DIGITAL TRANSFORMATION IN MEDICAL EDUCATION: A CASE STUDY OF CAN THO UNIVERSITY OF MEDICINE AND PHARMACY

Nguyen Huu Phuoc Dai[1*], Duong Quoc Thanh[1], Nguyen Thanh Hung[1], Nguyen Hoang Thai[1], and Huynh Dang Khoa[1]

[1] *CanTho University of Medicine and Pharmacy*
Email: nhpdai@ctump.edu.vn

ABSTRACT

Background: Digital transformation (DT) is shifting medical education worldwide through technologies such as Machine learning, Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), and others. However, in developing countries, DT adoption faces several challenges, including limited infrastructure, resource constraints, and insufficient digital competence among educators.

Aim: This study aimed to identify the key drivers and barriers influencing DT implementation at Can Tho University of Medicine and Pharmacy (CTUMP) and to explore how demographic and professional variables shape educators' perceptions.

Methods: Data were collected from 122 lecturers and staff from 8 faculties and other departments via an online survey. Descriptive statistics, independent-sample t-tests, and one-way ANOVA analyses were performed to examine differences in DT perceptions by gender, age, years of experience, educational qualifications, and faculties/departments.

Results: Overall, participants showed a generally positive attitude toward DT's ability to enhance teaching quality and effectiveness. Gender-based differences were observed in confidence and perceived AI risks among male respondents, while years of experience and educational background influenced views on ethical implications and digital training needs. The findings highlight the institutional and human factors that shape DT readiness, offering novel implications for strategic DT in medical education.

1. INTRODUCTION

Recently, DT has been implemented in numerous industries, including healthcare and education. Especially in medical education, with the integration of digital technologies such as VR, AR, and the like, they have emerged as valuable assets for future healthcare professionals with the requisite knowledge and abilities [1]. In Vietnam, particularly at CTUMP, medical education still faces several obstacles, such as a lack of resources for teaching, a shortage of highly qualified lecturers, inadequate digital infrastructure, and unequal access to high-quality learning materials across regional institutions. DT refers to the use of digital tools; for instance, e-learning systems, virtual simulations, telemedicine platforms, and AI in teaching, learning, and management. These technologies create new opportunities to improve learning effectiveness and student engagement. At Can Tho University of Medicine and Pharmacy (CTUMP), DT adoption remains

early, constrained by institutional, technical, and pedagogical challenges. Several previous studies [2],[3],[4] have examined DT readiness globally; however, there is still limited evidence on how DT can be effectively implemented in Vietnamese medical universities, especially in the Mekong Delta region.

This research mainly focuses on examining the current state of DT and identifying the key drivers and barriers to DT adoption from the perspectives of lecturers and staff at CTUMP by exploring how demographic and professional factors influence DT perceptions and readiness. The authors used a structured, validated questionnaire of 24 questions separated into four groups: infrastructure and organizational culture, skills and competencies, awareness and ethics, and learner feedback. Data were collected online from 122 lecturers and staff representing eight faculties/other departments. Descriptive statistics, independent-sample T-tests, and one-way ANOVA were applied using IBM SPSS Statistics v23 to examine perceptual differences across gender, age, qualification, and professional experience. This study offers practical insights into the institutional, human, and ethical dimensions shaping DT readiness, providing a foundation for future policy and research to advance sustainable and inclusive digital strategies in medical training. Furthermore, regarding the results of this research, the authors also express several potential recommendations to enhance the effectiveness of DT in medical education by utilizing new advanced technologies and improving training courses on DT for lecturers and staff.

This research is organized as follows: Section 2 is the background of DT, its benefits, and challenges. Section 3 presents research methodology. Section 4 expresses the results of research. Section 5 describes discussions and recommendations. Section 6 concludes the paper.

2. BACKGROUND

DT, or digitalization, refers to the process of changing and influencing all aspects of human life regarding the use of advanced technology [5]. DT brings many advantages, including enhancing customer satisfaction [5], improving high-quality user experiences, strengthening collaboration and communication, and enhancing operational efficiency. Especially, DT has become an indispensable driver of change in medical education by integrating digital tools [6], digital health platforms [7], AI [8], and smart systems to enhance accessibility, flexibility, and personalization of medical training [9], [10]. Moreover, digital platforms can help medical students access high-quality resources remotely, simulations, and develop their clinical skills in a safe environment [1]. However, DT faces several challenges in implementing digital solutions, including resistance to change [11], insufficient training [12], inadequate infrastructure, lack of support from institutions, data privacy and security concerns [11], data management, ethical considerations [13], and a lack of digital skills [12], limited access to technology [13], and highly qualified IT staff and lecturers [14]. In developing nations, limited infrastructure and fragmented policies often intensify these barriers. Addressing them requires a holistic approach that combines infrastructure development, faculty digital upskilling, and ethical governance mechanisms for emerging technologies. It is essential to comprehend these interconnected elements to help adopt DT sustainably and flexibly.

3. RESEARCH METHODOLOGY

3.1. Methodology

This research mainly focuses on the lecturers and staff's perception of DT in medical education at CTUMP. The authors created an online survey comprising 24 questions, with required fields based on the research aims. In our sample, we collected 122 lecturers/staff who filled out the online

questionnaire, expressing their opinions on how DT affects medical education. This research applied descriptive statistics to examine the differences in perceptions of DT in medical education at CTUMP. Furthermore, internal consistency was assessed using Cronbach's alpha, yielding high reliability across the four dimensions: infrastructure and culture ($\alpha = 0.86$), skills and competencies ($\alpha = 0.89$), awareness and ethics ($\alpha = 0.82$), and learner feedback ($\alpha = 0.84$). These coefficients indicate satisfactory reliability and internal consistency of the instrument.

3.2. Data collection and analysis

Data were collected between May and September 2025 using an online questionnaire distributed via institutional email lists. The population consisted of approximately 180 lecturers and staff members across eight faculties and departments. A total of 122 valid responses were received, corresponding to a response rate of 67.8%.

A 5-point Likert scale [15] questionnaire ranging from "strongly disagree" to "strongly agree" (from 01 to 05) was prepared using Google Forms. The quantitative data were formulated in Microsoft Excel and exported to IBM SPSS Statistics version 23 to conduct descriptive statistics (a measure of tendency, frequency, and percentage) with a significance level of $p < 0.05$. The authors categorize four main groups of factors that can affect DT in medical education, namely **IACF**, such as Group 1 (Infrastructures, policies, and organizational cultures), Group 2 (Abilities, skills, and mindset), Group 3 (Challenges, awareness, and ethics), and Group 4 (Feedback from learners/students toward DT in medical education). A comparison between the demographic factor (gender) and the factors (IACF) was observed using an independent sample T-test. Furthermore, the assessment variations between demographic characteristics (age, educational qualifications, faculties/departments, and years of experience) and the IACF were analyzed by one-way ANOVA. This study

involved voluntary participation of lecturers and staff through an anonymous online questionnaire. No personal or sensitive data was collected. In line with institutional and national research guidelines, formal ethics approval was exempted as the study posed no risk to participants and did not involve human or clinical experimentation.

4. RESULTS AND DISCUSSIONS

A total of 122 lecturers/staff completed the survey, including 72 males (59%) and 50 females (41%) from 08 faculties and other departments and divisions at CTUMP [Figure 1], [Figure 2], respectively. These participants have a range of ages, from 22 years old to over 50 years old [Figure 3]; their educational qualifications span secondary, college, university, and postgraduate levels [Figure 4]; and their years of experience range from 0 to over 20 years [Figure 5].
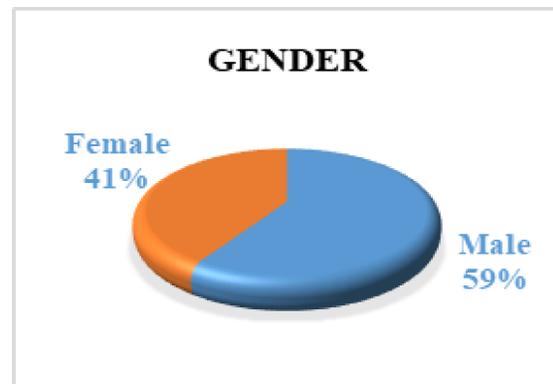

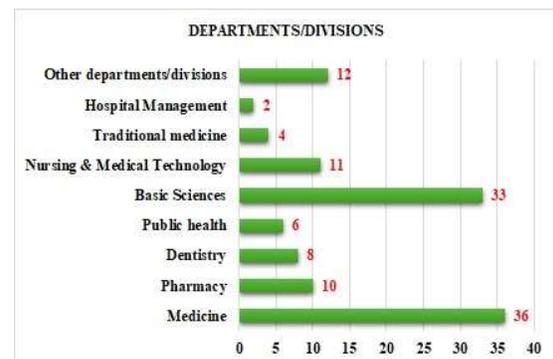**Figure 1. Participants' gender**

Figure 2. Participants' departments/divisions

Fig. 2 expresses that the majority of participants were from the Faculty of Medicine with 36 individuals (29.5%), followed by the Faculty of Basic Sciences with 33 individuals (27%), and other departments/divisions with 16 individuals (13.1%). At the same time, smaller proportions were presented by Nursing with 11 individuals (9%), Pharmacy with 10 individuals (8.2%), Public Health with six individuals (4.9%), Traditional Medicine with four individuals (3.3%), Dentistry with four individuals (3.3%), and Hospital Management with two individuals (1.6%). This diverse distribution of participants provides perspectives on DT in medical education, not only represented from the core faculties of Medicine and Basic Sciences, which are directly involved in training and supporting scientific disciplines, but also from other departments/divisions.

Figure 3. Participants' educational qualifications

Regarding [Fig. 3], it illustrates that most participants held postgraduate degrees (Master's, PhD, or higher), with 99 respondents, followed by university graduates (21 respondents), and with a minimal presentation from college and secondary education levels (1 respondent for each). This expresses that lecturers/staff at CTUMP are highly educated and positively adopt/implement digital technologies in medical education.
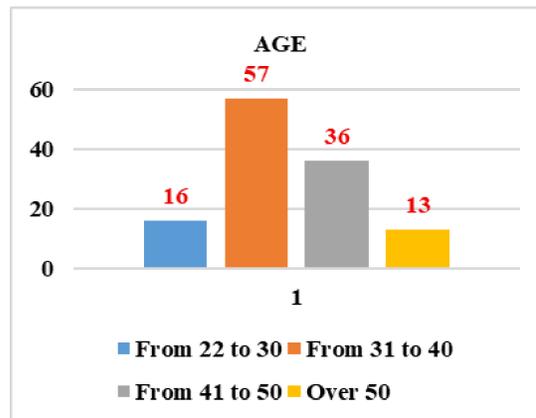

Figure 4. Participants' age

In Fig. 4, the age distribution of respondents shows that the largest group falls within the 31-40 age range (57 participants), followed by those aged 41-50 (36 participants), while smaller groups fall within the 22-30 (16 participants) and over 50 (13 participants). This demographic profile suggests that a mid-career workforce at CTUMP is advantageous for DT in medical education, as it balances professional experience with adaptability to new technologies.

Figure 5. Participants' years of experience

In Fig. 5, the largest group of respondents in teaching experience has 11-20 years of experience (47 respondents), followed by those with 0-5 years of experience (27 respondents). Two groups, with equal proportions of individuals aged 6-10 years and those over 20 years of age (24 respondents in each group), were observed. This figure indicates that diversity of teaching

experience at the mature level range (11-20 years) can enhance the potential for applying DT in their teaching methods.

4.1. Findings 1

Group 1 includes factors related to the current state of infrastructure, policies, and organizational culture at CTUMP to support the development of DT in medical education. In Fig. 6, it can be seen that most respondents agreed that digital training skills and sharing DT experiences between colleagues, with a rate of 48.4% agreeing and 36.9% strongly agreeing, respectively. It shows that lecturers/staff believe these factors are necessary to enhance their teaching capabilities in digital environments.
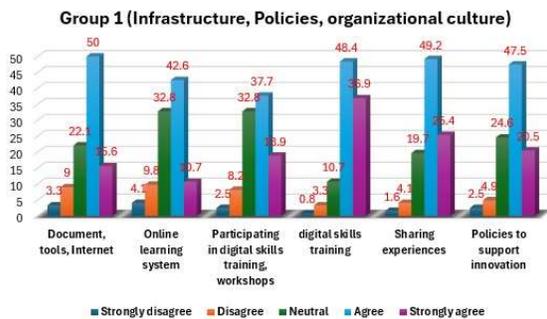

Figure 6. Frequency of Group 1

Group 2 encompasses the factors related to the abilities, skills, and mindset of lecturers/staff regarding DT in medical education. Fig. 7 shows that most respondents expressed positive attitudes toward DT in medical education. High levels of agreement were observed in three areas; for instance, DT can enhance the quality of teaching 86.1% (agree/strongly agree), and be Interested in exploring digital skills 86.9% (agree/strongly agree), and design online learning activities (74.6%). It has been proven that lecturers/staff strongly believe that DT can improve the quality and effectiveness of teaching for students. Furthermore, they are happy to learn and apply new digital skills or technologies within their online training curriculum.
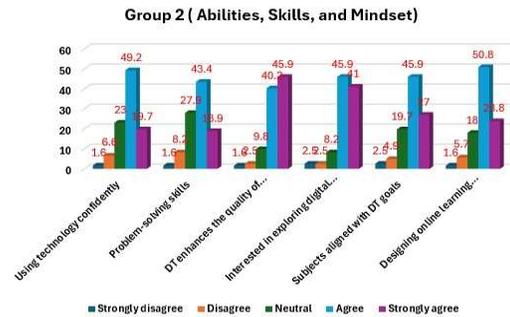

Figure 7. Frequency of Group 2

Group 3 reflects the challenges, awareness, and ethical concerns associated with DT in medical education. In the chart [Fig. 8], the most significant proportion of respondents indicated that balancing traditional and digital teaching was neutral (41.8%), while those largely agreed that insufficient time and inadequate support are challenges (43.4%). Besides, guidance on AI and adherence to ethical standards received the strongest endorsement, with 42.6% agreement and 35.2% strong agreement. It can be demonstrated that the lack of time and support from the University poses a significant challenge to the successful development of DT in medical education. In addition, the respondents expected that supporting AI's guidance and standards needs to be a priority task to ensure the effective use of AI.
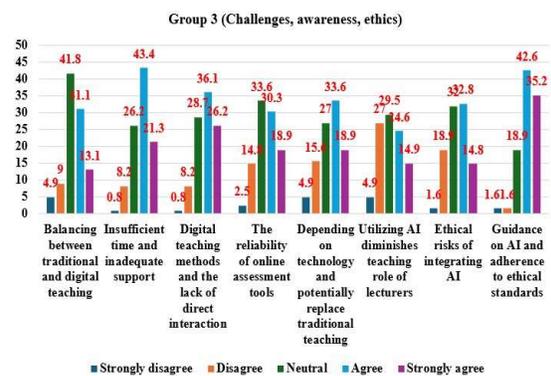

Figure 8. Frequency of Group 3

Group 4 is about the feedback from students/learners toward applying DT in education. Fig. 9 shows that students have a positive attitude and provide feedback indicating their interest in participating in online classes and the digital content of the

courses. DT creates a comfortable environment that encourages learners to adopt new teaching methods and provides them with more opportunities to acquire knowledge.
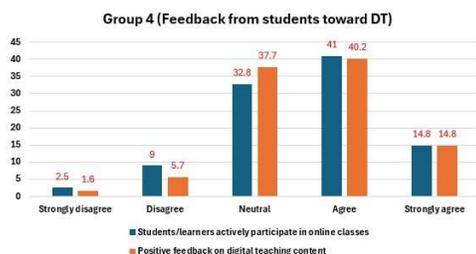

Figure 9. Frequency of Group 4

4.2. Findings 2

The authors used an independent samples T-test to examine the perceptions of female and male participants across six factors of Group 2. It revealed significant gender differences in four areas: using technology confidently ($p = 0.001$), problem-solving skills ($p = 0.031$), subjects aligned with DT goals ($p = 0.017$), and designing online learning activities ($p = 0.045$). It proved that males are more confident than females in using technology, problem-solving skills, designing online learning activities, and believe that subjects are suitable for DT goals. No significant differences were found for perceptions that DT enhances teaching quality ($p = 0.381$) or interest in exploring digital skills ($p = 0.117$). This may reflect the early stage of DT adoption at CTUMP, where digital technologies are acknowledged as applicable but have not yet shown quantifiable educational outcomes.

Furthermore, there are significant gender differences in Group 3. Male participants strongly believe that several considerable challenges affect DT; for instance, insufficient time and support ($p = 0.040$), digital teaching methods and lack of direct interaction in digital teaching ($p = 0.017$), AI diminishes the teaching role of lecturers ($p = 0.019$), and perceptions of ethical risks in AI integration ($p = 0.043$). No significant gender differences were observed in balancing traditional and digital teaching, the reliability of online assessments, dependence on technology, the potential for replacing traditional teaching, or the need for ethical guidance in AI.

Moreover, no significant differences were found between Groups 1 and 4.

4.3. Findings 3

In the sample of 122 individuals, the educational qualification groups are the Postgraduate group ($n = 99$), University group ($n = 21$), with minimal representation from the Secondary ($n = 1$) and College ($n = 1$) groups. The result from a one-way ANOVA shows that the overall mean scores for all measured variables ranged from 3.46 to 4.17 on a 5-point scale, indicating a generally positive perception of these groups and the factors of Group 1. It also revealed a statistically significant effect of the education levels on perceptions of *Digital skills training* with $F(3,118) = 3.034$, ($p = 0.032$). There were no statistically significant differences for the remaining variables. These findings suggest that education level significantly influences their perception of *Digital skills training*.

Another finding from the one-way ANOVA analysis for Groups 3 and 4 of educational qualifications showed that the overall mean scores for all measured variables ranged from 3.30 to 4.10 on a 5-point Likert scale, reflecting a generally high level of agreement with the factors in this group. A significant difference was observed only for the variable *Ethical risks of integrating AI*, $F(3,118) = 5.803$, ($p = 0.001$). This result suggests that perceptions of the *Ethical risks associated with AI integration* differ significantly across education levels. There are no statistically significant differences for the entire group of variables.

Based on years of experience, the largest group was "11 to 20 years" ($n = 47$), followed by "0 to 5 years" ($n = 27$), "6 to 10 years" ($n = 24$), and "Over 20 years" ($n = 24$). After applying the ANOVA test to this group with the factors of Group 1, it was found that a significant difference exists between the experience groups for "Document, tools, Internet" ($F(3,118) = 2.693$, $p = 0.049$). There are no significant differences among other variables in the groups. This result indicates that years of experience have a significant impact on the use of

Documents, tools, and the Internet. It suggests that individuals with more experience may perceive or use these resources differently than their less experienced counterparts.

4.4. Findings 4

Fig. 10 (a) displays potential solutions for enhancing the quality of digital training. Most participants, accounting for 60.7%, had no specific ideas. This was the largest response category. Among those who provided feedback, the most frequently suggested solutions were upgrading infrastructure and improving the system (18.9%), followed by staff training and workshops (12.3%), and developing digital infrastructure (7.3%). A small minority (0.8%) proposed *enhancing security and protection.*
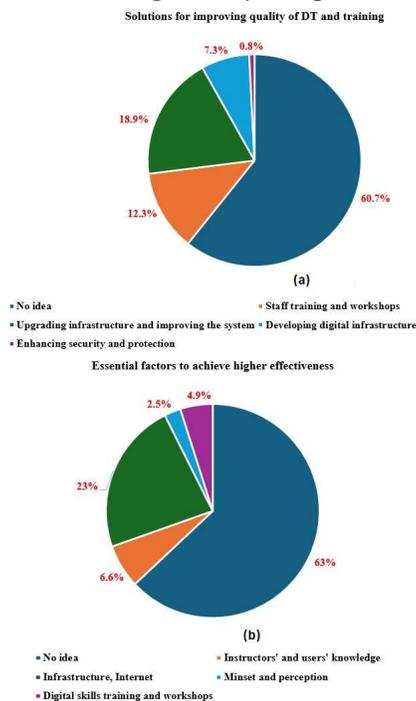

Figure 10 (a, b). Solutions and essential factors for improving the quality and effectiveness of DT and training

Fig. 10(b) illustrates the key factors that contribute to achieving higher effectiveness. As shown in Fig. 10(a), a majority of participants (63%) had no specific ideas. For those who did, the most critical factor was Infrastructure, Internet (23%). This was followed by Instructors' and users' knowledge (6.6%), Digital skills training and workshops (4.9%), and Mindset and perception (2.5%).

Regarding Fig. 10 (a) and 10(b), it can be seen that factors related to infrastructure and training were consistently identified as the most crucial elements for achieving better quality and higher effectiveness.

This research provides in-depth insights into DT adoption at CTUMP, highlighting lecturers/staff's competencies, challenges, and perceptions. The demographic profile indicates that mid-career groups with a well-educated and qualified workforce are ready to adopt DT because of their balance of experience and adaptability. Although the uneven distribution across faculties and experience levels may introduce potential bias, the dominance of the Faculty of Medicine could amplify perspectives more aligned with clinical education than basic sciences or administrative departments. Similarly, the underrepresentation of younger or early-career educators may limit the generalizability of findings. Nevertheless, this distribution provides valuable insight into the perceptions of those most engaged in medical teaching and digital adaptation. The findings declare that lecturers and staff at CTUMP generally recognize DT's potential to enhance teaching quality, efficiency, and learner engagement. However, as reflected in the diffusion of innovation theory, this positive attitude represents an early adoption stage, characterized by high expectations and intentions; however, institutional and pedagogical changes remain in progress. Gender and professional experience emerged as critical differentiators. For example, male respondents indicate higher confidence in using technology, problem-solving skills, and designing online activities, while female staff expressed greater caution regarding AI integration and workload. These differences, consistent with the Unified Theory of Acceptance and Use of Technology (UTAUT) model [16], underscore how "performance expectancy" and "effort expectancy" shape

DT acceptance. Years of experience and educational background also influenced ethical awareness, suggesting that digital competency development must consider generational and experiential diversity among educators. Additionally, over 60% of participants reported having no specific ideas for improving the quality of DT or essential factors to achieve higher effectiveness, which requires more explicit guidance and communication from the University to enhance DT readiness. The most common recommendations made by individuals were to improve training opportunities and upgrade infrastructure. Furthermore, the need for institutional regulations and guidelines is emphasized due to strong concerns about integrating AI to ensure the responsible use of this technology. Based on the findings mentioned above, several recommendations are proposed to enhance DT implementation at CTUMP; for instance, developing a strategic DT roadmap with clear objectives, priorities, and implementation steps, investing in infrastructure, training programs and capacity building based on various levels of experience and educational backgrounds, implementing gender-sensitive support mechanisms to address gender gaps, providing ethical guidelines for AI to solve ethical concerns, and promoting collaborative digital culture to exchange experiences and best practices.

5. CONCLUSIONS

This study provides empirical and theoretical insights into the implementation and challenges of DT in medical education at CTUMP. It highlights that while attitudes toward DT are positive, sustainable transformation depends on aligning technological integration with ethical responsibility and pedagogical innovation. By connecting empirical findings to frameworks such as diffusion of innovations and UTAUT, the research advances understanding of how institutional readiness, professional experience, and ethical awareness shape DT adoption.

Moreover, the results show that a consistent implementation approach is insufficient, even if the perceptions of DT's potential ability to improve teaching and learning were generally positive. In addition, gender, educational background and qualifications, and professional experience significantly influenced perceptions toward DT. It emphasizes the need for tailored strategies and targeted support. An unbalanced sample and little participant feedback on improvement strategies are among the limitations that highlight the lack of institutional guidance. Consequently, perceptions may not fully reflect the diversity of Vietnam's medical education sector. In future research, larger and more representative samples, along with qualitative methods, should be used to evaluate barriers and ethical concerns, particularly in the context of AI integration.

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CHUYỂN ĐỔI SỐ TRONG GIÁO DỤC Y KHOA: NGHIÊN CỨU TÌNH HUỐNG TẠI TRƯỜNG ĐẠI HỌC Y DƯỢC CẦN THƠ

TÓM TẮT

Chuyển đổi số (CĐS) đang định hình lại giáo dục y khoa toàn cầu thông qua việc ứng dụng các công nghệ tiên tiến: trí tuệ nhân tạo (AI), học máy, thực tế ảo... Tuy nhiên, tại các quốc gia đang phát triển, quá trình triển khai CĐS đối mặt với nhiều hạn chế: hạ tầng, nguồn lực và năng lực số của giảng viên/viên chức. Nghiên cứu nhằm xác định các yếu tố thúc đẩy và rào cản ảnh hưởng đến việc triển khai CĐS tại Trường Đại học Y Dược Cần Thơ, đồng thời phân tích tác động của các đặc điểm nhân khẩu học và nghề nghiệp đến nhận thức của giảng viên/viên chức. Dữ liệu thu thập từ 122 giảng viên/viên chức thuộc 8 khoa, phòng ban bằng khảo sát trực tuyến. Kết quả cho thấy giảng viên/viên chức có thái độ tích cực đối với CĐS trong nâng cao chất lượng và hiệu quả giảng dạy. Sự khác biệt đáng kể được ghi nhận theo các đặc điểm nhân khẩu học và nghề nghiệp. Nghiên cứu này làm tiền đề cho việc hoạch định và triển khai chiến lược CĐS tại trường.

Từ khóa: AI, chuyển đổi số, CĐS, giáo dục, trí tuệ nhân tạo, y khoa