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Migration Factors Impacting Instructors' Intention to Utilize Digital Tools for Teaching Sustainable Development

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Abstract

Higher education for sustainable development is an essential topic in the digital area. This study aims to identify the factors affecting the teachers' intentions to use digital tools to teach sustainable development and construct a structural equation model for encouraging instructors to use digital tools to teach sustainable development, a critical yet under-investigated domain. The research employs a quantitative method, gathering data from 644 valid questionnaires obtained through purposive sampling and an online survey. The findings enrich the application of the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB), demonstrating their capacity to elucidate the Intention to use digital tools in sustainable development education. The results reveal that Perceived Behavioral Control (PBC) and Subjective Norms of digitalization (SNod) positively influence the Intention to use digital tools, while the Perceived usefulness of digitalization (Puod) and Digital Attitude toward teaching sustainable development (DA) act as positive intermediary variables. The study also confirms the existence of a mediating effect in the model. These findings provide valuable implications for teachers and school administrators in implementing digital tools for sustainable development education. Future research is recommended to expand on these findings, further facilitating the integration of digital tools in teaching sustainable development.

Keywords: *Higher education for sustainable development; SDG4; structural equation model; teaching SDGs; digital for sustainable development; digital education development*

1. Introduction

Sustainable development has already become an essential world-class topic, and all industries are paying attention to sustainable development (Jiang & Pu, 2021). Higher education is essential in promoting sustainable development in the context of a knowledge economy and is crucial in sustainability. They are key drivers of future leadership education and will contribute to successfully implementing the United Nations SDGs (Pu et al., 2022). The current education industry widely uses digital technology, that is essential for developing and reforming education(W et al., 2023).

Adapting digital technology to the higher education system is an urgent task in the 21st century (Yuan et al., 2023). It is also a critical transformation method for higher education to be responsible for the sustainable development of the times (Ahel & Lingenau, 2020).

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Higher education in China has provided a large pool of talents for the sustainable development of the district(Holm et al., 2015). While improving citizens' quality has indeed improved the current status of local, sustainable development (Jiang & Pu, 2021).

Teaching is an essential part of higher education, in which teachers play a crucial role. The core of ESD emphasizes promoting sustainable development in teaching, including incorporating knowledge of sustainable development into teaching materials in preparing teaching plans before teaching (Lu & Zhang, 2014). The teaching activities in ESD have undoubtedly played a positive role and have achieved remarkable results in Higher Education in developed countries such as Europe and the United States (Elmassah et al., 2022). Education's role in promoting sustainable development is an indictable fact. Different fields are paying attention to higher education for sustainable development (Jiang & Pu, 2022).

China's higher education institutions have developed since they entered the 21 World, and they have more than 2,800 higher education institutions (Mei & Symaco, 2021). Based on the United Nations' sustainable development goal 2030, the Chinese Government has issued the National Program for implementing the Sustainable Development Agenda 2030 (Yichao Wang et al., 2020). China's First-class universities mainly guide China's sustainable development of higher education, while other parts are gradually joining the trend. However, most discussions focus on macro-concepts to illustrate the role of higher education in realizing sustainable goals and the achievements made (Han et al., 2023).

Almost little has been formed on China's sustainable development of higher education services. Therefore, the study attempts to study the promotion of higher education for sustainable development by digitization from a micro-perspective, with sustainable development teaching as the starting point. Teaching sustainable development (TSD) has found evidence and formed a theory in many empirical studies of primary and secondary school stages in Europe and the United States (Gomes et al., 2021). Research in higher education is more likely to focus on the TSD of a particular specialty. Higher education institutions' curricula and teaching practices require substantial changes to challenge dominant epistemology and discourse and to disrupt current ways of thinking and action about the environment (Toader et al., 2021).

Although there have been some breakthroughs in TSD in higher education, the current research mainly focuses on integrating sustainable development into teaching, changing the thinking mode, and achieving interdisciplinary cooperation (Bassachs et al., 2020). Of course, technology has been recognized in the development of higher education. Researchers also suggest that the TSD integration technology level in higher education should grasp the opportunities of digitization (Yuan et al., 2023).

However, studies have yet to discuss the impact of digitization on TSD in higher education. Higher education for sustainable development in the digital era has become an essential world-class issue (Wang & Zhou, 2023). TSD has made significant contributions to sustainable development processing. TSD also set off a wave worldwide and has provided many practical reference suggestions for higher education for sustainable development (Menon & Suresh, 2020). Hence, this study aims to identify the factors that enhance the behavior of teaching sustainable development in higher education institutions (HEI) course content in the digital context and to construct the structural equation model of adoption of TSD in HEI course content, furthermore to implicate the stakeholders, such as manager, lectures and the higher education department.

2. Literature review

2.1 Theoretical tools

Technology Acceptance Model (TAM) posts that the more an individual is committed to completing certain tasks or overcoming certain problems associated with particular technologies, the more likely he/she would adopt such technology (Yazici & Nakıboğlu, 2023). The TAM has two main factors. Perceived usefulness can be defined as the degree to which an individual expects to feel that embracing a specific technology can improve his or her work performance. The other is perceived ease of use, defined as the ease with which individual users expect to use the target system. The attitude of use refers to individual users' subjectively positive or negative feelings when using the system (Antonietti et al., 2022). Perceived usefulness is determined by external variables and perceived ease of use, and external variables determine perceived ease of use (Schoonenboom, 2014).

2.2 Hypothesis development and theoretical framework

Perceived behavior control always be a variable in predicting digital attitudes and behaviors (Lin & Roberts, 2020), such as the impact of perceived behavior control and usefulness on consumers' buying intention (Rehman et al., 2019).

Regarding digital technology, perceived behavior control is typical in predicting digital behavior as perceived usefulness (Peña-García et al., 2020). Perceived behavior control plays a prominent role in predicting the adaptation of electronic market use (Moussawi et al., 2021). Using digital financial systems also mediates the perceived behavior control, usefulness, and usage tendency (Moussawi et al., 2021). Hence, the study posits:

H1: Perceived behavior control positively affects the digital attitude toward sustainable development.

Perceived usefulness is essential in behavior research discussed in the technology acceptance model (Sukendro et al., 2020). The technology acceptance model believes that perceived usefulness affects behavioral intentions and specific behaviors. Perceived usefulness is often used in education to discuss how students predict technological behaviors (Al-Adwan et al., 2023). The adaptation of higher education teachers using the knowledge-sharing platform and their perception of the usefulness of the sharing platform positively impact their use of the platform for teaching (Sun et al., 2022). The perception of the platform's usefulness directly uses the sharing platform to affect their behavior through the digital adaptation (Prasetyo et al., 2021). Hence, this research proposes:

H2: Perceived Usefulness of digitalization positively affects digital attitude on sustainable development.

H3. The subjective norm of digitalization positively affects the digital attitude toward sustainable development.

H4: Digital attitude on sustainable development positively affects the Intention to TSD.

In the survey of public university students in Malaysia, the TPB supports subjective norms to influence lectures' awareness of sustainable digital adaptation (Al-Adwan et al., 2023). Therefore, we can recognize a hypothesis:

H5: Subjective norm of digitalization positively affects the Intention to TSD.

According to the TPB and TAM, an individual's intention to perform a behavior (in this context, the integration of digital tools into TSD) is influenced by their attitude towards that behavior. A positive attitude (influenced by the perceived ease of use) can lead to a stronger intention to incorporate digital tools into TSD (Wang et al., 2022).

In this case, the behavior is the actual use of digital tools in TSD. According to the TPB, the performance of a behavior is influenced by the intention to perform it. Therefore, a stronger intention to use digital tools, facilitated by the perception that these tools are easy to use, is likely to result in a higher degree of digital integration into TSD (Gani et al., 2022). Hence, this research assumes:

H6: Digital attitude on sustainable development mediates the relationship between the perceived behavior control and Intention to TSD.

H7: Digital attitude on sustainable development mediates the relationship between the perceived usefulness of digitalization and Intention to TSD.

A stronger intention to use digital tools, driven by subjective norms, will likely result in higher use of such tools in TSD.

H8: Digital attitude on sustainable development mediates the relationship between the subjective norm of digitalization and Intention to TSD.

H9. Perceived behavior control positively affects the perceived usefulness of digitalization.

H10. The perceived usefulness of digitalization mediates the relationship between the perceived behavior control and Intention to TSD.

3. Method

In this study, 644 valid questionnaires from Chinese universities were collected by purpose sampling. Purpose sampling was designed to determine the reliability of the sample, who were all lecturers in Chinese higher education. Table 1 reveals the description statistics of participants.49.5% (319 individuals) are male and 50.5% (325 individuals) are female, reflecting a roughly equal gender distribution among the participants. Participants are divided into four age groups. 32.8% (211 individuals) are under 30, 28.7% (185 individuals) are between 30-40, 23.6% (152 individuals) are between 40-50, and 14.9% (96 individuals) are over 50. Thus, the majority of the participants are under the age of 40. Participants are divided into four income groups. 28.1% (181 individuals) earn less than 100,000 RMB per year, 32.1% (207 individuals) earn between 100,000 to 200,000 RMB per year, 19.4% (125 individuals) earn between 200,000 to 300,000 RMB per year, and 20.3% (131 individuals) earn more than 300,000 RMB per year. Most participants earn between 100,000 to 200,000 RMB per year. The majority of the participants have a doctoral degree (48.4, 312 individuals). A smaller percentage have a master's degree (49.7%, 320 individuals) and only a few participants have a bachelor's degree (1.8%, 12 individuals). This table provides a basic demographic breakdown of the study's participants, which is useful for understanding the sample's diversity and generalizability. It's also crucial for interpreting the results of the study in the context of these demographic variables.

Table 1 Essential information

		Frequency	Percent
Gender	Male	319	49.5
	Female	325	50.5
	＜30	211	32.8
	30-40	185	28.7

Age	40-50	152	23.6
	>50	96	14.9
Family income/ year	＜100000￥	181	28.1
	100000￥-200000￥	207	32.1
	200000￥-300000￥	125	19.4
	>300000￥	131	20.3
Education level	Bachelor	12	1.8
	Master	320	49.7
	Doctor	312	48.4

The design of the questionnaire is comprised of six sections. The initial section seeks to gather foundational information. The succeeding section explores the perspectives on digital technology's role in sustainable development, The third section of the questionnaire delves into the subjective norms concerning digitalization, drawing upon the insights presented in the studies by the same authors. The fourth segment aims to evaluate the perceived utility of digitalization. The fifth part is designed to assess perceived behavioral control using the scale of digitalization. The final section strives to measure the intention to teach sustainable development. All the scales are refer to the methodologies developed in the studies by Sentosa and Mat (2012); Teo and Beng Lee (2010), Al-Mamary et al. (2023), and Teo et al. (2016). The questionnaire adopts a 5-point Likert scale for responses, with 1 representing 'Strongly Disagree' and 5 signifying 'Strongly Agree'. This choice of response format is based on the precedents set by the aforementioned studies.

4. Results

4.1 Reliability and validity statistics

Table 2 understand that Cronbach's alpha of 0.962 (>0.9), the internal consistency of the 38 items in the test is excellent. This suggests that the items in your survey are well correlated, and hence, they measure the same underlying construct effectively. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity are often used to check the appropriateness of applying a factor analysis to a dataset.

Table 2 Reliability Statistics

Cronbach's Alpha	N of Items
.962	38

Table 3 reflects KMO value is 0.979 (>0.9), which is considered marvelous. It indicates the survey have adequate sampling for factor analysis. Table 4.2 indicates the Bartlett's Test of Sphericity returns a p-value of .000 (<0.05), implying that there are some relationships between the variables that warrant a factor analysis (J. Yu et al., 2023). Taken together, both the KMO measure of sampling adequacy and Bartlett's Test of Sphericity indicate that the data is likely suitable for factor analysis.

Table 3 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.979
Bartlett's Test of Sphericity	Approx. Chi-Square	15297.515
	df	703
	Sig.	.000

4.2 Confirmatory factor analysis

Table 4 emphasis the results of a factor analysis that was used to verify the validity of different latent constructs associated with digitalization in the context of teaching sustainable development. These are intangible or unobservable constructs that are measured indirectly by various indicators. In this table, the latent variables are "Perceived usefulness of digitalization" (Puod), "Digital Attitude on teaching sustainable development" (DA), "Perceived Behavioral Control" (PBC), "Subjective Norms of digitalization" (SNod), and "Intention to use digital tools to teach sustainable development" (It). Observation indicators are the tangible, measurable items that are used to gauge the latent variables (J. Yu et al., 2023). Each latent variable is represented by several observation indicators, labeled Puod1, Puod2, etc. for Puod, DA1, DA2, etc. for DA, and so forth. In the table 4, all the latent variables have an AVE higher than 0.5, and all factor loadings are relatively high (close to 0.8 or above), which suggests that each set of observation indicators is a valid and reliable measure of its associated latent variable. The CR and AVE values are not repeated for each observation indicator of a given latent variable because these values are properties of the entire set of indicators for a latent variable, not individual indicators.

Table 4 Convergence Validity

Latent variables	Observation indicators	Factor loading	CR	AVE
Puod (Perceived usefulness of digitalization)	Puod1	0.799	0.908	0.622
	Puod2	0.773		
	Puod3	0.798		
	Puod4	0.787		
	Puod5	0.790		
	Puod6	0.785		
DA (Digital Attitude on teaching sustainable development)	DA1	0.755	0.928	0.618
	DA2	0.782		
	DA3	0.789		
	DA4	0.800		
	DA5	0.784		
	DA6	0.802		
	DA7	0.770		
	DA8	0.807		
PBC (Perceived Behavioral	PBC1	0.798	0.919	0.617
	PBC2	0.797		
	PBC3	0.770		

Control)	PBC4	0.783		
	PBC5	0.785		
	PBC6	0.793		
	PBC7	0.774		
SNod (Subjective Norms of digitalization)	SNod1	0.774	0.899	0.598
	SNod2	0.771		
	SNod3	0.775		
	SNod4	0.766		
	SNod5	0.760		
	SNod6	0.791		
It (Intention to use digital tools to teach sustainable development)	It1	0.822	0.916	0.608
	It2	0.744		
	It3	0.765		
	It4	0.777		
	It5	0.795		
	It6	0.785		
	It7	0.768		

From the table 5, it appears that all of the diagonal elements are larger than the off-diagonal elements, suggesting good discriminant validity.

Table 5. Distinguish between validity tests

Latent variables	1	2	3	4	5
Puod	0.789				
DA	0.736	0.786			
PBC	0.762	0.707	0.785		
SNod	0.750	0.723	0.724	0.773	
It	0.737	0.741	0.746	0.745	0.780

Note: The diagonal is the square root of the corresponding dimension AVE.

(Puod: Perceived usefulness of digitalization; DA: Digital Attitude on teaching sustainable development; PBC: Perceived Behavioral Control; SNod: Subjective Norms of digitalization; It: Intention to use digital tools to teach sustainable development)

For confirmatory factor analysis, combined reliability (CR) and mean variance extraction (AVE) were used as evaluation criteria for convergence validity. When the CR value of each factor is greater than 0.7 and the AVE value is greater than 0.50, the convergence validity is considered to be good (Mueller & Hancock, 2018). The passing

criterion for distinguishing validity is that the square root value of each factor AVE is greater than the correlation coefficient of the factor with other factors (Mueller & Hancock, 2018).

According to the aggregated validity, the AVE values extracted from the average variance of each variable in terms of convergence validity range from 0.598 to 0.622, all exceeding the standard of 0.5, and the combined reliability CR was more than 0.7 from 0.899 to 0.928, indicating that the convergence validity was reliable. It can be seen from the discrimination validity table that the absolute value of the correlation coefficient between any two factors is less than the square root of the corresponding factor AVE, which indicates that there is a certain degree of differentiation between the three factors in the study, so the discrimination validity is reliable.

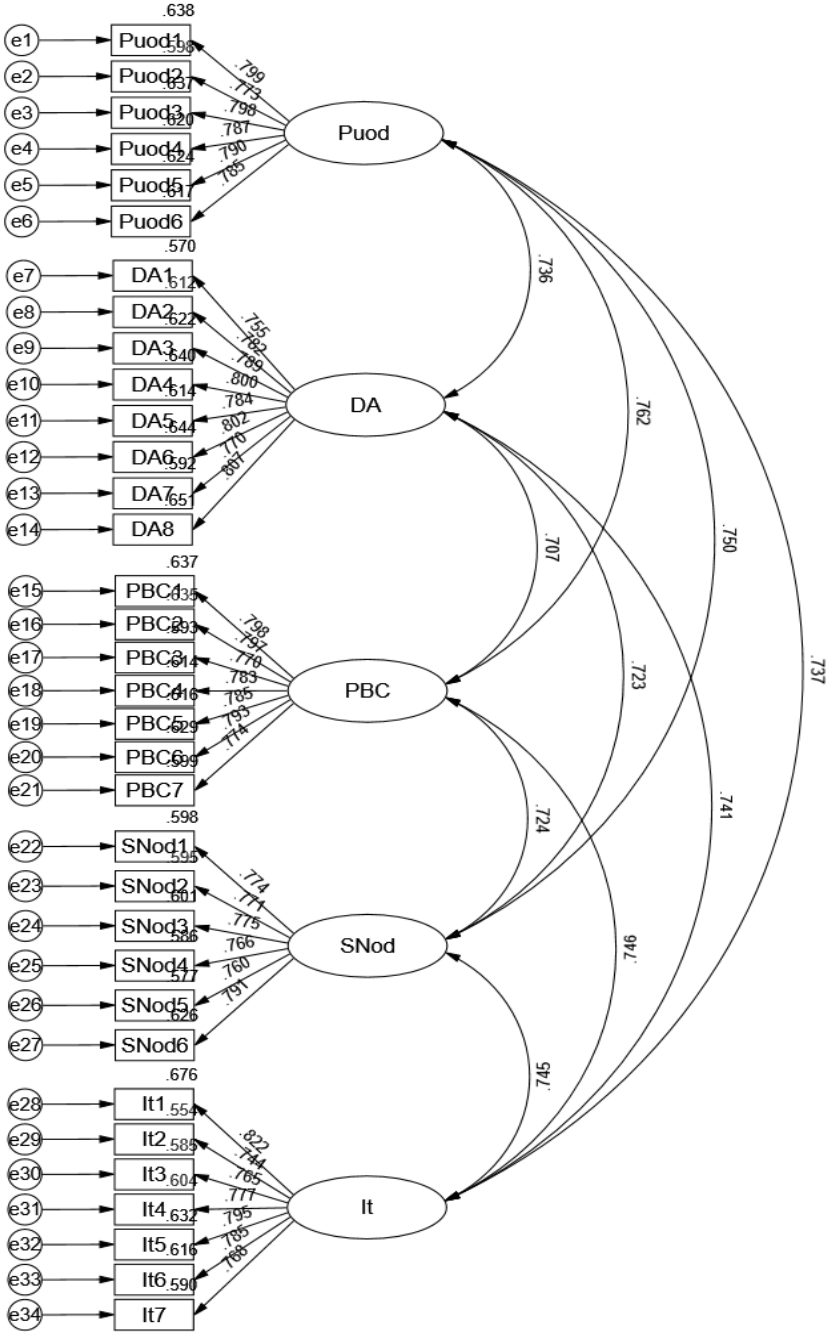

Figure 1. AMOS SPSS output of CFA for the structural equation model

(Puod: Perceived usefulness of digitalization; DA: Digital Attitude on teaching sustainable development; PBC: Perceived Behavioral Control; SNod: Subjective Norms of digitalization; It: Intention to use digital tools to teach sustainable development)

Table 6 and Table 7 emphasis that model fit metrics of the SEM illustrates that the ratio of chi-square degrees of freedom, RMSEA, GFI, GFI, NFI, TLI and CFI has reached the standard in confirmatory factor model fit metrics and SEM. From these results, we can conclude that the model has a good fit to the data across multiple fit indices, suggesting it is an appropriate representation of the structure of the data.

Table 6 Confirmatory factor model fit metrics

Fit index	χ2/df	RMSEA	GFI	AGFI	NFI	TLI	CFI
Reference standards	<3	<0.08	>0.9	>0.85	>0.9	>0.9	>0.9
Result	1.064	0.010	0.953	0.946	0.964	0.998	0.998

Table 7 Model fit metrics of the SEM

Fit index	χ2/df	RMSEA	GFI	AGFI	NFI	TLI	CFI
Reference standards	<3	<0.08	>0.9	>0.85	>0.9	>0.9	>0.9
Result	1.317	0.022	0.942	0.933	0.956	0.988	0.989

4.3 Structural equation model

Table 8 shows the results of hypothesis testing for the relationships between different constructs in a structural equation model (SEM) related to digitalization in teaching sustainable development. Table 8 concludes the results of the path analysis results:

The positive effect of Perceived Behavioral Control on Digital Attitude on teaching sustainable development was significant (β=0.237, p<0.001), H1 is supported.

The positive effect of Perceived usefulness of digitalization on Digital Attitude on teaching sustainable development was significant (β=0.351, p<0.001), H2 is supported.

The positive effect of Subjective Norms of digitalization on Digital Attitude on teaching sustainable development was significant (β=0.294, p<0.001), H3 is supported.

The positive effect of Digital Attitude on teaching sustainable development on Intention to use digital tools to teach sustainable development was significant (β=0.434, p<0.001), H4 is supported.

The positive effect of Subjective Norms of digitalization on Intention to use digital tools to teach sustainable development was significant (β=0.449, p<0.001), H5 is supported.

The positive effect of Perceived Behavioral Control on Perceived usefulness of digitalization was significant (β=0.786, p<0.001), H9 is supported.

Table 8. Structural equation model path test

Hypothesis	Path	Estimate	β	S.E.	C.R.	P
H1	PBC→DA	0.218	0.237	0.064	3.424	***
H2	Puod→DA	0.322	0.351	0.050	6.423	***
H3	SNod→DA	0.285	0.294	0.050	5.677	***
H4	DA→It	0.483	0.434	0.051	9.523	***
H5	SNod→It	0.485	0.449	0.050	9.773	***
H9	PBC→Puod	0.792	0.786	0.044	17.864	***

(Puod: Perceived usefulness of digitalization; DA: Digital Attitude on teaching sustainable development; PBC: Perceived Behavioral Control; SNod: Subjective Norms of digitalization; It: Intention to use digital tools to teach sustainable development)

Table 9 presents the results of a mediation analysis using bootstrapping, a resampling method used to estimate the sampling distribution of a statistic. The mediation analysis aims to test whether the effect of an independent variable on a dependent variable is mediated by one or more intervening variables.

Table 9 Mediation effect bootstrap test

Hypothesis	Mediation path	Effect size	SE	Bias-Corrected 95%CI	
H6	PBC→DA→It	0.105	0.053	0.015	0.220
H7	Puod→DA→It	0.155	0.047	0.075	0.259
H8	SNod→DA→It	0.137	0.042	0.062	0.229
H10	PBC→Puod→DA	0.255	0.066	0.123	0.378

The 95% upper and lower intervals of the "Perceived Behavioral Control→Digital Attitude on teaching sustainable development→Intention to use digital tools to teach sustainable development" mediation path were [0.015, 0.220], excluding 0, indicating that DA had a significant mediating role between PBC and It, with an effect value of 0.092. Hence, H6 is supported.

The 95% upper and lower intervals of the "Puod→DA→It" mediation path were [0.075, 0.259], excluding 0, indicating that Digital Attitude on teaching sustainable development had a significant mediating role between Perceived usefulness of digitalization and Intention to use digital tools to teach sustainable development, with an effect value of 0.113. Hence, H7 is supported.

The 95% upper and lower intervals of the "SNod→DA→It" mediation path were [0.062, 0.229], excluding 0, indicating that Digital Attitude on teaching sustainable development had a significant mediating role between Subjective Norms of digitalization and Intention to use digital tools to teach sustainable development, with an effect value of 0.113. Hence, H8 is supported.

The 95% upper and lower intervals of the "PBC→Puod→DA" mediation path were [0.123, 0.378], excluding 0, indicating that Perceived usefulness of digitalization had a significant mediating role between Perceived Behavioral Control and Digital Attitude on teaching sustainable development, with an effect value of 0.113. Hence, H10 is supported.

(Puod: Perceived usefulness of digitalization; DA: Digital Attitude on teaching sustainable development; PBC: Perceived Behavioral Control; SNod: Subjective Norms of digitalization; It: Intention to use digital tools to teach sustainable development)

All in all, figure 3 constructs the SEM for encouraging the lecturers to using digitalization to teach sustainable development.

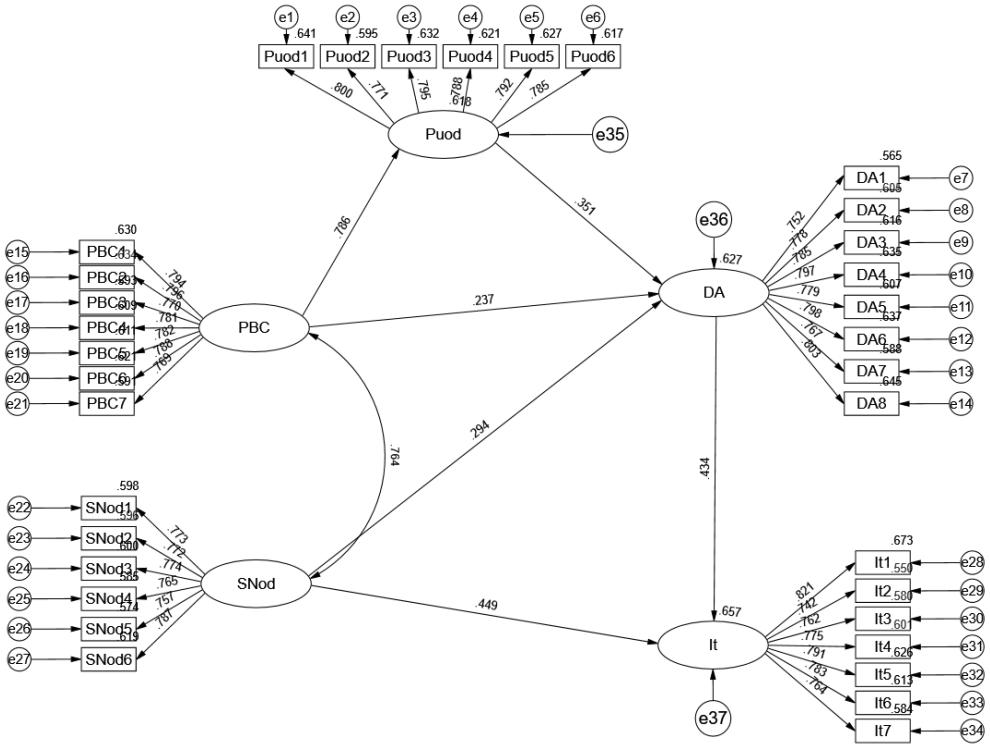

Figure 2. AMOS SPSS output of Path Diagram for the structural model (with hypotheses)

(Puod: Perceived usefulness of digitalization; DA: Digital Attitude on teaching sustainable development; PBC: Perceived Behavioral Control; SNod: Subjective Norms of digitalization; It: Intention to use digital tools to teach sustainable development)

5. Discussion

5.1 Implications to theory

The study constructed a structural equation model using a quantitative method based on the online questionnaire to encourage lecturers in Chinese universities to teach the Intention of sustainable development using digital tools. Integrating variables from the technical acceptance model and the theory of planning behavior revealed Puod (Perceived usefulness of digitalization); DA (Digital Attitude on teaching sustainable development); PBC(Perceived Behavioral Control); SNod (Subjective Norms of digitalization) how to predict the Intention to use digital tools to teach sustainable development。

TAM and TPB fusion to explain behavior is no longer a fresh topic (Al-Mamary et al., 2023; Teo et al., 2016). However, two classical theories are rarely explained the Intention to use digital tools to teach sustainable development, which enriches and strengthens the explanatory ability of the two theories. PBC (Perceived Behavioral Control) and SNod (Subjective Norms of digitalization) as independent variables, Puod (Perceived usefulness of digitalization), and DA (Digital Attitude on teaching sustainable development). Both mediating variables positively affected the Intention to use digital tools to teach sustainable development. Furthermore, the existence of the mediation effect was verified in the model.

In the study of sustainable development, TAM and TPB are often discussed based on consumer behavior (Choe et al., 2021), green consumption (Tang et al., 2023), and environmental protection behavior, mainly in the market, management, and economy fields (Li et al., 2023). This paper develops a fusion model of TAM and TPB from an educational teaching perspective, SEM for Intention to use digital tools to teach sustainable development. In addition, TAM and TPB's interpretations of teachers' behavior focus more on their research on the use of digital tools or teaching behavior (Antonietti et al., 2022; Yanrong Wang et al., 2020). The results of this paper promote the teacher behavior toward the sustainable teaching level. therefore, in terms of research areas and topics, the research is more prospective and more focused on the sustainable issues expected to be addressed, to further promote the sustainable development of higher education for or.

5.2 Implications to practices

The findings of this research offer significant implications for teachers and school administrators seeking to integrate digital tools into sustainable teaching development. These insights provide practical guidance on effectively stimulating intention and use of such digital tools in teaching, promoting sustainable development education.

Hence, relying on the results, teachers need to believe in their capability to use digital tools effectively for teaching sustainable development. Hence, continuous professional development workshops, training, and support systems should be provided to boost their perceived control over these tools. Therefore, to enhance their confidence and intention to use these tools in their teaching practices. Moreover, encouraging positive attitudes toward digitalization in teaching sustainable development is crucial. Teachers should be encouraged to understand the benefits and possibilities that these digital tools can bring to their teaching, including making complex sustainable development concepts more understandable, promoting student engagement, and allowing for innovative teaching methods.

School Administrators have a role in creating an environment where digital tools for teaching sustainable development are the norm, not the exception. Hence, it can be achieved by encouraging and rewarding innovative uses of technology in the classroom, providing access to necessary resources, and creating a culture of digitalization. It is important to communicate the usefulness and effectiveness of digital tools in teaching sustainable development to teachers. Demonstrating the direct benefits, such as improved student engagement, a better understanding of sustainable development concepts, and convenience in lesson delivery, can heighten the perceived usefulness, thus motivating teachers to adopt these tools.

Additionally, administrators should note the mediating effects of Puod and DA. The effort should not only be directed towards developing an environment conducive to digitalization (SNod) and enhancing teacher's control over digital tools (PBC) but also in bridging the gap by improving their understanding of the benefits (Puod) and cultivating a positive attitude (DA) towards the use of digital tools in teaching sustainable development.

Overall, the results of this study provide a roadmap to significantly boost the integration of digital tools in teaching sustainable development. By applying these insights, teachers and school administrators can proactively prepare students for a more sustainable future.

5.3 limitations and future study

The study only discussed the use of digitalization for sustainable development teaching at the teacher level in China. Although purpose sampling was used, the 644 samples may only partially reflect the development of some regions in China. In addition, the research and discussion of the factors affecting the sustainable development of digital teaching are

mainly based on two classical theories, and they should be discussed from other perspectives, such as social recognition, social identification, value, and expectation. Therefore, future studies could further partition China to compare the results between different regions and identify more factors that drive the use of digitalization to drive sustainable education. Of course, on the other hand, it is necessary to borrow more theories and research methods to promote the research of teachers' sustainable teaching behavior and intention.

6. Conclusion

In conclusion, this study explored the factors influencing teachers' intentions to use digital tools to teach sustainable development, a significant yet underexplored area of interest. Using quantitative research methods and retrieving 644 valid questionnaires, the study robustly integrated the Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) to explain this behavior, enriching and strengthening the explanatory power of these classical theories.

The findings of this research highlighted Perceived Behavioral Control (PBC) and Subjective Norms of digitalization (SNod) as significant independent variables. Meanwhile, the Perceived Usefulness of digitalization (Puod) and Digital Attitude on teaching sustainable development (DA) were identified as intermediary variables, all contributing positively to the intention to use digital tools for teaching sustainable development. Importantly, a mediating effect was verified, pointing to a more nuanced understanding of these relationships.

For teachers and school administrators, these results translate into tangible implications. They suggest that enhancing teachers' perceived control over digital tools and their positive attitude towards digital teaching of sustainable development, along with creating a digital-friendly norm and highlighting the usefulness of digital tools, can significantly encourage their use in teaching sustainable development. These efforts can elevate the quality of sustainable development education, ensuring that students are better prepared for the future.

This study represents an important step toward understanding the dynamics of digital tool adoption in teaching sustainable development. As the digital transformation of education continues, further research in this field is essential. The valuable insights provided by this research have shed light on a significant aspect of this transformation. They can guide future studies in this area, facilitating the sustainable development of education in the digital age.

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