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RESEARCH ARTICLE

The Study on the Acceptance and Learning Effectiveness of Using E-Learning for Students in Fine Art and Design Colleges

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ABSTRACT E-learning is gaining momentum in higher education globally, offering a solution to the limitations of geography and schedules that are inherent in traditional educational methods. These methods typically involve attending classes, listening to lectures, and taking tests. In China, many universities have transitioned to e-learning platforms, providing students with online access to educational content. This strategy is beneficial as it allows students to access the most current information and helps narrow the technology gap. In the corporate world, there is a growing trend of utilizing e-learning for enhancing employee skills and knowledge. This research focuses on understanding the acceptance and application of information systems among students at Fine Art and Design Colleges in China through the lens of the Technology Acceptance Model. Considering that students pursuing art and design have unique needs and experiences in the university setting, they might encounter specific challenges with e-learning systems. Thus, this study applies the TAM to analyze the specific attitudes of these students towards e-learning. The findings indicate that perceived usefulness remains the most significant factor, and the relationships between the various factors are also noteworthy. The statistical evidence suggests that the differences between college students studying art and design and those studying other subjects are not significant.

INDEX TERMS E-learning, technology acceptance model, partial lease square, perceived usefulness, learning performance.

I. INTRODUCTION

The sweeping advancements in information technology and the Internet have profoundly altered our daily habits and conduct. These changes are particularly noticeable in how people acquire information and pursue education due to ongoing technological innovation and multi-functionality. E-learning emerges as a dominant, convenient educational improvement method, marking a shift that seems irreversible. In the whirlwind of IT progression, online education has taken center stage, liberating learners from the traditional limitations of physical textbooks, strict schedules, and confined classrooms. The COVID-19 pandemic since 2019 has significantly disrupted the education system worldwide, particularly in countries like China that have implemented strict control measures. Consequently, educational strategies have inevitably pivoted to distance learning supported by various technologies. Online platforms, interfaces, and educational content have proven pivotal, offering students immediate feedback and potentially boosting their educational outcomes. Hence, discerning students' views and acceptance of online learning is fundamental to tailoring an educational approach that meets their preferences and maximizes efficacy.

In essence, this research explores e-learning aspects that are relevant to students at fine art and design institutes. It scrutinizes the architecture of e-learning platforms, the creation of digital textbooks, user-friendliness perceptions,

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practical usefulness, and the overall acceptance levels of online education among these students. This demographic traditionally prefers hands-on guidance and direct interaction in their learning processes. The research employs statistical analysis to explore these students' online learning perceptions and acceptance within fine art and design academia, intending to amplify online educational impact and underscore its importance. Reflecting on digital technology's rise, Internet evolution, and IT sophistication, the study acknowledges the extensive reach of online learning in both educational and commercial sectors. By evaluating fine art and design college students' understanding and reception of virtual education, the study advocates for an educational setting unbound by temporal or spatial restrictions, optimizing learning outcomes.

This research aims to investigate the impact of external factors, such as e-learning platforms and student experiences, on the usability, practicality, intention to engage, and overall acceptance of virtual learning environments. The Technology Acceptance Model (TAM) will be used as a framework for this study. The study has the following primary objectives: (1) To assess the current sentiment and receptiveness of fine art and design students towards e-learning; (2) To examine the factors that influence the effectiveness of online education within these groups, analyzing the relationships using the TAM framework; (3) To evaluate the correlation and impact of various external variables on the online learning experience for these artistic students; (4) To provide valuable recommendations for academic professionals to enhance the effectiveness of e-learning based on the study's findings. To order to investigate our research question, we will employ path analysis using the Partial Least Squares (PLS) approach. Our goal is to validate our research hypothesis by assessing the significance of the path coefficients related to the research variables, while examining the interrelationships among different constructs.

II. LITERATURE REVIEW

A. ONLINE, DISTANCE, AND E-LEARNING

Online, distance, or e-learning is the major trend in the information age. The purpose of this learning approach is to enhance learners' motivation and effectiveness, enabling them to engage in learning activities without being constrained by space and time. Additionally, learners can have better control over their learning progress to achieve optimal learning outcomes. Distance learning refers to a method of learning in which learners and teachers can convey knowledge without being limited by space and time [5]. Through systematic instructional design, and the use of computer technology, learners can plan suitable times and interact with teachers to achieve their learning goals. Yusuf and Al-Banawi [6] believe that distance education is highly cost-effective. It not only saves learners' transportation costs but also enables repeated practice. Especially in the knowledge economy era, knowledge workers still need to continue improving their professional skills and acquiring diversified knowledge literacy. Hebebci et al. [7] also pointed out that distance learning is a teaching process that utilizes computer technology and media to systematically deliver designed textbooks to learners. Because the internet is not limited by time and space, learners can learn online anytime and anywhere. They can also interact and communicate with teachers or peers while learning.

In the process of online learning, students and their peers share learning experiences to enhance their personal learning outcomes. The role of learners has also changed from traditional passive learning to an active learning role. Through the application and use of network system tools, learners can access a variety of learning methods and strategies from their peers. Students can collaborate with each other through discussion and dialogue to enhance their learning outcomes [8]. The ideal e-learning environment must consider both the selected technology and the course content in order to facilitate effective interaction between teachers and students for teaching and learning purposes [9]. Bremner et al. [10] pointed out that in the past, teaching activities that were centered on the teacher have gradually shifted towards activities that focus on student-centered learning. The school may gradually be replaced by the e-learning system as the primary learning environment. Online learning has many applications, offering various values and benefits to enterprises, individuals, and industries. The online learning method breaks away from the limitations of traditional learning and offers a great deal of flexibility in terms of time, location, and learning content. This is beneficial for reducing costs and ensuring compatibility in education and training. Online learning, in short, breaks away from the constraints of traditional learning, allowing for flexibility in terms of time and location. The learning content can be accessed and extended anytime and anywhere. It is more conducive to reducing the cost of training in companies or colleges [11].

B. SYNCHRONOUS AND ASYNCHRONOUS E-LEARNING

In general, e-learning can be divided into synchronous and asynchronous e-learning [12], based on the method of delivery. (1) Synchronous e-learning emphasizes the trans-mission of real-time information. All participants in the learning process must engage in online learning simultaneously in order to foster interaction during learning activities. For example, online real-time discussions, broadcast teaching, computer video conferences, etc., synchronous e-learning can break the limitations of spatial distance and al-low teachers and learners from different locations to gather together. However, if learners lack the necessary software and hardware equipment at home, they are still dependent on traditional classrooms and fixed class schedules. As a result, they miss out on the flexibility and convenience offered by online learning. (2) Asynchronous e-learning is less constrained by time. Students can only participate in the web course by using personal computers, cellphones, and other communication devices and connecting to the network learning platform

through a web browser. Asynchronous e-learning is less limited by time. Students can only participate in the web course by using personal computers, cellphones, and other communication devices and connecting the network learning platform through the browser. The standard implementation method is the on-demand video teaching system, where the teacher prerecords the course. It allows students to access the course materials they need anytime and anywhere through the computer and network to engage in learning activities. Since 1998, the United States has incorporated the development of information skills into school curriculum. Relevant scholars have also conducted various research on information and its application in the field of education [13]. Dwyer [14] pointed out that information technology can enable students to construct and observe real-life scenarios. Learners can adapt and utilize various resources to enhance their learning experience. Most colleges and universities in the United States have attempted to implement synchronous and/or asynchronous e-learning in their courses. It allows students to take courses online and encourages teachers to offer asynchronous internet courses, thereby making teaching methods and materials more flexible and diverse.

C. MOTIVATION, SATISFACTION, AND EFFECTIVENESS IN E-LEARNING

Motivation is one of the essential conditions for effective e-learning when teachers are engaged in teaching, and their primary task is to stimulate students' motivation to learn. Before starting the engine, they need to understand the current motivation of students. Motivation is a multifaceted issue in education. Learning motivation has a significant impact on students' learning. If the learning motivation of students is ignored during the implementation of teaching, students will not be satisfied with the teaching process. Powell et al. [15] once discussed the achievement goals and motivation of secondary school students. The study also examined the motivation strategies employed by teachers for high-achieving and low-achieving students. According to the prevailing theory, he believes that motivation refers to how individuals perceive tasks and performance. Therefore, it is better to understand the motivation behind why individuals want to participate in a task, rather than just knowing what they want to do or how long they have been doing it. Teachers can also employ effective motivation strategies by understanding how students perceive their learning. According to Racheva [16], learning motivation is important in e-learning programs. Immediate feedback and two-way interactive communication with distance students are effective ways to enhance students' learning motivation and cultivate their interest and attentiveness towards learning. Many factors of the course affect students' learning, including interaction and feedback. According to Hurlbut [17], students who participate in online learning through group teaching prefer this method over traditional group teaching in general. The most significant difference between group teaching in online learning and general classes is that online courses are more interesting, attractive, and can enhance the motivation for learning. The future classroom should be described as a place with an e-learning environment that combines cloud technology. This technology can effectively improve teachers' teaching effectiveness and students' learning effectiveness when incorporated into the classroom.

Learning satisfaction is one of the key factors used to measure learning outcomes. Many factors may affect students' satisfaction with their learning. In addition to students' personal characteristics, teachers, courses, and the learning environment, among other factors, may have an impact. Researchers will focus on different factors that influence various research purposes or environments. This study primarily examines the impact of learning motivation, learning styles, and learning outcomes on learning satisfaction in the online teaching environment. In terms of students' learning satisfaction, Zhang and Fulford [18] found that in interactive TV teaching courses, students' satisfaction with the course can be predicted by their perception of the overall level of interaction in the class. However, the individual extent of student participation does not necessarily predict their satisfaction with the course. Therefore, although students themselves may not exhibit many interactive behaviors, their satisfaction with the course may not necessarily decrease. They will be satisfied with the course due to the extensive level of interaction throughout the entire class.

Learning effectiveness is an indicator used to measure a student's learning achievement, and it is also one of the most important factors in evaluating teaching quality. Learning effectiveness can be influenced by various factors such as learning style, curriculum design, teaching methods, and other variables. Consequently, numerous researchers have examined the influence of personal characteristics and learning behaviors on learning effectiveness. In addition, some researchers have pointed out that the learning motivation of trainees is related to their learning performance. For example, Law et al. [19] indicated that motivation and learning performance are related. That is, learning motivation directly affects learning outcomes. Mathieu and Martineau [20] also believed that the effectiveness of learning depends on the trainees' level of motivation to learn. Chien [21] studied the impact of training methods, computer self-efficacy, and learning style on learning effectiveness. The study found that among the learners who were passively observed, those who preferred abstract concepts were more effective in learning. Duncan et al. [22] studied the impact of online asynchronous teaching on learning outcomes and found a significant positive relationship between the frequency of students' article postings on teaching websites and their grades. It can be seen that various personal characteristics do indeed influence learning effectiveness.

However, measuring learning effectiveness is difficult to be objective and specific. Kleingeld et al. [23] believe that trainees can best understand whether they are effective in achieving learning outcomes. To and Panadero [24], the absorption, understanding, and application of learning

content were considered to be best measured through the self-assessment method, making it more effective in evaluating learning effectiveness. They also pointed out that the most convincing assessment is the self-assessment made by learners. Chung and Hsiao [25] found in their research that when measuring changes in learners' behavior after learning, most researchers use the self-assessment method. Therefore, the evaluation of learning effectiveness by most scholars is measured through students' self-evaluation on the questionnaire. They also pointed out that successful online learning requires the cooperation of technology, systems, and learners. Therefore, it is more important to strengthen and cultivate learners' correct learning attitude and develop their ability for active learning in online education. Based on the discussion of the literature mentioned above, it is evident that numerous factors influence the effectiveness of learning. This study focuses on the factors that may impact learning effectiveness and examines the effectiveness of learning in an e-learning environment.

D. TECHNOLOGY ACCEPTANCE MODEL

The Technology Acceptance Model (TAM) was proposed by Davis in 1989 [26]. It is based on the Theory of Rational Behavior (TRA) and the Theory of Planned Behavior (TPB) to explore the relationship between rational and perceptual factors and the utilization of technology. The theory of rational behavior explains individual behavior in two aspects: human behavior is driven by personal volition and is rational. The intention of humans to engage in a specific behavior is the decisive factor in whether that behavior occurs or not [27]. The theory of planned behavior explains how human behavior is influenced by three factors: attitude towards the behavior, subjective norms, and perceived behavioral control [28]. The TAM consists of two key concepts: perceived usefulness and perceived ease of use. These concepts are used to explain, diagnose, and predict user behavior when encountering new information technology. The technology acceptance model consists of three stages: the development stage, which involves understanding users' ideas to enhance the system; the implementation phase, which involves assessing the user's acceptance level based on the implementation strategy; and the evaluation stage, which serves as the benchmark for the system's success. The TAM can be used to explain and predict the behavior of information technology use. Many studies have shown that the TAM model is a comprehensive and robust framework for influencing the acceptance behavior of information technology. This model can be applied to various information technologies, diverse user groups, and different national cultures. This model provides a theoretical framework for comprehending the influence of external factors on users' internal beliefs, attitudes, and intentions, which subsequently impact the practical utilization of scientific and technological tools. The TAM includes five primary dimensions: external variables, perceived usefulness, perceived ease of use, attitude towards using, and behavioral intention to use. In addition to the five dimensions mentioned above, we can include a dimension to predict future actual use behavior. Davis pointed out that the external variables of the TAM will affect the internal variables of users, including perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which users believe that the information system can improve work performance. Perceived ease of use is when users recognize that information systems can reduce the burden of operation. Perceived usefulness and perceived ease of use will affect attitudes, intentions, and actual usage behavior. In addition, Davis also demonstrated the existence of perceived usefulness and ease of use from the perspectives of the expectation model, self-efficacy theory, and innovation acceptance model, which may also impact user behavior. Davis and other researchers believe that there are many variables that affect users' acceptance of information systems, such as personal background, system quality, use of WebCT, and learning effectiveness [27], [29], [30], [31], [32], [33], [34], [35]. These related studies have indicated that there is a positive correlation between the quality of information systems and learners' computer self-efficacy, the perceived ease of use of the system, learners' satisfaction with the system, and their learning outcomes. Most empirical studies have confirmed that the perceived ease of use and perceived usefulness significantly impact the intention to use the network university system. This means that when students perceive university network systems as easy to use and useful, their intention to use these systems is higher. In the last ten years, there have been hundreds of studies on e-learning research using the TAM as the foundational model. Previous studies on the intention to use information systems have primarily focused on users' resistance to the system, without actually understanding the psychological mechanisms at play for the users. In light of this, our study utilizes the TAM as the theoretical foundation to investigate the psychological mechanism of users, specifically focusing on the perceived usefulness and perceived ease of use. We then refine the TAM, expand the internal and external variables, propose a research framework and assumptions, and predict the factors that will influence users' willingness to adopt e-learning systems. Finally, we employ empirical analysis of questionnaire data to validate the framework and assumptions proposed in this study.

III. THEORETICAL MODEL FRAMEWORK, HYPOTHESIS DEVELOPMENT, AND STATISTICAL ANALYSIS METHOD

This research utilizes the Technology Acceptance Model (TAM) to delve into the acceptance and effectiveness of e-learning for students at the College of Fine Art and Design. The TAM does not provide precise definitions or categorizations for the variables that influence perceived usefulness and ease of use. Nevertheless, Davis [26] highlighted that external variables can act as connectors linking perception, intention, and acceptance in the TAM to individual variances, situations, and manageable behaviors. These variables are viewed as indirect behavior influencers and

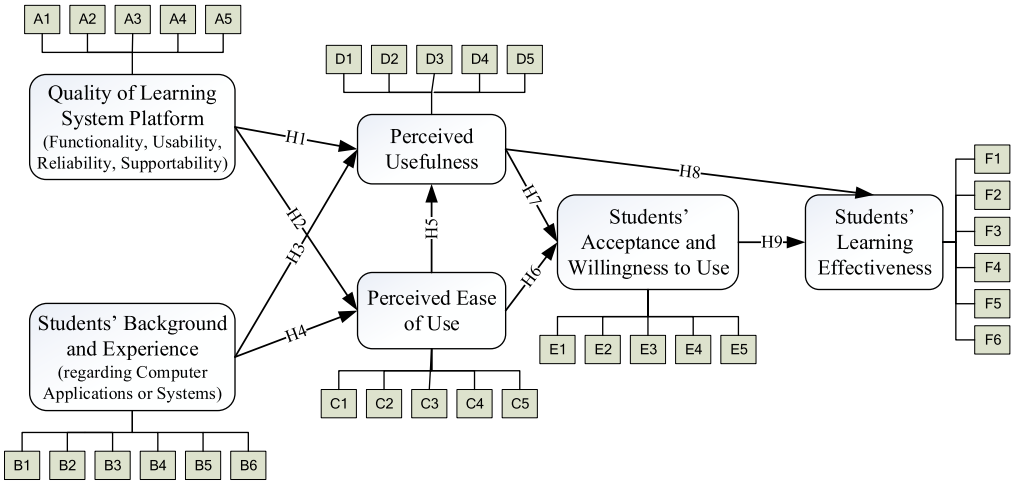

FIGURE 1. The research model and the hypotheses.

form the backbone of research and development efforts. Davis underscored the role of attitude in understanding the connection between "perceived usefulness," "perceived ease of use," and "behavioral intention." This attitude can also predict the intentions and actions of system users directly. To tackle the research questions at hand, we formulated specific hypotheses. These were then explored through a carefully crafted questionnaire and subsequent statistical data analysis. Drawing from the insights gathered, we formulated conclusions and recommendations. A visual representation of all the hypotheses from our theoretical model can be found in Figure 1.

A. RESEARCH CONSTRUCTS, OPERATIONAL DEFINITIONS, AND HYPOTHESES

This study encompasses several critical dimensions, such as the quality of the e-learning system platform, the students' individual backgrounds and experiences, the perceived usefulness and ease of use of the learning systems, the students' receptiveness and readiness to engage with these systems, and the overall impact on students' learning effectiveness. Each of these aspects plays a crucial role in understanding the complete e-learning experience. In order to ensure clarity and precision in our investigation, we not only established these research dimensions, but we also devoted considerable effort to providing operational definitions for each. These definitions are crucial in establishing clear boundaries that eliminate ambiguity, thereby ensuring a comprehensive and consistent understanding of each research construct. This meticulous approach reinforces the validity of our findings and the strategic directions inferred from them.

Moreover, to enhance the foundational understanding of each research construct, we extensively referenced scholarly literature. Each operational definition is supported by extensive academic research, providing a comprehensive understanding based on established studies and theories. This foundational support adds credibility to our research methods and findings, ensuring that they are relevant within the broader context of academic discourse and previous studies. The consolidation of our research dimensions, along with the corresponding operational definitions and their scholarly foundations, is comprehensively presented in Table 1. This tabulation serves not only as a navigational tool for our study but also as a quick reference to comprehend the empirical foundation supporting our investigative journey. It underscores our commitment to a robust, transparent, and replicable research methodology, paving the way for future scholarly inquiries and practical applications in the field of e-learning.

Research grounded in the TAM highlights the critical role of system quality in enhancing the perceived value and usability of online educational platforms for students,

TABLE 1. Definition of each research construct and operational definition.

Research Construct	Operational Definition
Quality of Learning System Platform	System Quality in e-learning measures the desired characteristics (functionality, usability, reliability, adaptability, and supportability). [26, 36, 37, 38]
Students' Background and Experience	Persons' knowledge background and living experience on computers or online systems. [26, 39, 40, 41, 42, 43, 44, 45, 46]
Perceived Usefulness	The concept involves the degree to which a person believes that using a particular system would enhance their academic or work efficiency. [26, 47, 48, 49, 50]
Perceived Ease of Use	It denotes the extent to which an individual perceives that using a specific system will require minimal effort. [26, 47, 48, 49, 50]
Acceptance and Willingness to Use	It refers to the intensity of the person's willingness to perform a specific behavior and the degree of their positive attitude toward the whole learning process. [26, 49, 50, 51, 54, 52, 53, 62, 63]
Students' Learning Effectiveness	It refers to the holistic process by which students engage in a high-quality learning experience. Learners' satisfaction with the system, willingness to participate and learning results. [55, 56, 57, 58, 59]

especially in the context of individualized English instruction for high school students. According to Alshurideh et al. [36], user engagement with learning platforms is not arbitrary but is influenced by a constellation of factors. A platform that guarantees high operational standards, rich content, and a superior navigational experience is crucial in enhancing user satisfaction. In the current landscape, where technological evolution and advancements in e-learning occur at a break-neck pace, ensuring the quality of e-learning experiences is more crucial than ever. Başaran [37] acknowledged that the positive trajectory of students' learning aspirations is a multi-faceted outcome influenced by factors such as technological infrastructure, educator competence, student participation, and course design. Hussein et al. [38] further elaborate on the importance of interactive education, highlighting engaging discourse as a crucial component of e-learning. They emphasize the significance of a system interface in e-learning, arguing that the quality of interface design not only enhances learning but also influences students' motivation to participate and their overall satisfaction with their learning experience. Acknowledging these insights underscores the importance of high-quality e-learning systems and leads to the formulation of the preliminary hypotheses for this study as follows:

H1: The quality of the e-learning system has a positive correlation with students' perceptions of its usefulness. This hypothesis is based on the understanding that a strong, efficient, and resourceful e-learning environment significantly enhances students' academic capabilities.

H2: Improved e-learning system quality has a positive impact on students' perceptions of the system's ease of use. This statement is based on the understanding that a intuitively designed, user-centric platform reduces complexities, which in turn encourages students to use the system more actively.

Lee et al. [46] suggest that various aspects of users' personal backgrounds, such as gender, educational history, duration of computer usage, comfort with technology, frequency of web system interaction, and enthusiasm for e-learning, significantly influence their e-learning characteristics, perceived utility, ease of system use, inclination to engage, and ultimately, the effectiveness of their learning. Essentially, individual learning journeys and histories have a positive impact on the perceived usefulness and ease of navigation of e-learning systems. Alismaiel [42] emphasized that personal experience not only contributes to but also positively moderates the connection between the ease of use and the perceived utility of educational systems. This perspective reinforces the idea that the accumulation of learning experiences enhances learners' appreciation for the value of educational platforms. Furthering this narrative, Rizun and Strzelecki [45] affirmed that a learner's proficiency in handling information, known as their information literacy, positively influences both the perceived ease and the recognized usefulness of e-learning interventions. In light of these insights, this study introduces the third and fourth research hypotheses as follows:

H3: In e-learning, students' background and experience positively impact their perceived usefulness. It means that within the e-learning context, students' backgrounds and accumulated experiences positively influence their perception of the system's usefulness.

H4: In e-learning, students' background and experience positively impact their perceived ease of use. In the realm of e-learning, students' individual histories and learning experiences positively contribute to their comfort and ease of navigation within the system.

Moreover, Tan [49] substantiated through research that there is a positive feedback loop between the perceived navigational simplicity of e-learning platforms and their recognized utility among digital learners. This correlation was particularly noted in the context of college students' responsiveness to English E-Tutoring sites, shaping the sustainability of these educational tools. Tawafak et al. [50] echoed this, revealing a noteworthy consensus among users of English e-tutoring services: the convenience and efficiency of online English learning resources are superior when benchmarked against their offline counterparts. They emphasized the importance of web designers meeting knowledge management needs and interface specifications to enhance the student learning experience. Hence, the study advocates the fifth research hypothesis:

H5: In e-learning, students' perception of ease of use will have a positive impact on their perception of usefulness.

In a study conducted by a researcher [51], it was found that there is a positive correlation between the perceived ease of use by users and their intention to use a system. Similarly, the perceived usefulness of a system is linked to users' intention to use it. However, a contrasting view was presented by Mailizar et al. [54]. Their research highlighted that an individual's attitude towards the application of e-learning and their past experiences with it are the primary determinants in predicting the adoption of e-learning platforms. This was a departure from previous research, as their findings indicated that neither the perceived ease of use nor the perceived usefulness had a significant impact on determining behavioral intentions. Tan [49] emphasized the idea that if learners find a system easy to use, it would positively influence their willingness to use e-learning. Meanwhile, Tawafak et al. [50] believed that a student's perception of a system's usefulness and ease of use is crucial in predicting their intention to engage with e-learning systems. They discovered a direct correlation between behavioral intentions and the actual usage of these e-learning systems. Such insights are invaluable for e-learning system designers, developers, and educators. With this knowledge, educators can develop e-learning platforms that are customized to meet the needs and expectations of students, thereby ensuring an optimal learning experience. Based on these findings, the study presents two research hypotheses.

H6: Students' perceived ease of use can positively impact their acceptance and willingness to use.

H7: Students' perceived usefulness can positively impact their acceptance and willingness to use.

In another study, Abdalla [55] proposed that students' attitudes towards a technological system are influenced by their perception of its ease of use and usefulness. These attitudes, in turn, determine how effectively the technology is utilized. Similarly, perceived usefulness plays a crucial role in determining the effectiveness of a particular technology. Mohammadi [56] echoed this sentiment, adding that the effectiveness of e-learning is positively influenced by its perceived usefulness. The author also pointed out that other factors can influence the impact of perceived ease of use on intentions to use a system. To promote the adoption of online learning platforms, it is crucial to accommodate individual learning preferences by providing a variety of learning methodologies. This study also emphasized the positive influence of perceived usefulness on user intentions. Ibrahim et al. [57] highlighted the role of perceived usefulness in enhancing the learning outcomes of college students. They also discussed the importance of computer self-efficacy in determining a user's intention to adopt a technology, which is influenced by their perception of its ease of use. Pal and Patra [59] observed a positive correlation between the acceptance of video-based learning and its impact on learning outcomes. On the other hand, Wang et al. [58] proposed a comprehensive model that integrates the technology acceptance model with the theory of planned behavior to understand MOOC learning performance. Their findings underscore the importance of various factors, such as perceived usefulness, learning attitudes, subjective norms, perceived behavioral control, and actual learning behaviors, in influencing learning outcomes. In light of these findings, the study introduces two additional research hypotheses.

H8: Students' perceived usefulness can positively impact their learning effectiveness.

H9: Students' acceptance and willingness to use can positively impact their learning effectiveness.

B. DESIGN OF QUESTIONNAIRE

The survey was designed to assess the effectiveness and educational impact of e-learning among students at the College of Fine Art and Design, using specific evaluation criteria for each aspect. It consists of two sections: the initial section gathers essential personal information from the participants, while the second section delves into an evaluation of several aspects, including: (1) Quality of Learning System Platform; (2) Student's Background and Experience; (3) Perceived Usefulness; (4) Perceived Ease of Use; (5) Acceptance and Willingness to Use; (6) Students' Learning Effectiveness. The study utilizes a five-point Likert scale for the assessment mechanism. The scale ranges from ''strongly agree'' to ''strongly disagree,'' with corresponding scores of 5 to 1.

After designing the initial draft of this questionnaire, the study conducted a pretest with 30 students from the Colleges of Fine Art and Design in Guangdong, China. The purpose of the pretest was to identify and correct any ambiguous questions that could potentially affect the effectiveness and reliability of the research. Necessary modifications were made based on the feedback received during the pretest, and a formal questionnaire survey was subsequently conducted.

C. RESEARCH OBJECT AND PROCESS

This study examines e-learning systems primarily used by academic institutions in Guangdong, China, with a specific focus on students from the Colleges of Fine Art and Design. The research investigates how platform quality and learner experiences influence their perceived value and ease of interaction, as determined by the technology acceptance model. It also examines how these perceptions impact students' readiness to adopt and embrace these digital platforms. The main focus is to understand how perceived value, student openness, and acceptance levels impact the effectiveness of learning outcomes.

The objective of this research is to utilize quantitative methods to evaluate students' preparedness and acceptance of online education, as well as the effectiveness of these digital learning methods within the College of Fine Art and Design. The study utilizes online surveys for data collection, with an expected retrieval of 200 valid responses.

D. STATISTICAL ANALYSIS METHODS AND TOOLS

In this research, we utilized the partial least squares (PLS) method to analyze the trajectory of our hypotheses. The data collected from the participants' questionnaires were analyzed using the SmartPLS statistical software. We conducted a descriptive statistical analysis of the variables in the study to assess their frequency and distribution within the sampled data. Following that, we assessed the reliability and validity of the questionnaire. Factor analysis was then used to ensure that the data model aligned with the researchers' expectations and to assess the reliability and distinctiveness of each variable dimension.

Subsequently, correlation analysis and path analysis were performed to scrutinize the variables and hypotheses of the study, thereby reinforcing the credibility of our proposed hypotheses. Pearson correlation analysis was used to determine any significant relationships between the study constructs. Path analysis, which involves concur-rent multiple regression analysis, allowed us to confirm the significance of each trajectory in our research model. Using PLS regression, a specific path analysis technique, we can evaluate the importance of each trajectory in our research model and determine the validity of our research hypothesis. PLS offers several benefits, which contribute to its widespread use in contemporary studies. These advantages include: (1) The ability to manage multiple dependent and independent variables. (2) The ability to address multivariate collinearity and simultaneously handle both reactive and formative indicators. (3) Its suitability for smaller sample sizes. (4) Its flexibility in data allocation ([60]).

To estimate and validate the significance of the path coefficient, PLS (Partial Least Squares) employs the Bootstrap, Blindfolding, and Jackknifing methods. These methods are particularly beneficial when evaluating exploratory research models.

IV. DATA ANALYSIS AND RESULTS

In this section, we delve into the primary data of students from the Colleges of Fine Arts and Design. In Subsection IV.A, we provide an overview of the questionnaire data and conduct a descriptive statistical analysis. The mean and standard deviation are used to demonstrate the overall trend and variability of each research factor. Subsection IV.B focuses on the analysis of reliability and validity. This helps determine the reliability of results under identical conditions and the validity of the results in representing their intended measure. In Subsection IV.C, we will conduct path analysis using the Partial Least Squares approach. By examining the relationships between different constructs, our objective is to validate our research hypothesis by assessing the significance of the path coefficient associated with the research variables. This section concludes with a summary of our research findings and the subsequent discussions.

A. DESCRIPTIVE STATISTICAL ANALYSIS

This study adopts the convenience sampling method to survey students from Fine Art and Design colleges in Guangdong, China. 212 questionnaires were recovered, and 29 invalid questionnaires were excluded. There were 183 valid questionnaires, and the response rate for completed questionnaires was 86.32%. After rearranging the samples, this study analyzed the 183 valid questionnaires. The demographic data of e-learning students is shown in Table 2. This table also displays the mean, standard deviation, and ranking for each questionnaire item related to endogenous constructs. Therefore, we can determine which questionnaire items are worth considering. According to Table 2, the majority of the respondent students are female. It is common in Chinese society for families in China to not encourage their sons to study subjects related to fine art and design. Furthermore, the majority of students (66.1%) come from the southern region of China. This distribution closely reflects the actual situation as the survey was conducted in the Guangdong area, where the majority of students prefer to study in their hometowns. Moreover, due to China's development, the majority of students (97.8%) have access to computers and internet services either at home or in their dormitories. As a result, there is virtually no information gap in e-learning activities.

Concerning the endogenous construct ''Perceived Ease of Use,'' all items in this construct are relatively lower than those in other constructs. Most students believe that the current e-learning systems may not be user-friendly. The university should make the learning process easier for students in the College of Fine Art and Design. Moreover, it can be seen that the levels of ''Perceived Usefulness'' and ''Acceptance and Willingness to Use'' are relatively higher. It may indicate that the students still hold a positive attitude towards e-learning, which can enhance the learning outcomes and the methods of learning. Besides, it implies that in terms of the arrangement of diversified learning for students in the colleges of fine art and design, by using e-learning, students' needs can be met in a more personalized manner.

B. RELIABILITY AND VALIDITY ANALYSIS

The following section of this paper provides a detailed analysis of the reliability and validity of the questionnaire used in the research. The ultimate goal is to assess its suitability for testing the proposed research hypothesis. The examination of reliability is crucial as it provides insights into the consistency of measurement results, which are essential for the interpretive power of confirmatory factor analysis findings.

Typically, Composite Reliability (CR) is used as a measure of internal consistency, examining the consistency of items within a single theoretical dimension. This standard, similar to Cronbach's α, suggests that a threshold above 0.6 indicates acceptable reliability. A review of Table 3 shows that the CR values for each research construct are 0.88, 0.93, 0.88, 0.87, 0.86, and 0.91, respectively, indicating a high level of internal consistency. Moreover, the factor loadings within the questionnaire have their own significance. A higher loading indicates a stronger reflection of the latent variables and a greater contribution to explaining the variance in observable variables. Consequently, the Average Variance Extracted (AVE) is computed, providing insight into the level of convergence. In the realm of measurement models, an Average Variance Extracted (AVE) exceeding 0.50 is considered satisfactory. Data in Table 3 highlights the strong convergent capabilities of the latent variables, as evidenced by the AVE values recorded as 0.60, 0.68, 0.60, 0.57, 0.55, and 0.64. The methodology employed in this study, confirmatory factor analysis, is aimed at assessing convergent validity. It involves examining factor loadings that exceed the 0.7 threshold, which indicates sufficient variance extraction across all constructs.

Turning to the analysis of validity, this process examines the extent to which an instrument accurately measures the intended psychological constructs. It depends on the alignment between the test scores and the traits that are theoretically being measured, essentially indicating the accuracy of the instrument. The current study employs two types of validity measures: content validity and discriminant validity. The former assesses whether the content of the questionnaire provides a comprehensive representation of the subject under scrutiny, thereby supporting the validity of external inferences. The items included in the questionnaire, as outlined in Table 2, underwent careful examination and refinement by experts in the field, ensuring its content validity.

Discriminant validity, on the other hand, is crucial in distinguishing the uniqueness between pairs of distinct

TABLE 2. Demographic data of E-Learning students (n=183).

	Frequency	Percentage (%)	Cumulative Percentage (%)
Gender			
Male	60	32.8	32.8
Female	123	67.2	100
Grade			
Freshman (First Year)	47	25.7	25.7
Sophomore (Second Year)	67	36.6	62.3
Junior (Third Year)	34	18.6	80.9
Senior (Fourth Year)	35	19.1	100
Area			
South	121	66.1	66.1
Middle	25	13.7	79.8
North	37	20.2	100
Is there any computer and Internet service at home or in dormitory?			
Yes	179	97.8	97.8
No	4	2.2	100
Place of E-Learning			
At home	34	18.6	18.6
At dormitory	149	81.4	100
Time for using computer per day			
Less than 1 hour	18	9.8	9.8
1-2 hours	51	27.9	37.7
2-4 hours	61	33.3	71.0
4-6 hours	41	22.4	93.4
More than 6 hours	12	6.6	100

Questionnaire items of endogenous constructs	Mean	S.D.	Rank
Perceived Ease of Use			
C1 I think it is easy to learn to use the e-learning system.	3.11	1.063	4
C2 I think it is convenient to use the e-learning system.	3.10	1.054	5
C3 I didn't spend much time to be familiar with the essential operation functions of the e-learning system.	3.14	1.017	3
C4 Using the e-learning system makes me feel that it is better and easy to arrange suitable learning activities.	3.17	1.085	1
C5 I can easily learn to operate the functions of the e-learning system.	3.15	1.024	2
Perceived Usefulness			
D1 I think the e-learning system can improve my learning effect	3.67	1.060	1
D2 I think using the e-learning system can make my learning easier.	3.46	0.900	5
D3 I think using the e-learning system can improve my learning style.	3.60	1.037	4
D4 I think that the e-learning system made it easier for me to obtain the knowledge I wanted.	3.66	1.014	2
D5 Overall, I think the e-learning system is helpful for my study.	3.65	1.037	3
Acceptance and Willingness to Use			
E1 I think I will be willing to use the e-learning system.	3.69	1.082	3
E2 I will often use the e-learning system for study activities to achieve my learning objectives.	3.78	1.036	2
E3 I am happy to continue using the e-learning system for learning courses.	3.54	1.189	5
E4 I am willing to add courses to participate in e-learning in the future.	3.64	1.168	4
E5 The e-learning system can help me repeat my study.	3.79	0.991	1
Students' Learning Effectiveness			
F1 After the e-learning, I can reorganize course materials to enhance my understanding.	3.60	1.124	3
F2 The e-learning system has improved my learning effect.	3.56	1.127	6
F3 The e-learning can truly reflect my learning performance.	3.69	1.121	1
F4 I gained from the e-learning courses more than from traditional courses.	3.64	1.137	2
F5 The e-learning system can improve discussion among students.	3.58	1.101	4
F6 I can learn the knowledge and skills I want from e-learning.	3.58	1.111	5

research constructs. A low correlation coefficient indicates the presence of discriminant validity between constructs. It is crucial that the correlation co-efficient between different constructs does not exceed the square root of the Average Variance Extracted (AVE) of each construct, as outlined in reference [61]. Inspection of Table 4 reveals that the diagonal elements represent the square root of the AVE, while the non-diagonal elements represent correlation coefficients. Notably, any non-diagonal elements surpassing the corresponding diagonal values indicate the confirmation of discriminant validity among the research constructs in the study. This comprehensive analysis confirms the strength of the questionnaire's design in accurately and effectively measuring the constructs of interest for the current study.

C. PATH ANALYSIS AND DISCUSSION

This research utilizes the capabilities of SmartPLS statistical software to conduct path analysis, a crucial method for examining the significance of path coefficients between variables. This analysis helps confirm or disprove the research hypotheses. Path analysis is widely used in the fields of sociology and behavioral science to explore causal relationships within complex models. The use of partial least squares regression in this context is particularly advantageous because of its flexibility in terms of sample size and data distribution requirements. This makes it particularly suitable for exploratory research in the social sciences. Nonetheless, a limitation of this approach is the absence of an overarching model fit indicator, with

TABLE 3. The confirmatory factors analysis (reliability and convergent validity).

Items in Questionnaire	MLE		CR	AVE
	Factor loading	M.E.		
Quality of Learning System Platform			0.88	0.60
A1 I think the e-learning system is stable, and failure rarely occurs.	0.80	0.63		
A2 I think the information provided by the e-learning system is highly reliable.	0.70	0.49		
A3 I think the e-learning system can provide timely and necessary information.	0.78	0.61		
A4 I think highly of the content provided by the e-learning system.	0.79	0.62		
A5 The user interface and operation of the e-learning system are clear and definite.	0.79	0.62		
Students' Background and Experience			0.93	0.68
B1 I am already familiar with the services provided by the e-learning system.	0.82	0.66		
B2 I am already familiar with the functions provided by the e-learning system.	0.86	0.73		
B3 I will set the objective of the e-learning courses and adjust the progress to achieve my learning objective.	0.77	0.60		
B4 I will try my best to finish the homework for e-teaching courses.	0.83	0.69		
B5 During the e-learning process, the e-learning system can appropriately provide a user with relevant information and online assistance.	0.83	0.69		
B6 I have computer skills to obtain the materials and information for my course and learning.	0.82	0.67		
Perceived Ease of Use			0.88	0.60
C1 I think it is easy to learn to use the e-learning system.	0.79	0.63		
C2 I think it is convenient to use the e-learning system.	0.76	0.57		
C3 I didn't spend much time to be familiar with the essential operation functions of the e-learning system.	0.75	0.57		
C4 Using the e-learning system makes me feel that it is better and easy to arrange suitable learning activities.	0.77	0.59		
C5 I can easily learn to operate the functions of the e-learning system.	0.79	0.62		
Perceived Usefulness			0.87	0.57
D1 I think the e-learning system can improve my learning effect	0.74	0.55		
D2 I think using the e-learning system can make my learning easier.	0.67	0.44		
D3 I think using the e-learning system can improve my learning style.	0.78	0.61		
D4 I think that the e-learning system made it easier for me to obtain the knowledge I wanted.	0.79	0.62		
D5 Overall, I think the e-learning system is helpful for my study.	0.79	0.62		
Acceptance and Willingness to Use			0.86	0.55
E1 I think I will be willing to use the e-learning system.	0.70	0.49		
E2 I will often use the e-learning system for study activities to achieve my learning objectives.	0.72	0.52		
E3 I am happy to continue using the e-learning system for learning courses.	0.74	0.55		
E4 I am willing to add courses to participate in e-learning in the future.	0.79	0.62		
E5 The e-learning system can help me repeat my study.	0.76	0.57		
Students' Learning Effectiveness			0.91	0.64
F1 After the e-learning, I can reorganize course materials to enhance my understanding.	0.77	0.59		
F2 The e-learning system has improved my learning effect.	0.80	0.63		
F3 The e-learning can truly reflect my learning performance.	0.79	0.62		
F4 I gained from the e-learning courses more than from traditional courses.	0.83	0.69		
F5 The e-learning system can improve discussion among students.	0.80	0.64		
F6 I can learn the knowledge and skills I want from e-learning.	0.82	0.67		

TABLE 4. The discriminant validity analysis.

Research Construct	(1)	(2)	(3)	(4)	(5)	(6)
(1) Quality of Learning System Platform	0.741					
(2) Students' Background and Experience	0.571	0.800				
(3) Perceived Usefulness	0.616	0.469	0.821			
(4) Perceived Ease of Use	0.583	0.707	0.622	0.771		
(5) Acceptance and Willingness to Use	0.564	0.663	0.667	0.760	0.772	
(6) Students' Learning Effectiveness	0.573	0.645	0.666	0.661	0.754	0.754

Note: The diagonal elements are the square root of AVE; The non-diagonal elements are the correlation coefficients.

interpretive reliance placed predominantly on the R-squared value.

The outcomes obtained from the partial least squares regression, particularly the standardized path coefficients and p-values, serve as indicators of the accuracy of each path hypothesis. Inspection of Table 5 and Figure 2, which present the results of the path analysis, reveals non-significant path coefficients for "Quality of Learning System Platform ➔ Perceived Usefulness" and "Acceptance and Willingness to Use ➔ Students' Learning Effectiveness." The p-values (0.121, 0.059) for these paths exceed the 0.05 threshold, resulting in the rejection of hypotheses H1 and H9 as outlined in Table 5. Subsequent discussions arising from the research findings include:

There is a significant discrepancy observed concerning the impact of e-learning system quality on perceived usefulness and ease of use. Observed. While the quality of the system has a significant impact on its perceived ease of use, its influence diminishes when it comes to perceived usefulness. This suggests that despite having an intuitive design, the system's content or educational material might be lacking, which could diminish its perceived usefulness among students. Furthermore, lower scores for the item assessing information reliability suggest that students may underestimate the

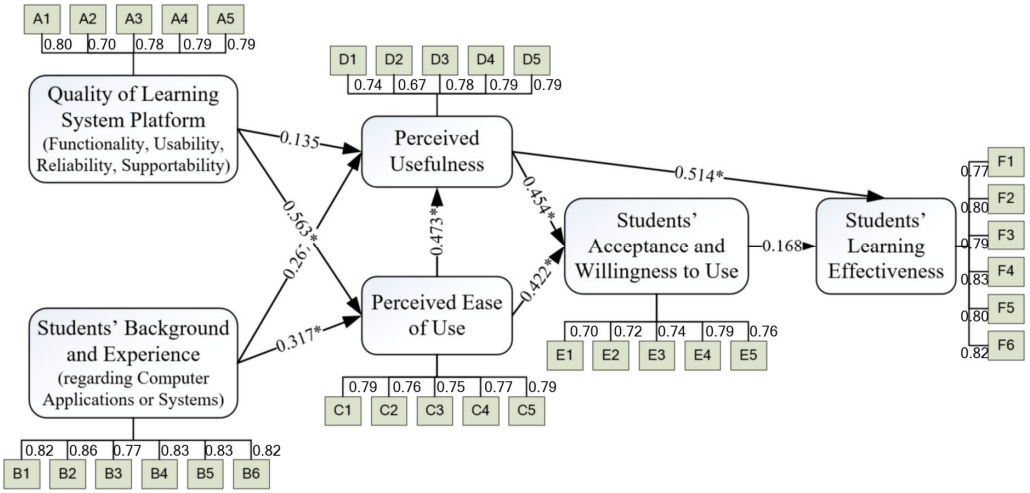

FIGURE 2. The results of path analysis (*: p-value<0.05).

TABLE 5. Statistical results of path analysis.

Path	Path Coef.	S.D.	T-Stat.	P-Value
H1: Quality of Learning System Platform ➔ Perceived Usefulness	0.135	0.087	1.553	0.121
H2: Quality of Learning System Platform ➔ Perceived ease of use	0.563	0.046	12.342	0.000
H3: Students' Background and Experience ➔ Perceived Usefulness	0.267	0.068	3.936	0.000
H4: Students' Background and Experience ➔ Perceived ease of use	0.317	0.050	6.304	0.000
H5: Perceived ease of use ➔ Perceived Usefulness	0.473	0.076	6.239	0.000
H6: Perceived ease of use ➔ Acceptance and Willingness to Use	0.422	0.061	6.927	0.000
H7: Perceived ease of use ➔ Perceived Usefulness	0.454	0.063	7.216	0.000
H8: Perceived usefulness ➔ Students' Learning Effectiveness	0.514	0.081	6.319	0.000
H9: Acceptance and Willingness to Use ➔ Students' Learning Effectiveness	0.168	0.089	1.894	0.059

importance of content reliability. This could be attributed to their inherent trust in the reliability of educational resources within the Chinese educational system.

The highlights underscore the importance of the perceived ease of use in influencing the shaping of perceived usefulness, acceptance, and willingness to engage with e-learning systems among fine art students. The path coefficients for H5 and are 0.473 and 0.422, respectively. These findings reinforce the significance of having user-friendly e-learning platforms, particularly in creative disciplines, to enhance student engagement and improve learning outcomes.

The path coefficients for H7 and H8 (0.454 and 0.514, respectively) indicate a significant impact of perceived usefulness, acceptance, and willingness to engage on learning effectiveness among students. These insights suggest that enhancing the perceived value and ease of use of e-learning platforms could significantly improve learning effectiveness. The widespread acceptance of e-learning activities within these disciplines indicates their potential for achieving positive educational outcomes.

However, the study reveals an insignificant and inconsequential effect of students' acceptance and willingness to engage in learning (H9), with a path coefficient and p-value of 0.059. This implies a discrepancy between the acceptance of online learning methods and their actual impact on educational outcomes. The research instrument does not account for several potentially influential factors, such as the workload of home-work or the balance between synchronous and asynchronous learning. This suggests that there may be other unidentified variables that could be influencing the results. Uncovering these factors could have a significant impact on the research findings, providing insights into areas that need further exploration to comprehend the dynamics that influence the effectiveness of e-learning among students.

V. CONCLUSION

This study focuses on the fine art and design students at China colleges. It explores the relationship between the quality of e-learning systems, learners' background and experience, perceived usefulness, perceived ease of use, learners' willingness and acceptance, and learning effectiveness. The results of the study except that the quality of e-learning system has no significant positive impact on perceived usefulness and students' acceptance and willingness on learning effectiveness. Other empirical results are consistent with the original research hypothesis.

The empirical results of this study can provide college supervisors with feasible solutions to design e-learning system platforms that effectively improve the acceptance and learning effectiveness of students' e-learning. Additionally, these results can offer managerial suggestions and the direction of future studies as follows: (1) It is suggested that colleges and universities should not only design relevant interfaces according to the established learning objectives

when designing the e-learning system platform, but also incorporate a user-friendly module on the operation interface or website pages. This module should be able to change or hide the functions of the website pages, and provide real-time and timely assistance to improve the convenience of e-learning. By doing so, learners can experience the ease of use and usefulness of online teaching, ultimately enhancing learning effectiveness. (2) This research is aimed at students in fine art and design colleges, who appear to have some deficiencies in their utilization of the Internet in today's society. Students in fine art and design colleges are no longer learning in the traditional way of drawing, designing, editing, performing…In this study, learners' experience shows that the network teaching mode is also popular in colleges of fine art and design. Therefore, future research can be expanded to include music or sports colleges, which will enhance the richness and applicability of the research findings.

REFERENCES

[1] L. Hai, G. Sang, H. Wang, W. Li, and X. Bao, "An empirical investigation of university students' behavioural intention to adopt online learning: Evidence from China," *Behav. Sci.*, vol. 12, no. 10, p. 403, Oct. 2022.

[2] A. Saykili, "Distance education: Definitions, generations, key concepts and future directions," *Int. J. Contemp. Educ. Res.*, vol. 5, no. 1, pp. 2–17, 2018.

[3] D. M. Stenhoff, R. C. Pennington, and M. C. Tapp, "Distance education support for students with autism spectrum disorder and complex needs during COVID-19 and school closures," *Rural Special Educ. Quart.*, vol. 39, no. 4, pp. 211–219, Dec. 2020.

[4] A. B. Yilmaz, "Distance and face-to-face students' perceptions towards distance education: A comparative metaphorical study," *Turkish Online J. Distance Educ.*, vol. 20, no. 1, pp. 191–207, Jan. 2019.

[5] O. Peters, "Distance teaching and industrial production: A comparative interpretation in outline," in *Distance Education*. Evanston, IL, USA: Routledge, 2020, pp. 95–113.

[6] N. Yusuf and N. Al-Banawi, "The impact of changing technology: The case of E-learning," *Contemp. Issues Educ. Res. (CIER)*, vol. 6, no. 2, p. 173, Mar. 2013.

[7] M. T. Hebebci, Y. Bertiz, and S. Alan, "Investigation of views of students and teachers on distance education practices during the coronavirus (COVID-19) pandemic," *Int. J. Technol. Educ. Sci.*, vol. 4, no. 4, pp. 267–282, Sep. 2020.

[8] A. Z. Al Rawashdeh, E. Y. Mohammed, A. R. Al Arab, M. Alara, B. Al-Rawashdeh, and B. Al-Rawashdeh, "Advantages and disadvantages of using e-learning in university education: Analyzing students' perspectives," *Electron. J. e-Learn.*, vol. 19, no. 3, pp. 107–117, May 2021.

[9] A. Carr-Chellman and P. Duchastel, "The ideal online course," *Brit. J. Educ. Technol.*, vol. 31, no. 3, pp. 229–241, Jul. 2000.

[10] N. Bremner, N. Sakata, and L. Cameron, "The outcomes of learner-centred pedagogy: A systematic review," *Int. J. Educ. Develop.*, vol. 94, Oct. 2022, Art. no. 102649.

[11] J. Du, "Exploration on the integration path of distance and open education and vocational education under the background of 'internet,'" *OALib*, vol. 8, no. 4, pp. 1–15, 2021.

[12] K. Hadullo, R. Oboko, and E. Omwenga, "Factors affecting asynchronous e-learning quality in developing countries university settings," *Int. J. Educ. Develop. Using ICT*, vol. 14, no. 1, pp. 152–163, 2018.

[13] J. Levine, "Planning strategically for technology integration," in *Proc. Soc. Inf. Technol. Teacher Educ. Int. Conf. (AACE)*, 1998, pp. 305–307.

[14] D. C. Dwyer, "Since computers came to school," *Educ. Technol.*, vol. 42, no. 4, pp. 17–18, 2002.

[15] W. W. Powell, K. W. Koput, and L. Smith-Doerr, "Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology," *Administ. Sci. Quart.*, vol. 41, no. 1, p. 116, Mar. 1996.

[16] V. Racheva, "Social aspects of synchronous virtual learning environments," in *Proc. AIP Conf.*, 2018, Art. no. 020032.

[17] A. R. Hurlbut, "Online vs. traditional learning in teacher education: A comparison of student progress," *Amer. J. Distance Educ.*, vol. 32, no. 4, pp. 248–266, Oct. 2018.

[18] S. Zhang and C. P. Fulford, "Are interaction time and psychological interactivity the same thing in the distance learning television classroom?" *Educ. Technol.*, vol. 34, no. 6, pp. 58–64, 1994.

[19] K. M. Y. Law, S. Geng, and T. Li, "Student enrollment, motivation and learning performance in a blended learning environment: The mediating effects of social, teaching, and cognitive presence," *Comput. Educ.*, vol. 136, pp. 1–12, Jul. 2019.

[20] J. E. Mathieu and J. W. Martineau, "Individual and situational influences on training motivation," in *Improving Training Effectiveness Work Organizations*. London, U.K.: Psychology Press, 2014, pp. 193–221.

[21] T. Chien, "Computer self-efficacy and factors influencing e-learning effectiveness," *Eur. J. Training Develop.*, vol. 36, no. 7, pp. 670–686, Aug. 2012.

[22] K. Duncan, A. Kenworthy, and R. McNamara, "The effect of synchronous and asynchronous participation on students' performance in online accounting courses," *Accounting Educ.*, vol. 21, no. 4, pp. 431–449, Aug. 2012.

[23] A. Kleingeld, H. van Mierlo, and L. Arends, "The effect of goal setting on group performance: A meta-analysis," *J. Appl. Psychol.*, vol. 96, no. 6, p. 1289, 2011.

[24] J. To and E. Panadero, "Peer assessment effects on the self-assessment process of first-year undergraduates," *Assessment Eval. Higher Educ.*, vol. 44, no. 6, pp. 920–932, Aug. 2019.

[25] C.-Y. Chung and I.-H. Hsiao, "Investigating patterns of study persistence on self-assessment platform of programming problem-solving," in *Proc. 51st ACM Tech. Symp. Comput. Sci. Educ.*, Feb. 2020, pp. 162–168.

[26] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quart.*, vol. 13, no. 3, p. 319, Sep. 1989.

[27] R. J. Hill, M. Fishbein, and I. Ajzen, "Belief, attitude, intention and behavior: An introduction to theory and research," *Contemp. Sociol.*, vol. 6, no. 2, p. 244, Mar. 1977.

[28] I. Ajzen, "From intentions to actions: A theory of planned behavior," in *Action Control: From Cognition to Behavior*. Berlin, Germany: Springer, 1985, pp. 11–39.

[29] V. Venkatesh and F. D. Davis, "A model of the antecedents of perceived ease of use: Development and test," *Decis. Sci.*, vol. 27, no. 3, pp. 451–481, Sep. 1996.

[30] J. Moon, J. Shim, and W. S. Lee, "Antecedents and consequences of the ease of use and usefulness of fast food kiosks using the technology acceptance model," *Systems*, vol. 10, no. 5, p. 129, Aug. 2022.

[31] J. C. Roca, C.-M. Chiu, and F. J. Martínez, "Understanding e-learning continuance intention: An extension of the technology acceptance model," *Int. J. Hum.-Comput. Stud.*, vol. 64, no. 8, pp. 683–696, Aug. 2006.

[32] E. W. T. Ngai, J. K. L. Poon, and Y. H. C. Chan, "Empirical examination of the adoption of WebCT using TAM," *Comput. Educ.*, vol. 48, no. 2, pp. 250–267, Feb. 2007.

[33] A. K. M. N. Islam, "Investigating e-learning system usage outcomes in the university context," *Comput. Educ.*, vol. 69, pp. 387–399, Nov. 2013.

[34] H. Al-Samarraie, B. K. Teng, A. I. Alzahrani, and N. Alalwan, "E-learning continuance satisfaction in higher education: A unified perspective from instructors and students," *Stud. Higher Educ.*, vol. 43, no. 11, pp. 2003–2019, Nov. 2018.

[35] C. Tam, D. Santos, and T. Oliveira, "Exploring the influential factors of continuance intention to use mobile apps: Extending the expectation confirmation model," *Inf. Syst. Frontiers*, vol. 22, no. 1, pp. 243–257, Feb. 2020.

[36] M. T. Alshurideh, B. Al Kurdi, A. Q. AlHamad, S. A. Salloum, S. Alkurdi, A. Dehghan, M. Abuhashesh, and R. Masa'deh, "Factors affecting the use of smart mobile examination platforms by universities' postgraduate students during the COVID-19 pandemic: An empirical study," *Informatics*, vol. 8, no. 2, p. 32, Apr. 2021.

[37] S. Başaran, "Investigating university students' acceptance of blended learning during COVID-19 pandemic," *Int. Trans. J. Eng. Manag. Appl. Sci. Technol.*, vol. 12, pp. 1–11, Oct. 2021.

[38] M. H. Hussein, S. H. Ow, I. Ibrahim, and M. A. Mahmoud, "Measuring instructors continued intention to reuse Google classroom in Iraq: A mixed-method study during COVID-19," *Interact. Technol. Smart Educ.*, vol. 18, no. 3, pp. 380–402, Oct. 2021.

[39] D. R. Compeau and C. A. Higgins, "Computer self-efficacy: Development of a measure and initial test," *MIS Quart.*, vol. 19, no. 2, p. 189, Jun. 1995.
[40] N. S. Bhati and B. Arya, "Impact of COVID-19 on undergraduate and postgraduate students' usage intention towards E-learning," in *Proc. IEEE Int. Conf. Technol., Eng., Manage. Societal Impact Using Marketing, Entrepreneurship Talent (TEMSMET)*, Dec. 2020, pp. 1–5.
[41] K. Cicha, M. Rizun, P. Rutecka, and A. Strzelecki, "COVID-19 and higher education: First-year students' expectations toward distance learning," *Sustainability*, vol. 13, no. 4, p. 1889, Feb. 2021.
[42] O. A. Alismaiel, "Using structural equation modeling to assess online learning systems' educational sustainability for university students," *Sustainability*, vol. 13, no. 24, p. 13565, Dec. 2021.
[43] N. Nurse-Clarke and M. Joseph, "An exploration of technology acceptance among nursing faculty teaching online for the first time at the onset of the COVID-19 pandemic," *J. Prof. Nursing*, vol. 41, pp. 8–18, Jul. 2022.
[44] M. A. Almulla, "Using digital technologies for testing online teaching skills and competencies during the COVID-19 pandemic," *Sustainability*, vol. 14, no. 9, p. 5455, May 2022.
[45] M. Rizun and A. Strzelecki, "Students' acceptance of the COVID-19 impact on shifting higher education to distance learning in Poland," *Int. J. Environ. Res. Public Health*, vol. 17, no. 18, p. 6468, Sep. 2020.
[46] H.-I. Lee, T.-Y. Lin, Z. Wang, S. Li, and S.-H. Chiu, "Teacher's acceptance of online education platform into foreign language teaching in Chinese higher education," in *Proc. 12th Int. Conf. E-Educ., E-Bus., E-Manag., E-Learn.*, Jan. 2021, pp. 260–263.
[47] N.-S. Chen, H.-Y. Huang, and Y.-C. Shih, "Factors affecting usage of web-based teachers' training in elementary and high school," in *Proc. Int. Conf. Comput. Educ.*, 2002, pp. 589–592.
[48] W.-T. Wang and C.-C. Wang, "An empirical study of instructor adoption of Web-based learning systems," *Comput. Educ.*, vol. 53, no. 3, pp. 761–774, Nov. 2009.
[49] P. Tan, "An empirical study of how the learning attitudes of college students toward English E-tutoring websites affect site sustainability," *Sustainability*, vol. 11, no. 6, p. 1748, Mar. 2019.
[50] R. M. Tawafak, W. M. Al-Rahmi, A. S. Almogren, M. N. Al Adwan, A. Safori, R. W. Attar, and M. Habes, "Analysis of E-learning system use using combined TAM and ECT factors," *Sustainability*, vol. 15, no. 14, p. 11100, Jul. 2023.
[51] Z. Hussein, "Leading to intention: The role of attitude in relation to technology acceptance model in E-learning," *Proc. Comput. Sci.*, vol. 105, pp. 159–164, Jan. 2017.
[52] A. M. Al-Rahmi, W. M. Al-Rahmi, U. Alturki, A. Aldraiweesh, S. Almutairy, and A. S. Al-Adwan, "Exploring the factors affecting mobile learning for sustainability in higher education," *Sustainability*, vol. 13, no. 14, p. 7893, Jul. 2021.
[53] A. Widjaja and Y. G. Widjaja, "The influence of interaction, learner characteristics, perceived usefulness, and perceived satisfaction on continuance intention in e-learning system," *Int. J. Res. Bus. Social Sci.*, vol. 11, no. 2, pp. 381–390, Mar. 2022.
[54] M. Mailizar, A. Almanthari, and S. Maulina, "Examining teachers' behavioral intention to use E-learning in teaching of mathematics: An extended TAM model," *Contemp. Educ. Technol.*, vol. 13, no. 2, Feb. 2021, Art. no. ep298.
[55] I. Abdalla, "Evaluating effectiveness of e-blackboard system using TAM framework: A structural analysis approach," *AACE Rev.*, vol. 15, no. 3, pp. 279–287, 2007.
[56] H. Mohammadi, "Investigating users' perspectives on e-learning: An integration of TAM and IS success model," *Comput. Hum. Behav.*, vol. 45, pp. 359–374, Apr. 2015.
[57] R. Ibrahim, N. S. Leng, R. C. M. Yusoff, G. N. Samy, S. Masrom, and Z. I. Rizman, "E-learning acceptance based on technology acceptance model (TAM)," *J. Fundam. Appl. Sci.*, vol. 9, no. 4S, pp. 871–889, 2017.
[58] Y. Wang, C. Dong, and X. Zhang, "Improving MOOC learning performance in China: An analysis of factors from the TAM and TPB," *Comput. Appl. Eng. Educ.*, vol. 28, no. 6, pp. 1421–1433, Nov. 2020.
[59] D. Pal and S. Patra, "University students' perception of video-based learning in times of COVID-19: A TAM/TTF perspective," *Int. J. Hum.–Comput. Interact.*, vol. 37, no. 10, pp. 903–921, Jun. 2021.
[60] D. M. Pirouz, *An Overview of Partial Least Squres*, document SSRN 1631359, 2006.
[61] J. F. Hair, R. E. Anderson, R. L. Tatham, and W. C. Black, *Multivariate Data Analysis*. Upper Saddle River, NJ, USA: Prentice-Hall, 1998.
[62] C. Gupta, V. Gupta, and A. Stachowiak, "Adoption of ICT-based teaching in engineering: An extended technology acceptance model perspective," *IEEE Access*, vol. 9, pp. 58652–58666, 2021.
[63] D. Bilegjargal and N.-L. Hsueh, "Understanding students' acceptance of online judge system in programming courses: A structural equation modeling approach," *IEEE Access*, vol. 9, pp. 152606–152615, 2021.

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