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Navigating the need for mobile apps in higher education: The Mediating role of digital transformation

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Abstract: In today's fast-paced and interconnected digital era, universities must provide digital academic support services to facilitate effective learning for students. Universitas Indonesia (UI), as part of higher education, has implemented comprehensive academic digitalization, but most of these are web-based. Since mobile apps are growing, the need for such applications has become necessary. This study aims to analyze the digital transformation process of campus support services at UI and assess the need for mobile apps, which are limited to three applications at UI: SIAK-NG, EMAS, and SIGMA. Data collection was obtained through direct surveys distributed to 589 UI Vocational students. Data analysis was conducted quantitatively using Structural Equation Modeling-Partial Least Squares (SEM-PLS). The findings indicate that digital transformation significantly moderates the relationship between user experience and students' need for mobile apps. The model demonstrates a good fit. It is confirmed that user experience has a significant and positive impact on digital transformation, and digital transformation significantly and positively influences students' need for mobile apps. The need for mobile apps in higher education continues to grow alongside advancements in technology and increasing student expectations for faster, more accessible services.

Keywords: *Campus services, Device ownership, Digital transformation, Mobile apps needed, User experience.*

1. Introduction

Digital transformation refers to the organizational effort to adopt and utilize digital technologies such as Cloud Computing, Internet of Things (IoT), Blockchain (BC), Artificial Intelligence (AI), and Machine Learning (ML) [1]. Digital transformation is "a process aimed at enhancing an entity by inducing significant changes in its properties through a combination of information technology, computing, communication, and connectivity" [2]. This framework views digital transformation as the mechanism by which organizations respond to changes in their environments using digital technologies.

One of the key factors supporting the success of digital transformation is the public's access to digital devices, such as laptops, tablets, or smartphones. Devices with high specifications, such as fast processors, large RAM capacity, ample storage, 4G/5G network support, and high-quality display, enable users to access various applications and digital platforms more quickly, smoothly, and comfortably. In contrast, individuals with low-specification devices often face technical issues such as sluggish performance, incompatibility with newer apps, or limited network access, all of which ultimately hinder their participation in the digital transformation process.

Device ownership in this era is less about outright possession and more about seamless access, flexible usage, and the services that devices enable. This shift brings both opportunities for innovation and challenges related to privacy, security, and sustainability. Internet accessibility refers to the ability of all individuals, regardless of their physical or cognitive abilities or socio-economic circumstances, to

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access and use the internet effectively. The internet brings a lot of personalized experiences and flexibility than has been experienced before. The internet, which is the hub of almost all online technologies, is very important [3].

In an educational system of a university, campus services play a vital role in ensuring that students can access campus services easily. As the main stakeholders in the university, students need unlimited access to campus services. Therefore, generally, campus services can be accessed via the official campus website. The more complete the campus services, the easier and more seamless their students' business, which in turn can support them in finishing their education. To accommodate and facilitate their students' needs, the campus needs to understand their students' needs and behavior: culture, norms, students' willingness to gain and access information, as well as the facilities provided by the campus for them to fulfill their needs [4].

Traditional education is based on a relatively small premise - that the surrounding world does not change much after the formative years and that people are not actually mobile. Consequently, today's education traditions and systems were developed mainly at a time before the expansion of accelerated learning methods. On average, the intensity of innovation is higher in higher education, where there is the highest level of funding for private sector education, with approximately equivalent primary and secondary education in terms of their level of innovation.

User Experience (UX) is a crucial factor influencing the effectiveness and adoption of campus e-learning applications. Good UX design ensures students can access learning materials intuitively, interact with content seamlessly, and engage actively with digital learning environments. Accessibility and responsive design are essential to support diverse devices and user contexts, especially as students increasingly use smartphones for learning [5]. A study by Al-Sharhan et al. [6] highlighted that usability, aesthetics, and perceived usefulness directly affect students' intention to continue using e-learning platforms.

Currently, mobile applications (mobile apps) are a growing trend. Mobile apps are software designed for installation on mobile devices, typically featuring smaller sizes and fewer functionalities compared to applications designed for computers and laptops [7]. Mobile apps are now widely used for various tasks, including social media, e-book reading, gaming, music streaming, video watching, and other meaningful aspects of daily life. The expansion of mobile apps has propelled industry adoption and innovation, making the mobile app business one of the most rapidly growing sectors with substantial financial turnover [8]. A study by Sensor [9] 258,000 apps are downloaded per minute in 2024. It indicates a strong demand for premium services and paid app content.

From a user perspective, mobile apps offer instant connectivity, enabling quick and seamless internet access or communication with other devices. For mobile app providers, highlight that instant connectivity benefits companies in creating mobile commerce applications, allowing direct interaction and customer shopping behavior observation [10]. There are two primary advantages of using mobile apps: monitoring and data measurement [11]. Similarly, during the pandemic, mobile apps played a crucial role in identifying infected individuals, facilitating control measures, aiding decision-making processes, and predicting pandemic spread patterns [12]. Studies show that mobile app usage in higher education not only enhances accessibility but also strengthens student-faculty interactions, fostering technology-driven adaptive learning environments [13].

Universitas Indonesia (UI) has implemented a comprehensive academic digitalization process as part of its digital transformation strategy in the higher education sector. This process covers the entire academic lifecycle of students, from registration, completion of the Study Plan Form (IRS), online learning, learning evaluations, to graduation administration. Digital systems and online learning platforms are utilized to enhance service efficiency, accelerate administrative processes, and improve academic transparency and accountability.

The three widely used digital system platforms in UI are SIAK-NG (Sistem Informasi Akademik - Next Generation) in terms of academic administration, EMAS (E-learning Management System) UI for online learning services, and SIGMA (Sistem Informasi Kegiatan Mahasiswa) for extracurricular and

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student activities services. Currently, each of these three systems can be accessed via a website using Single Sign-On (SSO) authentication with the student's ID and password. Recently, the three systems are still functioning well. However, along with the increasing development of mobile apps, the need for mobile-based applications for education services has become necessary.

This study focuses on the digital transformation of mobile education services within UI, which ranks 189th globally in the QS World University Rankings 2025. The study aims to analyze the relationship between user experience and digital transformation concerning students' needs for mobile apps. Additionally, it examines the impact of device ownership and campus services on student user experience. This study is limited to analyzing the needs of mobile apps in three applications at UI, namely SIAK-NG, EMAS, and SIGMA. Data was obtained from survey results conducted from April to August 2024, with respondents being UI Vocational Program students.

This study presents a novel exploration of how digital transformation acts as a mediating factor in the integration and necessity of mobile applications within higher education. While previous research has examined the adoption of educational technologies and mobile learning tools, few have specifically analyzed the intermediary role of institutional digital transformation in shaping both the demand and effectiveness of mobile app implementation, Natalia [13] and Lu et al. [14]. By bridging technology adoption frameworks with transformation management theories, this research offers a unique interdisciplinary approach to understanding how universities can strategically align mobile app development with broader digital goals. Furthermore, this study contributes original insights by empirically validating the mediating effect of digital transformation on the relationship between user needs (students, faculty) and mobile app integration, thereby filling a critical gap in the literature on educational innovation, infrastructure readiness, and digital equity in higher education.

2. Materials and Methods

2.1. Research Design

As discussed in the introduction, this study is limited to examining the needs of mobile apps for three applications at UI, namely SIAK-NG, EMAS, and SIGMA. The three applications are currently accessed via the website using Single Sign-On (SSO) authentication with the student's ID and password. This indicates that the digital transformation process has been carried out at UI. There are several reasons why enterprises may undergo digital transformation, but so far, the main reasons are related to issues of competitive advantage and survival. The need to study the three applications as mobile apps, considering user experience, is essential. Digital transformation is a process involving student user experiences while using the three applications and the needs of mobile apps. Therefore, the design research conducted can be seen in Figure 1 below.

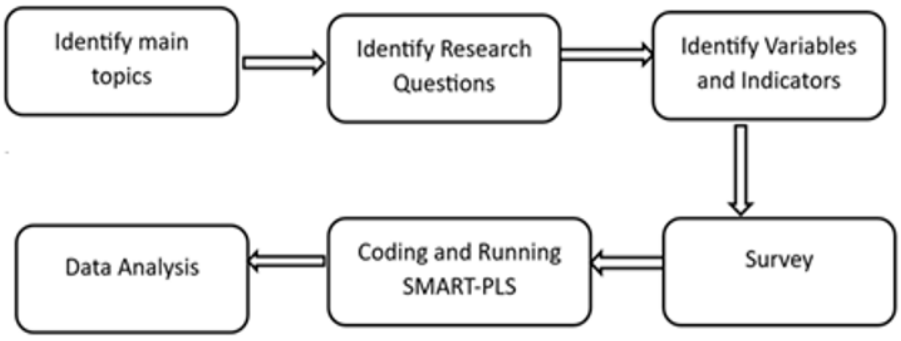

Figure 1.
Research Design.

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2.2. Data Collection

The UI Vocational Program is one of the faculties at UI that offers higher education at the diploma and applied bachelor levels (D3 and D4), with a focus on the application of applied skills in various fields. This program aims to produce graduates who are ready to work and possess the practical skills needed by the industry. The respondents of this study were UI Vocational Program students from 15 study programs.

Data collection was carried out using purposive random sampling, where each study program was represented. The survey was conducted by distributing questionnaires via G-Forms from April to August 2024. The questionnaire was designed using a Likert scale to measure respondents' perceptions of device ownership, campus services, user experience, digital transformation, and needs. Each item on the scale ranged from 1 (strongly disagree) to 5 (strongly agree). The number of respondents collected was 589. Considering that the total number of UI Vocational students is around 3,000, the number of respondents is quite representative of the population, which is approximately 20% of the total population.

Data analysis was conducted quantitatively, divided into two, namely descriptive analysis and inference analysis using Structural Equation Modeling-Partial Least Squares (SEM-PLS). The software used is SMARTPLS 4.

2.3. Variables Operational and Research Paradigms

This study employs a quantitative approach to explore the need for mobile apps in campus support services. The survey method is used to address research questions regarding the influence of device ownership, digital transformation, campus services, and user experience on the need for mobile apps. There are five variables along with their respective indicators: Device Ownership, Campus Services, User Experience, Digital Transformation, and Needs, which are detailed in Table 1.

Like Dollah et al. [15], who studied the need for mobile apps at a bank, this study began by examining how respondents owned devices, including whether they had smartphones, laptops, or tablets. Additionally, Dollah et al. [15] also investigated user experience in using existing applications, focusing on aspects such as user interface, content navigation, and dashboards. Furthermore, the campus service variable refers to [4], who studied campus services in higher education, where the learning experience of students and campus administrators is the main indicator [16], making the ease-of-use indicator the focus of the campus service approach taken. The Needs variable itself refers to Sun et al. [17], who created 2 indicators, namely Utilitarian Needs Satisfaction and Security Needs Satisfaction. The list of variables and indicators is presented in Table 1.

Table 1.
List of Variables and Indicators.

No	Variables	Indicators
1.	Device Ownership	Device ownership
2.	Digital Transformations	Digitalization of educational services
3.	Campus Services	Academic and Student Learning
		Ease of use
4.	User Experience	Interface Preference
5.	Needs	Utilitarian Needs Satisfaction
		Security Needs Satisfaction

The path relationships between variables addressing the hypotheses are illustrated in Figure 2. This figure depicts the conceptual framework outlining the interconnections between key variables in this study. Specifically, it shows how Device Ownership and Campus Services influence User Experience, which in turn impacts Digital Transformation, ultimately shaping students' needs for mobile apps on the three platforms mentioned above.

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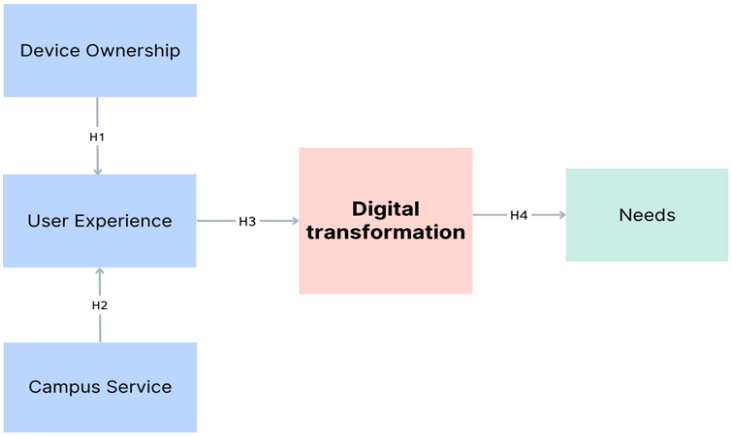

Figure 2.
Research Conceptual Framework.

Therefore, we propose the following hypotheses:
Hypothesis 1 (H1): The effect of device ownership on user experience
Hypothesis 2 (H2): The effect of campus services on user experience
Hypothesis 3 (H3): The effect of user experience on digital transformation
Hypothesis 4 (H4): The effect of digital transformation on needs

3. Results

3.1. Respondent Profile

Most respondents in this study are male (70.1%), while female respondents account for 29.9%. Based on age groups, most participants are 19 years old (41.3%), followed by those aged 20 years (27.2%) and 18 years (15.8%). Respondents under 17 years old and over 22 years old are significantly fewer, at 2.7% and 1.3%, respectively. Regarding educational levels, 61% of respondents are enrolled in a Diploma 4 (D4) program, while 39% are in a Diploma 3 (D3) program. In terms of residence, most respondents live with their parents (69.6%), while 24.3% reside in rented accommodations. A smaller portion live in dormitories (1.3%), with extended family members (3.4%), or other arrangements (1.1%). The dominant respondent profile consists of male students aged 19–20 years, enrolled in a D4 program, and living with their parents, as summarized in Table 2.

Table 2.
Characteristics of Respondents.

Characteristics	Description	Percentage
Gender	Male	70.1%
	Female	29.9%
Age	<17 years old	2.7%
	18 years old	15.8%
	19 years old	41.3%
	20 years old	27.2%
	21 years old	11.7%
	>22 years old	1.3%
Education	Diploma 3 (D3)	39%
	Diploma 4 (D4)	61%
Residence	Living with parents	69.6%
	Renting	24.3%
	Dormitory	1.3%
	Living with extended family	3.4%
	Others	1.1%

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3.2. Reliability and Validity Construct

Before testing the proposed hypotheses, it is essential to conduct validity and reliability assessments. The measures for validity and reliability include Average Variance Extracted (AVE), Composite Reliability (CR), Cronbach's Alpha, and Communality, as presented in Table 3.

Table 3.
Validity and Reliability Test.

Variable Construct	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extracted (AVE)
Campus Service	0.857	0.871	0.898	0.639
Device Ownership	0.651	0.667	0.850	0.739
Digital Transformation	0.876	0.880	0.910	0.670
Needs	0.968	0.973	0.973	0.819
User Experience	0.819	0.820	0.893	0.735

Based on the displayed output, all constructs in the model demonstrate strong reliability and convergent validity. The constructs Campus Services, Digital Transformation, Needs, and User Experience have Cronbach's Alpha values above 0.8 and CR values above 0.8, indicating high internal reliability. Additionally, the AVE for these four constructs exceeds 0.63, satisfying the minimum threshold of 0.5 for convergent validity. The Needs construct exhibits particularly high reliability and validity, with Cronbach's Alpha of 0.968, CR of 0.973, and AVE of 0.818.

However, the Device Ownership construct shows slightly lower reliability, with Cronbach's Alpha (0.651) and rho_A (0.667), which fall slightly below the ideal threshold of 0.7. Despite this, the constructs remain acceptable as their CR reaches 0.850 and AVE 0.739, indicating adequate internal consistency and convergent validity. Overall, the five constructs in the model demonstrate strong reliability and convergent validity, making them suitable for further analysis.

Discriminant validity was assessed by comparing the square root of AVE for each construct with its correlation values with other constructs, using the Fornell-Larcker criterion. According to Table 4, which applies the Fornell-Larcker criterion, discriminant validity among constructs is confirmed. The square root of AVE for each construct (displayed on the diagonal of the table) is greater than its correlation values with other constructs (off-diagonal values).

Table 4.
Fornell-Larcker Criterion.

	Campus Service	Device Ownership	Digital Transformation	Needs	User Experience
Campus Service	0.799				
Device Ownership	0.389	0.860			
Digital Transformation	0.558	0.357	0.819		
Needs	0.241	0.130	0.363	0.905	
User Experience	0.687	0.319	0.440	0.225	0.857

The square root of AVE for the Campus Services construct is 0.799, which is higher than its correlation values with Device Ownership (0.389), Digital Transformation (0.558), Needs (0.241), and User Experience (0.687). A similar pattern is observed in other constructs. The square root of AVE for Device Ownership is 0.860, exceeding its correlations with Digital Transformation (0.357), Needs (0.130), and User Experience (0.319). Meanwhile, the square root of AVE for Digital Transformation is 0.819, also higher than its correlations with Needs (0.130) and User Experience (0.319). These results confirm that each construct remains conceptually distinct, thereby validating the discriminant validity of this model.

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3.3. Structural Model and Hypothesis Test Results

The structural modeling was employed in the analysis after ensuring that each construct demonstrated adequate reliability and validity. Based on the analysis results, the following Table 5 is a summary of the hypothesis testing outcomes.

Table 5.
Hypothesis Test Results.

Hypothesis	Original Sample (O)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
H1: Device Ownership → User Experience	0.061	0.033	1.841	0.066
H2: Campus Service → User Experience	0.663	0.029	22.978	0.000
H3: User Experience → Digital Transformation	0.440	0.045	9.735	0.000
H4: Digital Transformation → Needs	0.363	0.039	9.296	0.000

Three relationships in the model are statistically significant ($p < 0.05$): Campus Services → User Experience, Digital Transformation → Needs, and User Experience → Digital Transformation. However, one relationship is not significant, namely Device Ownership → User Experience, indicating that device ownership does not necessarily guarantee an improved user experience. The relationship between Campus Services and User Experience is strongly significant, with a coefficient of 0.663, and the t-value is well above the critical threshold of 1.96 (for 5% significance), while the p-value is < 0.001. This suggests that better campus services lead to a more positive user experience.

The goodness-of-fit evaluation was conducted to assess the extent to which the structural model aligns with the observed data, as presented in Table 6.

Table 6.
Goodness-of-Fit.

Criterion	Estimated Model
SRMR	0.079
d_ULS	2.253
d_G	0.460
Chi-Square	1532.607
NFI	0.90

Based on the goodness-of-fit model assessment, the obtained indicators suggest that the structural model aligns well with the observed data. The Standardized Root Mean Square Residual (SRMR) value of 0.079 is below the threshold of 0.08, indicating minimal residual differences between the observed covariance matrix and the model-predicted matrix. The Unweighted Least Squares Discrepancy (d_ULS) of 2.253 and Geodesic Discrepancy (d_G) of 0.460 reflect acceptable levels of model discrepancy, demonstrating that model estimation is sufficiently accurate. The Chi-Square value of 1532.607 indicates an absolute model misfit; however, because this statistic is sensitive to large sample sizes, its interpretation should be complemented by other fit indices. The Normed Fit Index (NFI) of 0.90 suggests a strong model fit, surpassing the commonly cited threshold of 0.90. Therefore, the structural model in this study is overall acceptable and suitable for further analysis. The evaluation results indicate that the developed structural model exhibits a sufficiently high degree of fit, enabling reliable interpretation of relationships among constructs in this research.

4. Discussion

The SEM-PLS analysis provided critical insights into the reliability and validity of the constructs and the structural relationships between them. The constructs of Campus Services, Device Ownership, User Experience Digital Transformation, and Needs demonstrated good reliability and validity, as indicated by Cronbach's alpha, CR, and AVE values. Employing SEM-PLS enabled this study to effectively model the complex relationships between various factors influencing the need for mobile apps in UI, which are SIAK-NG, EMAS, and SIGMA. The relationships between all variables are illustrated in Figure 3.

The relationship between device ownership and user experience is not statistically significant at the 5% level ($p = 0.09 > 0.05$), although it is close to the threshold. This implies that device ownership does not convincingly influence user experience within this model.

UI vocational students who are included in Generation Z, where gadget ownership is commonplace, find it natural that their experience of using gadgets and/or applications is considered common. This is in line with Gulatee and Combes [18], where 75% of those who participated in the research use their mobile phones every day; thus, the experience of using gadgets is considered normal. Device ownership is also not significant to technology proficiency, which is part of the user experience [19].

The strong relationship between campus services and user experience demonstrates how the campus industry is centered on its consumers, namely, students. Figure 3 shows that campus services contribute 66.3% to user experience. The campus industry must develop a strategy to create new value through digital transformation, where services are not solely industry-centered but are distributed to each consumer who possesses independent technology, such as smartphones and internet access [20]

User Experience exerts a significant and moderately strong influence on perceptions of Digital Transformation, demonstrating that a positive user experience enhances acceptance and perception of digital transformation. The relationship between user experience and digital transformation, which is around 44%, shows that user experience has a considerable influence on the digital transformation process. This can happen because user experience is one of the pillars of digital transformation [21]. Meanwhile, Digital Transformation, which is a mediating variable, has a significant impact on Needs (36.3%). The t-value and p-value confirm that this relationship is highly significant. Therefore, user experience also influences the need for mobile apps, in this case, the three applications above.

User experience aspects critical to a mobile app's nature and goal vary [22]. Some users feel comfortable with efficiency and understandability, and others choose enjoyment and exciting elements. Similarly, in assessing the need for mobile apps at UI as part of the digital transformation process, numerous studies have examined the benefits of using mobile apps in higher education. For instance, both students and academics reported that institutional support and flexibility would likely provide motivation and lead to increased app use for both research and teaching [23]. Mobile learning has empowered interaction in content creation, communication, and collaboration between learners and instructors, significantly impacting learning effectiveness [24]. Mobile apps enable educational institutions to collect and analyze user data, improving service quality and student learning experiences Naveed et al. [25]. The main advantages of using mobile apps in the educational process are increasing the level of knowledge and skills of higher education students [26]. Considering the increasing development of mobile apps today, the need to change the SIAK-NG, EMAS, and SIGMA applications from web-based to mobile apps is worth considering.

Further study of this research can be conducted by adding the Human-Computer Interaction (HCI) variable. HCI is fundamental in understanding data management via intelligent devices, connected smart objects, and computer-networked technologies. HCI significantly influences interactions between virtual and physical components in networked systems, bridging them with users and learners.

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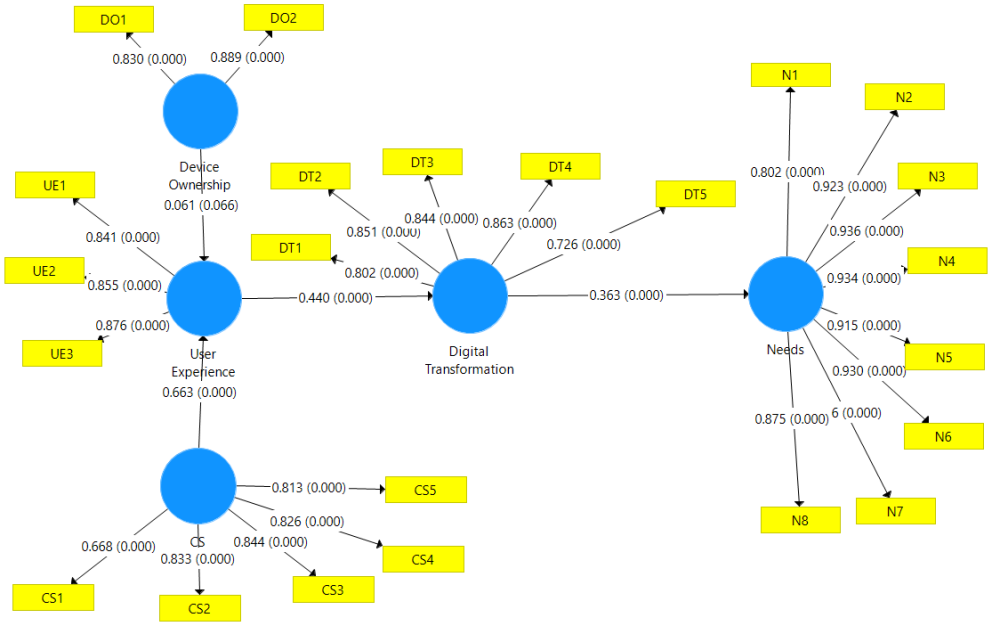

Figure 3.
Structural Model of the Study.

5. Conclusions

Digital services create opportunities for students to access education more efficiently while reducing human contact dependency. Based on the analysis results, digital transformation acts as a moderating variable between user experience and student needs. Mobile app-based digital services have become essential for students in accessing educational services. Our findings indicate that user experience has a significant and positive impact on digital transformation, and digital transformation significantly and positively influences students' need for mobile apps.

The demand for mobile apps serves as a key driver of digital transformation in higher education, including SIAK-NG, EMAS, and SIGMA in UI. Digital transformation has fundamentally changed how students access academic and administrative services. One of its core aspects is the adoption of mobile apps, enabling students to retrieve academic information, communicate with faculty, and manage their schedules more efficiently. Mobile apps offer greater flexibility, allowing students to learn anytime and anywhere without relying on paper-based systems or desktop computers.

Thus, digital transformation through mobile apps is not just a necessity but a strategic imperative for improving higher education quality in the digital era. The need for mobile apps in higher education continues to grow alongside advancements in technology and increasing student expectations for faster, more accessible services. Furthermore, mobile apps act as catalysts for digital transformation, integrating various educational services into a single user-friendly platform.

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Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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