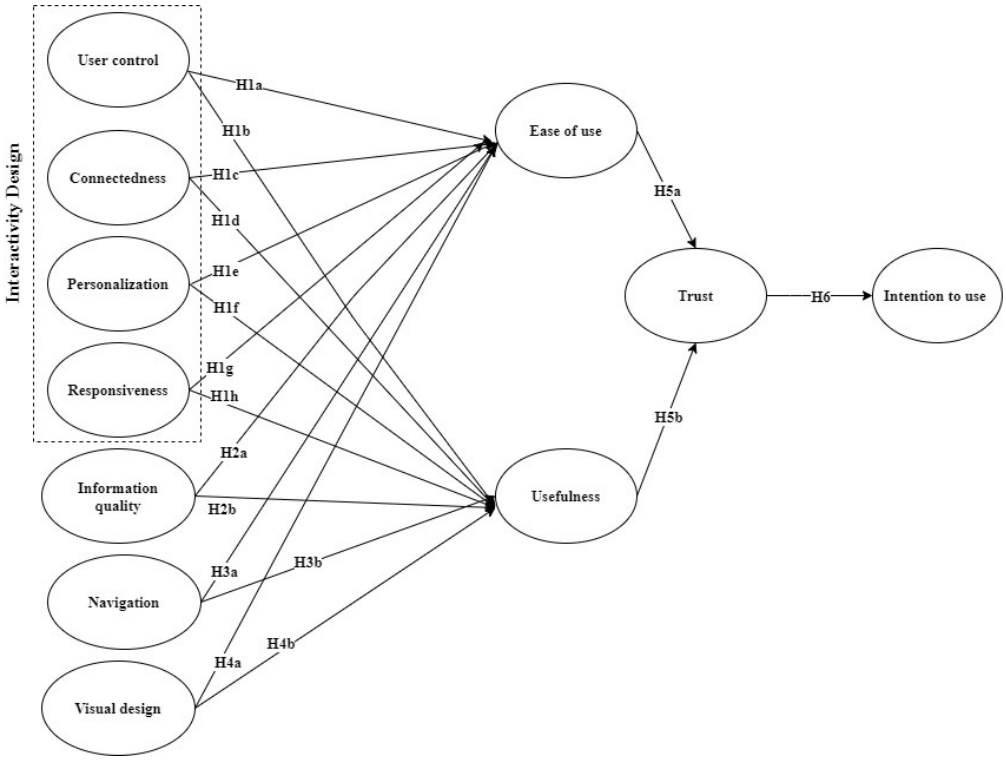

FIGURE 2. Proposed design cognitive beliefs trust and intention (DCTI) model.

environment's response to learner input timely and provided relevant information. In this research, responsiveness is also considered a system that allows the user to comment against any reading material or course. Thus, we assumed that if the learning environment is perceived as interactive, in the context that learners feel enhanced access and control over the contents, timely response, and provide facility to personalized information, it will be viewed as more favorable and result in a significant impact on cognitive beliefs of learners. Thus, the following hypotheses are deemed necessary for an online learning environment's interactivity design to determine the learner's cognitive beliefs.

- H1a: User control positively influences ease of use.
- H1b: User control positively influences usefulness.
- H1c: Connectedness positively influences ease of use.
- H1d: Connectedness positively influences usefulness.
- H1e: Personalization positively influences ease of use.
- H1f: Personalization positively influences usefulness.
- H1g: Responsiveness positively influences ease of use.
- H1h: Responsiveness positively influences usefulness.

B. INFORMATION QUALITY

It can be defined as the required features and online learning content elements [78]. Using online learning for desired information that may be essential for learning and which is updated to make it easier for the learner to comprehend it [17]. In this manner, the design of information should be assembled properly to fulfill the user's instant requirements [79], [80]. Detlor *et al.* [81] concluded a constructive association between information quality and ease of use. Prior studies have also found a significant relationship between information quality on perceived ease of use [82]–[84]. Therefore, there is a potential role of information quality on the perceived usefulness of online learning systems [82], [85], [86]. Lai and Yang [87] verified the effect of information quality for usefulness for intention to use an enterprise application in e-business. They found a positive connection between information and the usefulness of enterprise applications. Salloum *et al.* [17] found a positive relationship between information quality and ease of use and the usefulness of an online learning system. Thus, based on theoretical backgrounds, we believed that up-to-date and relevant information with proper placement layout reduces the user cognitive complexity and enhances its performance in terms of usefulness.

- H2a: Information design positively influences ease of use.
- H2b: Information design positively influences usefulness.

C. NAVIGATION DESIGN

Websites with navigation facilities help the user complete the task timely and accurately [88]. Navigation quality consists of visible navigational layout such as menus and links that allowed learners with many options over the system components [52]. The good design of navigation includes multiple options and easy methods to access desired contents or information instantly [80]. Otherwise, a messy, confusing, and complex navigation structure irritates the users;

consequently, they may find it complicated to access the required information, hence losing curiosity and leaving the website immediately. Consequently, ease to navigate lessens the user's cognitive complexity and time spent and boosts the system's involvement [89]. Thowfeek *et al.* [90] defined navigation in the system's flexibility as usability measures in an online learning context. Thus, it is expected that persons who have this greater wish for choice through alternate navigation forms will perceive the online process as ease of use and more favorable and concluded that navigation positively affects online shopping ease [91]. The proper labeling and arrangement of hyperlinks will promptly influence the efficient use of the website. Website layout and reorganization have a vital role in decreasing user information overload, exploring difficulty, and web browsing time [32]. Thus, we believed that proper navigational design helps the users easily access the information at different sections and pages of Websites with easy go and back options and proved useful in completing tasks efficiently.

- H3a: Navigation design positively influences ease of use.
- H3b: Navigation design positively influences usefulness.

D. VISUAL DESIGN

Visuals can be defined as anything we see from any source in the form of an attractive and appealing image, graphics, or videos and help us to understand the things and their meanings conveniently [70]. Cyr and Head [92] discussed in their paper information content, information design, navigation design, and visual design on trust, transactional security, and loyalty across different cultures. Cyr & Head [93] discussed visual design under the category of aesthetic design and investigates its effect on ease of use and usefulness. Their findings concluded that mobile users' loyalty could be increased through its aesthetic design if users perceived this design easy to use and useful. Users' assumption about an Information System is that enhanced attractiveness will be easier to use. The website's visual attractiveness refers to its visual elements, most notably its colors and overall layout. Colors and structure are direct system characteristics, can positively influence website usage through usefulness, enjoyment, and ease of use [47]. The visual design has been least discussed in the online learning domain, especially to evaluate its effects on learners' cognitive beliefs. So, we have hypothesized that the attractive color of images and interface and layout of information positively affect users' cognitive beliefs towards an online learning environment.

- H4a: Visual design positively influences ease of use.
- H4b: Visual design positively influences usefulness.

E. COGNITIVE BELIEFS ON TRUST

Wu and Chen [94] found a positive correlation between perceived ease of use and trust on the initial adoption of online tax applications. Wu *et al.* [95] determined the effect of trust on TAM attributes and found that trust directly impacts usefulness, attitude, and behavioral intention [95]. For instance, consumers who achieve satisfaction using a website will trust the website more and engage with the continuous intention [96]. Trust identification has a direct positive effect on continuance knowledge sharing intention in the online community. Trust identification and affective commitment positively impact continuance knowledge sharing intention in the online community context [97].

Perceived ease of use ought to likewise expand trust through the insight that the e-seller is putting resources into the relationship and, in doing so, signals a pledge to the relationship [98]. An examination by [99] uncovered that if the e-financial vendors locate the monetary information helpful for their motivations, it will support their trust. Subsequently, they are bound to utilize these online applications. Casaló *et al.* [100] discovered that site security, protection, and convenience, which are similar ideas to perceived ease of use and perceived usefulness, impact trust. They likewise determined that trust was a fundamental intervening variable in creating relationships potentially in the web-based financial setting. The strong association between ease of use and trust proves that trust is an important factor in innovation adoption [95]. It is estimated that ease of use genuinely affects trust because ease of use could build purchasers' fulfillment from e-dealers in their first-time utilization of e-administrations. Mou *et al.* [101] recommended that usefulness and trust are both huge components at the underlying and later periods of online health administrations' selection by users. The basic part of PU in developing trust has been set up in past studies [23], [102]. Trust is additionally presented as an indicator of TAM factors like usefulness and ease of use [103]. The TAM model's joining of trust has uncovered its significance in anticipating clients' intentions to utilize new advances [25], [104]. This research formulates the hypotheses to predict trust based on ease to use and usefulness in an online learning context as no previous research has evaluated this relationship. Based on theoretical backgrounds, we hypothesized that users' trust in an online learning environment could be increased through cognitive beliefs if they perceive the system as easy to use and useful while performing different activities.

- H5a: Ease of use positively influence learner's trust.
- H5b: Usefulness positively influences learners' trust.

F. TRUST ON INTENTION TO USE

Previously, trust has been discussed in different scenarios as online shopping, online gaming, online banking [105], and ERP but has least discussed in the context of learner's intention towards the usage of an online learning environment. In previous studies, [114], trust is the least significant in online purchases and mobile applications. While [5] have derived a positive relation of trust and attitude towards the blog. In the innovation setting, trust alludes to

solid beliefs in a specific innovation in a workspace. More explicitly, it alludes to people's expectations and decisions that a given innovation's helpfulness, reliability, and usefulness will assist them with their assignments [12]. It is surely a critical factor in utilizing an innovation that isn't inconceivably utilized, as it beats the risk and suspiciousness seen in the beginning stages of innovation adoption [106]. Akbari *et al.* [10] characterize trust as significant conclusions concerning a 5G innovation. The absence of trust can start protective behaviors and may stop information progression that comprises powerful correspondence [29]. Trust in such a context is essential for building socially acceptable and reliable behavior when users belong to different backgrounds and age groups, genders, and even different geographically dispersed locations without physically implementing workable rules. Thus, we hypothesized that users' trust potentially influences users' intention to use an online learning context.

- H6: Trust positively influences intention to use online learning.

IV. METHODOLOGY

This research aims to determine how interface design features affect the continued intention to use via cognitive beliefs and trust. The investigation is employed in this research primarily based on data collection through a questionnaire from university students. In addition, an experimental prototype of MOOC (Massive Online Open Courses) is developed to test the participants.

A. INSTRUMENTS

To achieve the goal of this study, a reliable and valid questionnaire has been developed to test research hypotheses. A close-ended questionnaire was adapted and includes answer choices where the respondents select the best answer from provided choices. The instrument used for this research is a survey developed after the extensive literature review in online learning and the marketing domain. The survey is included in the experimental prototype. The participants have to perform certain tasks and later share with perceptions through the questionnaire. The survey has been divided into two sections: The first section is related to participants' demographics, while the second section is design attributes, cognitive beliefs, trust, and continued intention to use. A seven-point Likert scale ranging from1 ''strongly disagree'' to 7 ''strongly agree'' has been employed to compute each observed item. All statements included in the survey are employed from existing studies to make sure reliability. The design aspects of the experimental prototype are majorly categorized into four design dimensions (i.e., interactivity, navigation, information, and visual design). The interactivity dimensions are further categorized into subdimensions, i.e., user control, personalization, connectedness, and responsiveness. The features related to user control include advanced search options, course enrollment, layout changing features, other choices. The personalization features include features that help to personalize the contents through the profile. Connectedness and responsiveness are managed through group discussion portals, chat features, blogs, or other social media support. Through structure, the quality of information makes sure, up to date, organized, and relevant. We removed the additional promotional information, contents, and artifacts that are not relevant to the course. Navigation is supported through aid, cues, buttons, links, and structured paths to access desired information content conveniently. The appropriate graphics, text, and color scheme are employed in interface design as suggested in prior literature.

B. DATA COLLECTION AND PILOT RESEARCH

The prime objective of the current research is to determine the students' perception and preferences towards the design quality. The university students considered a suitable sample to explore the online learning adoption and acceptances. The research is conducted in different higher educational institutions. The usability experts from universities are requested to inspect the prototype as per available heuristic guidelines. The experts' suggestions and value able comments are incorporated to improve the design of the prototype. Later on, pilot research is conducted to check the functionality of the employed experimental prototype and assess the reliability of the design assessment tools. Therefore, 20 undergraduate and graduate students from different disciplines in National Textile University participated in the pilot research. Cronbach's Alpha (α) value for the adopted question is observed between 0.767 and 0.864, which shows strong reliability. Brief information about the tasks and experimentation is shared with participants. An online link to the prototype is shared with students of all selected universities. In the four-month data collection process, 592 students return the questionnaire, and from 592, only 521 were found completed.

C. DATA ANALYSIS TOOL

The collected data is analyzed using Partial Least Square-Structured Equation Modeling (PLS-SEM) method using SmartPLS3 [97]. SEM allows a wide range of statistical methods to test proposed hypotheses for determining the relationship among observed variables and latent variables [96]. This provides two types of measures, structural measures, a measurement model, and a facility for multivariate analysis to evaluate all constructs' relationships in the conceptual model [98]–[100]. PLS-SEM additionally gives stable and stable weights along with no inflated, or increased measurement [100]. Thus, PLS-SEM delivers an adaptable approach to establish the essential constructs and implement the complicated structured model. A model composed of 10 or more constructs is considered to be complex [98]. This DCTI model consists of 11 reflective constructs. PLS was the preferred method for testing measurement, and structural model [95], [101].

TABLE 4. Demographic characteristics of respondents.

Demographic data	Distribution	Frequency	Percentage
Gender	Male	246	47.21
	Female	275	52.78
Age	18-25 years	352	67.56
	26-33 years	169	32.43
Study level	Graduation	333	63.91
	Post - graduation	188	36.08
Web browsing experience	Less experienced (1-3 years)	260	49.90
	Experienced (3-7 years)	261	50.09
Total	521		100.0

V. STATISTICAL ANALYSIS AND RESULTS

A. DEMOGRAPHIC BACKGROUND

In the employed sample (age group), a continuous measure was used. The groups specifically listed from 17 to 25 years old comprised 67.56% (352 respondents); while the remaining sample 32.43% represents as a senior group (were between 26−33 years). The sample of the undergraduate program includes 63.91% (333 participants) while the remaining 36.08% (188 respondents) from the post-graduate program. Similarly, the students having 1 and 3 years browsing experience for online learning system were about 49.90% (260 students). At the same time, 50.09% (261 students) reported that they had been using the online learning system in their course for between 1 − 7 years and considered themselves experienced.

An incomplete questionnaire, response time less than threshold value less than five minutes, and select the same options for all survey questions are not included in the research for analysis. A total of 592 submissions are received. After reviewing all responses, 71 responses are excluded based on the criteria mentioned above, and 521 (88%) responses are included in the final analysis research. The detail of all demographic data is represented in TABLE 4.

B. STRUCTURE EQUATION MODELING (SEM)

A two-step SEM method was adopted for data analysis. First of all, the evaluation of the measurement-model was computed by analyzing the consistency and reliability. The convergent and discriminant validity were also computed to make sure consistency and reliability. Then, the execution of the structural model to determine the nature and strength of the relationship between the constructs was performed.

C. ASSESSMENT OF MEASUREMENT MODEL

The outer model is evaluated using methods Construct validity and uni-dimensionality. Thus, uni-dimensionality has been calculated by using the component factor analysis method. According to the suggested criteria, Kaiser [13], [107], there is uni-dimensionality in the dataset if the eigenvalue is greater than 1 in the first-factor analysis. Thus, all the proposed constructs in this research fulfilled the suggested value, and the principal component accounts for most of the variance. The results were obtained to satisfy the suggested criteria (see TABLE 5.).

1) CONVERGENT VALIDITY

Construct validity can be assessed by using two essential methods. The first method is Convergent Validity (CV), and the second method is Discriminant Validity (DV). Further convergent validity has been measured through variance Extracted and reliability measures. The survey questionnaire's reliability is assessed using Cronbach's Alpha (α) to measure internal consistency. By [108], an acceptable reliability value for construct is greater than 0.6. TABLE 5 indicates that Alpha values for all constructs ranged between 0.7 to 0.8, which concluded that all variables used in this research are reliable. Secondly, Variance Extracted method has been used values to measure the convergent validity of constructs. According to [109], acceptable AVE values should be greater than 0.6. This research shows that AVE values here ranged between 0.68 to 0.82, indicating the validation of satisfactory convergence of constructs. TABLE 5 also indicated the composite reliability (CR) values in the present research ranged from 0.86 to 0.92, which is even greater than the recommended threshold value of 0.7 [109].

2) DISCRIMINANT VALIDITY

Discriminant Validity described that the amount of a variable is different from other variables [110]. Thus, the discriminant validity of constructs is assessed by two essential criteria: the cross-loading and Fornell-Larcker Criterion. Chin [110] defined Cross loading as the observed construct that should be strongly correlated with its associated items except for all other constructs and their corresponding objects. Gefen and Straub [111] elaborated this concept of cross loading as the correlation values of latent variables' objects load higher values on their corresponding constructs than other items and constructs. Therefore, the cross-loading values of items have been placed diagonally, which are greater on their relevant construct and smaller on all other constructs' items displayed vertically and horizontally indicated in TABLE 6 Fornell and Larcker [110], [112] and Hair *et al.* [113] consist in determining the outer-loadings pattern of the adopted items.

TABLE 5. Unidimensionality, convergent validity, composite reliability and reliability of constructs.

Constructs	Factor Loadings	Mean	SD	Unidimensionality Eigenvalues		Variance explained		Reliability and Convergent validity			
				1st com	2nd com	1st (%)	2nd (%)	α	rhoA	CR	AVE
User Control											
	0.911	4.84	1.810								
1				1.638	0.362	81.87	18.12	0.779	0.781	0.900	0.819
	0.898	4.97	1.777								
2											
Connectedness											
	0.897	4.89	1.860								
1				1.647	0.353	82.33	17.66	0.785	0.791	0.903	0.823
	0.917	4.93	1.920								
2											
Personalization											
	0.813	5.10	1.679								
1											
	0.830	5.23	1.588	2.062	0.506	68.73	16.85	0.772	0.773	0.868	0.687
2											
	0.844	5.06	1.562								
3											
Responsiveness											
	0.868	5.01	1.627								
1											
	0.865	4.99	1.609	2.284	0.400	76.13	13.34	0.843	0.846	0.905	0.761
2											
	0.883	5.06	1.648								
3											
Information											
	0.877	5.17	1.603								
1											
	0.833	5.18	1.577	2.209	0.440	73.61	14.65	0.821	0.823	0.893	0.736
2											
	0.863	5.17	1.536								
3											
Navigation											
	0.879	5.10	1.635								
1											
	0.884	5.02	1.712	2.35	0.34	78.56	11.62	0.864	0.864	0.917	0.786
2											
	0.897	5.05	1.711								
3											
Visual											
	0.936	5.10	1.786								
1				1.712	0.288	85.59	14.40	0.832	0.845	0.922	0.855
	0.913	4.98	1.782								
2											
Ease of Use											
	0.857	5.44	1.461								
1											
	0.895	5.31	1.498	2.095	0.543	69.82	18.10	0.783	0.784	0.874	0.698
2											
	0.853	5.40	1.517								
3											
Usefulness											
	0.842	5.38	1.427								
1											
	0.801	5.36	1.452	2.086	0.558	69.52	18.58	0.780	0.779	0.872	0.695
2											
	0.856	5.32	1.458								
3											
Trust											
	0.891	5.11	1.816								
1				1.622	0.378	81.11	18.88	0.767	0.772	0.896	0.811
	0.910	4.94	1.807								
2											
Intention to use.											
	0.845	5.29	1.673								
1											
	0.900	5.17	1.577	2.326	0.478	77.55	15.92	0.856	0.858	0.912	0.776
2											
	0.900	4.84	1.740								
3											

Note(s): α = Cronbach's alpha; CR= Composite Reliability; AVE = Average Variance Extracted; 1st com = 1st Component; 1st (%) = % of Variance

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The value of loadings in this research exceeded 0.7 and ranged from 0.795 to 0.936 as highlighted in TABLES 6 and 7 with significance levels (≤ 0.05) along with t values (≥ 1.96). According to [112], a variable should describe the variance better than its items on which variable is based. The Average Variance Extracted from a latent variable should be higher than the latent variable's squared correlations and all other variables [112], [114]. Diagonal bold values in TABLE 7. show the AVE while different benefits show the squared correlations. Thus, the overall summary of the measurement model evaluation through Convergent Validity and Discriminative Validity resulted that all necessary criteria are met, and Construct validity was acceptable [109].

3) ADDITIONAL COEFFICIENTS

TABLE 8 shows other coefficients for proposed research constructs. For the proposed model, the Goodness of Fit (GoF) [115] Tenenhaus method has been applied. 0.56 is the acceptable value for the GoF model. In the previous research of [116], agreeable values of GOF ranged as follows: Small ≥ 0.1, medium ≥ 0.25, and large ≥ 0.36. Thus, this research fulfilled the GoF criteria mentioned in previous studies to support our research model analysis. Lastly, the verification of multicollinearity between the variables is analyzed. Pallant [117] defined multicollinearity as two variables highly correlated to each other. So different authors proposed different values in this regard. Tabachnick and Fidell [118] defined a correlation value up to 0.8 or 0.9 as required to be considered the reason for concern; correlation values between two variables (0.7) are considered problematic [117]. In this research, the value of multicollinearity is determined by two factors: tolerance and VIF as proposed by [117], as a threshold value for tolerance is > 0.10 and for VIF < 3.0. So, the tolerance values and VIF values for independent constructs considered in this research ranged between (tolerance $= 0.6$ and VIF $= 2.4$). They concluded no multicollinearity in sample data, and no two variables are correlated with each other. Lastly, the verification of multicollinearity between the variables is analyzed. Pallant [117] defined multicollinearity as two variables highly correlated to each other. So different authors proposed different values in this regard. Tabachnick and Fidell [118] defined a correlation value up to 0.8 or 0.9 as required to be considered the reason for concern; correlation values between two variables (0.7) are considered problematic [117]. In this research, the value of multicollinearity is determined through Variance Inflation Factor VIF, as proposed by [117], the threshold value for VIF should be less than < 5.0 or even more relaxed criteria is less than 10. Where the ideal recommended value for the VIF should be equal to or less than VIF ≤ 3.3 [6]. So, VIF values for independent constructs considered in this research ranged between VIF $= 2.4$. They concluded no multicollinearity in sample data, and no two variables are correlated with each other.

D. ASSESSMENT OF STRUCTURAL MODEL

After the measurement model, for structure model measures, we used the SmartPLS 3.0 tool [119] to execute the PLS algorithms with bootstrapping set to 5000 subsamples and confidence interval was 0.05 [120], we evaluated the Explanatory Power (EP), path coefficients (β), t-value, p-value and amount of variance R^2 of dependent variables elaborated by independent variables as shown in TABLE 9.

The inner model describes the strength of the relationship among the hypothesized variables derived from substantive theory [110], [121]. We assess the explanatory power of the inner model path coefficient (β) and the amount of variance (R^2) [110], [122], where independent factors explain dependent factors. FIGURE 3 and TABLE 9. demonstrate the β for each path along with its significant p-value [13], [66]. When discussed the Explanatory Power (EP), the (R^2) value of construct has been used. Thus, the EP of all considers design attributes on Ease of Use is 51%, and the EP of all these design attributes on Usefulness is 50%. EP of Ease of Use and Usefulness versus Trust is 31%. The EP of Trust versus Behavioral Intention is 30%. These results show that each construct's (R^2) square value is higher than the threshold value of 10% recommended by [123]. Thus, these results concluded that the model has good Explanatory Power [109].

It is also crucial to examine and compute the level of impact (effect size) to identify which one of the construct, factor or independent variable reasons for utmost of the variance in a variable [120]. TABLE 9. demonstrate the level of impact or effect size values. The computed values i.e., 0.02, 0.15, and 0.35 showing small, average, and large effect sizes, respectively. The computed value satisfy the criteria mentioned in the literature. Overall, it is concluded that all proposed hypotheses in the model are significant except the H3b., indicating that out of seventeen, sixteen hypotheses are supported. Thus, learners' intention towards using an online learning environment is profoundly affected by trust, and trust is significantly affected by the learner's cognitive beliefs. These cognitive beliefs are divided into two factors ease of use and usefulness. They are affected considerably by interactivity dimensions, visual design, and information quality provided by that learning environment and partially influenced by navigation design.

VI. DISCUSSION

A. INTERACTIVITY

In this research, interactivity is a multidimensional construct, i.e., user control, connectedness, personalization, and responsiveness. These dimensions are rarely employed to determine the cognitive beliefs (e.g., ease of use and usefulness) in an online learning context. *User control* refers to the individual's ability to manipulate and control the information and contents available [6]. The effect of user control is observed to be positive ($\beta = 0.061, p \leq 0.076, t = 1.778$) on ease of use and ($\beta = 0.099, p \leq 0.005, t = 2.802$) usefulness

TABLE 6. Cross loading method for measuring discriminant values of constructs.

Sr. No.	Construct name	1	2	3	4	5	6	7	8	9	10	11
1	Intention to use	**0.845**	0.569	0.346	0.408	0.452	0.422	0.286	0.395	0.526	0.590	0.318
		0.900	0.568	0.288	0.400	0.387	0.397	0.237	0.285	0.451	0.579	0.315
		0.900	0.545	0.285	0.365	0.362	0.351	0.199	0.259	0.476	0.543	0.303
2	Ease of use	0.531	**0.857**	0.383	0.564	0.527	0.519	0.354	0.456	0.436	0.667	0.369
		0.494	**0.795**	0.322	0.504	0.443	0.458	0.335	0.367	0.470	0.670	0.391
		0.575	**0.853**	0.407	0.510	0.482	0.453	0.299	0.411	0.439	0.697	0.383
3	Connectedness	0.314	0.379	**0.897**	0.366	0.405	0.317	0.323	0.255	0.250	0.402	0.250
		0.322	0.425	**0.917**	0.452	0.457	0.376	0.297	0.367	0.264	0.441	0.290
4	Information quality	0.405	0.563	0.422	**0.877**	0.516	0.519	0.374	0.509	0.378	0.519	0.376
		0.370	0.518	0.367	**0.833**	0.441	0.517	0.366	0.482	0.411	0.469	0.336
		0.372	0.541	0.375	**0.863**	0.542	0.537	0.368	0.463	0.351	0.505	0.437
5	Personalization	0.394	0.452	0.448	0.429	**0.813**	0.433	0.248	0.318	0.314	0.466	0.259
		0.376	0.506	0.422	0.498	**0.830**	0.579	0.291	0.448	0.344	0.479	0.330
		0.372	0.482	0.315	0.522	**0.844**	0.532	0.302	0.431	0.368	0.474	0.418
6	Responsiveness	0.367	0.460	0.292	0.472	0.529	**0.868**	0.280	0.380	0.355	0.465	0.366
		0.432	0.532	0.352	0.552	0.575	**0.865**	0.350	0.449	0.404	0.521	0.377
		0.363	0.498	0.354	0.568	0.522	**0.883**	0.319	0.424	0.330	0.509	0.383
7	User control	0.260	0.380	0.303	0.398	0.302	0.336	**0.911**	0.333	0.224	0.377	0.321
		0.240	0.333	0.315	0.380	0.312	0.323	**0.898**	0.318	0.229	0.374	0.283
8	Navigation Design	0.310	0.431	0.331	0.469	0.432	0.421	0.361	**0.879**	0.321	0.422	0.346
		0.338	0.426	0.308	0.515	0.425	0.409	0.267	**0.884**	0.353	0.385	0.349
		0.312	0.454	0.281	0.518	0.427	0.448	0.327	**0.897**	0.340	0.405	0.294
9	Trust	0.465	0.470	0.204	0.449	0.394	0.401	0.259	0.366	**0.891**	0.456	0.291
		0.530	0.496	0.302	0.351	0.352	0.353	0.195	0.323	**0.910**	0.485	0.256
10	Usefulness	0.511	0.642	0.396	0.436	0.464	0.468	0.344	0.335	0.407	**0.842**	0.392
		0.552	0.715	0.400	0.532	0.496	0.474	0.318	0.450	0.454	**0.801**	0.404
		0.561	0.669	0.367	0.480	0.465	0.488	0.375	0.353	0.444	**0.856**	0.385
11	Visual Design	0.357	0.454	0.300	0.438	0.395	0.402	0.325	0.343	0.296	0.465	**0.936**
		0.296	0.384	0.248	0.385	0.354	0.395	0.291	0.345	0.263	0.406	**0.913**

Note(s): The bold values are the factor loadings of scale items for each construct and more than 0.70.

TABLE 7. FORNELL-LARCKER criterion for the discriminant validity of constructs.

Sr. No.	Name	1	2	3	4	5	6	7	8	9	10	11
1	Intention to use	**0.881**										
2	Ease of use	0.638	**0.836**									
3	Connectedness	0.351	0.444	**0.907**								
4	Information quality	0.446	0.631	0.453	**0.858**							
5	Personalization	0.459	0.580	0.476	0.584	**0.829**						
6	Responsiveness	0.445	0.571	0.383	0.611	0.623	**0.872**					
7	User control	0.276	0.395	0.341	0.430	0.339	0.364	**0.905**				
8	Navigation design	0.360	0.493	0.346	0.565	0.483	0.481	0.360	**0.886**			
9	Trust	0.554	0.537	0.283	0.442	0.413	0.417	0.250	0.381	**0.900**		
10	Usefulness	0.651	0.811	0.465	0.581	0.571	0.573	0.415	0.456	0.523	**0.833**	
11	Visual design	0.355	0.456	0.298	0.447	0.406	0.431	0.334	0.372	0.303	0.473	**0.925**

Note(s): Bold diagonal values in the table are the square root of AVE

respectively. However, the relationship between user control and usefulness is stronger than between user control and ease of use. In online learning, the learners' features to manage and control the interaction lead to higher productivity. Scheiter and Gerjets [124] found positive results between the control and feedback on learner's interest and motivation for the learning environment. Moreno and Mayer [125] considered control an important aspect of information, exploration, and navigation in the online learning environment. *Connectedness* is the feeling of being linked to a world outside the specific site [62]. The effect of connectedness is observed to be positive on both ease of use and usefulness ($\beta = 0.095, p \leq 0.010, t = 2.601$), ($\beta = 0.138, p \leq 0.001, t = 3.921$) respectively. However, the relationship between connectedness and usefulness is stronger than between user control and ease of use. Therefore, connectedness-related features such as links and discussion portals help the learner be more productive. In research, Agudo-Peregrina *et al.* [126] found a positive relationship between connectedness with ease of use and usefulness, leading to online learning system acceptance. Cigdem and Ozturk's [40] observed the impact of sharing experiences on behavioral intention via ease of use and usefulness. *Personalization* reflects the degree to which information is tailored

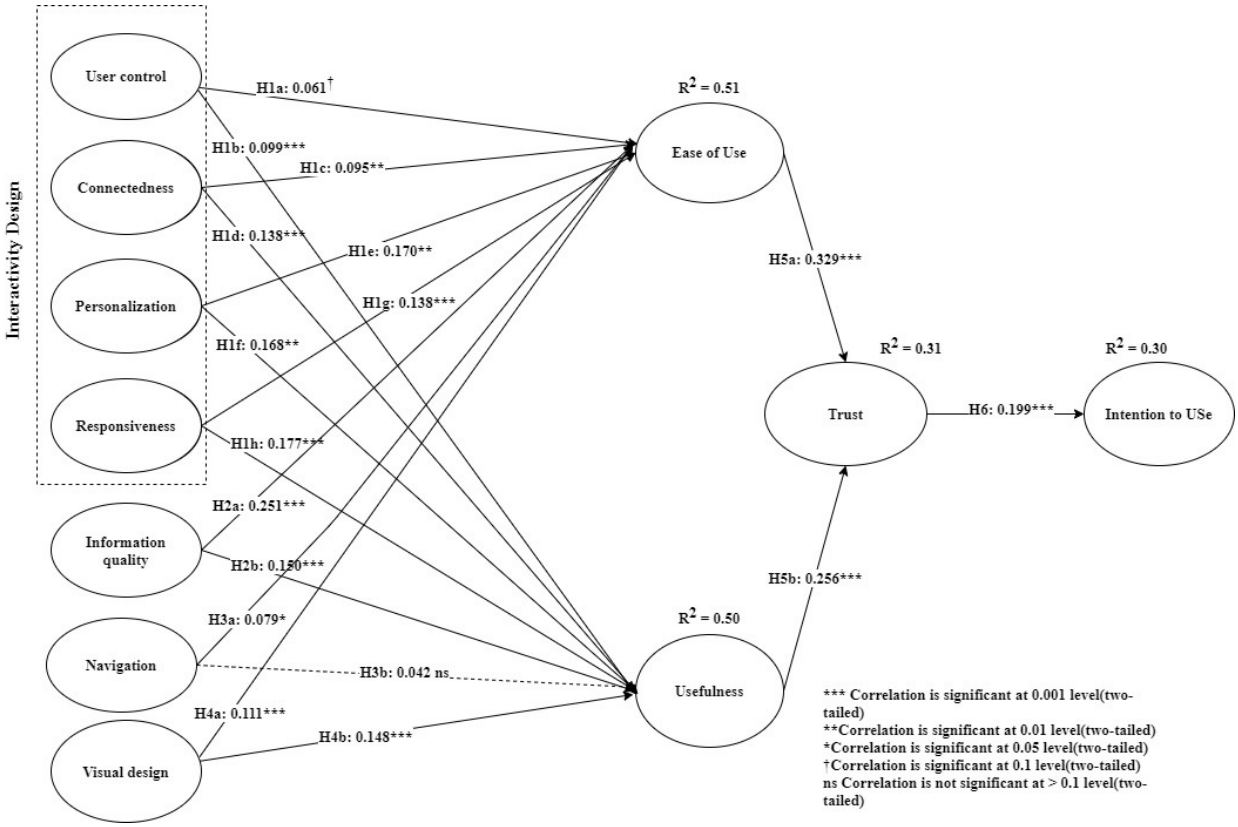

FIGURE 3. Results from structural analysis of our proposed DCTI model. Notes(s): The solid lines represent significant relationships: the dotted lines non-significant relationships or unsupported hypotheses.

to meet individual needs [59]. The effect of personalization is observed to be positive ($\beta = 0.170, p \leq 0.015, t = 2.437$) on ease of use and ($\beta = 0.168, p \leq 0.018, t = 2.381$) usefulness. Personalization helps learners to customize the features as per their capabilities. Likewise, Kim and Chang [77] found a positive relationship among customization, ease of use, and usefulness to extended the TAM in the health informatics domain.

Responsiveness represents the ''level of user interaction via instant response against their queries [61].'' The effect of responsiveness is observed to be positive ($\beta = 0.138, p \leq 0.005, t = 2.848$) on ease of use and ($\beta = 0.177, p \leq 0.001, t = 3.669$) usefulness respectively. Thus, instantaneous information and feedback against user requests facilitate them to access the required features conveniently and recover from the errors through instant feedback. Cyr *et al.* [58] also found a positive relationship between user control, connectedness, and responsiveness on cognitive beliefs towards websites' e-loyalty. Lee [59] argues that interactivity features such as user control, connectedness, personalization, and responsiveness are important to determine the user behavioral intention via trust.

B. INFORMATION QUALITY

Information quality is defined as the desired informational aspects essential for learning [17]. In this research, information is considered as a design to determine cognitive beliefs. The effect of information quality is observed to be positive on both ease of use and usefulness ($\beta = 0.251, p \leq 0.001, t = 4.325$), ($\beta = 0.150, p \leq 0.007, t = 2.718$) respectively. Therefore, the information quality potentially influences users' cognitive beliefs and is observed as a stronger antecedent of ease of use than usefulness. Therefore, appropriate information with a proper placement layout that is easy to use enhances the learning effectiveness and performance. Several other studies also observed the positive relationship between information quality and usefulness, information quality, and ease of use [81], [127]. Lai and Yang [87] verified the effect of information quality on usefulness, ultimately leading to intention to use. Therefore, the learner's cognitive perception is highly affected by the organization of contents, consistency, and information structure for online learning systems [49]. Bateman *et al.* [128] observed that representations decrease visual ornamentations.

C. NAVIGATION

Navigation refers to the navigational aspects, schemes, and layouts such as menus and links. Navigation and convenience to use online learning environment is considered as an imperative design attribute. The effect of navigation is observed to be positive on both ease of use and usefulness

TABLE 8. Additional coefficients.

Sr. No.	Name	Observed value	Acceptable	Ideal value	95%	99%
1	SPR	1.000	≥ 0.7	1		
2	RSCR	1.000	≥ 0.9	1		
3	SSR	1.000	≥ 0.7			
4	Nonlinear bivariate causality direction ratio	1.000	≥ 0.7			
5	SRMR	0.068			0.035	0.035
6	d_ULS	2.440			0.730	0.800
7	d_G	1.128			0.520	0.540
8	AVIF	2.4	≤ 10		≤ 3.3	

TABLE 9. Path coefficients.

Path	β	f2	Indirect effect	M	SD	t	p	Significancd
H1a: User control→ Ease of use	0.061	0.006		0.063	0.036	1.778	0.076	Supported
H1b: User control→ Usefulness	0.099	0.015		0.099	0.036	2.802	0.005	Supported
User control→ Trust			0.047					
User control→ Intention to use			0.026					
H1c: Connectedness→ Ease of use	0.095	0.014		0.097	0.037	2.601	0.010	Supported
H1d: Connectedness→ Usefulness	0.138	0.028		0.142	0.036	3.921	0.000	Supported
Connectedness→ Trust			0.068					
Connectedness→ Intention to use			0.038					
H1e: Personalization→ Ease of use	0.170	0.032		0.177	0.072	2.437	0.015	Supported
H1f: Personalization→ Usefulness	0.168	0.030		0.173	0.073	2.381	0.018	Supported
Personalization→ Trust			0.102					
Personalization→ Intention to use			0.057					
H1g: Responsiveness→ Ease of use	0.138	0.022		0.147	0.051	2.848	0.005	Supported
H1h: Responsiveness→ Usefulness	0.177	0.034		0.183	0.050	3.669	0.000	Supported
Responsiveness→ Trust			0.095					
Responsiveness→ Intention to use			0.053					
H2a: Information quality→ Ease of use	0.251	0.066		0.260	0.061	4.325	0.000	Supported
H2b: Information quality→ Usefulness	0.150	0.024		0.164	0.060	2.718	0.007	Supported
Information quality → Trust			0.128					
Information quality → Intention to use			0.071					
H3a: Navigation→ Ease of use	0.079	0.010		0.090	0.044	1.963	0.050	Supported
H3b: Navigation→ Usefulness	0.042	0.003		0.052	0.043	1.173	0.241	Not-Supported
Navigation→ Trust			0.042					
Navigation→ Intention to use			0.023					
H4a: Visual design→ Ease of use	0.111	0.022		0.118	0.045	2.671	0.008	Supported
H4b: Visual design→ Usefulness	0.148	0.036		0.154	0.044	3.563	0.000	Supported
Visual design→ Trust			0.080					
Visual design→ Intention to use			0.044					
H5a: Ease of use→ Trust	0.329	0.053		0.328	0.068	4.831	0.000	Supported
Ease of use→ Intention to use			0.181					
H5b: Usefulness→ Trust	0.256	0.033		0.256	0.070	3.661	0.000	Supported
Usefulness → Intention to use			0.143					
H6: Trust → Intention to use	0.199	0.033		0.553	0.043	12.847	0.000	Supported

($\beta = 0.079, p \leq 0.05, t = 1.963$), ($\beta = 0.042, p \leq 0.241, t = 1.173$) respectively. Thus, guided navigation, structured path, recoverability, and appropriate buttons minimize the extra mental efforts. Thus, navigation design and clues facilitate the users to access the information efficiently. Childers *et al.* [91] found a positive relationship between navigation and ease of use to lead to an e-commerce context. They also found that when a user feels convenience in assessing different system sections, his performance increases. They also observed a positive relationship between convenience and usefulness.

D. VISUAL DESIGN

Appealing color schemes, appropriate typography, and graphics are considered impotent aspects of visual design [13]. The effect of visual design is observed to be positive on both ease of use and usefulness ($\beta = 0.111, p \leq 0.008, t = 2.671$), ($\beta = 0.148, p \leq 0.001, t = 3.563$) respectively. Thus, the employed aspects of visual design significantly affect user intention to use through cognitive beliefs. The visual design was observed as a stronger antecedent of cognitive beliefs in TAM. The user believes that the system having attractive features provides pleasurable experiences.

Cyr [56] discussed visual design as an important aspect to determine trust and satisfaction. Heijden [47] observed a strong relationship between visual attractiveness usefulness. Liao *et al.* [129] employed various design attributes to determine trust and usefulness. These results revealed that attractiveness, appropriate fonts, and colors positively affect the usefulness, which leads to continued intention to use. In contrast, Websites with high visual complexity and messiness negatively influence the cognitive beliefs in the e-health context [74].

E. COGNITIVE BELIEFS

Cognitive beliefs can be defined as the degree to which a person feels that using a particular system is easy to use, effort-free, and enhanced working capabilities [33]. The effect of ease of use and usefulness is observed to be positive on trust ($\beta = 0.329, p \leq 0.001, t = 4.831$), ($\leq= 0.256, p \leq 0.001, t = 3.661$) respectively. The results demonstrated that ease of use is a stronger determinant of trust as compared to usefulness. Thus, if a user perceives an online learning system convenient to use and facilitates him to access the desired information easily, it ultimately increases their level of trust. However, both the ease of use and usefulness observed as imperative determinants of trust. No prevalent work discusses the role of cognitive beliefs in determining trust in the online learning environment. This is the first research that discussed trust based on cognitive beliefs in the online learning environment. Ing-Long Wu and Chen [94] found a positive relationship between perceived ease of use and trust.

F. TRUST

From a technology perspective, trust suggests solid beliefs in a specific innovation in an online workspace [12]. The effect of trust is observed to be positive on intention to use ($\beta = 0.199, p \leq 0.001, t = 2.031$). The results demonstrated that trust is a stronger determinant of learners' intention to use an online learning environment. User trust strongly helps build user behavior through cognitive beliefs and interactive, informative, and attractive design artifacts. Roy *et al.* [12] identified trust and self-efficacy as key determinants of post-adoptive behavior for technology. He further observed that trust is crucial in the technology for usage behavior through computer-related self-efficacy beliefs. For instance, individuals who achieve satisfaction using a website will trust the website more and engage with the continuous intention [96]. Thus, determining trust has a direct impact on continuance knowledge sharing intention in the online community.

VII. CONCLUSION, LIMITATION AND FUTURE WORK

This research investigated the effect of design attributes on learner's cognitive beliefs in the online learning context. Accordingly, an online learning prototype was developed by employing the design attributes, i.e., interactivity, information quality, navigation, and visual design. Furthermore, the questionnaire scale was developed to collect data from participants related to employed measures. For data analysis, the PLS-SEM was used. The results reveal that interactivity (i.e., user control, connectedness, responsiveness, and personalization), information quality, and visual design significantly influence the learners' cognitive beliefs, i.e., ease of use, usefulness. However, no relationship was between navigation and usefulness. In conclusion, the web design attributes affect learners' cognitive beliefs, ultimately leading to intention to use via trust.

Interactivity artifacts established a stronger foundation to build user positive behavioral intention through cognitive beliefs. In addition, the individuals feel more comfortable and consider their experiences more creditable if they feel more control over contents and can manage the customized features and instant response to their queries while learning online. Therefore, educational institutions should focus on interface design while developing online learning systems to heighten the learners learning experiences.

Moreover, other architectural features, i.e., information (e.g., up-to-date, concurrent, consistent, relevance, presentation) and navigation (structure, ease of use, menus and click style, and clue), also play an important role in improving learners' experiences. Furthermore, the designers should incorporate appropriate visual facets, such as font, images, color, and multimedia, to attract and engage learners and passively increase learning, effectiveness, and efficiency in completing tasks quickly. This is because the users always give preference to design that is easy to use and facilitates them to complete their tasks effectively. Overall, users give preference to useful design features. So, design with enriched artifacts proved useful for learning tasks. These described design artifacts enhanced the functionality offered by that system to assist the user [51]. Likewise, the appropriate design strategies improve usability and heighten understanding and learnability [52]. The results also demonstrate that appropriate design strategies influence cognitive beliefs and increase the individual's level of trust, ultimately leading to intention to use online learning.

This research has not incorporated all aspects of design attributes as antecedents in the model necessary for an online learning environment. Likewise, different authors determined the behavioral intention based on computer self-efficacy, subjective norm, internet cognitive failure, playfulness, innovativeness, and openness in previous studies. All these variables belong to a user, not with interface design; therefore, this research did not include these variables as antecedents. It included only specific variables that fall under the interface design paradigm. This research has not covered students that are geographically located far from Punjab, Pakistan. The learners suffering from color blindness have not participated in research as they might perceive the interface design visually differently. As multiple stakeholders of an online learning environment, such as instructors, administration, university staff, are also not included in this research. This model considers factors important and relevant to accepting an online learning environment from the

TABLE 10. Students perception of the design of an online learning environment.

Constructs	Items	Statement	Sources
User control	UC1	"I was in control over the information display format, a condition when using this online learning environment."	Lee [59]
	UC2	"I was in control of the content of this online learning environment that I wanted to see."	
Connectedness	C1	I can share experiences about the online learning environment or course with others outside this environment.	Cyr [58], Lee [59]
	C2	"In general, I think this online learning environment provides excellent opportunities for interaction with other users."	Fan Liu [64]
Personalization	P1	"I feel secure about the confidentiality of my personal information."	Barnes [130]
	P2	"The online course creates a sense of personalization."	
	P3	This online learning environment offers customization.	Faisal [13]
Responsiveness	R1	This online learning environment provides relevant information concerning my input.	Lee [61]
	R2	This online learning environment provides me adequate feedback when I perform a task.	Faisal [13]
	R3	This online learning environment provides a facility that I can put my feedback /comment about any particular topic or reading material.	Self - developed
Information Design		This online learning environment provide _____ Information.	
	ID1	Accurate information (i.e., grade).	Salloum [17], Roca [65]
	ID2	"easy- to- understand information."	
	ID3	"information is at the right level of detail and in appropriate format."	
Flexibility / Navigation Design		This online learning environment provides————	
	ND1	This online learning environment provided easy navigation.	Thowfeek et al. [90]
	ND2	Provided the right site direction.	
	ND3	Provide an easy get back option.	
Visual Design	VD1	"The screen design (i.e., colors, images, layout, etc.) is attractive."	Cyr [131]
	VD2	The online learning environment animations are meaningful.	
Ease of Use		This online learning environment is _____.	
	EOU1	easy to use.	Davis [33], Aixia [132]
	EOU2	easy to learn.	
	EOU3	is easy to access.	
Usefulness		I think the Using of the online learning environment in my major has helped me to_____.	
	U1	accomplish learning tasks more quickly.	Davis [33], Chang [133]
	U2	improve my learning usefulness.	
	U3	enhance my effectiveness in learning.	
Trust	T1	I trust the information presented in this online learning environment.	Faisal [13]
	T2	This online learning environment is credible for me.	
Intention to Use	IU1	"Assuming I had access to the online learning environment, I intend to use it."	Davis [33], Chang [133]
	IU2	"Given that I had access to the online learning environment, I predict that I would use it."	
	IU3	"I plan to use the online learning environment in the future."	

students' perspectives. Only the graduation or post-graduation level students were included, which may limit the generalizability of the results. Although this is consistent with past studies [6], [48], conducted using a single prototype with limited activities and sample. This research model has also not been differentiated based on participants' demographic variables such as gender, age, research levels, educational background, and browsing experience. But it could be

interesting to explore these aspects using the proposed model in the future. We developed an online learning prototype to experience the real-time environment and avoid individuals' biasness with existing learning websites. The emphasis was given only to the design discussed in the proposed research; accordingly, a careful design strategy was adopted to develop the online learning environment prototype. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

APPENDIX

A. QUESTIONNAIRE

The questionnaire of this study is described in TABLE 10.

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