Abstract

Purpose – The purpose of this study is to investigate the factors that affect students’ behavioral intentions to use virtual classrooms at Princess Sumaya University for Technology (PSUT) in Jordan.

Design/methodology/approach – A quantitative research approach was adopted, an online survey method was used and the data were collected among students at PSUT in Jordan. A total of 511 responses were usable for analysis. A structural equation modeling partial least squares technique was used to examine the hypothesized model.

Findings – The findings reveal that the proposed factors have direct and indirect relationships with behavioral intentions to use virtual classrooms. They show that students’ satisfaction has a direct influence on behavioral intention, while other variables such as instructor characteristics, virtual classroom quality, perceived self-efficacy, perceived organizational support, perceived ease of use and perceived usefulness have an indirect effect on behavioral intentions to use virtual classrooms.

Research limitations/implications – The study was conducted at PSUT in Jordan, which could limit the generalizability of the findings. Furthermore, the present study measured students’ behavioral intentions to use virtual classrooms and future research should consider the actual use of virtual classrooms.

Practical implications – The findings of this study offer significant and useful information to policymakers, instructors, developers and students regarding the use of virtual classrooms in universities. Based on students’ needs and readiness, the findings identify which factors to consider when developing an e-learning system to enhance learning and teaching performance.

Originality/value – This study extends existing knowledge by developing a conceptual model to identify the key factors of virtual classroom adoption in higher education institutions in Arab countries. This study contributes to the literature in the context of e-learning by validating an extended technology acceptance model for virtual classroom adoption in Jordan.
model from an Arab countries perspective and considering the differences in culture, learning style and physical environment compared to developed countries.

**Keywords**  Distance learning, Higher education, E-learning, Information systems models

**Paper type**  Research paper

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**Introduction**

The unfolding outbreak of COVID-19 has shifted the gears of human interaction. In such a critical situation, businesses such as large organizations and SMEs, private sector businesses (e.g. financial institutions) and the educational industry, including both public and private schools and universities, have been forced to change their methods of communication from face-to-face interactions to virtual interactions. To cope with the challenging circumstances and to allow businesses and learning institutions to continue operating, various e-platforms have been adopted (e.g. e-commerce and e-learning). Several western and eastern higher education institutions adopted e-learning platforms before the COVID-19 crisis and were shifting from a teacher-centered to learner-centered focus (Lee et al., 2009). This evolutionary shift toward electronic learning (e-learning) involves the use of information and communications technology (ICT) that enables students to access learning resources. Examples of e-learning platforms include Moodle, Google Classroom, WebCT, Blackboard or any other Web 2.0–based e-learning (Boateng et al., 2016). These platforms have shown several benefits in terms of convenience, accessibility and reducing cost (Kelly and Bauer, 2004). There have been constant calls to introduce online teaching in higher education institutions in the Hashemite Kingdom of Jordan (the context of this study). However, few universities have adopted features of e-learning platforms. The majority of Jordanian universities are adopting a traditional offline class approach to teaching. This could be due to the difficulty of changing cultural behavior, as well as people’s resistance to change (Thomas, 2015). This supports our argument that very few higher education institutions in Jordan have responded to the calls to adopt online or virtual classes, as professors resist changes to their teaching methods (Al-Adwan and Smedley, 2013). However, the COVID-19 pandemic caused a drastic change in higher education institutions’ teaching methods through a complete shift to virtual teaching. Accordingly, all Jordanian higher education institutions with more than 280,000 students (which consist of 10 public universities, 19 private universities and 44 community colleges) are forced to offer complete virtual and online classes using different e-learning platforms.

The adoption of e-learning has been investigated extensively in developed countries. Most of these studies have used the technology acceptance model (TAM) as a theoretical basis due to its validity and power in predicting technology adoption, particularly in the e-learning context (Tarhini et al., 2013). However, the findings from these studies might not be applicable in developing countries and, in particular, Arab countries due to several reasons such as cultural differences, lack of ICT infrastructure and internet illiteracy (Al-Azawei et al., 2016). Salloum et al. (2019) attempted to further investigate e-learning adoption in higher education institutions in Arab countries. This research responds to these calls for further study in Jordan by investigating the key factors associated with students’ acceptance of e-learning (i.e. virtual classrooms) in Jordanian universities using a case study of Princess Sumaya University for Technology (PSUT). This research attempts to address the gap in the literature by developing a conceptual model to identify the key factors of e-learning adoption in higher education institutions from the perspective of Arab countries. Therefore, this paper attempts to explain the effect of different factors on students’ satisfaction through the TAM to provide a better understanding of e-learning preference in Jordan.
This study is organized as follows. The first section provides an introduction. The second section presents the literature review in the context of e-learning adoption. In the third section, the research model and hypotheses are provided. In the fourth section, the research methodology and data analysis are described. In the fifth section, findings and discussion are presented. Finally, the conclusion, implications and limitations are presented.

Literature review

The concept of e-learning has been defined in many previous studies. However, there is no single widely accepted definition among these studies. Some studies have defined e-learning as courses that are delivered via computer networks such as the internet, intranet and extranet networks (Boateng et al., 2016; Pham et al., 2019; Sylvia and Abdurachman, 2018). Other studies have proposed that e-learning is not only restricted to web-based applications but e-learning activities can also be conducted via digital media such as audio and video tapes, TV, mobile and teleconference (Basak et al., 2018; Hill and Wouters, 2010).

A review of the literature about e-learning shows that e-learning activities are classified into two categories, namely, synchronous and asynchronous and each of these categories has its own features. Synchronous e-learning involves teaching and learning that occurs in real-time such as through video conferences, webinars, live to chat with discussion, application sharing and virtual classrooms, while asynchronous e-learning is time-independent, which means that instructors and participants cannot be online at the same time. For example, a learning management system (LMS) allows learners to download course materials via LMS platforms. Discussion forums, emails, blogs and recorded audio and videos are examples of asynchronous e-learning. Although prior studies have been conducted to investigate the determinates of e-learning adoption in educational institutions, most literature the one-learning adoption has not clearly focused on synchronous e-learning, asynchronous or both. Many previous studies have been conducted to examine the effectiveness of e-learning from different perspectives such as at the learners’ level (Boateng et al., 2016; Mohammadi, 2015; Pham et al., 2019; Qteishat et al., 2013) and the institutional level (Ansong et al., 2016; Nyeko and Ogenmungu, 2017; Tyilo, 2017). The literature shows that different factors have been identified as possible determinants of e-learning adoption. These factors were derived from well-established theories in information systems research such as diffusion of innovation (DOI) (Rogers, 1995), technology-organization-environment (TOE) (Tornatzky and Fleischer, 1990), the TAM (Davis, 1989) and the unified theory of the acceptance and use of technology (UTAUT) (Venkatesh et al., 2003). Table 1 presents a summary of selected research frameworks, factors identified, authors and the context of the studies.

The wide range of theoretical foundations that have been used to explain e-learning adoption increases the difficulty of selecting an appropriate theory. Therefore, the levels of analysis that differentiate these theories must be considered. Alrousan (2015) found that heterogeneity in selecting appropriate theory is caused by the nature of the study. He stated that TOE and DOI are appropriate to explain technology adoption at an organizational level, while TAM is developed to identify technology adoption at an individual level. Although different theories are used to study e-learning adoption, the reviewed literature confirms that TAM as a theoretical foundation is the most robust and appropriate theory for explaining learners’ behavioral intentions to use e-learning (Abdullah et al., 2016; Boateng et al., 2016; Hanif et al., 2018; Lee et al., 2009; Sylvia and Abdurachman, 2018). Therefore, TAM is used as the theoretical foundation of this study.

TAM was developed by Davis (1989) and originally adapted from the theory of reasoned action (TRA) to explain the acceptance and use of technology adoption on users’ behavior. As shown in Figure 1, TAM assumes that an individual’s actual usage of technology is determined by a behavioral intention to use that technology and behavioral intention is
<table>
<thead>
<tr>
<th>Theory</th>
<th>Factors identified</th>
<th>Participants</th>
<th>Place of study</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAM</td>
<td>Computer self-efficacy, perceived ease of use, perceived usefulness and attitude</td>
<td>Students</td>
<td>Ghana</td>
<td>Boateng et al. (2016)</td>
</tr>
<tr>
<td>TAM</td>
<td>Educational quality, service quality, technical system, quality, information quality, perceived usefulness, perceived ease of use and satisfaction</td>
<td>Students</td>
<td>Iran</td>
<td>Mohammadi (2015)</td>
</tr>
<tr>
<td>TAM</td>
<td>Perceived ease, usefulness, perceived ease of use, self-efficacy and behavioral intention to use</td>
<td>University Stakeholders</td>
<td>Ghana</td>
<td>Budu et al. (2018)</td>
</tr>
<tr>
<td>TAM</td>
<td>Perceived ease, usefulness, perceived ease of use, patronize, practiced and attitude</td>
<td>Students</td>
<td>Jordan</td>
<td>Qteishat et al. (2013)</td>
</tr>
<tr>
<td>TAM</td>
<td>Perceived ease of use, perceived usefulness, attitude and intention to use e-learning</td>
<td>Students</td>
<td>India</td>
<td>Ratna and Mehra (2015)</td>
</tr>
<tr>
<td>TAM</td>
<td>Perceived ease of use, perceived usefulness, attitude and intention to use e-learning</td>
<td>Instructors</td>
<td>Taiwan</td>
<td>Weng et al. (2015)</td>
</tr>
<tr>
<td>TOE</td>
<td>Relative advantage, complexity, compatibility, size, IS/IT knowledge, top management support, competition pressure and regulatory environment</td>
<td>Students</td>
<td>Uganda</td>
<td>Nyeko and Ogenmungu (2017)</td>
</tr>
<tr>
<td>TOE</td>
<td>IT infrastructure, perceived ease of use, compatibility, expected benefits, competitive pressure, educational partners, course content and e-learning curriculum</td>
<td>University Stakeholders</td>
<td>Ghana</td>
<td>Ansong et al. (2016)</td>
</tr>
<tr>
<td>UTAUT</td>
<td>Performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value and intention to use</td>
<td>Instructors</td>
<td>Taiwan</td>
<td>Tseng et al. (2019)</td>
</tr>
<tr>
<td>UTAUT</td>
<td>Perceived ease of use, effort expectancy, social influence and facilitating conditions</td>
<td>Instructors</td>
<td>Singapore</td>
<td>Teo and Noyes (2014)</td>
</tr>
</tbody>
</table>
affected by attitude toward using technology and perceived usefulness. Attitude toward using technology is affected by perceived usefulness (PU) and perceived ease of use (PEOU), which are considered the two main factors in the model. PU measures the degree to which individuals’ perceptions of using technology will improve their efficiency, while PEOU measures the degree to which individuals believe that using technology is simple and free of mental effort.

Alkis et al. (2014) conducted a systematic review of the e-learning adoption context and found that perceived ease of use and perceived usefulness are the most important factors that affect e-learning adoption. Abdullah and Toycan (2017), who performed a study to explain e-learning adoption in Iraqi universities as an example of developing countries, found that perceived usefulness and perceived ease of use are the main constructs of TAM in explaining the influence of e-learning adoption. However, other studies found that these factors are insufficient to explain the adoption of e-learning. Therefore, these studies suggested alternate antecedents to the factors of perceived usefulness and perceived ease of use to determine and explain the influence of these antecedents on these factors in the context of e-learning adoption (Al-Azawei and Lundqvist, 2015; Abdullah and Ward, 2016; Qteishat et al., 2013). The reviewed literature shows that there has been inconsistency in the number of factors used to determine the adoption of e-learning. For example, Mehta et al. (2019) identified 12 predictors to study e-learning adoption, while Sylvia and Abdurachman (2018) conducted a study with a similar objective to that of Mehta et al. (2019) and identified five variables. Furthermore, the literature shows inconsistency in the findings among studies that use TAM. These variations in the findings can be explained via the existence of cultural differences, technological readiness, information literacy and educational mechanisms (Sylvia and Abdurachman, 2018; Tarhini et al., 2013; Wang et al., 2018; Abdullah and Toycan, 2017). Therefore, it is necessary to conduct further studies to develop a comprehensive model that includes validated and consolidated factors to provide the best explanation of e-learning adoption. E-learning adoption is considered a growing area of study with very limited research to date, particularly in synchronous e-learning adoption (i.e. virtual classrooms) and more specifically in developing countries such as Jordan. Therefore, it is necessary to conduct more studies to investigate the determinates of educational institutions’ use of virtual classrooms to effectively implement appropriate teaching and learning strategies.

Research model and hypotheses
As mentioned earlier, the objective of this study is to investigate the factors that affect e-learning adoption (i.e. virtual classrooms) by universities in developing countries, using PSUT as a case study. Among many theories, TAM has been widely used to study technology adoption in the context of information technology. Moreover, the literature shows that TAM has explanatory and predictive power in the domain of e-learning adoption. Therefore, TAM is used as a theoretical basis for this study. Although the literature agrees on the importance of TAM’s main factors (i.e. perceived ease of use, perceived usefulness and attitude), it is
necessary to know that these factors are insufficient to explain technology adoption and more factors must be added to provide a comprehensive framework for explaining technology adoption, particularly in the e-learning context (Abdullah and Ward, 2016; Ajibade, 2018; Hanif et al., 2018; Yang and Wang, 2019). Therefore, many studies in e-learning extended TAM by including different additional factors, resulting in a large number of factors. These factors include self-efficacy, personal characteristics, subjective norms, system accessibility, internet experience, computer anxiety, enjoyment, organizational technical support, system quality, job relevance, uncertainty avoidance and user satisfaction. Surprisingly, attitude, which was included in the original TAM, was not found significant in e-learning literature. According to Abdullah et al. (2016), who conducted a meta-analysis of 107 published papers related to the extension and use of TAM in the context of e-learning adoption, the role of attitude is insignificant in explaining behavioral intention. This result was also confirmed by previous studies that excluded attitude from the original TAM (Liu, 2010; Mehta, 2019; Tarhini et al., 2013; Wang and Wang, 2009; Chuo et al., 2011; Yang and Wang, 2019). Therefore, attitude is excluded from this study.

Based on the above literature, this study proposes an extended version of TAM. The proposed model consists of seven factors that may influence e-learning adoption. These factors are instructor characteristics, virtual classroom quality, perceived self-efficacy, perceived organizational support, perceived ease of use, perceived usefulness and students’ satisfaction, as shown in Figure 2.

**Instructor characteristics**

Instructor characteristics play an important role in the success and effectiveness of e-learning adoption (Ahmed, 2010). Kisanjara et al. (2019) stated that technology and the execution of technology are the main reasons for successful e-learning outcomes. Instructors must have a high level of knowledge and motivation to use e-learning technologies to enhance students’ acceptance of e-learning experiences. In terms of technology adoption, instructor characteristics include timely response, technical knowledge, confidence and innovativeness that enable him or her to encourage students to learn in an e-learning atmosphere (Bhuasiri et al., 2012; Ahmed, 2010). Tarus (2015) conducted a study to identify the challenges of implementing e-learning in a Kenyan university and found that
instructors’ technical skills and computer literacy were the main inhibitors to adopting e-learning in higher education institutions. Similarly, Alhabeeb and Rowley (2017) supported these views with qualitative data and argued that the most critical success factor for Saudi Arabian universities to adopt e-learning is related to instructor characteristics. This was also confirmed by Alqahtani and Rajkhan (2020), who found those instructor characteristics are a crucial factor for successful e-learning implementation in Saudi Arabian universities. Many prior studies found that instructor characteristics are a positive significant predictor of perceived usefulness (Hadullo et al., 2017; Lee et al., 2009; Yiong et al., 2008). Thus, the following hypothesis is presented:

H1. Instructor characteristics (IC) have a positive and significant influence on PU in the adoption of virtual classrooms.

Virtual classroom quality
Well-designed online courses were found to play a significant role in shaping students’ and instructors’ readiness to adopt e-learning technologies (Peltier et al., 2007; Roca et al., 2006). Online course design is also considered a primary factor in evaluating the success or failure of e-learning adoption among learners (Liu et al., 2010). Pham et al. (2019) found that the effectiveness of e-learning quality, including functionality, usability and media presentation of course materials, are critical success factors for learners to adopt e-learning. In this study, e-learning quality is defined as the extent to which technology provides a suitable learning environment for learners. This includes user interface design, reliability, usability and service quality. Many previous studies have found that e-learning quality has a positive and significant impact on the perceived usefulness of e-learning adoption (Al-Busaidi, 2013; Lee and Hwang, 2007; Mtebe and Raphael, 2018; Sandjojo and Wahyuningrum, 2015; Liu et al., 2010). Thus, the following hypothesis is presented:

H2. Virtual classroom quality (VCQ) has a positive and significant influence on PU in the adoption of virtual classrooms.

Perceived self-efficacy
Self-efficacy is defined as “the belief in one’s capabilities to organize and execute the courses of action required to manage prospective situations” (Bandura, 1998, p. 2). Therefore, this concept focuses on individuals’ ability to achieve specific tasks successfully. Alqurashi (2016) conducted a systematic literature review of 31 articles focused on self-efficacy in online learning environments. She found that self-efficacy is described differently among studies and is mainly divided into three categories, namely, computer self-efficacy, internet and information-seeking self-efficacy and LMS (learning management systems) self-efficacy. According to this study, self-efficacy concerns students’ knowledge of and necessary skills for using virtual classrooms, which is under the category of internet and information-seeking self-efficacy. The reviewed literature suggested that more studies should be conducted on self-efficacy, particularly in the e-learning context (Al-Azawei et al., 2017a; Alqurashi, 2016; Hodges, 2008; Chuo et al., 2011). Abdullah et al. (2016) conducted a study focused on the most common external factors of TAM associated with the adoption of students’ e-learning. They found that self-efficacy is one of the most significant influences on students’ perceived ease of use. Meanwhile, Siron et al. (2020) showed that while self-efficacy had a positive impact on PEOU, it did not have a notable effect on PU. These results are also supported by Abdullah and Ward (2016), who found a significant correlation between self-efficacy and PEOU, particularly in an e-learning adoption context. Moreover, many previous studies found that self-efficacy is a positive and significant predictor of the
PEOU of e-learning systems (Alqurashi, 2016; Budu et al., 2018; Chao et al., 2018; Sylvia and Abdurachman, 2018; Chuo et al., 2011; Patricia, 2020).

Furthermore, the study results are inherent with studies that state that increased self-efficacy is highly correlated with perceived usefulness in using learning technology (Chang et al., 2017; Abdullah and Ward, 2016). Thus, the following hypothesis is presented:

\[ H3. \text{Perceived self-efficacy (PSE) has a positive and significant influence on PEOU in the adoption of virtual classrooms.} \]

**Perceived organizational support**

There is much disagreement in the literature on e-learning about the definition of organizational support. Organizational support refers to the extent to which an individual believes that the availability of technical infrastructure in an institution supports the use of e-learning (Selim, 2007). According to Ndonje (2013), the degree of commitment and investment is of crucial importance for institutions to implement and use e-learning. Organizational support was found to have a significant impact on successful e-learning implantation in higher education institutions (Ahmed, 2010). Organizational support is not limited by the sufficiency of the university’s IT infrastructure, technical support and training provided to learners and instructors but also includes other necessary tools that facilitate the success of sustainable e-learning adoption by institutions such as information availability, internet speed, online course structure, course contents and security (Sarabadani et al., 2017; Selim, 2007; Khalifeh et al., 2020). Ahmed (2010) argued that efficient and effective organizational support will increase learners’ acceptance and use of e-learning. Moreover, sufficient support by institutions motivates learners to accept and use new technology for learning. A recent study by Alqahtani and Rajkhan (2020) identified the critical success factors in implementing e-learning in Saudi Arabian universities. They found, more specifically, that organizational support was one of the most significant elements for success in the process of e-learning during the COVID-19 pandemic. The link between organizational support and perceived ease of use has been acknowledged in the literature.

Many previous studies have examined the relationship between organizational support and perceived ease of use in different industries (Esen and Özbağ, 2014; Zainab et al., 2017). In terms of e-learning literature, a positive relationship has been found between organizational support and perceived ease of use (Cheng, 2012; Chou et al., 2010). In line with prior literature, the following hypothesis is presented:

\[ H4. \text{Perceived organizational support (POS) has a positive and significant influence on PEOU in the adoption of virtual classrooms.} \]

**Perceived ease of use**

Perceived ease of use is defined as “the degree to which a person believes that using a particular system would be free from effort” (Davis, 1989, p. 320). According to the present study, perceived ease of use refers to the degree to which students perceive that using a virtual classroom system will be easy. The literature shows that perceived ease of use has a positive and significant effect on learners’ intentions toward the use of e-learning systems (Al-Gahtani, 2016; Budu et al., 2018; Islam, 2013; Mohammadi, 2015; Tarhini et al., 2014). To better explain users’ e-learning adoption behavior, many previous studies have argued that there is an important link between PEOU and learners’ satisfaction. Al-Azawei et al. (2017a, p. 4) stated that “the high expectation that a particular learning technology that uses less effort and can enhance learning outcomes may lead to promoting learner satisfaction.”
Furthermore, previous studies have revealed that PEOU has a direct influence on satisfaction, particularly in the e-learning context (Al-Gahtani, 2016; Chiu et al., 2005; Weng et al., 2015). Therefore, the following hypothesis is presented:

**H5.** PEOU has a positive and significant influence on learners’ satisfaction with using virtual classrooms.

**Perceived usefulness**

Perceived usefulness is defined as “the degree to which an individual believes that using a particular system would enhance his or her performance” (Davis, 1989, p. 320). This means that users’ willingness to accept and use a new system depends on their perceptions of whether using this system will improve their job performance. In this study, PU assesses students’ perceptions of whether using a virtual classroom system is effective and useful in improving his or her academic performance. The reviewed literature shows that PU has a significant impact on intention to use, particularly in the e-learning context (Abdullah et al., 2016; Al-Gahtani, 2016; Budu et al., 2018; Chen and Tseng, 2012). Moreover, many prior studies have highlighted the importance of PU as a predictor of students’ satisfaction with adopting an e-learning system (Azawei et al., 2017a; Al-Azweei and Lundqvist, 2015; Joo et al., 2018; Weng et al., 2015). A recent study conducted by Hossain et al. (2020) also found that PU has a positive and significant effect on usage intention toward the adoption of an e-learning system. Therefore, the following hypothesis is presented:

**H6.** PU has a positive and significant influence on learner’s satisfaction with using virtual classrooms.

**Students’ satisfaction**

Students’ satisfaction measures students’ positive or negative feelings that result from using e-learning systems. Learners’ satisfaction has been considered an important factor in e-learning literature, as this satisfaction has an important impact on learners’ decisions to adopt or not adopt e-learning systems (Pham et al., 2019). Moreover, satisfaction has significant importance for evaluating the effectiveness and quality of e-learning systems, including both teaching and learning. As a result, dissatisfaction with using e-learning systems, regardless of the quality of the e-learning systems, means that the system is indeed poor (Al-Azweei et al., 2017a). Conversely, a high degree of user satisfaction with using e-learning systems will lead to increased intention to use them (Mtebe and Raisamo, 2014). Therefore, it is clear that satisfaction with using e-learning systems is positively correlated with the behavioral intention of the user (Al-Azweei et al., 2017a; Chao et al., 2018). A recent study conducted by Patricia (2020) found that the main reason for students’ dissatisfaction toward e-learning systems was system difficulty and lack of supporting resources. Al-Samarraie et al. (2017) found that students’ satisfaction plays an essential role in intention to use e-learning. This is also confirmed by other studies that found that satisfaction has a positive and significant effect on the intention to use e-learning systems (Al-Busaidi, 2013; Hassanzadeh et al., 2012; Mohammadi, 2015). Thus, the following hypothesis is presented:

**H7.** Students’ satisfaction (SS) has a positive and significant influence on intention to use e-learning in the adoption of virtual classrooms.
Methodology
Research design

It is necessary to choose an appropriate research methodology to ensure a successful connection with the research objective(s) and obtain accurate results. According to Saunders et al. (2019), there is no ideal approach to research methodology, as this depends on the research question(s) and nature and objective(s) of the research. Furthermore, research methodology is governed by the availability of resources such as time, amount of knowledge and researchers’ skills (Khalifeh et al., 2019). This study aims to develop a conceptual model on the basis of extended TAM to understand the factors affecting students’ behavioral intentions to use virtual classrooms at PSUT. Therefore, this study follows a deductive approach, which is based on testing existing theory. Many previous studies have proposed that a deductive approach is associated with a quantitative method of data collection, as it is concerned with pre-existing theories, examining hypotheses in a statistical form rather than developing a new theory (Neuman, 2014; Creswell, 2012). While a quantitative method requires a large-sized sample and it is challenging to control the environment and to explain the context of the phenomena, it is nonetheless characterized as a highly structured methodology that seeks to optimize objectivity and generalizability in the research. With this in mind, the present study, thus, used a quantitative approach and used the survey technique as a method of data collection. This study applied an online survey using the Google Forms platform as a tool for collecting data for the following reasons. First, using an online survey increases data reliability; this method is also inexpensive and facilitates a fast response and the anonymity of respondents. Second, it is considered the most effective tool for collecting large amounts of data which, in turn, improves the study’s validity and generalizability. Finally, due to the COVID-19 pandemic and the subsequent lockdown in Jordan during Spring 2020, the Government of Jordan ordered schools and universities to shut down and forced students and instructors to shift from physical classrooms to e-learning platforms. An online survey is, therefore, a viable method for data collection (Rice et al., 2017). The target respondents are all current students (undergraduate and postgraduate) who are studying at Princess Sumaya University for Technology located in Amman, Jordan. The survey consists of two sections. The first section covers the demographic information of the participants and the second section measures eight constructs for this study, namely, IC, VCQ, POS, PEOU, PU, PSE, SS and BI. The measurement of these constructs was adapted from validated studies that were conducted in similar contexts. Each construct was measured using a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree.

The five-point Likert scale was adopted to measure each construct in the survey for many reasons. For instance, this scale is appropriate for measuring individual attitudes and perceptions; it is also believed to be the most reliable way of obtaining respondents’ opinions. Finally, when using several statistical techniques, the responses of the Likert scale can be easily encoded and controlled (Saunders et al., 2019).

The online survey included a cover letter that highlighted the purpose of this study and ensured the confidentiality of participants’ answers. Before the online survey was conducted, the survey was first checked by three undergraduate students, three postgraduate students and two professors and then slightly refined according to their feedback. The data was collected in the second semester of the 2019/2020 school year through Google forms among target participants. The link was shared among all students through the PSUT e-learning platform. During the data collection phase, 531 responses were collected; 20 were excluded from the analysis due to large amounts of missing data and outliers. Subsequently, a total of 511 were identified as valid for analysis.
Demographic analysis
Descriptive analysis was used to obtain the demographic characteristics of the respondents for the research. The data relating to respondents’ profiles were tabulated to allow for greater familiarity with the data, as recommended by Sekaran (2003). Table 2 shows the characteristics of the respondents’ profiles, covering issues related to age, gender, the current level of education and college name.

As shown in Table 2, the age range of respondents between 18 and 27 dominated the total sample, at 96.3%, followed by respondents in the age group of 28–37, which represented 3.1%. The age group over 38 comprised 0.6%. The majority of respondents were female, representing 65.6%, while 34.4% were male. With regard to education level, 93.3% of respondents were enrolled in a bachelor’s program, while only 6.7% were enrolled in a master’s program. In relation to educational level distribution, most respondents in the surveyed sample majored in business technology (King Talal School of Business Technology), representing 75.9%, followed by those who majored in engineering (King Abdullah II School of Engineering) and computing (King Hussein School of Computing Sciences), representing 11.5% and 11%, respectively, while 1.6% of respondents were studying in a postgraduate program (King Abdullah I School of Graduate Studies and Scientific Research).

Data analysis
The proposed research model was tested and analyzed using a structural equation modeling (SEM) partial least squares (PLS) technique. PLS is recommended for examining complex frameworks such as multiple simultaneous relationships among variables (Hair et al., 2010) and when small samples are used for estimation and testing (Chin et al., 2003). The PLS approach is selected as the most suitable method in the current study as it is a robust analysis tool that provides high statistical power in explaining structural models consisting of several constructs with multiple indicators. In the current research, SmartPLS 3.0 software was used (Sarstedt et al., 2017a) by applying the bootstrapping technique (5,000 resample; Gil-Garcia, 2008) to assess factor loadings and method coefficients. To take this method further, as suggested by Anderson and Gerbing (1988), a two-stage analysis approach was applied in the current research. First, the measurement (outer) model was assessed by performing validity and reliability analyzes on each of the measures of the model and then the structural (inner) model was examined with regard to the significance of the paths between the constructs in the model, as well as the predictive power of the model.

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>Answers</th>
<th>Frequency</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>18-27</td>
<td>492</td>
<td>96.3</td>
</tr>
<tr>
<td></td>
<td>28-37</td>
<td>16</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>38+</td>
<td>3</td>
<td>0.6</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>334</td>
<td>65.6</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>176</td>
<td>34.4</td>
</tr>
<tr>
<td>Current level of education</td>
<td>Bachelor</td>
<td>477</td>
<td>93.3</td>
</tr>
<tr>
<td></td>
<td>Master</td>
<td>34</td>
<td>6.7</td>
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<tr>
<td>College</td>
<td>King Abdullah I School of Graduate Studies and Scientific Research</td>
<td>9</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>King Talal School of Business Technology</td>
<td>388</td>
<td>75.9</td>
</tr>
<tr>
<td></td>
<td>King Hussein School of Computing Sciences</td>
<td>56</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>King Abdullah II School of Engineering</td>
<td>59</td>
<td>11.5</td>
</tr>
</tbody>
</table>

Table 2. Profile of the respondents
Results

Measurement model
To begin with, it is essential to assess the measurement model by performing an examination of the reliability and validity of all the latent variables in the proposed research model (Hair et al., 2019). This has been accomplished by assessing Cronbach’s alpha, composite reliability (CR) and average variance extracted (AVE), as shown in Table 3. In particular, internal consistency reliability was highly satisfactory as Cronbach's alpha and composite reliability both exceeded the acceptable threshold value of 0.70 suggested by Hair et al. (2010). To further examine the reliability of a model, it is essential to calculate the loading values of each indicator associated with a latent variable and compare these calculations with threshold values. In general, the loadings with values above 0.70 indicate reliability (Hair et al., 2010). In the current research, the data analysis shows that the loadings of all indicator variables are above the threshold value of 0.70, as shown in Table 3. Similarly, the AVE values of the constructs included in the model also met the minimum required value of 0.5 for convergent validity (Henseler et al., 2016).

Hair et al. (2019) defined discriminant validity as the extent to which a construct is different from other constructs. According to Fornell and Larcker’s (1981) criteria, a higher degree of discriminate validity indicates that constructs are different from their respective variables and, as such, do not clearly describe certain phenomena. In addition, Fornell and Larcker’s (1981) suggested that discernment validity is achieved if the square root of AVE for each construct is larger than the corresponding correlations. As shown in Table 4, the square root of average variance extracted for each construct is shown in the bold diagonal, while the correlations between other constructs are shown in the off-diagonal of the table. The table shows that the square roots of AVE of all constructs were larger than all other correlations. Thus, adequate discriminant validity was met.

The results of all the preceding analyzes indicate that all of the measurement items satisfied the requirements for establishing reliability and discriminant/convergent validity. Thus, further assessment of the structural model may be conducted.

Hypothesis testing results
To examine the structural model, following the suggestions of Hair et al. (2013), an assessment of the significance of the path coefficients, overall predictive power of the model, model fit ($R^2$ value) and the values of t-statistics via bootstrapping with 5,000 resamples should all be calculated. In particular, Falk and Miller (1992) determined that the path coefficient is a reasonable criterion for evaluating the significance of the individual paths, as it represents a valid estimate of the standardized regression weights and produces an index of the variance in an endogenous variable that explains the particular path. The authors recommended 1.5 (0.015%) of the variance as the cut-off point. Meanwhile, several studies suggested that the predictive power of the model could be assessed using the $R^2$ value for the endogenous latent variables (Chin et al., 2003; MacMillan et al., 2005). Taking this point further, the amount of variance explained by the $R^2$ value provides an indication of the model fit. Hair et al. (2013) suggested that an individual $R^2$ should be greater than the minimum acceptable level of 0.10. When the $R^2$ value is more than 0.67, it is perceived as high, whereas the values between 0.33 and 0.67 are considered moderate and the values between 0.19 and 0.33 are considered weak. The results of the hypothesis testing are reported in Figure 3 and Table 5.

Table 5 shows the hypotheses of the study and exhibits the path coefficients between the latent variables. The bootstrap t-statistics demonstrated the stability of the estimates and all t-values were acceptable, namely, they were above 1.96 at the 95% confidence interval (Chin et al., 2003). The $R^2$ values of perceived usefulness, perceived ease of use and students'
<table>
<thead>
<tr>
<th>Constructs</th>
<th>Items</th>
<th>Factor loadings</th>
<th>AVE</th>
<th>CR</th>
<th>Cronbach's alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor characteristics (IC)</td>
<td>IC1: The instructor provides high-quality instructions</td>
<td>0.878</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IC2: The instructor provides information on learning progress</td>
<td>0.853</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IC3: The instructor delivers instructions clearly</td>
<td>0.870</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IC4: The instructor’s measurement of student performance is fair</td>
<td>0.778</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IC5: The instructor motivates me to use the virtual classroom</td>
<td>0.802</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtual classroom quality (VCQ)</td>
<td>VCQ1: The layout and user interface design of the virtual classroom is user-friendly</td>
<td>0.753</td>
<td>0.685</td>
<td>0.915</td>
<td>0.885</td>
</tr>
<tr>
<td></td>
<td>VCQ2: It is easy to navigate the virtual classroom</td>
<td>0.748</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VCQ3: The virtual classroom provides the service I need</td>
<td>0.896</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VCQ4: I feel comfortable using the functions and services provided by the virtual classroom</td>
<td>0.863</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VCQ5: The virtual classroom provides complete information</td>
<td>0.867</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived self-efficacy (PSE)</td>
<td>PSE1: I feel confident using the virtual classroom</td>
<td>0.885</td>
<td>0.715</td>
<td>0.909</td>
<td>0.865</td>
</tr>
<tr>
<td></td>
<td>PSE2: I have the necessary skills for using the virtual classroom</td>
<td>0.815</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSE3: I feel confident operating virtual classroom functions</td>
<td>0.903</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSE4: I feel the virtual classroom is important to me</td>
<td>0.771</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived organizational support (POS)</td>
<td>POS1: My university really cares about my well-being</td>
<td>0.895</td>
<td>0.800</td>
<td>0.941</td>
<td>0.917</td>
</tr>
<tr>
<td></td>
<td>POS2: My university shows concern for me</td>
<td>0.923</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POS3: My university is willing to help me if I need a special favor</td>
<td>0.870</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POS4: My university strongly considers my goals and values</td>
<td>0.889</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived usefulness (PU)</td>
<td>PU1: The virtual classroom improves my learning outcomes</td>
<td>0.936</td>
<td>0.899</td>
<td>0.964</td>
<td>0.944</td>
</tr>
<tr>
<td></td>
<td>PU2: The virtual classroom is very useful to me</td>
<td>0.953</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PU3: The virtual classroom helps me accomplish my learning effectively</td>
<td>0.957</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived ease of use (PEOU)</td>
<td>PEOU1: Virtual classroom methods are easy to understand</td>
<td>0.874</td>
<td>0.699</td>
<td>0.874</td>
<td>0.790</td>
</tr>
<tr>
<td></td>
<td>PEOU2: The virtual classroom is easy to use</td>
<td>0.831</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PEOU3: Using the virtual classroom is free of mental effort</td>
<td>0.794</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students’ satisfaction (SS)</td>
<td>SS1: I am satisfied with the performance of the virtual classroom</td>
<td>0.929</td>
<td>0.863</td>
<td>0.962</td>
<td>0.946</td>
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<tr>
<td></td>
<td>SS2: I am pleased with the experience of using the virtual classroom</td>
<td>0.943</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS3: I am satisfied with the virtual classroom learning experience</td>
<td>0.950</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS4: I am satisfied with my performance in the virtual classroom</td>
<td>0.892</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioral intentions to use VC (BI)</td>
<td>BI1: I prefer the virtual classroom to traditional learning</td>
<td>0.916</td>
<td>0.718</td>
<td>0.909</td>
<td>0.863</td>
</tr>
<tr>
<td></td>
<td>BI2: I will recommend virtual classes to other students</td>
<td>0.930</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BI3: I intend to use the virtual classroom as the only learning tool in the future</td>
<td>0.856</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BI4: I intend to use the virtual classroom in addition to the traditional classroom (blended learning)</td>
<td>0.660</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Reliability and validity measurements
satisfaction were 62.6%, 62% and 78.8%, respectively, and the $R^2$ value for behavioral intention to use virtual classrooms was 51%. All the above-mentioned $R^2$ values are, thus, greater than Hair et al.’s (2013) recommended level of 0.10; therefore, it was adequate to assess the significance of the paths concerned with these variables. All of the paths and variables had bootstrap critical ratios, as presented in Table 5.

The results of the PLS analysis indicate that all hypotheses were supported, as shown in Table 5. These results show that instructor characteristics have a moderately significant positive influence on students’ perceived usefulness of virtual classrooms ($\beta = 0.364$, $t = 3.977$, $p < 0.01$), supporting $H1$. The results of the data analysis of the second hypothesis demonstrate that virtual classroom quality has a moderately significant positive impact on students’ perceived usefulness of lectures using virtual classrooms ($\beta = 0.481$, $t = 5.222$, $p < 0.01$), confirming $H2$. Moving to the third hypothesis, the results indicate that students’ perceived self-efficacy has a strongly significant positive influence on students’ perceived ease of using virtual classrooms ($\beta = 0.649$, $t = 9.744$, $p < 0.01$), confirming $H3$. The results of the PLS analysis show that perceived organizational support has a weak significant

<table>
<thead>
<tr>
<th>Constructs</th>
<th>IC</th>
<th>VCQ</th>
<th>PSE</th>
<th>POS</th>
<th>PU</th>
<th>PEOU</th>
<th>SS</th>
<th>BI</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC</td>
<td>0.837</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>VCQ</td>
<td>0.745</td>
<td>0.828</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSE</td>
<td>0.677</td>
<td>0.799</td>
<td>0.846</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POS</td>
<td>0.583</td>
<td>0.499</td>
<td>0.477</td>
<td>0.895</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU</td>
<td>0.723</td>
<td>0.753</td>
<td>0.701</td>
<td>0.476</td>
<td>0.947</td>
<td></td>
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<tr>
<td>PEOU</td>
<td>0.729</td>
<td>0.742</td>
<td>0.760</td>
<td>0.542</td>
<td>0.656</td>
<td>0.836</td>
<td></td>
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<tr>
<td>SS</td>
<td>0.748</td>
<td>0.804</td>
<td>0.745</td>
<td>0.519</td>
<td>0.867</td>
<td>0.713</td>
<td>0.929</td>
<td></td>
</tr>
<tr>
<td>Discriminant validity</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>BI</td>
<td>0.526</td>
<td>0.624</td>
<td>0.582</td>
<td>0.261</td>
<td>0.731</td>
<td>0.529</td>
<td>0.714</td>
<td>0.847</td>
</tr>
</tbody>
</table>

Table 4.

Figure 3.
The research model with the PLS reported results
impact on students’ perceived ease of using virtual classrooms ($\beta = 0.233$, $t = 2.968$, $p < 0.01$), thus providing support for $H4$. Furthermore, the perceived usefulness of virtual classrooms was found to have a strong significant impact on students’ satisfaction with virtual classrooms ($\beta = 0.700$, $t = 11.506$, $p < 0.01$), indicating that $H5$ is confirmed. In addition, perceived ease of use positively and significantly affects students’ satisfaction with virtual classrooms ($\beta = 0.254$, $t = 3.879$, $p < 0.01$). Thus, $H6$ is supported. Finally, the results also reveal that students’ satisfaction with virtual classrooms has a strongly significant positive impact on students’ behavioral intentions to use virtual classrooms in the future ($\beta = 0.714$, $t = 14.803$, $p < 0.01$), supporting $H7$.

**Discussion**

This study was conducted with the main objective of examining the most significant factors that influence students’ satisfaction and behavioral intentions to use virtual classrooms at Princess Sumaya University for Technology in Jordan. The conceptual model of the current study was developed based on the TAM, with the additional four external variables of instructor characteristics, virtual classroom quality, perceived self-efficacy and perceived organizational support. According to the findings of the current data analysis, the proposed research model has been proved to be a valid and useful technology acceptance framework to empirically understand students’ satisfaction and behavioral intentions to use virtual classrooms in the Jordanian context.

The results of the current study support all the proposed hypotheses regarding the relationships among the model’s variables. Furthermore, the empirical data analysis results strongly support the extended TAM in predicting students’ satisfaction and intentions to use virtual classrooms in the future. In particular, the overall explanatory power of the current research model was revealed through an $R^2$ of 78.8% for students’ satisfaction with virtual classes and an $R^2$ of 51% for students’ behavioral intentions to use virtual classrooms, indicating that the newly extended model has the capability of explaining a relatively high percentage of differences in students’ satisfaction and behavioral intentions to use virtual classrooms in Jordan. Moreover, the current research determined that students’ satisfaction with learning through virtual classrooms was significantly impacted by perceived ease of use and perceived usefulness of virtual classrooms. Perceived ease of use was significantly influenced by perceived self-efficacy and perceived organizational support and perceived usefulness was significantly and strongly impacted by instructor characteristics and virtual classroom quality. Finally, students’ behavioral intentions to use virtual classrooms for learning purposes were significantly and strongly impacted by students’ satisfaction with learning through virtual classrooms.

The data analysis of the first hypothesis indicated that the instructor characteristics aspect of virtual learning is positively and significantly related to the perceived usefulness

<table>
<thead>
<tr>
<th>Predicted variable</th>
<th>Predictor variable</th>
<th>Hypothesis</th>
<th>Path</th>
<th>$R^2$</th>
<th>$t$-value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU</td>
<td>IC</td>
<td>$H1$</td>
<td>0.364</td>
<td>0.626</td>
<td>3.977</td>
<td>Supported</td>
</tr>
<tr>
<td>PU</td>
<td>VCQ</td>
<td>$H2$</td>
<td>0.481</td>
<td>0.626</td>
<td>5.222</td>
<td>Supported</td>
</tr>
<tr>
<td>PEOU</td>
<td>PSE</td>
<td>$H3$</td>
<td>0.649</td>
<td>0.620</td>
<td>9.744</td>
<td>Supported</td>
</tr>
<tr>
<td>PEOU</td>
<td>POS</td>
<td>$H4$</td>
<td>0.233</td>
<td>0.620</td>
<td>2.968</td>
<td>Supported</td>
</tr>
<tr>
<td>SS</td>
<td>PU</td>
<td>$H5$</td>
<td>0.700</td>
<td>0.788</td>
<td>11.506</td>
<td>Supported</td>
</tr>
<tr>
<td>SS</td>
<td>PEOU</td>
<td>$H6$</td>
<td>0.254</td>
<td>0.788</td>
<td>3.879</td>
<td>Supported</td>
</tr>
<tr>
<td>BI</td>
<td>SS</td>
<td>$H7$</td>
<td>0.714</td>
<td>0.510</td>
<td>14.803</td>
<td>Supported</td>
</tr>
</tbody>
</table>

Table 5. Path coefficients and hypotheses testing
of virtual classrooms. This finding is consistent with the results found by Alhabeeb and Rowley (2017), Hadullo et al. (2017), Yiong et al. (2008) and Lee et al. (2009), who concluded that instructor characteristics had a direct and significant positive effect on perceived usefulness. Based on the current research findings, instructor characteristics such as timely response, technical knowledge, confidence and innovativeness should facilitate and encourage students to learn in an e-learning atmosphere and view it as useful and beneficial.

The data analysis of the second hypothesis of the study showed that virtual classroom quality has a significant positive influence on students’ perceived usefulness. The respondents of the current research indicated that well-designed and high-quality online courses played a significant role in shaping students’ perceptions of the usefulness of virtual classes, as well as their readiness to adopt e-learning technologies. This finding is in line with previous studies within the e-learning context (Al-Busaidi, 2013; Lee and Hwang, 2007; Mtebe and Raphael, 2018; Sandjojo and Wahyuningrum, 2015; Liu et al., 2010) and mobile learning context (Almaiah and Jalil, 2014). Accordingly, virtual classroom quality, including functionality, usability and media presentation of course materials, should be continuously enhanced to be viewed as useful and beneficial for students in the virtual learning environment.

The data analysis of the third hypothesis demonstrated that perceived self-efficacy has a significant positive impact on Jordanian students’ perceived ease of using virtual classrooms. This result is consistent with prior research findings within the e-learning context (Abdullah and Ward, 2016; Alqurashi, 2016; Sylvia and Abdurachman, 2018; Siron et al., 2020; Budu et al., 2018; Chao et al., 2018; Chu et al., 2011; Patricia, 2020). For example, Abdullah et al. (2016) found that self-efficacy is viewed as the most significant predictor of students’ perceived ease of use.

With regard to perceived organizational support and its positive influence on students’ perceptions of ease of using virtual classrooms, the current study found a moderately significant positive relationship between these two constructs. Furthermore, the current research confirms that perceived organizational support plays a significant determinant role in the perceived ease of using virtual classrooms in the Jordanian context. This empirical evidence is consistent with several previous studies conducted in various contexts (Esen and Özbağ, 2014; Zainab et al., 2017), particularly in the e-learning context (Cheng, 2012; Chou et al., 2010; Alqahtani and Rajkhan, 2020; Patricia, 2020).

Perceived ease of use was hypothesized to have a significant positive influence on students’ satisfaction with learning through virtual classrooms. The findings of the data analysis of the current study support this hypothesis. Furthermore, this finding was previously confirmed in existing relevant literature in various contexts and settings. In particular, previous e-learning research found that perceived ease of use played an important role in students’ satisfaction with e-learning (Al-Gahtani, 2016; Chiu et al., 2005; Pham et al., 2019; Weng et al., 2015; Patricia, 2020). The current research supports the hypothesis that perceived ease of using virtual classrooms has a significant positive influence on students’ satisfaction with learning through virtual classrooms, which, in turn, leads to greater acceptance and higher intention to use virtual classrooms in the future.

The data analysis also indicated that the perceived usefulness of virtual classrooms has a significant positive influence on students’ satisfaction with learning through virtual classrooms. The sample in the current study contended that the nature of the information provided through virtual classrooms is considered a valuable motivation that leads to greater satisfaction with learning through such a platform. When virtual classrooms are perceived as useful, students’ satisfaction will be higher. This finding is consistent with several previous studies within the e-learning context (Al-Azawei and Lundqvist, 2015; Al-
Finally, students' satisfaction with learning through virtual classrooms was found to have a strongly significant positive impact on students' behavioral intentions to use and adopt virtual classrooms as an effective means for learning in Jordan. This conclusion has been confirmed by several previous studies that indicated that there is a direct link between students' satisfaction and behavioral intentions within various contexts, including e-learning context (Al-Azawei et al., 2017a; Al-Busaidi, 2013; Chao et al., 2018; Hassanzadeh et al., 2012; Mohammadi, 2015; Mtebe and Raisamo, 2014).

Implication for research
Drawing upon the TAM, this research has examined learners' acceptance of or intentions to use virtual classrooms from the perspective of students at Princess Sumaya University for Technology in Jordan. Therefore, this study contributes to the literature in the context of e-learning by validating TAM from an Arab country's perspective. As a result, this presents an important contribution to the literature on technology acceptance by providing an additional perspective on the e-learning adoption process in Arab countries, as they have several differences from other countries such as culture, learning style, the physical environment and the internet illiteracy. Moreover, this study extended TAM and proposed relevant external variables to explain students' satisfaction and behavioral intentions to use virtual classrooms in Arab countries. The results show that all proposed factors have directly and indirectly significant impacts on intention to use virtual classrooms among university students. Therefore, this research provides an alternate view of the adoption process to the technology acceptance literature and illustrates significant antecedents of students' intentions to use virtual classrooms, providing different solutions that explain e-learning adoption. Finally, as far as we know, this study is among the first to investigate the impact of external variables on TAM, students' satisfaction and behavioral intentions to use virtual classrooms. This study went beyond the stream of research on behavioral intention to use e-learning systems.

Implications for teaching and learning
The findings of this study offer significant and useful information in the context of teaching and learning. First, the outcomes of this study might be useful for decision-makers to develop appropriate e-learning systems based on students' needs and e-learning readiness to enhance learning and teaching performance. It shows that students' satisfaction has the most significant direct effect on the intention to use virtual classrooms. Thus, if they are satisfied with virtual classroom tools that enable them to enhance required skills and knowledge, their continued intention to use virtual classrooms will increase. Second, the outcome of each identified construct that plays a significant role in students' intentions to use virtual classroom systems will provide a practical roadmap to instructors, which, in turn, will affect teaching performance and students' academic achievements. Therefore, instructors should provide and maintain high-quality instruction, well-defined content, fair assessments of student performance and motivation to use virtual classrooms. Third, the results of the research demonstrate how identified constructs contribute to students' acceptance of virtual classroom systems. Therefore, the culture of using e-learning systems among students should be improved. Finally, virtual classroom learning is scalable and universities, in general, should invest heavily in this type of teaching as it is the future of
learning and has proved to be the only effective method to continue teaching through the COVID-19 crisis that the whole world is facing.

Implications for students
In accordance with the recent studies of Patricia (2020) and Hossain et al. (2020), the findings show the substantial effect of perceived usefulness and perceived ease of use on students’ satisfaction with e-learning usage. Indeed, students’ satisfaction is significantly linked to their intention to use e-learning systems. As a result, meeting students’ expectations enhances the acceptance of adopting an e-learning system. To recognize their expectations, decision-makers should build a strong relationship with students to fulfill the present and future needs and preferences of students. Moreover, students’ levels of readiness to adopt virtual classrooms should be addressed. It is, thus, necessary to provide training, accessibility and suitable facilities to help them enhance their knowledge and skills in using e-learning systems, which will, in turn, improve their satisfaction and intentions to use virtual classrooms. Finally, focusing on the interactive features provided by virtual classrooms such as online discussions, live chat, screen-sharing, interactive digital whiteboard, recorded classes and backup is essential to obtain real feedback on students’ skills and knowledge. Therefore, decision-makers should address this to improve students’ productivity and efficient learning by using virtual classrooms.

Conclusion and future research
This study examined the factors that affect students’ intentions to use virtual classrooms through the extended TAM lens using Jordan as an example of Arab countries. The proposed model has been validated using a PLS-SEM technique. According to the study findings, all hypotheses have either direct or indirect significant impacts on university students’ intentions to use virtual classrooms. The results of the analysis are consistent with many previous TAM studies, which found that perceived usefulness and perceived ease of use are crucial predictors of technology adoption. The results show that the best predictor of perceived usefulness is virtual classroom quality, followed by instructor characteristics. Furthermore, this study found that perceived self-efficacy is the best predictor of perceived ease of use, followed by perceived organizational support. Both perceived ease of use and perceived usefulness positively influence students’ satisfaction, which is a predictor of behavioral intention to use virtual classrooms. Furthermore, students’ satisfaction was recorded as the highest predictor of students’ intentions to use virtual classrooms. Therefore, it is the responsibility of university management to invest in e-learning system infrastructure and quality to incorporate them more effectively in academic programs.

The results make an important contribution to the information technology literature, particularly in the e-learning context. This study, thus, fills a knowledge gap by investigating virtual classroom adoption in higher education institutions in Jordan, as limited studies are available in this context, particularly in Arab countries. However, this study has several limitations. First, the study only examined the effects of four external variables (i.e. instructor characteristics, virtual classroom quality, perceived organizational support and perceived self-efficacy). Thus, future studies must examine the effects of other external variables that could affect behavioral intention to use virtual classrooms. Another opportunity for future research is to extend the model to include additional variables and examine, for example, the moderating effects of demographic variables such as age, gender and educational levels. In addition, the current research focused mainly on measuring the direct relationships between the focal constructs without addressing any mediating relationships, following many of the previous TAM
studies in the context of e-learning. Therefore, further examination of the indirect effects of external factors on students’ satisfaction and behavioral intentions could be conducted in future studies. Furthermore, the study was conducted at Princess Sumaya University for Technology. Although it was sufficient to represent the population in the context of Jordanian higher education, it is still essential to consider larger and highly representative populations with various distinct incomes, education levels, demographical backgrounds and psychological attitudes. Future researchers should replicate the model in a larger sample with different universities to generalize the findings of the study to the entire Jordanian higher education context. Second, the study was conducted at Princess Sumaya University for Technology, so future researchers should replicate the model in a larger sample with different universities to generalize the findings of the study. Third, the present study measured the students’ behavioral intentions to use virtual classrooms and future research should consider the actual use of virtual classrooms. Finally, a cross-sectional approach was used to determine students’ intentions to use virtual classrooms at a single point in time. Future research should use longitudinal approaches to gain a better understanding of the changes in students’ perceptions regarding the intention to use virtual classrooms in higher education.

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