Facilitated virtual learning for advanced geriatric education among nursing students during the COVID pandemic in Taiwan

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Abstract

Purpose – This study explored the students' perception of their adoption and acceptance of virtual learning (VL), the factors affecting the adoption of educational technologies and the correlation between their intention, perceived behavioral control and care competence in caring for older adults.

Design/methodology/approach – A cross-sectional survey was conducted. Surveys were administered to evaluate the participants who were involved in VL on geriatric care during coronavirus disease 2019 (COVID-19) pandemic. A total of 315 nursing students participated in the survey, and 287 valid questionnaires were collected (response rate: 91.11%).

Findings – A total of 287 participants (mean age 21.09, SD 1.44 years; 242/287, 84.3% female) were included in the study. The variables of intention to use technologies were positively correlated with care competence ($r = 0.59$, $p < 0.001$). The results revealed that the major predictors were perceived ease-of-use (PEOU) ($\beta = 0.28$, 95% confidence interval (CI) 0.16–0.40) and perceived usefulness (PU) ($\beta = 0.22$, CI 0.09–0.35) which were significantly positive predictors of competence in geriatric care.

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Research limitations/implications – Nursing students lack in clinical knowledge and situational experience in geriatric care; therefore, their perceptiveness, expressions and reflection on the process of providing care to hospitalized older patients should be increased. These results indicated that students improved in geriatric healthcare after/during the VL program during COVID-19 pandemic.
Originality/value – It is hoped that the present study would make an invaluable contribution to existing research on education in general and on the quality of care in geriatric nursing as limited studies have been published so far.

1. Introduction

Coronavirus disease 2019 (COVID-19) started to spread globally in the spring of 2020; thus, the preparation of healthcare staff and training of an adequate number of nurses and high-quality professionals have become key challenges (World Health Organization, 2021). As these changes appear to be far from temporary, they have accelerated the transition to a "new normal" regime of nursing education online for the foreseeable future (Hatzipanagos *et al.*, 2020; Pham and Ho, 2020). During the COVID-19 outbreak, virtual technologies have supported education-related projects pertaining to policy, business and societal applications (Crawford *et al.*, 2020).

Virtual learning environments (VLEs) have developed steadily since the advent of the COVID-19 pandemic. Its development and usage also meant the permanent availability of accessories including earpiece, personal computers and Internet connectivity (Amrane-Cooper, 2020). The extent to which countries have been able to adapt to this new normal is dictated by prior experience in and the limitations of VLEs themselves (Dhawan, 2020), with the education for the majority of students around the globe at a standstill (Adedoyin and Soykan, 2020). In Indonesia, for instance, major barriers included Internet instability, cost and long periods of concentration (Amir *et al.*, 2020), while those found in Sudan included connectivity issues, unfamiliarity, technical issues, time flexibility and others (Gismalla *et al.*, 2021). A World Bank briefing report explored VLE strategies implemented in different countries (Ludi, 2020).

In response to the COVID-19 pandemic, medical education shifted toward virtual courses between 2020 and 2021 (Du *et al.*, 2020; Harper *et al.*, 2020). However, students have reported stress related to virtual learning (VL) and difficulties in completing their schoolwork or practicum. Faced with this problem, there is a need to get prepared for the possibility of another transition to remote learning if a second wave of COVID-19 outbreak occurs, and educators must understand whether their students' challenges and preferences, and medical education institutions can develop virtual teaching strategies to support students. Distance education has evolved from offline to virtual settings, and high levels of Internet accessibility and the COVID-19 pandemic have made VLEs become a common delivery method for higher education (Ali, 2020; Murphy, 2020).

2. Literature review and hypothesis formulation

VLEs have improved learning accessibility for students in remote locations who may not be able to attend classes conducted at educational facilities during the COVID-19 pandemic (Daniel, 2020). VLEs related to geriatric care have several applications in the field of gerontology and provide a secure environment for activities. Educational facilities are improving their technological capabilities and continually integrating innovative teaching platforms into education (Esfijani, 2015). Despite the decline in higher education enrollment, VLEs in public institutions is increasing (Gonzalez *et al.*, 2020).

The technology acceptance model (TAM) is a most widely applied information systems theory that models how learners come to accept and use a technology. The model suggests

that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it. The factors included the perceived usefulness (PU) which means whether or not someone perceives that technology to be useful for what they want to do; Perceived ease-of-use (PEOU) which refers to the degree to which a person believes that using a particular system would be free from effort; Perceived flexibility (PF) that has a significantly positive and direct effect on affective commitment. If the technology is useful, easy to use and flexible, then the barriers are conquered, and the ease-of-use enables learners to hold a positive attitude towards learning it (Davis and Venkatesh, 1966; Lee *et al.*, 2005, 2011).

VLEs have different possible ways of its evaluation of the students' perception and intention, such as satisfaction proved to be decisive for continuance intention, and practical implications (Knutzen, 2019), motivation, cognitive benefits, agentic learning, social constructivism and reflective thinking (Pereira *et al.*, 2015). The TAM for the acceptance of the e-learning system, which can help organization decision-makers in planning, evaluating and executing the use of e-learning systems, is used to improve the students' learning performance, which can help decision-makers in higher education, universities, as well as colleges to evaluate, plan and execute the use of e-learning systems (Al-Rahmi *et al.*, 2019).

The aging population and corresponding need to train healthcare providers in the provision of safe and quality geriatric care has implications for professional nursing education. An essential factor in building knowledge and expertise in the future workforce is the curriculum for programs, which must include content on geriatrics and the provision of geriatric care. A new paradigm in the teaching and learning of geriatric care through VL is catalyzing a pedagogical shift in how we teach and learn during the COVID-19 pandemic (Joos *et al.*, 2021).

Top-down lecturing and student passivity are being replaced by a more interactive and collaborative framework through which students and instructors cocreate the learning process. Although studies have examined specific VL topics, few studies have explored the broader aspect of VL of geriatric care as a research theme (Davis and Venkatesh, 1966; Lee *et al.*, 2005, 2011). The study explored the correlation between nursing students' acceptance of VL and their care competence after they participated in VL related to geriatric care during the COVID-19 pandemic.

The study explored the nursing students' acceptance of new technological learning after they participated in VL related to geriatric care during the COVID-19 pandemic. The hypothesis (H) and research questions (RQs) of the study are as follows.

RQ1. What are nursing students' perceptions of their adoption and acceptance of VL during the COVID-19 pandemic?

H1, H2 and H3. PU, PEOU and PF influence VL adoption intention.

H4 and H5. PEOU influences the perceived VL usefulness and flexibility.

We aimed at testing hypotheses H1 through H5 of the research model under this research question [RQ1]. To bridge the gap, we proposed hypotheses H6, H7 and H8 under RQ2 and RQ3.

RQ2. What are the nursing students' perceptions of factors (e.g. intention, perceived behavioral control and care competence) that affect the adoption of educational technologies?

RQ3. How do intention, perceived behavioral control and care competence influence each other?

H6, H7 and H8. PF, usefulness and intention to use influences care competence.

3. Methods

3.1 Study design, setting and participants' recruitment

The present study adopted a cross-sectional design to investigate nursing students' current perceptions regarding the VL for geriatric care education. A total of 315 nursing students from the department of nursing of a national university of science and technology were enrolled as participants during the COVID-19 pandemic in Taiwan. The themes for VL were as follows: (1) provision of the most up-to-date and culturally appropriate geriatric care available and (2) teaching nursing care related to aging-process assessment and care planning through the Internet or Cisco Webex online meetings and discussions.

Purposive sampling was used to collect data, and participants were enrolled. To determine if we achieved the needed sample size for our regression analyses, *a priori* sample size calculator for multiple regressions was used. The result showed that with the anticipated medium effect size set at 0.10, the statistical power level at 0.95, and the significance level at $p = 0.05$, the minimum sample size required for the current study was 133. Thus, the sample size requirement in this study was reached. In total, 315 questionnaires were administered, and 287 valid questionnaires were collected (response rate: 91.11%).

The participants were students from selected courses and programs who were invited to voluntarily participate in the study if they were nursing students who completed a geriatric care course; students who dropped out of their study and transferred students were excluded. Due to the pandemic, online courses were provided from November 2020 to January 2021 through Cisco Webex, and the recruitment of participants was conducted before the implementation of online course. In the VL course, weekly (2 h) learning tasks or activities were designed and respective completion time was required for these tasks within the 8-week course during COVID pandemic. Each virtual lecture included 100-min chunked lectures that covered one course topic each, including the lecture of the teacher (30-min lecture) and links to illustrative web resources in each lecture (20-min). It was assumed that the students spent additional time to review these lectures and explored the links to web resources (20-min). After reading/viewing the lectures, students or team leader would post a short "knowledge check" self-assessment statement to the course Dropbox (15 min). This activity would help the student gauge his/her understanding and retention of the lecture material (15 min). The students were required to complete a 5-item online quiz to check their understanding of key terms and concepts from the lecture at the end of the course.

The survey was used to evaluate the participants who were involved in courses during COVID-19 pandemic for VL to geriatric care in the university. Surveys were administered between February and April in 2021. A signed informed consent form was obtained from each participant after the objective of the study was explained in website. Mandarin Chinese versions of the questionnaire and consent forms were filled out by the participants.

3.2 Measurements

The study variables were developed based on the relevant literature and the TAM as the study conceptual framework (Davis and Venkatesh, 1966; Lee *et al.*, 2005, 2011). The questionnaire was divided into three parts. The first part covered the participants' general information, the second part examined their use of virtual technology while engaging in home-based learning during the COVID-19 pandemic period, and the third part was related to the geriatric care competence variables of this research. In total, 5 primary variables and 30 items were used in the research; the variables were PF, PEOU, PU, intention to use technologies and care competence.

3.3 Acceptance of virtual learning for geriatric care education questionnaire

This study used a self-developed questionnaire survey designed by the author to assess variables related to care competence and acceptance of VL during the COVID-19 pandemic.

The scale used in the present study is based on the TAM model developed by Davis and Venkatesh (1966) and Lee *et al.* (2005); it examined PF (three items), PEOU (three items), PU (six items), and attitude toward and intention to use technologies (three items). All questions were evaluated on a five-point Likert scale (1 = *strongly disagree*, 5 = strongly *agree*).

3.4 Geriatric care competence questionnaire
Current care competence was assessed using a self-developed questionnaire to assess factors related to care competence based on the essential components of baccalaureate education for professional geriatric practice from American Association of Colleges of Nursing (AACN) in 2010; the questionnaire contained 15 items that were scored using a five-point Likert-type scale (1 = *strongly disagree*, 5 = strongly *agree*).

3.5 Pilot testing
The content of the self-developed questionnaires was developed with reference to the literature, and validity was assessed through expert review. The researcher tested the reliability (with the Cronbach's alpha equal to or greater than 0.70) of the questionnaires administered to 30 respondents before the actual process of data collection commenced. The expert panel reported a mean individual content validity index of 0.80–0.90. The scales' high consistency and reliability were verified by a Cronbach's alpha of 0.92.

3.6 Data analysis
Data were analyzed using SPSS version 20 (SPSS, Chicago, IL, USA). Demographic characteristics were summarized using descriptive statistics, specifically frequency distributions, numbers (percentages) and means ± standard deviations. Cronbach's alpha reliability analysis was used to examine the internal consistency of the questionnaire items. Pearson's correlation coefficient was conducted to examine the criterion validity of the questionnaire. Multiple regression was performed to determine the factors affecting attitude toward and intention to use virtual technology learning and nursing competence in geriatric care, and the factors were revealed by including variables with statistical significance.

3.7 Ethical approval
Ethical approval for human research was obtained from the Central Regional Research Ethics Committee. A signed-informed consent form was obtained from each participant after the objective of the study was explained to them. To ensure that research ethics standards were adhered to, the researcher explained the study's purpose and research process to the participants and informed them about the protection of their personal rights. Signed-informed consent forms were obtained from the participants prior to data collection.

4. Results
4.1 Participants' characteristics
Most participants (97.9%) were new to VL. The statistical analysis results indicated that most participants were female (84.3%) and had an average age of 21.09 (standard deviation [SD] = 1.44) years. College seniors accounted for the largest percentage (38.5%) of the sample followed by juniors (37.3%). In terms of practicum experience, 98.9% of the participants had practicum experience in basic nursing, and 49.5%, 49.5% and 8.01% had practicum experience in community nursing, medical-surgery and geriatric/long-term care settings. Table 1 presents the full demographic profile of the final sample.

4.2 Acceptance of virtual learning for geriatric care education and perception of geriatric care competence

Figure 1 shows the respondents' answers to the acceptance of VL for geriatric education and perception of geriatric care competence. The participants' scores for overall VL acceptance ranged from agree to strongly agree (total mean = 4.13, SD = 0.66). The highest and lowest average scores were observed for PF and PEOU. The participants' mean score for care competence ranked close to full agreement (total mean = 3.96, SD = 0.51). The highest score was obtained for care ethics, followed by basic elderly care capacity, and information management and application in individual care.

4.3 Regression analysis of factors associated with acceptance of virtual learning and care competence

The present study analyzed the correlations between demographic attributes, current acceptance of VL for geriatric care education, attitude toward and intention to use technologies, and care competence. Table 2 provides an overview of the correlation between TAM, care intention and competence variables. Convergent validity was evaluated with the measurement scales using two criteria suggested by Fornell and Larcker (1981), namely the average variance extracted (AVE) of all indicator factors for each construct exceeding the variance due to measurement error for that construct (i.e. should exceed 0.50) (Fornell and Larcker, 1981) and the study composite reliability (CR) ranging from 0.71 to 0.94 and the AVE from 0.50 to 0.54. A Pearson's correlation analysis revealed significantly positive correlations between the PU, intention to use ($r = 0.68$, $p < 0.001$) and the care competence ($r = 0.54$, $p < 0.001$) that could verify H1, H2 and H3. PEOU was positively correlated with flexibility ($r = 0.88$, $p < 0.001$), intention to use ($r = 0.56$, $p < 0.001$) and usefulness ($r = 0.78$, $p < 0.001$) that could verify H4 and H5. PF was positively correlated with intention to use ($r = 0.84$,

Variables	Value
Age in years, mean (SD)	21.09 (1.44)
Gender, female, n (%)	242 (84.3)
School system, n (%)	
Junior college	44 (15.3)
College	243 (84.7)
Year, n (%)	
Freshman	44 (15.4)
Junior	132 (37.3)
Senior	110 (38.5)
Virtual learning experience, n (%)	
Yes	2 (0.7)
No	281 (97.9)
Practicum experience, n (%)	
Basic nursing	284 (98.9)
Medical-surgical nursing	142 (49.5)
Acute-critical nursing	16 (0.06)
OB/GYN	137 (47.7)
Pediatrics	154 (0.54)
Psychiatry	134 (46.7)
Community nursing	142 (49.5)
Geriatric/long-term care	23 (8.0)

Table 1.
Baseline demographic characteristics of subjects ($N = 287$)

What is your opinion about virtual learning materials on older adult care? (*N* = 287)

(a)

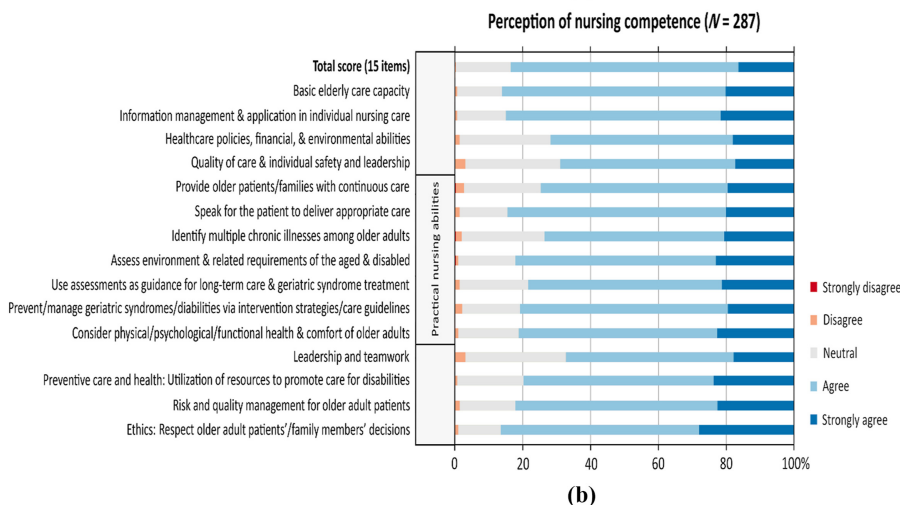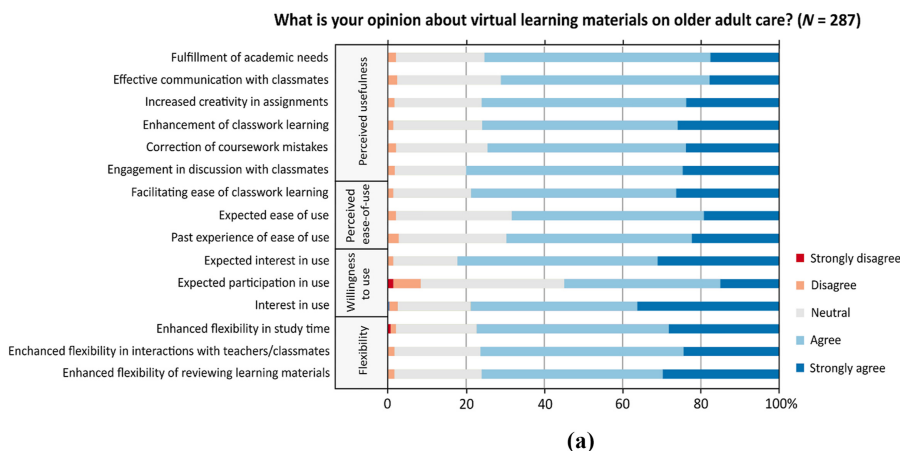**Perception of nursing competence (*N* = 287)**

(b)

Figure 1.
VL for geriatric
education and
perception of geriatric
care competence. (a)
Acceptance of virtual
learning for geriatric
care education. (b)
Perception of care
competence

Items	AVE	Usefulness	Ease of use	Flexibility	Intention to use	Nursing competence
Usefulness	0.53	1				
Ease of use	0.52	0.78**	1			
Flexibility	0.50	0.93**	0.88**	1		
Intention to use	0.54	0.68**	0.65**	0.84**	1	
Care Competence	0.51	0.54**	0.56**	0.47**	0.59**	1

Note(s): ** Significant at the 0.01 level
Statistic was based on Pearson correlation analysis
AVE = average variance extracted

Table 2.
Correlation between
technology acceptance
model, care intention
and care
competence (*N* = 287)

$p < 0.001$) and care competence ($r = 0.47$, $p < 0.001$) that could verify H6, H7 and H8. Furthermore, the variables of intention to use technologies were positively correlated with care competence ($r = 0.59$, $p < 0.001$). For all the multiple regression model constructs, the significant factors were identified using survey data. The results revealed that the major predictors were PEOU ($\beta = 0.28$, 95% confidence interval (CI) 0.16–0.40) and PU ($\beta = 0.22$, CI 0.09–0.35); the explanatory power of competence in geriatric care was 33%.

5. Discussion
5.1 Principal results and comparison with prior studies
The present study explored students' adoption and acceptance of VL for geriatric care education during the COVID-19 pandemic (while they were affected by stay-at-home lockdown measures). The body of evidence indicates that VL simulation distinguishes participants' experience levels (Knutzen, 2019; Martín-Gutiérrez et al., 2017). Ease of use and usefulness were ranked as the major factors that influenced the participants' competence after they engaged in VL (Araka et al., 2020; Aslan and Duruhan, 2021). Virtual education offers students the opportunity to study at their own pace and convenience. Therefore, flexibility and convenience are major drivers of the demand for VL education (Adedoyin and Soykan, 2020; Amrane-Cooper, 2020; Crawford et al., 2020; Dhawan, 2020; Hatzipanagos et al., 2020; Pham and Ho, 2020).

The present study results indicated that the participants' PEOU, PF and PU with respect to VL for geriatric care education could affect their competence (Davis and Venkatesh, 1966; Gonzalez et al., 2020). After transitioning to VL, many students reported that VL was a pleasant experience and expressed positive attitudes toward VL for geriatric care education (Araka et al., 2020; Aslan and Duruhan, 2021). This study explored students' care competence and examined its relationship with their acceptance of VL for geriatric care education during the COVID-19 pandemic.

Previous studies indicated that many students worldwide have had to transition from in-person instruction to a VLE midway through their semester during the COVID-19 pandemic (Adedoyin and Soykan, 2020; Amrane-Cooper, 2020; Amir et al., 2020; Dhawan, 2020; Gismalla et al., 2021; Ludi, 2020). The interaction between students and teachers is mediated by technology, and the design of learning content and environments can influence learning outcomes (Araka et al., 2020; Aslan and Duruhan, 2021). An evaluation of the effectiveness of VL of geriatric care revealed that as a tool, VL has positive effects on the social and emotional well-being of older adults.

Comparison with prior studies have explored specific areas of VL such as innovations in VL strategies (Joos et al., 2021), synchronism and quality in virtual education (Esfijani, 2015), accessibility in virtual higher education (Martín-Gutiérrez et al., 2017), problem-based learning in VLEs (Aslan and Duruhan, 2021), self-regulated learning in VLEs (Araka et al., 2020) and game-based learning in VLEs (Pellas and Mystakidis, 2020). The study participants had the highest average score for PF of VL. Since virtual education has been studied for decades, and the positive effects of virtual teaching are the result of instructional design and planning (Hodges et al., 2020), the findings in this were consistent with past studies that have reviewed VL and positive innovations in VL strategies (Araka et al., 2020; Aslan and Duruhan, 2021; Esfijani, 2015; Joos et al., 2021; Martín-Gutiérrez et al., 2017; Pellas and Mystakidis, 2020).

Most participants were new to VL and might have thought that VL was not desirable for geriatric care education. However, they were still able to learn about geriatric care (including aspects such as basic geriatric care skills, assessment, nursing ethics and case management) through VL. Therefore, instructors must clearly explain to students that the transition to VL was a response to the global COVID-19 crisis. VL instruction is an

extensively studied field due to the anticipated full-scale adoption of VL and teaching in the future (Murphy, 2020).

Significant effects on behavioral change (with respect to geriatric care competence) were also observed; this finding is consistent with those of previous studies (Amir *et al.*, 2020; Bervell and Umar, 2017; Lafraxo *et al.*, 2021). Attitudes toward and intention to adopt VL and student's behavioral change in care competence positively influence the actual adoption of VL and teaching during the COVID-19 crisis (Bączek *et al.*, 2021; Muthuprasad *et al.*, 2021; Pal and Vanijja, 2020).

The findings verified that the participants' motivation increased when they transitioned to VL, and interaction was a motivating factor for them during the COVID-19 pandemic. The findings also indicated that the participants used more platforms and virtual educational tools after transitioning to VL. Furthermore, the present study revealed that PU and PEOU influenced the participants' intention to use VL technology. Collectively, the before mentioned findings are consistent with those of previous studies (Adedoyin and Soykan, 2020; Amrane-Cooper, 2020; Amir *et al.*, 2020; Araka *et al.*, 2020; Aslan and Duruhan, 2021; Bączek *et al.*, 2021; Dhawan, 2020; Gismalla *et al.*, 2021; Ludi, 2020; Martín-Gutiérrez *et al.*, 2017; Muthuprasad *et al.*, 2021; Pal and Vanijja, 2020; Pellas and Mystakidis, 2020).

5.2 Limitations
The survey results could have been influenced by the situation of the participants when they filled out the questionnaire; thus, the results may not fully reflect their current situation. Moreover, the participants' responses included subjective statements, making it difficult to determine their actual intention. Due to the quantitative nature of the study, it was difficult to clarify the participants' perceived acceptance of technology through their care experiences. Future studies should incorporate qualitative interviews to expand on the influencing factors revealed in the present study.

6. Conclusion
On the basis of the findings, it can be learned that when transitioning to VL, the participants' motivation would increase, and more platforms and virtual educational tools would be used. During the COVID-19 pandemic, the need for the transition to VL has brought positive influence when it comes to medical education. This present study, thus, proposes the following suggestions regarding medical education, practice and research. This study identified the factors that influence students' adoption and acceptance of VL during the COVID-19 pandemic and implementation of stay-at-home orders; it also verified that VL provides more learning opportunities for students and can lead to behavioral change with regard to care competence. It is hoped that this study can serve as a reference for future study on the online teaching strategy and its effectiveness in the post COVID-19 era in the field of clinical medicine and nursing education.

Abbreviations

H1	Hypothesis 1
H2	Hypothesis 2
H3	Hypothesis 3
H4	Hypothesis 4
H5	Hypothesis 5
H6	Hypothesis 6
H7	Hypothesis 7
H8	Hypothesis 8

RQ 1	Research question 1
RQ 2	Research question 2
RQ 3	Research question 3
VL	Virtual learning
CI	Confidence interval
PU	Perceived usefulness
PEOU	Perceived ease-of-use
PF	Perceived flexibility
AVE	Average variance extracted
CR	Composite reliability

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