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**HOW DO NURSING STUDENTS PERCEIVE HEALTHCARE TECHNOLOGY? A
PSYCHOMETRIC VALIDATION STUDY OF THE USABILITY EVALUATION
QUESTIONNAIRE IN VIETNAM**
**COMO É QUE OS ESTUDANTES DE ENFERMAGEM PERCEBEM A TECNOLOGIA EM
SAÚDE? UM ESTUDO DE VALIDAÇÃO PSICOMÉTRICA DO USABILITY EVALUATION
QUESTIONNAIRE NO VIETNAME**

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ABSTRACT

The rapid advancement of technology has transformed the role of nurses and nursing students in patient care, making it an integral component of healthcare delivery. The use of innovative technologies has become commonplace in healthcare settings, creating a high-tech environment that can enhance nursing care quality and patient experience. It is essential for nursing staff and students to be receptive to incorporating such tools into their practice to ensure safe and efficient use of various forms of healthcare technology.

Objective: Given the absence of an existing tool in Vietnam to evaluate healthcare students' technology acceptance, the aim of our research was to culturally adapt, translate, and validate the Usability Evaluation Questionnaire (UtEQ) among nursing students in Vietnam.

Method: We conducted a methodological and cross-sectional study in two phases: translation of the UtEQ to Vietnamese (UtEQ-V) following six stages proposed by Beaton and collaborators, and assessment of its psychometric properties in a non-probability sample of 295 Vietnamese nursing students.

Results: The UtEQ-V's reliability was found to be above 0.8 for all factors (.88–.95), while confirmatory factor analysis showed adequate goodness-of-fit indicators.

Conclusion: The UtEQ-V is a reliable and valid instrument that can support nursing educators and researchers to assess students' technology acceptance during their clinical training.

Keywords: Technology Acceptance, Nursing Students, Vietnam.

RESUMO

O rápido avanço da tecnologia transformou o papel das enfermeiras e dos estudantes de enfermagem nos cuidados aos pacientes, tornando-o um componente integral da prestação de cuidados de saúde. O uso de tecnologias inovadoras tornou-se comum nos contextos de saúde, criando um ambiente de alta tecnologia que pode melhorar a qualidade dos cuidados de enfermagem e a experiência do paciente. É essencial que a equipa de enfermagem e os estudantes estejam recetivos à incorporação de tais ferramentas na sua prática, a fim de garantir o uso seguro e eficiente de várias formas de tecnologia de saúde.

Objetivo: Dada a inexistência de uma ferramenta existente no Vietname para avaliar a aceitação da tecnologia por parte dos estudantes de saúde, o objetivo da nossa investigação foi adaptar culturalmente, traduzir e validar o Questionário de Avaliação da Usabilidade (UtEQ) entre estudantes de enfermagem no Vietname.

Método: Realizámos um estudo metodológico e transversal em duas fases: tradução do UtEQ para vietnamita (UtEQ-V) seguindo as seis etapas propostas por Beaton e colaboradores e avaliação das suas propriedades psicométricas numa amostra não probabilística de 295 estudantes de enfermagem vietnamitas.

Resultados: A fiabilidade do UtEQ-V revelou-se superior a 0,8 para todos os fatores (.88–.95), enquanto a análise fatorial confirmatória apresentou indicadores adequados de ajustamento.

Conclusão: O UtEQ-V é um instrumento fiável e válido que pode apoiar os educadores e os investigadores de enfermagem na avaliação da aceitação da tecnologia pelos estudantes durante o seu treino clínico.

Palavras-Chave: Aceitação de Tecnologia, Estudantes de Enfermagem, Vietname.

1. INTRODUCTION

In Vietnam, nursing staff and students commonly use information and communication technologies such as electronic patient health records, internet-based health websites, digital applications, and telemedicine software in their daily clinical performance [1–3]. According to Barchielli et al. [4], there is a harmonious coexistence between technological competence and nursing care for nurses. Technological innovations enable nurses to establish closer connections with individuals by facilitating a more profound understanding of their patients. When nurses proactively embrace and purposefully adopt technological innovations, they can be viewed as successful innovators [4]. Nurses must recognize the potential opportunities presented by these innovations and strive to minimize direct risks for both themselves and the patients under their care.

However, before implementing a new technology, it is crucial to evaluate its

advantages and limitations. Low levels of technology acceptance can negatively impact the adoption and implementation of new technologies in daily clinical practice, leading to delayed or failed attempts at integrating these technologies into healthcare delivery [5,6]. This can hinder the quality and safety of nursing care delivery and negatively impact healthcare objectives [2].

Technology acceptance refers to users' willingness to use technology for the tasks it is designed to support [3]. Understanding how nursing professionals and students react to new technologies is therefore crucial in ensuring their successful implementation and adoption in daily clinical practice [2]. Nursing professionals and students' knowledge and beliefs influence the evaluation process and contribute to their adoption of technology [3]. Social and cultural factors, as well as changes in information systems, designs, working environments, and potential users, can affect

nursing professionals and students' needs and acceptance of technology [3].

In their scoping review on technology literacy in nursing education, Nes et al. [7] identified a significant gap in pedagogical models that comprehensively address the acquisition, measurement, and maintenance of technological literacy among nursing students. According to the authors, nursing universities and colleges bear the responsibility of equipping future nurses with the necessary technological literacy knowledge to thrive in an increasingly technology-driven healthcare environment [7].

To achieve this, nursing educators and researchers can use several technology acceptance models and theories to identify underlying factors that affect users' behaviors towards technology. The Technology Acceptance Model (TAM) is widely accepted in existing literature for understanding predictors of user intention towards technology usage [5,8,9]. According to TAM, perceived ease of use and perceived usefulness are two primary factors that influence an individual's intention to use new technology. The Usability Evaluation Questionnaire (UtEQ) has been developed based on TAM to measure end-users' assessment of medical devices' efficacy, performance, and safety [10]. Healthcare educators and researchers in several countries, including Portugal, Belgium, Finland, Slovenia, and Vietnam, have used the UtEQ to assess healthcare students' acceptance of different technologies during their clinical training, with positive results [11,12].

As no instrument is available to assess nursing students' technology acceptance in Vietnam, we aim to culturally adapt and validate the psychometric properties of the UtEQ among undergraduate medical and nursing students.

2. MATERIALS AND METHODS

2.1. STUDY DESIGN

Phase 1: Translation and Adaptation/Cross-Cultural Adaptation

The UtEQ was translated into Vietnamese following the guidelines for the process of cross-cultural adaptation of self-report

measures of Beaton and collaborators [13], in six stages. In stage I (Translation), two reviewers with a background in nursing were invited to independently assess and translate the UtEQ into Vietnamese. All the invited reviewers were fluent in written and spoken English and had integrated the language into their professional activities, with high knowledge of scientific and technical terms.

In stage II, the research team and the reviewers analyzed and discussed the two resulting translations, which were synthesized, and resulted in the development of a new version in Vietnamese (UtEQ-V). In stage III, two official translators whose native language was English back-translated the new version from Vietnamese to English. Both back-translations were reviewed by the research team in collaboration with the translators. To proceed with the translation process, an Expert Committee was formed (stage IV). Each expert from each University was invited to assess the UtEQ-V. After reviewing all feedback provided by the experts, the research team deemed that the original UtEQ and the developed new version of the instrument in Vietnamese (UtEQ-V) had linguistic equivalence.

In stage V (Pretest), 68 students from three Vietnamese Higher Education Institutions (Hanoi Medical College, Hanoi Medical University, and Namdinh University of Nursing) were requested to score the UtEQ-V. In general, the students considered that the items on the UtEQ-V were clear and easily scored, alluding to the fact that no deviations were needed to answer the scale. In terms of questionnaire completion, the mean time required by the student participants was 15 minutes. With regard to the questionnaire's content, no issues were reported by the students concerning the comprehension of the questions.

Phase 2: Psychometric Validation of the UtEQ-V Instrument

The psychometric validation of the UtEQ-V was conducted between Hanoi Medical University and Nam Dinh University of Nursing in Vietnam. The selected HEIs are members of a consortium financed by the European Union Erasmus+ Capacity Building initiative.

2.2. INSTRUMENTS

The UtEQ was developed by Parreira and collaborators [10] based on the TAM model, and includes 45 items divided into four factors: Utility Performance (UP), Utility Empowerment (UE), Utility Relationship (UR), Easy of Use (EU). The UtEQ items can be scored between 1 (Strongly disagree) and 7 (Strongly agree) points. As the respondent's score increases, their inclination towards incorporating technology in their daily clinical practice becomes more apparent, as they perceive it as a beneficial tool for delivering care [9]. A succinct segment containing inquiries regarding the sociodemographic characteristics of participants (e.g., age, sex) and their academic information (e.g., course year, enrollment status) was also included at the end of the data collection instrument.

2.3. SAMPLE SIZE, STUDY RECRUITMENT AND DATA COLLECTION

Hair and colleagues [14] recommend using confirmatory factor analysis if the scale has already undergone exploratory factor analysis, and they suggest having at least five respondents per item. Kline [15], on the other hand, proposes a sample size of at least 200 participants for such assessments. Based on these assumptions, recruitment and data collection for this study were conducted at Hanoi Medical University and Nam Dinh University of Nursing from May to August 2021, using a non-probability convenience sampling method. A senior research team member approached students between classes, explained the study's objectives, and asked if they would like to participate in completing the UtEQ-V. Once completed, the students were instructed to place the scale form in a sealed box.

Inclusion criteria for the study required that students be at least 18 years old, enrolled in a bachelor's degree program in nursing science, and proficient in written Vietnamese. Exclusion criteria included students who did not want to participate in the study and international students who were enrolled in the selected Higher Education Institutions for a brief mobility period.

2.4. DATA ANALYSIS

The data were synthesized by using SPSS 20.0 and AMOS 20.0 software. Descriptive statistics including mean, percentage, and the standard deviation were used to describe the variables of the study. We conducted a confirmatory factor analysis (CFA) using AMOS (SPSS Inc., Chicago IL) to estimate the structural model. Cronbach's alpha was used to estimate the reliability of the factors. A variety of goodness-of-fit indexes was used to assess the data's fit of the model. There were specific measures that can be calculated to determine goodness of fit along with their acceptable fit. Hu and Bentler [16] suggested that the goodness of fit of the proposed structures to the correlational structure of the data was evaluated with χ^2/df , CFI, GFI, TLI, SRMR, RMSEA, and the 90% confidence interval for RMSEA. It is assumed that a good fit occurred when the chi-square/degrees of freedom should be less than 5.0. When CFI is greater than .97, we considered good adjustment, when between $.95 \leq CFI < .97$, we considered acceptable fit. About GFI, we considered a good fit when it is greater than .95 and an acceptable fit when $.90 \leq GFI < .95$. A Root Mean Square Error of Approximation (RMSEA) value of less than .05 was considered to indicate a good fit, while values between .05 and .08 were considered acceptable. The statistical significance was assumed at a .05 level [17].

2.5. ETHICAL CONSIDERATIONS

The research proposal was approved by the Ethics Committee of the Health Sciences Research Unit: Nursing of the Nursing School of Coimbra with number P781-5/2021. Informed consent was obtained to ensure that the subjects voluntarily participated in this study. The students participating in the study were provided with full information about the study, including the purpose, data collection and treatment procedures, and rights when participating in the study. Students were informed of their right to withdraw from the study at any time without consequences.

3. RESULTS

A total of 295 nursing students participated voluntarily in the study. Most of the participants were female students ($n = 267, 90.5\%$), which

is representative of the gender distribution in the nursing workforce in Vietnam. Most of the participants ($n = 239$, 81%) were full-time students, with only a small proportion being part-time students ($n = 56$, 19%). The average

age of the respondents was 22.7 years (± 5.69). The descriptive statistics of the UtEQ-V for phase two can be found in Table 1.

Table 1 – Descriptive statistic of the UtEQ-V ($n = 295$)

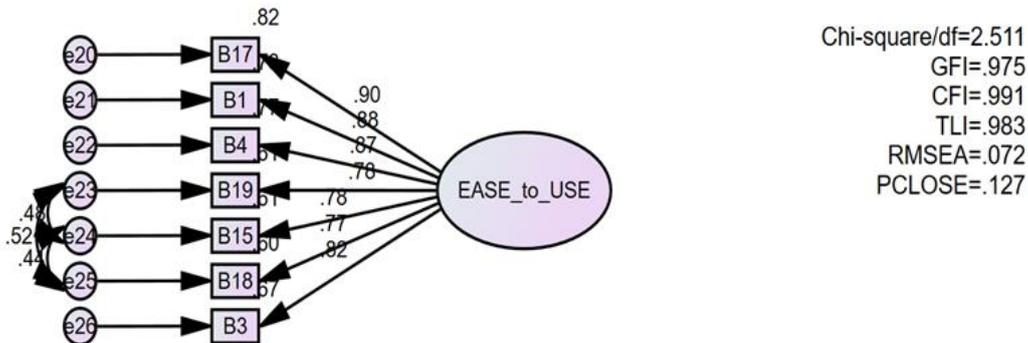
| Subscales | Min. value | Max. value | Mean \pm SD |
|---------------------------|------------|------------|----------------|
| Utility-Performance (UP) | 2.67 | 7.00 | 5.51 \pm .81 |
| Utility-Empowerment (UE) | 2.00 | 7.00 | 5.38 \pm .96 |
| Utility-Relationship (UR) | 2.80 | 7.00 | 5.29 \pm .95 |
| Ease of Use (EU) | 1.86 | 7.00 | 5.08 \pm .87 |

The Cronbach’s Alpha values for the factors were respectively adequate: Utility-Performance (UP) with $\alpha = .95$, Utility-Empowerment (UE) with $\alpha = .88$, Utility-Relationship (UR) with $\alpha = .94$, and Ease of Use (EU) with $\alpha = .94$.

RMSEA = .072, which is less than 0.08; and PCLOSE = .127, which is greater than .05) are adequate, supporting the factor of Ease of Use ($\alpha = .94$), as depicted in Figure 1. Additionally, all observed variables in the model are significant (p -values $< .05$), and all normalized weights are greater than .5, indicating a high degree of agreement among the observed variables. Moreover, the CR values are greater than .7, and AVE is greater than .5, demonstrating convergence.

Confirmatory factor analysis was performed (Figure 1). The results showed that the goodness-of-fit indexes (CMIN/DF = 2.511, which is less than 3; GFI = 0.975, which is greater than .9; CFI = .991, which is greater than .9; TLI = .983, which is greater than .9;

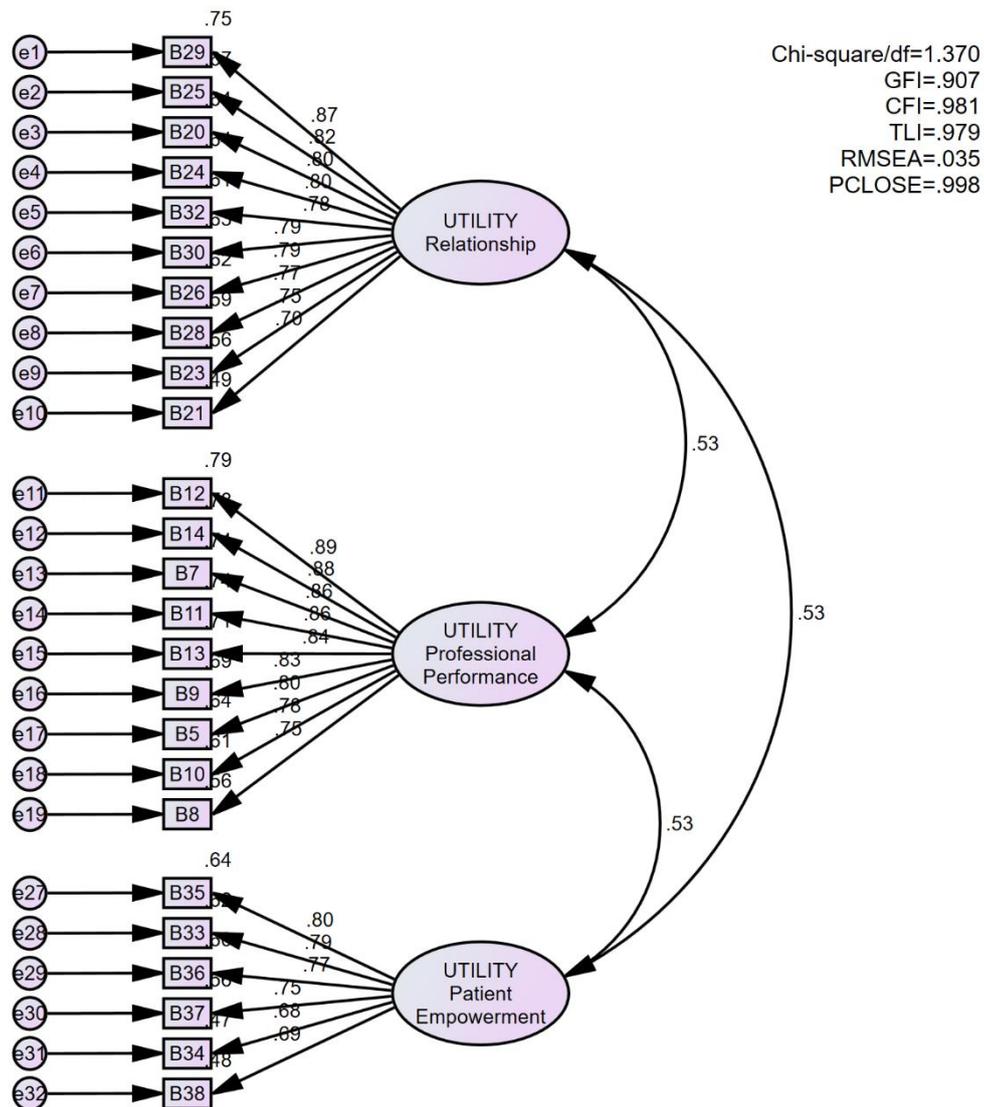
Figure 1 – Confirmatory Factor Analysis of the UtEQ-V’s EU factor



Confirmatory factor analysis was conducted based on the proposed model shown in Figure 2. The results indicated good model fit with the following goodness-of-fit indexes: CMIN/DF = 1.370 (less than 3), GFI = .907 (greater than .9), CFI = .981 (greater than .9), TLI = .979 (greater than .9), RMSEA = .035 (less than .08), and PCLOSE = .998 (greater than .05). All

observed variables in the model were found to be significant, with p -values less than .05. Additionally, all normalized weights were greater than 0.5, indicating a high degree of agreement among the observed variables. The CR values were greater than .7, and AVE was greater than .5, confirming the UtEQ-V’s convergence.

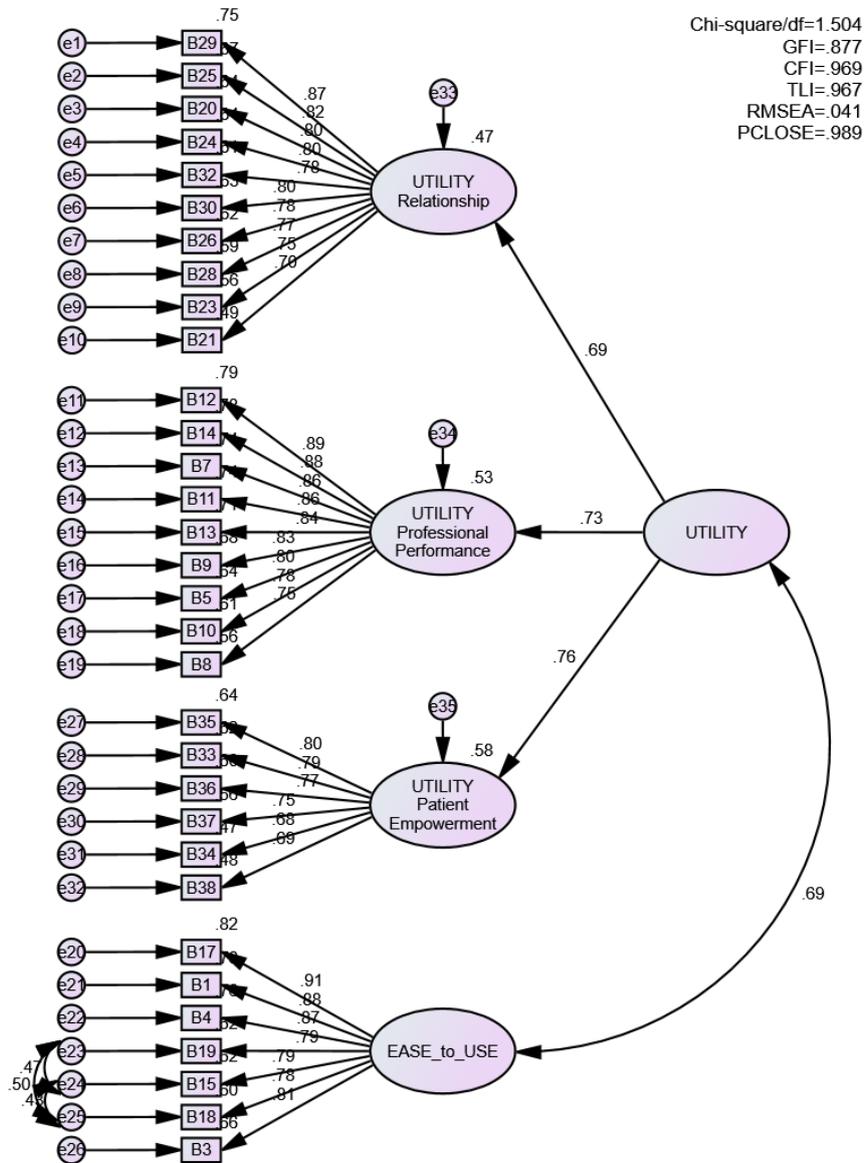
Figure 2 – Confirmatory factor analysis for the factors UP, UE, and UR



We attempted a third model proposal that integrated all the factors of the original UtEQ (Figure 3). The model fit showed an improvement in RMSEA, with the following goodness-of-fit indexes: CMIN/DF = 1.504 (less than 3), GFI = .877 (greater than .8), CFI = .969 (greater than .9), TLI = .967 (greater than .9), RMSEA = .041 (less than .08), and PCLOSE = .989 (greater than .05), indicating a good model fit (Figure 3). All subscales of UTILITY were found to be significant, with p-values less than .05. The results showed that the order of explanation for the UTILITY variable, from strong to weak, is UTILITY_Patient_Empowerment >

UTILITY_Professional_Performance > UTILITY_Relationship. The CR values were greater than .7, and AVE was greater than .5, indicating that the scales were convergent. Additionally, the square root of AVE was larger than the correlations between latent variables, and MSV was less than AVE, indicating that the discriminant was guaranteed. The correlation analysis indicated a significant positive correlation between EASE_to_USE and UTILITY, with a p-value of .000 (less than .05) and a high correlation coefficient of .692, suggesting a strong correlation between these two factors.

Figure 3 – Goodness-of-fit indexes obtained in Confirmatory Factor Analysis of all the factors of the UtEQ-V



4. DISCUSSION

This study aimed to translate the UtEQ from English to Vietnamese and evaluate its psychometric properties among nursing students in Vietnam. The Vietnamese version of the UtEQ was assessed for internal consistency, construct validity, and external validity. The Cronbach’s alpha coefficients for all items were above .80 for the four factors measured (Utility Performance, Utility Empowerment, Utility Relationship, and Ease of Use), indicating high internal consistency.

The final model proposal showed adequate goodness of fit, suggesting that the original model proposed by Parreira et al. [10] could be used in Vietnamese nursing student population. However, correlating the error of items 23, 24, and 25 was necessary to improve the goodness of fit, indicating the need for further research to explain the unexplained variability in the sample. The results also revealed a high positive correlation between Ease of Use and Utility, consistent with previous studies [4,18–20].

Regarding construct validity, the factor of Utility Relationship in the Vietnamese version was interpreted by items B20, B21, B23-B26, B28-B30, and B32 (factor loadings .75–.88); Utility Performance by items B5 and B7-B14 (factor loadings .72–.91); Utility Empowerment by items B33-B38 (factor loadings .82–.89), and Ease of Use by items B1, B3, B4, B15, and B17-B19 (factor loadings .69–.83). It is important to note that the factor loadings and factors themselves vary depending on the national culture of each study population [19,20].

This study has several limitations that need to be addressed. Firstly, the participants were recruited from only two universities in a non-randomized manner, which could limit the generalizability of the findings. Likewise, our model analysis did not consider the potential differences in undergraduate students' perceptions of healthcare technology during the advancement of their studies. As an example, first-year students may have more reservations with some forms of healthcare technology than last-year students, who have more experience in a real-life clinical setting. Therefore, further testing of the instrument is necessary to ensure its reliability and construct validity. Secondly, although the selection of undergraduate nursing students was intentional, we believe that the UtEQ-V may also be a reliable instrument to assess technology acceptance among post-graduate nursing students and nursing staff. These groups are constantly under pressure to plan and deliver care in increasingly technological clinical environments. Moreover, given its structure, content, and nature, future researchers may want to explore the UtEQ-V's applicability and reliability in assessing technology acceptance among other healthcare professionals and students from different backgrounds, such as medicine, physiotherapy, and pharmacy.

5. CONCLUSIONS

The UtEQ-V was found to have semantic equivalence to the original version and was positively received by academic experts and undergraduate nursing students. The UtEQ-V demonstrated satisfactory reliability properties, rendering it a useful tool for evaluating nursing

students' technology acceptance during their formal education. Structured evaluation of this domain could be advantageous for nursing educators and researchers, enabling targeted interventions to enhance students' perceptions of the role of technology in care delivery, as well as its ease of use and utility.

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PROCEDIMENTOS ÉTICOS

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