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Intentions of Students to Continue Using Virtual Desktop Infrastructure: Expectation Confirmation Model Perspective

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ABSTRACT This predictive correlational study investigated the extent to which the expectation confirmation model can predict the intention of students to continue using virtual desktop infrastructure (VDI). It also examined the relationships of satisfaction, perceived usefulness, and the confirmation level with the intention to continue using. The data were collected through an e-questionnaire in which 367 male and female students from the Institute of Public Administration (IPA) participated. They had previously used computer applications and software through the VDI for a number of their courses. Structural equation modeling (SEM) was used to test the hypotheses. The results indicated that satisfaction and perceived usefulness were statistically significant in predicting that the students intended to continue VDI use. The confirmation level indirectly predicted the students' intention to continue using VDI through its effect on satisfaction and perceived usefulness. The findings suggest that it is important to improve learning experiences through VDI to raise students' satisfaction due to its impact on their intention to continue using VDI. The study also recommends that more research be conducted in the field of VDI to explore other factors that explain and contribute to continued VDI use.

INDEX TERMS Cloud computing, expectation confirmation model, online learning, virtual desktop infrastructure.

I. INTRODUCTION

Universities and educational institutions may have made plans to provide online courses after experiencing online learning, especially after the restrictions imposed during the COVID-19 pandemic, to reduce the physical closeness among students. A trend toward blended learning, distance learning, and the provision of virtual learning environments and technologies has played a major role in harnessing and overcoming many of the difficulties that may face the provision of these modes of education. Acquiring knowledge and developing skills differ in terms of difficulties and possibilities based on disciplines, especially those that require acquiring practical skills. The need to provide licensed computer programs, programming languages and other applications

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that learners require may well be one of, if not the most important, difficulties ahead for those teaching computer sciences and digital technology over the internet. Educational institutions in the traditional mode provide computer-equipped labs with these programs and software, which facilitates students' access to them. During the pandemic, many of these labs were transformed to accommodate remote learning [1].

However, teaching science, technology and engineering, because of the very nature of the fields, still lags behind when using new technical methods, especially in online learning. The reason is that these fields often require hands-on lab training to acquire practical skills and experience [2]. Technological innovations, one of which is virtual desktop infrastructure (VDI), has contributed to the transformation to online learning. The idea of VDI is to enable access to a virtual personal computer (PC) environment at anytime from anywhere, regardless of the connected device, as long as the

internet connection allows access to computer applications and software provided by their educational institutions.

In computer courses and digital technologies, concepts are usually taught in theoretical lectures, and practical application is carried out in computer labs where the theoretical concepts and practical application are linked. A number of services and resources must be available during the period of practical lectures or practical training. Usually, the resources are limited, and the number of students exceeds these resources. Virtual labs work to solve this problem by increasing the number of programs, applications or resources [3]. VDIs are considered a solution to such problems because they enable the distance learning of computer courses, which requires practice in computer programs and applications. Because the learning experience that uses these programs differs from that in traditional labs and because a teacher does not physically stand in front of the student's computer, it cannot be assumed that a student will use the programs in the same way that he or she uses them in the computer lab [4].

This study aims to investigate using VDI more deeply and to participate in formulating applicable recommendations for educators. Based on the expectations confirmation model (ECM), this study aims to explore the factors that influence students' intention to continue using VDI to expand the current understanding of using VDI. The literature has demonstrated that intention is inspired by a complex set of factors, and many theories can help in understanding these factors. Researchers in the educational field continue to study the factors that influence the intention of students or teachers to use different technologies in education [5]–[9] to activate their use more effectively [10]. Knowing the factors that lead to the continued use of VDI may help educational institutions provide learning experiences that support the optimal use of technologies [10].

Moreover, the intention to continue using technologies in education is key to enhancing online learning in future university settings [6]. The literature indicates that little academic attention has been given to the issue of students' intention to continue using VDI; therefore, educational institutions urgently need to explore it to enhance it [11]. Understanding students' intention concerning this type of service will enhance their prospects at educational institutions [11]. Measuring the extent to which users intend to continue using an educational technology is necessary, as students may accept a particular technology but do not continue to use it. Therefore, the intention to continue using an educational technology is an indicator of its success [17]. Additionally, there is insufficient information about students' experience with VDIs and their intention to continue using them [9].

Based on the above, it is hoped that this study contributes to educational research by providing information about students' experience with VDIs and their intention to continue using them and to helping educational institutions provide learning experiences that support the optimal use of technologies. Knowing the factors

that lead to the continued use of VDI facilitates such goals.

The rest of this paper is organized as follows. Section 2 presents the relevant studies concerning VDI. Section 3 shows the study methodology and the study framework and hypotheses. Section 4 describes the results. Section 5 demonstrates the discussion. Section 6 presents the limitations and future work. Finally, Section 7 provides the conclusion.

II. THEORETICAL FRAMEWORK

A. VIRTUAL DESKTOP INFRASTRUCTURE

VDI belongs to the family of cloud computing applications that provides customized network access to users, which consequently saves network resources, reduces costs and improves production efficiency. All resources in cloud computing, such as processing units, storage, and network resources, are virtual, and users can access them according to their needs through virtual desktops [17]. VDI refers to the provision and management of virtual desktops on a central server. Access is provided on demand. Users remotely access virtual desktops through PCs, tablets, laptops and smartphones, and remote access is an integral part of this technology [16]. Users can interact and use the resources with a keyboard, mouse, touch screen, and peripheral devices [12]. Virtual desktop technology contains a number of servers and advanced storage systems in which virtualization technology allows users to access and use virtual computers directly on the internet without having to take extra steps through their mobile devices or browsers, such as installing software or changing the interface setup. A server responsible for the connection verifies the identity and credibility of the user's login and then creates an active connection in the form of a session so that each user has a session until he or she disconnects or shuts down the virtual device. The user may be able to enter the same session if the disconnection is temporary [11].

In a virtual desktop environment, what is typically done in a user's personal desktop environment, such as operating system processes, applications, and file and data storage, is stored and executed remotely in a remote desktop virtualization host (RDVH), which can be stored in the cloud or on a local computer [13]. The virtual desktop is connected to the end user's device using the remote desktop protocol (RDP) [14]. VDI was introduced in the early 1980s by IBM with the aim of ensuring that organizations could use computing resources efficiently, effectively and frugally, and it makes computing power seamless and unaffected by location [15]. Computer applications and user operating systems have become so complex that they require complex computing processes and large resources. Personal computers have become so powerful that most users do not use the full capabilities of their devices all the time, and organizations have begun to take advantage of the redundant capabilities in the server and share it with many other users [13]. Over the past decade, to reduce the cost of information technology (IT)

infrastructure, a centralization approach has received much attention and has become a useful technique for software testing, high availability, real-time migration, and load balancing [16]. Despite the quality of their performance, servers' low prices have helped convince companies to move their systems and services to cloud computing environments to reduce the cost of information management [17].

VDI has attracted increasing interest from educational institutions because it allows students to learn beyond the limits of time and space by giving them access to licensed software that was previously inaccessible off campus [11]. VDI thus became a good option for institutions because of high-speed computing, virtualization technology, and the centralized management of desktops, which has led to lower costs for users and easier management of their devices [18]. During the pandemic, many online learning platforms have been available in different cloud forms. VDI played an important role in higher education until moving labs to the cloud seemed mandatory to provide labs on demand, and it is considered a resolution to many difficulties related to the purchase of hardware or software and the allocation of space or hiring staff [4].

VDI provides significant benefits for institutions in terms of data security, flexibility, and a lower total cost of ownership, which has attracted many organizations to it [16]. VDI also offers users such core benefits as increased digital access, a lower operational cost, improved security, higher reliability, increased performance and availability, reduced downtime, and the ability to run old applications on newer or incompatible platforms. It simplifies the management of data and uses resources efficiently [12], [19], [20].

The use of VDI in education provides advantages such as cost-effectiveness, multiple access that allows a number of students the simultaneous use of the same software, the quick and easy processing of workstations, the centralized management of system files, data security, and standardized installation of applications and software. This applies even with the problem of incompatibility with other systems or with systems that are expensive to install. Furthermore, data are secured since they are all stored on a virtual desktop either located on a server or in the cloud, not on the endpoint itself. This greatly reduces the threat associated with lost devices and increases access from anywhere to workstations and applications. In the event of any malfunction or problem, only one system repair on the server is required [2], [21].

The use of VDI by educational institutions limits such challenges as installing complex applications on their available infrastructure, a lack of sufficient computers for their number of students, quarterly schedule changes, maintaining desktop computers in labs during teaching hours, practical training to prepare for exams, and the challenges of providing multiple operating systems [21], [22]. Additionally, there is the risk of losing the work of students who try to save their work on lab equipment. Using VDI helps institutions keep abreast of developments in the field of learning programs and applications, despite the high cost of updating programs. The need to

provide such programs on large numbers of lab devices may lead to the use of programs with old or inappropriate copies. Some of these copies may be complex and require advanced and modern equipment, while the institutions' lab equipment is not advanced and modern [22].

B. EXPECTATIONS CONFIRMATION MODEL

In recent decades, predicting the intentions of future behavior has received great attention in various fields, including the use of technologies. Many models and theories have been developed, such as the theory of reasoned action [23], the acceptance technology model (TAM) [24] and many others that have addressed using technology after its initial acceptance. Attention then shifted from initial acceptance to continued use. Several models and theories have been developed that address the intention to continue using technologies as a dependent variable in different contexts. This research relies on ECM, which is compatible with the study objective. An ECM developed from the consumer behavior literature was combined with the theoretical and empirical results from previous technology and information systems usage research to develop a model that predicts the continued usage of technologies and information systems [25].

ECM addresses the cognitive beliefs that impact a person's intention to continue using technologies and has been widely used to explain satisfaction and continuance behavior [6]. ECM has been used by researchers to verify, interpret, explore and explain learners' intentions to continue using online learning systems or tools such as virtual and remote labs [9], e-learning in the primary stage [7], with university students [6] for online tutoring [8] and for massive open online courses (MOOCs) [5]. This study aims to explore learners' intentions to continue using VDI.

The model confirms that prior experience has a significant impact on a user's future behavior toward the use of the product or service by explaining the relationship among the following four variables that make up the theory: perceived usefulness; confirmation; satisfaction; and intention to continue using the technology.

The theory assumes the existence of five relationships: users' intention to continue using a certain technology or information system is driven by their satisfaction with its use and the perceived usefulness of using it. Although perceived usefulness is affected by the level of users' confirmation of their previous expectations of this technology, this confirmation affects their satisfaction with their use of the technology [25]. The study seeks to investigate the extent to which satisfaction, perceived usefulness, and expectations can predict students' intention to continue using VDI. Thus, the main study question is as follows: can ECM explain the intention of students to continue using VDI? Figure 1 shows the suggested relationships from the ECM perspective.

In this paper, perceived usefulness describes the degree to which students believe that using VDI will be beneficial to them.

Perceived usefulness has been found to predict the continuance intention to use technology [6], [9], [31] therefore, students' continuance intention to use VDI is also expected to be significantly affected by their perceived usefulness of VDI. Variable confirmation refers to the degree to which students' expectations are met when they use VDI. Satisfaction refers to users' positive emotions toward the use of VDI, which is the result of the evaluation of this use. Perceived usefulness is hypothesized to positively affect satisfaction. Individuals' satisfaction level increases when they feel that they can gain some benefits from technology [25]. In this study, when students feel that VDI provides them benefits upon its usage, they will have a higher satisfaction level. ECM also suggests that individuals' satisfaction with the use of technology is positively affected by their confirmation [25].

The key variable in the theory – Continuance Intention – refers to how willing students are to make an effort to continue using VDI. Studies have suggested the relationship between satisfaction and continuance intention in using technology settings [6], [9], [31]. Thus, students' satisfaction is expected to positively affect their VDI continuance intention.

Based on the above explanation, five hypotheses were generated as follows.

- H1: The perceived usefulness of using VDI positively affects students' intention to continue using it.
- H2: Student satisfaction with the use of VDI positively affects students' intention to continue using it.
- H3: The perceived usefulness of using VDI positively affects students' satisfaction with its use.
- H4: Confirmation of the use of VDI positively affects students' satisfaction with its use.
- H5: Confirmation of the use of VDI positively affects perceived usefulness.

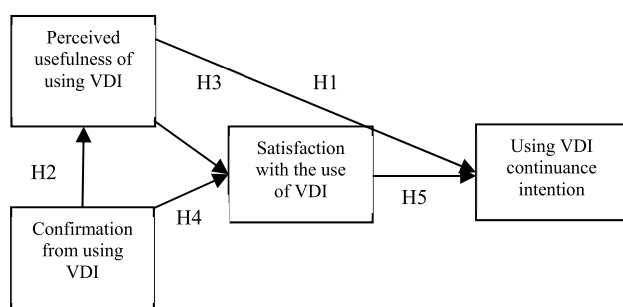


FIGURE 1. A model of ECM, source (Bhattacharjee, 2001, p.356).

III. METHODOLOGY

The study uses the descriptive correlational method, which measures the relationship between dependent and independent variables and then predicts a certain level of significance quantitatively.

A. CONTEXT AND PARTICIPANTS

The Institute of Public Administration (IPA) offers a number of academic programs in different disciplines; some target

high school graduates, and others target university graduates. In 2019, the IPA began teaching computer programs and applications such as office package programs (Outlook, PowerPoint, Word, Excel, and Access) through VDI and other programs such as visual studio EPR and SPSS. After the suspension of attendance at educational institutions and universities in Saudi Arabia due to the pandemic, the IPA expanded the teaching of computer and digital technology courses in this mode.

The study population consists of students at the IPA who studied computer applications and programs through VDI during the second semester of 2020. There were 2,000 students in various branches of the IPA in Saudi Arabia. After obtaining the approval of the Research Ethics Committee, the researcher coordinated with the concerned department at the IPA to send a link to the e-questionnaire via e-mail to male and female IPA students in all different branches. Thus, the sample consisted of male and female students who responded voluntarily to the questionnaire. The accompanying e-mail explained the purpose of the study and pointed out that participation was voluntary and that the participants could withdraw at any time, whether or not the questionnaire had been completed. Their consent to participate was granted by clicking on the questionnaire link. The participants were notified that the data would be kept confidential and used for scientific research purposes. There were 367 responses, with a rate of 18%. Table 1 shows the distribution of study participants in terms of the gender, age and program variables.

B. INSTRUMENT

The data were collected through a two-part online questionnaire. Questions in the first part related to the participants' demographic information, such as age, gender, and program. The second part included 18 items developed to measure the four ECM variables of perceived usefulness, confirmation, satisfaction, and continuance intention. The questionnaire was developed following a literature review [25]–[29].

To measure these items, a five-point Likert scale was used. The answer choices for each item ranged from 1 (strongly disagree) to 5 (strongly agree). To ensure that the phrases were clear and understandable and to achieve the purpose for which they were developed, five experts in the field of education and educational technology reviewed the items. To verify the validity of the instrument, it was piloted and applied to 30 students in the last level who used virtual desktop software for the first semester of the same year, which preceded the application of the study.

C. DATA ANALYSIS

Intellectus Statistics software (2021) was used to perform structural equation modeling (SEM) to test the hypotheses of the study model and to show the causal relationships among the variables. The SEM conditions were verified. Table 3 shows the matrix of the correlations among the variables of the study model.

D. RELIABILITY COEFFICIENTS

Reliability coefficients were calculated for all constructs, and the results were acceptable, as the Cronbach’s alpha for the four variables ranged from 0.95-0.80, and no adjustment was needed. After collecting the study data, the reliability of the tool was tested again by calculating both the Cronbach’s alpha and composite reliability (CR). As shown in Table 2, all Cronbach’s alpha coefficients and those for CR exceeded 0.90, which indicates good internal consistency.

TABLE 1. Distribution of participants by gender, age and program variables (n = 367).

Variable	Variable’s value	N	%
Gender	male	195	53%
	female	172	47%
Age	18 to 22	229	62.4%
	23 to 27	96	26.1%
	Older than 27	42	11.4%
Post-secondary programs	Executive secretary	167	46%
	Human resources	26	7.1%
	Computer networks	13	4%
	Computer programming	10	3%
	Sales and marketing	2	1%
	Accounting	23	6.3%
	Banking	27	7.3%
	Hospital management	20	5.5%
	Total	288	80%
	Post-University Programs	Higher diploma in legal sciences	12
Management of administrative leaders' offices		11	3%
local administration			
Applied statistics and data management		5	1.36%
Anti- corruption		3	0.82%
Internal audit		15	4.1%
Total		46	12.6%
Unspecified		31	8.5%

E. CONVERGENT VALIDITY

To assess convergent validity, the factor loading of the indicator, CR and the average variance extracted (AVE) were used. Only the items whose load on the associated variable was 0.70 or above were accepted [30]. Therefore, to maintain the quality of the variables, the following four items were deleted: two from the confirmation construct, one from satisfaction and one from perceived usefulness. Table 2 indicates that all AVE values were above 0.5, which indicates good discrimination validity [30]

F. DISCRIMINANT VALIDITY

The discriminant validity of the instrument was evaluated by using the Fornell and Larcker criterion. The square root of each construct’s AVE was compared with the correlation of the latent constructs and was found to be greater than the correlations with other latent constructs.

G. COMMON METHOD BIAS (CMB)

To test whether CMB is of concern, Harman’s single factor score was used, in which all items (measuring the latent variables) were loaded into one common factor. The total variance for a single factor was less than 50%, which suggests that CMB does not affect the data.

TABLE 2. Indicators of the study model variables (perceived usefulness, satisfaction, confirmation, and continuance intention).

Variables	Items	M	SD	Factor loading	Cronbach’s alpha	AVE	CR
Perceived usefulness	PU1	3.16	1.07	0.94	0.95	0.745	0.94
	PU2			0.92			
	PU3			0.86			
	PU4			0.73			
	PU5			0.85			
Confirmation	C1	3.75	1.11	0.94	0.98	0.89	0.96
	C2			0.95			
	C3			0.94			
Satisfaction	S1	3.70	1.19	0.83	0.98	0.78	0.87
	S2			0.87			
	S3			0.80			
Continuance intention	I1	3.71	1.09	0.86	0.93	0.84	0.96
	I2			0.94			
	I3			0.97			
	I4			0.90			

TABLE 3. The matrix of the correlations among the variables of the study model.

	Perceived Usefulness	Confirmation	Satisfaction	Continuance Intention
Perceived Usefulness	1.00			
Confirmation	0.83	1.00		
Satisfaction	0.72	0.74	1.00	
Continuance Intention	0.44	0.40	0.45	1.00

H. MODEL FIT

To ensure the suitability of the data to the study model, the following appropriateness indicators were used: goodness-of-fit index (GFI); root mean square error of approximation (RMSEA); comparative fit index (CFI); Tucker-Lewis index (TLI); and standardized root mean square residual (SRMR). Their values were within the domains that indicate the fit of the model. Table 4 shows their values and recommended values.

TABLE 4. Values of the suitability indicators.

Indicator	Indicator's value in this study	Recommended Values [30]
GFI (p value)	0.21	> 0.5
RMSEA	0.08	CI=[0.07, 0.09]
CFI	0.97	greater than .95
TLI	0.97	greater than or equal to .95
SRMR	0.04	less than .05

IV. RESULTS

Figure 2 shows the results of the SEM analysis. The regressions were checked based on $\alpha < 0.05$. The results indicate that the proposed model can explain 23% of the variance in users' intention to continue using VDI. The effect size (Cohen's f^2) for this model is 0.33, and according to Cohen (1988), this effect is considered to be moderate ($f^2 \geq 0.15$) to significant ($f^2 \geq 0.35$). Table 5 summarizes the results of the hypothesis testing. It indicates that all hypotheses were significant.

The first hypothesis examines whether the perceived usefulness of using VDI positively affects students' intent to continue using it. The results show that perceived usefulness is considered a statistically significant predictor of users' intention to continue using VDI, $\beta = 0.23$, $z = 3.31$, $p < .001$, which indicates that a one-unit increase in perceived usefulness will increase the expected value of intent to continue using VDI by 0.23 units. Thus, the first hypothesis is accepted.

The second hypothesis investigates whether confirmation from the use of VDI positively affects perceived usefulness. The results show that confirmation affects perceived usefulness, $\beta = 0.73$, $z = 21.74$, $p < .001$, which indicates that an increase of one unit in confirmation increases perceived usefulness by 0.73 units. Thus, the second hypothesis is supported.

The third hypothesis examines whether the perceived usefulness of using VDI positively affects students' satisfaction with its use. The results indicate that perceived usefulness positively affects satisfaction, $\beta = 0.37$, $z = 4.94$, $p < .001$, which indicates that a one-unit increase in perceived usefulness will increase satisfaction by 0.37 units. Therefore, H3 is accepted.

The fourth hypothesis evaluates whether confirmation from the use of VDI positively affects students' satisfaction with its use. The results show that confirmation positively affects satisfaction, $\beta = 0.43$, $z = 6.68$, $p < .001$, which indicates that an increase of one unit in confirmation will increase the value of satisfaction by 0.43 units. Therefore, H4 is supported.

The fifth hypothesis investigates whether student satisfaction with the use of VDI positively affects students' intention to continue using it. The results show that there is a positive relationship between satisfaction and intention to continue using VDI, where satisfaction is a statistically significant predictor of users' intention to continue using VDI, $\beta = 0.25$, $z = 3.86$, $p < .001$. This indicates that a one-unit increase in satisfaction will increase the expected value of users'

intention to continue using VDI by 0.25 units. Therefore, H5 is accepted.

TABLE 5. Structural equation modeling (SEM) analysis results.

Hypotheses	β	p	z	Result
H1: Perceived usefulness \rightarrow Continuance Intention	0.23	<.001	3.31	Accept
H2: Confirmation \rightarrow perceived usefulness	0.73	<.001	21.74	Accept
H3: Perceived usefulness \rightarrow satisfaction	0.37	<.001	4.94	Accept
H4: Confirmation \rightarrow satisfaction	0.43	<.001	6.68	Accept
H5: Satisfaction \rightarrow Continuance Intention	0.25	<.001	3.86	Accept

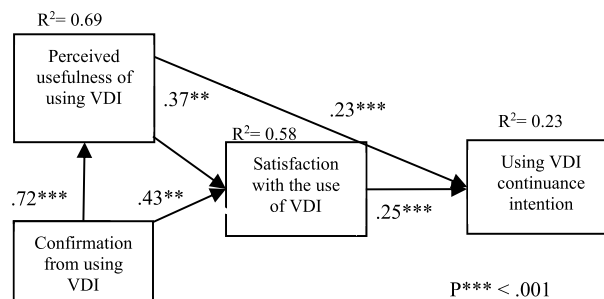


FIGURE 2. Analysis results of SEM.

V. DISCUSSION

The current study addressed the factors that affect the continued use of computer programs and applications through VDI for IPA students from the perspective of ECM. An SEM analysis was used to understand whether the students intended to continue using virtual labs and to determine the factors that drive them to do so. Based on the results, the model explained 23% of the variance in the students' intention to continue using this technology with a medium-to-large effect size. The results of this study show that satisfaction, perceived usefulness, and confirmation are statistically significant in predicting students' intention to continue using VDI. When students' expectations about their use of VDI are met, they perceive greater benefits of this technology and are satisfied with the experience. When the perceived usefulness and satisfaction of students with VDI are greater, their intention to continue using it is greater. The satisfaction and perceived usefulness variables had almost the same contribution to predicting the dependent variable, which is the intention to continue using VDI. This is consistent with previous studies that have examined students' intention to continue using technology such as virtual and remote labs [9], their intention to continue using e-learning [6], and their intention to continue using digital books [31]. These studies have determined that satisfaction and perceived usefulness are statistically significant in predicting the intention to continue using these technologies.

In addition, the results show that 60% of the variance in the students' satisfaction with their experience using VDI can be explained by perceived usefulness and confirmation with almost the same contribution size. This is in line with previous

studies that have detected a positive effect of confirmation on students' satisfaction with their virtual lab experience [9], e-learning [6] and digital books [31]. It also agrees with studies that have found an effect of perceived usefulness on satisfaction [6], [31]. However, confirmation positively affects perceived usefulness and explains 70% of the variance in perceived usefulness among the students. This is consistent with previous studies [6], [9], [31]. These results suggest that higher education institutions can work to improve students' satisfaction with the use of VDI, thereby increasing their intention to continue using it in their future studies [9].

The results of this study also reflect information about students' intention and satisfaction with the experience of using VDI ($M = 3.70$), which is similar to a previous study that investigated students' intention and satisfaction with the experience of using VDI [9].

VI. RESEARCH LIMITATIONS AND FUTURE WORK

The limitation of this study is that 80% of the sample were students in disciplines that rely heavily on technology, which means that the majority of the participants were familiar with computer applications. Therefore, hypothesis testing with a sample of nontechnology disciplines may lead to different results. The study was also limited to specific computer applications, namely, those taught at the IPA, and the relationships among the variables of the model, including the perceived usefulness of the program and satisfaction with using more complex computer software, may be affected.

Based on the above, recommendations for future research include obtaining more predictive factors from different theories and models in the theoretical model, expanding the range of respondents to include students of higher education at different institutions and from different disciplines and addressing other applications and software to obtain more results.

VII. CONCLUSION AND RECOMMENDATIONS

Rapid technological developments have resulted in innovative applications to support online learning in various disciplines. Understanding students' intent to continue using online and cloud learning applications is critical [32]. It can help improve the quality of online learning in the computer sciences field. This study explored the factors that influence the intention of students to continue using VDI based on ECM. Knowing such factors will help to provide learning experiences that support the optimal use of these technologies [10].

Based on these results, it is recommended that educational institutions give more attention to student satisfaction with the use of VDI and educate students about its benefits, as this will have a positive impact on their intention to continue using it. An awareness of the perceived usefulness will also positively affect student satisfaction, which is an important requirement and an indicator of successful educational experiences. Since confirmation will improve student satisfaction and perceived usefulness and will consequently increase the

TABLE 6. Constructs and items in the questionnaire.

Construct	Item
Perceived Usefulness	Using VDI improves my learning performance.
	Using VDI was useful to my learning.
	Using VDI helps me to be more successful in my courses.
	Using VDI helps me expand my knowledge. I feel that I learn in good way while using VDI.
Confirmation	My experience with VDI was better than I expected.
	The level of services that I got when I used VDI was better than I expected.
	In general, most of what I expected from using VDI was met.
Satisfaction	In general, my experience with VDI was satisfactory.
	My experience with VDI was interesting.
	I am satisfied with my experience with VDI.
Continuance Intention	I intend to continue using VDI rather than stop using it.
	I intend to continue using VDI as long as possible.
	I will continue to use VDI in the future.
	I intend to try other software using VDI in the future.

intention to continue using VDI, this study recommends that the expectations of students about VDI and the factors that positively affect meeting these expectations be studied. The results show that the study model can explain 23% of the variance in the intention to continue using VDI, which calls for more research to identify other factors that may have an impact on explaining a greater percentage of variance. Other studies have used variables such as the technical self-efficacy variable [32] and students' enjoyment of the learning experience [9], [32] and found a positive impact on students' satisfaction with the use of technologies and applications in education across the cloud and their intention to continue this usage. Therefore, it is recommended that the impact of these variables on student satisfaction and their indirect influence on students' intention to continue using VDI be studied. Together, these recommendations may help in designing and improving educational environments to thus enhance students' experience and satisfaction and meeting their expectations.

This study makes a number of contributions. It contributes to the evaluation of the extent to which ECM is confirmed on a modern and interesting technology. Understanding the intention of students to continue using VDI will support its spread in educational institutes [11]. This study has suggested the validity of the theoretical model used (ECM) in explaining the intention to continue using VDI for students of the IPA. Of the three perceived factors, usefulness and satisfaction are direct factors, and confirmation is an indirect factor that is positively related to the intention to continue using VDI. The study contributes to increasing knowledge about the positive impact of these variables on the intentions to continue using VDI. It also increases the scientific understanding of higher education students' experiences and perceptions about the use of VDI, especially their satisfaction with it and their intention to continue using it. These are two necessary factors for further understanding the application of online learning in engineering, science and computer education [9].

The study further provides data about the experience of using VDI among a sample of higher education students in Saudi Arabia, where a previous study indicated that there is insufficient information about students' experience with VDI or about their intention to continue using VDI [9]. Looking at the averages of the variables, it appears that the students have a high intention to continue using VDI and have a high satisfaction rate with this experience. This can be viewed as a result that encourages the expansion of remote teaching computer applications through VDI, particularly in view of the continuous growth of virtual reality technologies and cloud computing applications.

APPENDIX

See Table 6.

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