Technology Acceptance Model: Cloud HD Video Meetings in the Context of Medical Education

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ABSTRACT: *The main aim of this paper is to shed light on the role of the cloud HD video meeting technology acceptance model in the context of medical education and to assess its benefits for academics, teachers, and students. The importance of the cloud deployment service model technology as an application model was tested in the context of five popular medical areas: 1) treatment, 2) medical education, 3) rehabilitation, 4) training, and 5) surgery. A concluding theory about the Technology Acceptance and its benefits to assist improving the values, applications, and methods to make such technology better tolerated in the context of medical education is also discussed.*

Keywords: Technology Acceptance Model, Cloud Technology, Medical Education

1. Introduction

The rapid development of technology, especially wireless technology, provides another means of communication that can support learning at any time and place. Technological advancements in chat options on online video conferencing platforms now include expanded audiovisual options that can support remote work. Being online has been especially useful during the recent COVID-19 pandemic that has limited physical meetings amid the

imposition of measures to curb the risk of infection, such as social distancing and schools closing (Wannapiroon, Nilsook, Jitsupa, & Chaiyarak, 2021), can be used as a communication channel between learners and teachers for immediate and consistent interaction (Wongdee, Suwannawong, & Boonlue, 2017) in the application of wireless network technology (Srikong & Wannapiroon, 2020). The surge in video communication in the context of COVID-19 has also been seen in the context of medical education, where cloud HD video meeting technology through modern video communications has been integrated into lessons to support teleconference teaching for medical students. Although this recent surge has been primarily driven by the COVID-19 pandemic, the uptake in video communications may have occurred anyway as, according to a 2019 report by the International Telecommunication Unit, 53.6% of people worldwide have access to the internet (www.itu.int, n.d.) see Figure 1, and the benefits of using smartphones and accessing the internet through new technologies are well recognized and have made life easier. This new normal way of life has greatly affected and changed the lives of people around the world. Also, this has a circular effect whereby as digital technology and online technology are increasingly being used, this increases the demand for new digital technologies, such as computers, mobile phones, software, and applications, making the internet increasingly necessary in all areas of life and greatly expanding its use, with the number of users expanding rapidly in recent years (Zarafshani, Solaymani, D'Itri, Helms, & Sanjabi, 2020).

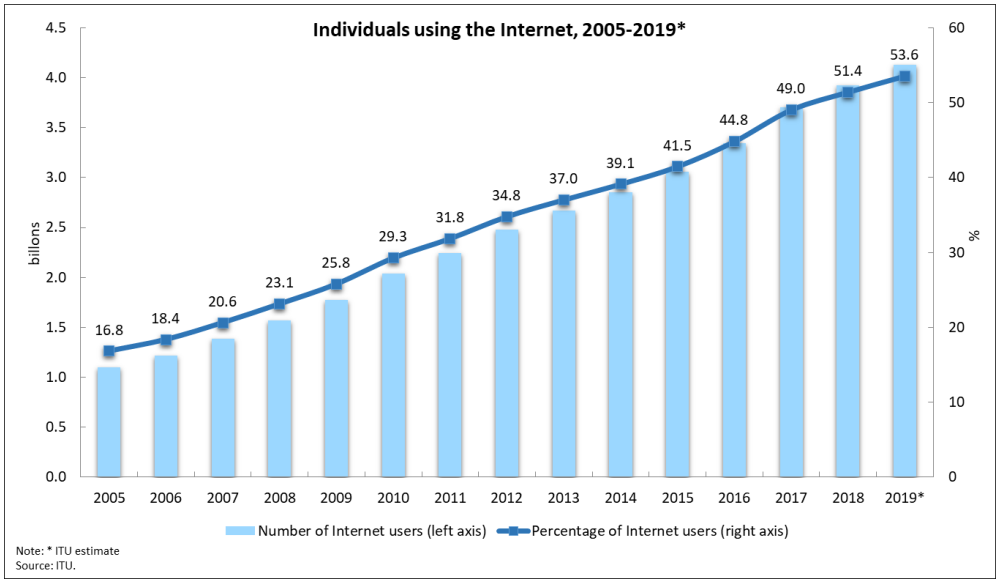

Figure 1. Growth in the number of Internet users from 2005 to 2019 (www.itu.int, n.d.)

2. Cloud Technology

Cloud technology involves collecting, sending/retrieving and storing data on a remote server on the internet, known as the "cloud". Cloud computing facilitates on-demand access to online resources, including a network of servers that store data, applications, and services, which can allow reducing workloads and enabling cost savings at individual sites. In a medical context, this could including supporting how patient information is handled, providing and accessing medical information, supporting a rapid healthcare response, and facilitating information sharing, as well as ensuring the reliability and security of information. The National Institute of Standards and Technology (NIST) (Mell & Grance, 2011) defines cloud computing as a model for enabling widespread networking. Convenience can be assured according to the needs of the groups for accessing the resources through their interaction with the cloud service providers. Virtualization technology can also be incorporated to simulate a virtual environment for access for users, whereby users could define their own resources that could be accessed from anywhere at any time. The term "cloud computing" incorporates the development of the internet "cloud" and the use of computing technology "computing". With the enhanced accessibility of various services online and the ability to expand the scope of computing processes, individual users and organizations are increasingly delivering data and services through the cloud, taking advantage of cloud storage servers and related technology (J.P. et al., 2019).

The cloud model includes the key features of the cloud, a cloud deployment pattern, and cloud service model (Mell & Grance, 2011), as described below:

Key features of the cloud

1. On-demand self-service: users can provide computing capabilities, such as server time and network storage, as needed through the cloud.
2. Broad network access: wide network access, the ability to access multiple networks by a variety of platforms.
3. Resource pooling: the pooling of resources to provide services to multiple users using a multi-tenant model, with the capability for resources to be dynamically defined and reassigned according to user needs.
4. Rapid elasticity: flexible arrangements that can be made at any time.
5. Measured service: the cloud automatically controls and optimizes the use of resources that are appropriate for the type of service, and that can be transparently monitored, controlled, and reported on for both service providers and users.

Could deployment patterns

1. Private cloud: the cloud infrastructure operates exclusively for an enterprise.
2. Community cloud: the cloud infrastructure is provided for exclusive use by a community.
3. Public cloud: the cloud infrastructure is provided for open use by the general public.
4. Hybrid cloud: a combination of private, community, or public as a component of two or more different cloud infrastructures integrated with standardized or proprietary technologies that enable data and ease of use for all users.

Cloud service models

1. Software as a Service (SaaS): Software and Application services on the cloud. Through the internet, users can use applications running on the cloud infrastructure, with applications accessible from various devices and through various interfaces, such as a web browser, without the user managing or controlling the underlying cloud infrastructure, including the network servers, storage operating systems, or even individual application capabilities.

2. Platform as a Service (PaaS): A platform service for software and application developers, where users can deploy and create applications created by a platform on the cloud that provides facilities without managing the underlying cloud infrastructure, including the server operating system network

3. Infrastructure as a Service (IaaS): Users can provide computing, storage, networking, and other underlying resources that can deploy and run software, including the operating system and system infrastructure applications. On-premise IT and on-premise storage is allowed, as well as enhancements to data stored through software and applications that support the service without managing or controlling the underlying cloud infrastructure.

Cloud technology computing also supports mobile applications with a cloud-based platform, enabling real-time collaboration between service providers and resulting in more streamlined data management by enterprises. In healthcare, using cloud services allows for faster data management when connecting patients and tracking disease efficiently (Wang & Alexander, 2013).

Cloud technology	(Wang & Alexander, 2013), (Bawa A., A., & A., 2013), (S. A., V.L., D., & A.K., 2019), (M. S., R., J., M., M., R., C., R., N., L.I., M., J.C., A., M., A., A., et al., 2019), (P. D., M., F., & G., 2011), (M. S., R., J., M., M., R., C., R., N., L.I., M., J.C., A., M., A., M., et al., 2019), (B., D., B., C., & A., 2019), (T. X. & S., 2019), (B.E. et al., 2019), (K. L., S.A., B., & D., 2017), (K. L. et al., 2017), (Q. L. & C., 2017), (M. S., R., F., F., A., J., M., M., R., C., A., et al., 2019), (R., 2019), (G. M. & T., 2011), (R. K., Z., & D., 2015), (M. S., R., F., F., A., J., M., M., R., C., F., et al., 2019), (N.U., B.S., & S.J., 2019), (X. L., 2019), (T. et al., 2017), (G.C., 2014), (X. Y. & R., 2019), (M.A. et al., 2019), (G. A., S., M., V., & P., 2019), (V. D., P., L., & L.F., 2013)

3. Medical Education

There are five key areas where video communication technology commonly supports remote work in the context of medical education: 1) treatment, 2) medical education, 3) rehabilitation, 4) training, and 5) surgery (L. Chen, Day, Tang, & John, 2017).

Table 1. Literature related to the use of video communication technology in medical education

Treatment	(Banbury A. et al., 2016), (J.I. et al., 2018), (Germain, Marchand, Bouchard, Guay, & Drouin, 2010), (Soegner, Rettenbacher, Smekal, & Zur Nedden, 2003), (Rasmussen et al., 2015), (Wallace, Hussain, Khan, & Wilson, 2012), (Wirthlin et al., 1998), (Redlick, Roston, Gomez, & Fish, 2002), (Rho, Kim, Chung, & Choi, 2015)
Medical education	(Z. S. et al., 2018), (Marconi, Brovetto, Mendez, & Perera, 2018), (M.P., S., J., & R., 2018), (P., S., M., M., & D., 2019), (Z. et al., 2019), (Allsop et al., 2020)
Rehabilitation	(Aanestad, Driveklepp, Sørli, & Hertzum, 2017), (Bernard et al., 2009), (Kavamoto, Chao, Battistella, & Böhm, 2005)
Training	(A.S., J.A., N.A., M., & D.J., 2019), (M.H., 2017), (Vaughan et al., 2019), (Parikh, Bostwick, & Taubman, 2019)
Surgery	(R. M. et al., 2016), (A. K. et al., 2016), (K.N. et al., 2016), (Doering, Legido-Quigley, Glinos, McKee, & Maarse, 2013), (Greiner et al., 2010), (Pap, Lach, & Upton, 2002)

4. Technology Acceptance Models

Theory of Reasoned Action (TRA). This is a social psychology theory that deals with predicting and understanding human behavior in applied problem-solving and policy decision-making, which is often necessary to forecast or make predictions. People's behavior is key, such as if they have a positive attitude and others want them to act, and so behavior is considered a higher intentional motivation (I Ajzen & Fishbein, 1980). Figure 2 illustrates the theory of rational action, showing how TRA was designed to describe human behavior, and considers two factors affecting behavior : intention and attitude toward behavior, and subjective norms (Davis, Bagozzi, & Warshaw, 1989) (Zolait, 2014). A case study examining the effect of continuing the theory of rational action study found that the extended theory of rational action may be a suitable framework for a study design to promote self-care behaviors for people with diabetes (Jeihooni, Khiyali, Faghih, Harsini, & Rahbar, 2020).

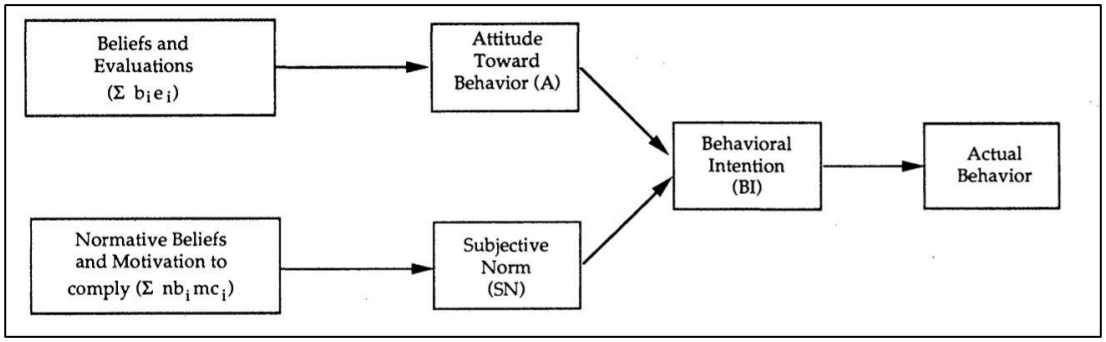

Figure 2. Theory of reasoned action *(*TRA*) (*Davis, Bagozzi, & Warshaw, 1989*)*

Theory of Planned Behavior (TPB). This theory considers a behavioral intention can be predicted with high accuracy from the attitudes toward behavioral norms, subjective norms, and perceptions of behavioral and intentional control along with the perceived control over behavior (Icek Ajzen, 2012). Figure 3 illustrates the theory in the form of a structural diagram (Icek Ajzen, 1991). The TPB theory facilitates the presentation of the possible effects of behavior as in the traditional theory of behavioral control. Acting rationally, a key factor in the theory of planned behavior is the intention of the individual. In the implementation of a given behavior, the intention is considered as the motivating factor that influences behavior.

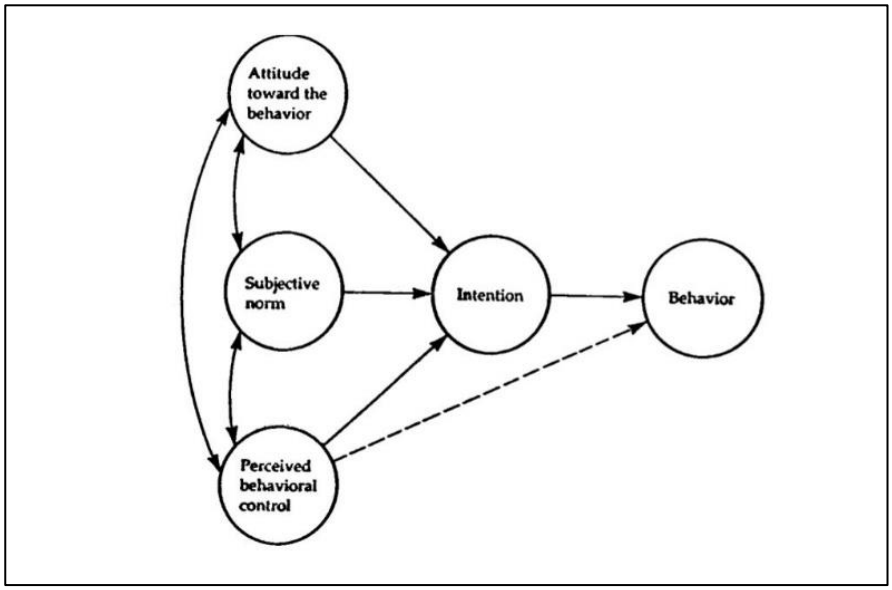

Figure 3. Theory of planned behavior *(*TPB*) (*Icek Ajzen, 1991*)*

Technology Acceptance Model (TAM). This is a theory of development and validation, where perceived usefulness and perceived ease of use are hypothesized to be fundamental factors for acceptance (Davis et al., 1989).TAM was developed based on the Theory of Reasoned Action (TRA), but TAM uses two variables, namely the perceived benefit (PU) and perceived ease of use (PEOU), as determinants of user acceptance (Bradley, 2009). TAM is a simulation of the intention and behavior of a user-friendly system of useful perception and recognition that has been confirmed to be reliable and accurate in multiple iterative simulations and applications. A slope is plotted that covers a range of technologies and users, and it advises how TAM users should use the traditional model to predict and explain user acceptance of information technology (Davis & Venkatesh, 1996). Figure 4 shows that two key beliefs are to recognize the benefits (Perceived Usefulness: U) and the perceived ease of use (Perceived Ease of Use: E) (Davis et al., 1989) . Based on the case studies, an empirical assessment of technology acceptance models for the use of mobile

technology was studied as well as "applications" in medical studies. It was found that 46.7% of behavioral intentions in mobile phone use were for learning, which would allow us to adapt and understand the current situation of applications in medical education learning (Briz-Ponce & García-Peñalvo, 2015).

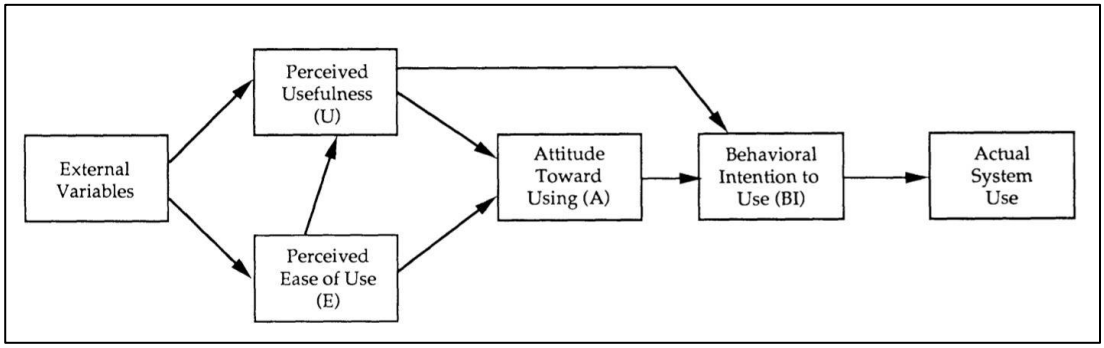

Figure 4. Technology acceptance model (TAM) (Davis et al., 1989)

Information and Communication Technology Acceptance Model (ICTAM) (An, 2006). The ICTAM is a starting point for describing and predicting consumer acceptance and use behaviors regarding information and for understanding consumer technology acceptance of the internet health. In one case study, a model of information and communication technology acceptance was studied, explained, and used to predict consumer health behavior and their use of information and internet services. It was found that the information and communication technology acceptance model provided empirical support for development. ICTAM's Continuity in Health Consumer Information Acceptance and Communication Technology.

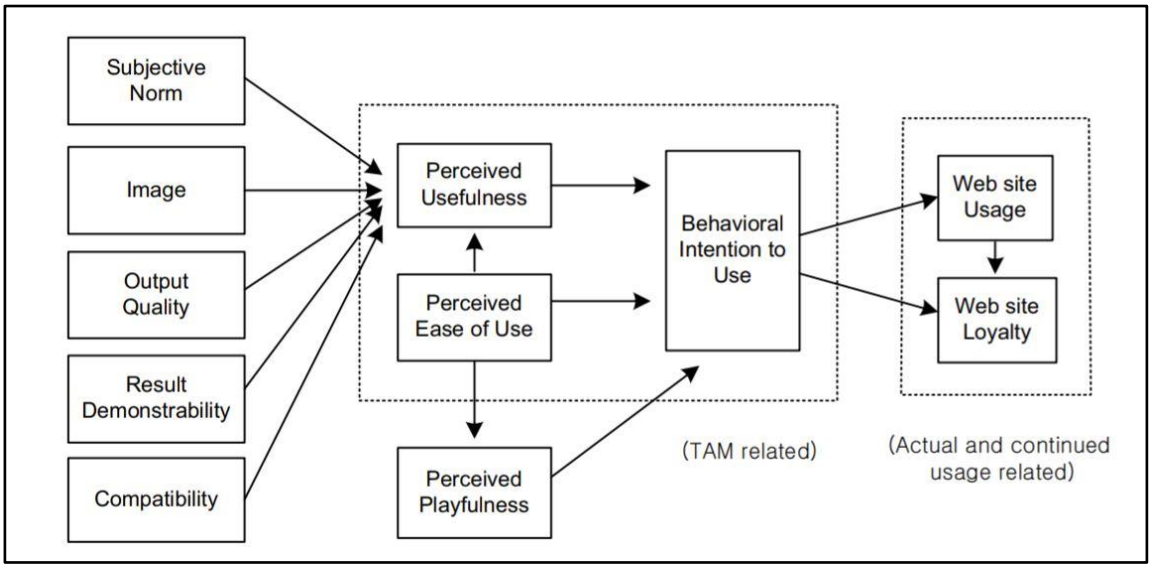

Figure 5. Information and communication technology acceptance model (ICTAM) (An, 2006)

Unified Theory of Acceptance and Use of Technology Model (UTAUT) (Davis, F**.** D**.**, Bogozzi, R**.**, P**.**, & Warshaw, P**.**, 1989**)**. The UTAUT describes the acceptance and use of information systems (IS) and information technology (IT) innovation as characterized by four factors: performance expectations, effort expectations, social influence, and facilitation conditions (Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, 2003). A case study example involved solving theoretical models, which were empirically validated using metadata analysis and structural equation modeling (MASEM) techniques. The acceptance and implementation of IS/IT with the structural equation model (SEM) showed that attitude is central to behavioral intention and behavioral use. It partially mediates the effect of external structures on behavioral intentions and directly influences behavior, with a number of implications for theory and practice derived from the findings (Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2019).

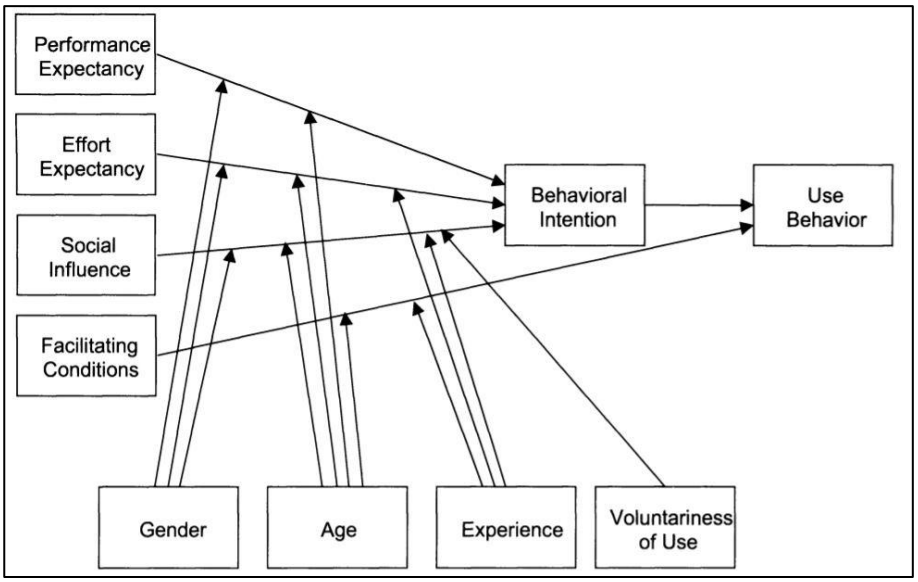

Figure 6. Unified theory of acceptance and use of technology model **(**UTAUT**)** (Venkatesh, Morris, Davis, & Davis, 2003)

Table 2. Literature related to technology acceptance models in the context of medical education

TRA (Theory of Reasoned Action)	(Jeihooni et al., 2020), (Procter, Angus, Blaszczynski, & Gainsbury, 2019), (Gainsbury, Philander, & Grattan, 2019), (Z. A., N., M.M., V.P.K., & L.M., 2019), (Z. X., X., K.-H., F., & C., 2014)
TPB (Theory of Planned Behavior)	(Heuckmann, Hammann, & Asshoff, 2018), (B. Y. et al., 2020)
TAM (Technology Acceptance Model)	(Davis, 1989), (Bradley, 2009), (Davis & Venkatesh, 1996), (Granić & Marangunić, 2019), (Yuan et al., 2017), (Muiruri et al., 2014), (Chipps, Kerr, Brysiewicz, & Walters, 2015), (Bagot et al., 2020), (Camilleri & Camilleri, 2019), (Rafique, Omran, Shamim, & Anwar, 2020), (I. J. Chen, Yang, Tang, Huang, & Yu, 2008), (Yu, 2020), (Gance-Cleveland et al., 2019), (Portz et al., 2019), (Barteit et al., 2019), (Mussa, Al-Raimi, & Becker, 2019), (Al-Jumaili et al., 2017), (Prieto, Migueláñez, & García-Peñalvo, 2014), (Holden & Karsh, 2010), (Mitzner et al., 2010), (Aggelidis & Chatzoglou, 2009), (Melas, Zampetakis, Dimopoulou, & Moustakis, 2011), (Pai & Huang, 2011), (Tsai, 2014), (Ketikidis, Dimitrovski, Lazuras, & Bath, 2012), (Huang, 2010), (Abdekhoda, Ahmadi, Dehnad, & Hosseini, 2014), (Rahimi, Nadri, Lotfnezhad Afshar, & Timpka, 2018)
ICTAM (Information and Communication Technology Acceptance Model)	(An, 2006), (J.-Y., L.L., T., & B., 2007), (L.K. & G.P., 2007), (M. A., 2016)
UTAUT (Unified Theory of Acceptance and Use of Technology Model)	(Dwivedi et al., 2019), (Nurjanah, Santoso, & Hasibuan, 2018), (Ruangvanich, 2019), (N. et al., 2020), (Cimperman, Makovec Brenčič, & Trkman, 2016), (Kohnke, Cole, & Bush, 2014), (Kijsanayotin, Pannarunothai, & Speedie, 2009), (Duyck et al., 2008), (Schaper & Pervan, 2007)

The use of cloud technology for HD video meetings in the context of medical education

Cloud technology HD video meetings or videoconferences or teleconferences involves using cloud technology to create new experiences to impart and increase knowledge. Through the online system, students can study anywhere, at any time, and with any device for the study of the medical curriculum. Systematic videoconferencing can serves as a means for social practice. However, it also carries a risk of inadvertent disclosure; whereby unintentional audio or video may be revealed in video conferencing. Preventing this adds to the level of complexity needed in the system and points to the need for more critical research to discover how distributed medical education (DME) technology transforms medical education in both intended ways and inadvertently (MacLeod, Cameron, Kits, & Tummons, 2019). In one medical study, the utilization and response of mid-range medical students in Google Hangouts video conferencing were examined. It was found that there were no significant differences in the overall experience of online video meeting participants and in-person meetings. Also, the meeting usefulness, or meeting stress level, between those meeting via video conferencing and those meeting via video conferencing was rated higher in the subjects doing video conferencing. The meeting rated the effectiveness of communication higher than those involved in video conferencing, who were able to achieve it with ease without compromising on the experience. The students felt that overall a mixture of meetings may be useful in rotation with different teachers and class schedules (L.E. et al., 2019). Lessons could also be gained from a telehealth rehabilitation project that uses videoconference for older adults at home to see and hear each other in real-time with a computer device. The process of connecting with each other in interaction could be delivered by a videoconference for the elderly (Banbury A. et al., 2016). Learning media communication can be delivered through a learning management system (LMS) using video conferencing technology. One application design of m-learning with videoconferencing for higher education is the use of LMS Moodle integrated with multimedia communication systems, such as conferencing and video calling, to support distance learning, and this was found to have better response times when deployed by up to 500 users at the same time (Bandung, Tanjung, & Subekti, 2018). Powerful teleconferencing was organized by the Greek School Network (GSN) with the school community, with the web conferencing used in large-scale meetings as a communication channel for the educational community (Perikos, Gkamas, Zarouchas, & Paraskevas, 2016).

Videoconference	(Banbury A. et al., 2016), (J.I. et al., 2018), (Z. S. et al., 2018), (Marconi et al., 2018), (M.P. et al., 2018), (P. et al., 2019), (A.S. et al., 2019), (M.H., 2017), (R. M. et al., 2016), (A. K. et al., 2016), (K.N. et al., 2016), (MacLeod et al., 2019), (Bandung et al., 2018), (Perikos et al., 2016), (Depešová & Tureková, 2015), (L.S., A.G., & T.L., 2018)

Technology acceptance is more specific than in the TAM and UTAUT technology acceptance models

Telemedicine acceptance for chronic disease rehabilitation depends on many factors, which highlights the relevant healthcare and psychology contexts (Jansen-Kosterink, Dekker-van Weering, & van Velsen, 2019). Case studies on the widespread use of telemedicine in healthcare have provided insights to policymakers and hospitals. It was found that additional factors contributing to the use of telemedicine services need to be considered. Financial stability through different strategies, and providing opportunities for capacity and accountability enhancements increase acceptance, and in turn, help support corporate stability in telemedicine services (Segato & Masella, 2017).

5. Conclusion

The use of technology acceptance models in the context of medical education may be subject to a specificity of the wider factors involved that may be more relevant than the underlying technology acceptance model. However, an original theory was needed that could explain the permitting. There is a need to embrace user technologies, such as TRA, TAM, or UTAUT, as a framework to assess and analyze outcomes to improve validity for future research. The implementation of cloud HD video meetings can play a role in helping to share expertise and new methods in the context of medical education, especially promoting the connection with patients and effective disease monitoring in five key areas of medicine: 1) treatment, 2) medical education, 3) rehabilitation, 4) training, and 5) surgery, for which a cloud computing system could be supported by a cloud-based platform model, resulting in real-time collaboration, making data management more agile for future roles. A technology acceptance model is also required for a decision support system (DSS) on virtual medicine for decision-making. It is likely that a virtual reality system will appear soon.

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