Biometric Technology in Digital Banking: Insights from Generation Z and Millennials

Herwin Ardianto[1*], Chitra Laksmi Rithmaya[2], Larasati Ayu Sekarsari[3]

Universitas Hayam Wuruk Perbanas, Surabaya, Jawa Timur, Indonesia

A B S T R A C T

Biometric technology offers various conveniences and security features that can enhance the user experience of digital banking. This study explores the adoption of biometric technology in digital banking among Indonesian Generation Z and Millennials. Utilizing the Technology Acceptance Model (TAM), we investigate factors influencing attitudes, intentions, and actual use of biometrics among 326 respondents. Data analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM). Findings indicate that perceived usefulness, ease of use, security, and convenience significantly affect user attitudes, intentions, and actual usage. Additionally, perceived usefulness moderates the relationship between perceived ease of use and attitudes toward biometric adoption. These insights imply that to increase the adoption of biometric technology in digital banking among Indonesia's Generation Z and Millennials, service providers must focus on improving perceptions of usefulness, ease of use, security, and convenience, as well as considering the impact of perceptions of usefulness on user attitudes.

A B S T R A K

Teknologi biometrik menawarkan berbagai kemudahan dan fitur keamanan yang dapat meningkatkan pengalaman pengguna dalam perbankan digital. Studi ini mengeksplorasi adopsi teknologi biometrik dalam perbankan digital di kalangan Generasi Z dan Milenial Indonesia. Dengan menggunakan Model Penerimaan Teknologi (TAM), kami meneliti faktor-faktor yang mempengaruhi sikap, niat, dan penggunaan aktual biometrik di antara 326 responden. Analisis data dilakukan menggunakan Partial Least Squares Structural Equation Modeling (PLS-SEM). Hasil penelitian menunjukkan bahwa persepsi kegunaan, kemudahan penggunaan, keamanan, dan kenyamanan secara signifikan mempengaruhi sikap, niat, dan penggunaan aktual pengguna. Selain itu, persepsi kegunaan memoderasi hubungan antara persepsi kemudahan penggunaan dan sikap terhadap adopsi biometrik. Temuan ini mengimplikasikan bahwa untuk meningkatkan adopsi teknologi biometrik dalam perbankan digital di kalangan Generasi Z dan Milenial Indonesia, penyedia layanan harus fokus pada peningkatan persepsi kegunaan, kemudahan penggunaan, keamanan, dan kenyamanan, serta mempertimbangkan dampak dari persepsi kegunaan terhadap sikap pengguna.

Keywords: *Biometric, TAM Generation Z, Millennial, digital bank.*

1. INTRODUCTION

In recent years, digital banking services have experienced significant growth, driven by technological advances and changes in consumer behavior. Data from Bank Indonesia shows that the use of mobile banking and internet banking services increased by more than 50 percent between 2019 and 2023. Additionally, the number of transactions conducted through digital banking services reached 10 trillion transactions, or approximately 12,334,036 thousand transactions in 2023 (OJK, 2023), indicating that society is increasingly reliant on digital solutions for its financial needs.

Biometric technology and cybersecurity are closely linked in the context of modern banking. With the increasing use of digital services, banks face challenges in protecting sensitive data and customer transactions. In this regard, biometric technology emerges as a promising solution. This technology utilizes users' unique physical characteristics, such as fingerprints, faces, and voices, to enhance authentication security. This technology not only offers a higher level of security compared to conventional methods such as passwords or Personal Identification Number (PINs) but also provides greater convenience for users. According to research by MarketsandMarkets, the biometric market is projected to grow from $3.75 billion in 2024 to $4.72 billion in 2025, with a compound annual growth rate (CAGR) of 25.8 percent, with the banking sector being one of the key drivers of this growth. (MarketsandMarkets, 2025). Growth during this period can be attributed to increasing digital transformation, the emergence of cloud services, increased remote work and access, and improved accuracy and reliability.

Previous studies have shown that user acceptance of biometric technology in banking is quite high. A survey conducted by Saputri (2023) found that out of 500 mobile banking app users, 78 percent of respondents implemented biometrics to access banking apps and 85 percent of biometric users were highly satisfied. This shows that users not only appreciate the added security but also the convenience offered by biometric systems. As security risks increase, banking institutions need to adopt a more proactive approach to protecting customer data. The use of biometric technology can be integrated with other cybersecurity systems, such as data encryption and behavioral analysis, to create a stronger layer of protection. Cahyono et al. (2024) show that banks that implement a multi-layered approach can reduce the potential for cyberattacks.

Regulations also play an important role in the implementation of biometric technology. In many countries, including Indonesia, banking institutions are required to comply with data protection regulations, which cover how biometric data is collected, stored, and used (Lim et al., 2025). Compliance with these regulations not only protects customers but also helps banks avoid legal sanctions that could damage their reputation. In addition, innovation in biometrics continues, with research focusing on new technologies such as behavioral pattern recognition (Kariuki et al., 2025) and big data analysis. According to a report from Gartner, 60 percent of financial institutions will adopt behavior-

based biometric solutions by 2024 (Gartner, 2024). This innovation will help improve security and provide a better user experience.

The growth in smartphone users has supported developments in various digital activities, one of which is digital-based financial transactions. Digital banking, which is easily accessible using smartphones, has encouraged the development of digital financial transactions, despite the potential for cybercrime in digital activities. The value of mobile banking transactions has grown consistently from 2017 to 2021, with significant increases particularly in 2020 and 2021, reaching its peak in 2022. However, there was a sharp decline in growth in 2023, and the transaction value is expected to continue to decline in 2024 (Huda et al., 2024). This condition may reflect changes in consumer behavior and the adoption of new technologies. Data security threats and cybercrime are potential causes of this decline, so biometric technology could be an alternative solution to increase public confidence in using digital banking services. This aligns with the results of a Populix survey of 250 respondents (Table 1), which showed that 31 percent of respondents (primary need) in using digital banking prioritize data and transaction security, followed by easy access anytime and anywhere at 12 percent (Populix, 2024).

Table 1
Use of Digital Banks

Needs and Benefits Sought	
Data and transaction security	31%
Easy access anytime, anywhere	12%
Full features	12%
Integration with other financial services	11%
Promotions and special offers	10%
Fast transactions	8%
Online account opening	5%
Responsive customer support service	4%
Easy access to transaction information and reports	3%
Ability to manage and monitor investments	2%

Source: Populix, 2024

Security features are an important consideration for digital banking users in order to ensure the security of transactions, as is localization within the application. The localization feature in the application facilitates automatic location settings, eliminating the need to reconfigure settings when conducting transactions. The use of fingerprints (biometrics) as a security measure in using the application also provides an alternative security option in digitalization (Muhammad & Khalaf, 2025). Increased perception of security risks may lead to user resistance to digital banking services. Users perceive risks when conducting online transactions. Most studies focus on factors that influence acceptance rather than barriers. As a result, the impact of limitations such as trust, privacy, and security concerns on customer behavior has not been further explored.

The potential threat of cybercrime is increasing along with the use

of smartphones for online shopping, bill payments, and gaming, so the implementation of multi-factor authentication, encryption protocols, and continuous monitoring is essential to protect against identity theft, fraud, and cyberattacks. Biometric technology is one of the alternative solutions for security in the digital world. Biometric recognition is an interdisciplinary and comprehensive technology that closely integrates computer technology with optics, acoustics, sensors, and biostatistics, utilizing the physiological and behavioral characteristics commonly found in humans to authenticate an individual's identity.

Existing research focuses on digital banking such as Gupta & Varma (2019) Julia et al. (2024), Nguyen (2020), Raksadigiri & Wahyuni (2020), and Saripudin et al. (2024) emphasize the use of banking applications with the aim of facilitating customer transactions. Saripudin et al. (2024) more specifically, the experience of using Quick Response Code Indonesia Standard (QRIS) in transactions found that perceptions of security do not influence user attitudes. Research focusing on biometrics, such as Gupta & Varma (2019), has not yet touched much on the understanding of comfort and safety in the use of technology. The same issue is found in Mróz-Gorgoń et al. (2022) that explore biometric security factors and Hossain & Phoha (2021) which focus convenience in the use of biometrics. Therefore, it is important for research on digital banking to provide a comprehensive understanding of the various factors that influence the use of this biometric technology. Considering this, a comprehensive model that can assess the factors that influence its use can provide practitioners with information about understanding the behavior of digital banking users.

This study aims to explore the acceptance and effectiveness of biometric technology in enhancing the security and convenience of digital banking services. By identifying the factors that influence user trust, this study expects that effective strategies can be found to increase the adoption of biometric technology in the banking sector.

The novelty of this research lies in several key aspects that have not been explored much before. First, the latest research adopts a multidimensional approach that combines technical, psychological, and social aspects, covering analysis of how users perceive security and comfort as well as social factors that influence the acceptance of biometric technology. The emphasis on user perception is a central focus, where the research not only measures technical effectiveness but also explores how users feel about the use of their biometric data.

2. THEORETICAL FRAMEWORK AND HYPOTHESIS

The model used in this study is the Technology Acceptance Model (TAM), which was first introduced by Fred Davis in 1986. This model was developed from the Theory of Reasoned Action (TRA). This theory focuses on the relationship between attitudes, subjective norms, and intentions to act. TRA explains that the intention to perform a behavior is influenced by an individual's attitude toward that behavior and the social norms that surround it. TRA can be applied to various types of behavior, not limited to technology alone. Meanwhile, TAM is more specific to the context of technology and information systems.
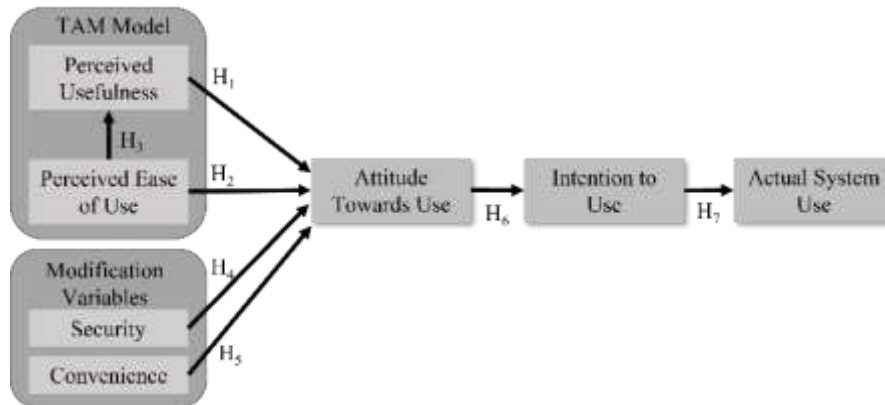
Figure 1
Research Framework

The purpose of TAM is to explain and predict how users accept and use new technologies, especially in the context of information systems. Davis focuses on two main factors that influence individuals' decisions to use technology: perceived ease of use and perceived usefulness. This model was further developed by incorporating security and convenience by Jayawardhena & Foley (2000) and Wu et al. (2016) in using digital banking biometric technology.

Security and comfort are two important aspects that influence the user experience when using technology, and the two are interrelated. Several previous studies have emphasized the importance of security in the use of technology, especially in anticipation of terrorism and crime (Agidi, 2018), use of the Internet of Things (Liang et al., 2020), and the importance of biometrics compared to the use of PINs in banking transactions. These studies have provided an overview of the importance of security in technology adoption. Therefore, it is necessary to include in the model the importance of security in biometric technology for digital banking. Security encompasses data protection, privacy, and user safety when interacting with various applications or systems. Factors influencing security include data protection to ensure secured personal information, clear and transparent privacy policies, and the use of secure technologies such as encryption and strong authentication. Additionally, regularly updated systems to address security vulnerabilities provide users with a sense of security. On the other hand, convenience relates to the user experience, which is influenced by intuitive interface design, accessibility for various user groups, and adequate technical support. Convenience might be one of the reasons why people adopt technology, such as the convenience of utilizing digital banking (Nguyen, 2020), as well as the convenience of using biometrics in mobile banking applications (Saputri, 2023). These studies show the importance of convenience in technology adoption, where users prefer to use technology based on ease of use. This is also the reason why we included convenience in our research model. The relationship between security and convenience is significant; if users feel that technology is not secure, they will hesitate to use it, even if the interface is convenient. Conversely, if security is guaranteed, users can focus more on a convenient user experience.

Perceived Usefulness (PU) is one of the key components in TAM. PU refers to the extent to which individuals believe that using a technology will improve their performance or effectiveness in performing certain tasks. These experiences and beliefs greatly influence users' attitudes toward the use of that technology. In other words, the higher the PU perceived by users, the more positive their attitudes toward the use of that technology. PU indicators, based on Davis (1989) and Gupta & Varma (2019), are reliability, benefits, and efficiency.

Attitude Towards Use (ATU) is an individual's overall evaluation of technology use. ATU reflects whether users feel positive or negative about using a particular technology. This attitude is rooted in the beliefs held by individuals, including PU. If users feel that the technology will provide significant benefits, they are more likely to develop a positive attitude toward using it. According to Davis (1989) and Gupta & Varma (2019), the indicators of attitude towards use are cognitive, affective, and conative. The relationship between PU and ATU is very important in technology adoption. When users perceive that a technology is useful, they tend to feel more motivated to use it.

Kim et al. (2015), who focus on mobile applications, mention the benefits of features that can attract consumers to the application and provide uniqueness from other competing technologies and show the usefulness of features that attract users. Based on the above arguments, we suspect that users expect biometric technology in digital banking applications to create a strong perception (high PU) of the usefulness of the technology for them, thereby tending to generate positive attitudes toward the use of technology (ATU), which leads to the following hypothesis:

H1: Perceived usefulness of biometric technology has a positive effect on attitude towards use in the use of digital banking services.

Another variable in our model is Perceived Ease of Use (PEU), which according to the TAM is a concept that refers to the extent to which users feel that using a technology will be effortless or uncomplicated (Davis, 1989). The importance of the PEU construct is demonstrated in the technology acceptance model by Davis (1989) in explaining the adoption of computer systems. High PEU can reduce confusion and frustration, thereby creating a more enjoyable user experience. According to Davis (1989) and Gupta & Varma (2019), the indicators of PEU include easy to use, easy to learn, and quick to learn.

Research on mobile applications for shopping and/or information sharing technology by Taylor & Levin (2014) reports that mobile app users are interested in simplicity of transactions and prefer mobile apps that have fewer distracting and irrelevant features. Based on these arguments, this study assumes that biometric technology users may want to expend less effort learning how to use biometric technology. Therefore, this study proposes the following hypothesis:

H2: Perceived ease of use of biometric technology has a positive effect on attitude towards use in the use of digital banking services.

PEU has a significant influence on ATU, and one of the paths of in-

fluence is through PU. PEU refers to the extent to which users feel that using a technology will be effortless (Davis, 1989). When users find technology easy to use, it not only improves their comfort level but also allows them to better understand the benefits offered by the technology. In this context, ease of use is an important first step in improving perceived usefulness.

Several studies have noted that using biometrics offers many advantages and speeds up data recovery compared to manual or traditional verification methods (Ahmad et al., 2012). When users experience ease of use with biometrics, they will feel positive about its usefulness, which will encourage a positive attitude towards its use, as was the case in the study Mróz-Gorgoń et al. (2022). Based on this, the following hypothesis is proposed:

H3: Perceived ease of use of biometric technology through perceived usefulness has a positive effect on attitude towards use in the use of digital banking services.

Another construct we will test in our model is security. Security refers to the protection of users' data and personal information from threats or unauthorized access (Jayawardhena & Foley, 2000; Kariuki et al., 2025). When users perceive a system or application as secure, they are more likely to develop a positive attitude toward the use of that technology. Conversely, if they perceive a risk to the security of their personal data, their attitude toward the use of that technology may become negative. Indicators for security, based on Wu et al. (2016) and Mróz-Gorgoń et al. (2022), are transaction security, data privacy, and security against scams. One of the main factors influencing positive attitudes toward the use of technology is users' trust in the security systems in place.

Some studies that highlight the importance of security in technology usage, such as Agidi (2018), show that the use of biometric security technology can address terrorism and criminal activity. Liang et al. (2020) demonstrate the importance of security in the Internet of Things (IoT) era, where authentication is essential for the security of connections between devices. Hosseini & Mohammadi (2012) show that it is no longer relevant for the banking industry to use authentication systems with PINs or passwords, but that the right solution is to use biometrics. Based on this empirical data and the reasoning described above, this study proposes the following hypothesis:

H4: Biometric technology security has a positive effect on attitude towards use in the use of digital banking services.

Convenience (CV) refers to the ease and efficiency experienced by users in performing an activity or using a service (Jayawardhena & Foley, 2000; Wu et al., 2016). Convenience can encompass various aspects, such as an intuitive user interface, uncomplicated processes, and high accessibility. According to Jayawardhena & Foley (2000) and Kim et al. (2015), the indicators for convenience include transaction convenience, application convenience, and enjoyment.

Evidence from previous research on biometric technology adop-

tion supports the inclusion of convenience in the research model. Wu et al. (2016) suggest that convenience plays an important role in the adoption of mobile banking. Research using an experimental method on two multi-biometric verification systems was conducted by Hossain & Phoha (2021) and provides evidence that convenience relevance with biometric use, and a significant positive effect was found on the use of multi-biometric verification. Based on this evidence, the following hypothesis is proposed:

H5: The convenience of biometric technology has a significant positive effect on attitudes towards the use of digital banking services.

Attitude Towards Use (ATU) refers to an individual's attitude towards the use of a technology, which can be either positive or negative (Davis, 1989). When users have a positive attitude toward a particular technology, they tend to be more interested in using it in the future. A positive attitude toward the use of technology can be influenced by various factors, including ease of use and security. Intention to Use (IU) refers to a person's tendency or willingness to use a technology or system in the future (Zhong et al., 2021).

If users have a negative attitude toward technology, they will be more hesitant to use it. For example, if someone finds it difficult to use an app or has concerns about the security of their personal data, this negative attitude will reduce their intention to use the technology. Indicators of intention to use, according to Zhong et al. (2021), consist of intention to use technology and intention to continue using the technology.

Research emphasizes the importance of ATU on users' intention to use in the adoption of biometric technology. A study by Mróz-Gorgoń et al. (2022) which analyzes the development of biometric market innovation in Poland, shows that attitude towards use had a positive influence on intention to use, while there are concerns about the misuse of data stored in biometric systems. Gupta & Varma (2019) obtain similar results, whereby usage attitudes have a strong positive influence on behavioral intentions to use biometric technology in India. These findings and arguments give us reason to assume in our research that price value will be one of the important factors in the process of using digital banking applications. Therefore, the next hypothesis is as follows:

H6: Attitude towards use of biometric technology has a significant positive effect on intention to use in the use of digital banking services.

Intention to Use refers to an individual's intention to use a system, while Actual System Use (AU) is the actual use of the system (Davis, 1989). When individuals have a strong intention to use a technology, they are more likely to actually use it. Research shows that user intention is often a strong predictor of actual usage behavior, as intention reflects an individual's commitment and desire to engage with the technology. AU refers to the extent to which users actually utilize a technology or system after going through the adoption process (Davis, 1989). According to Davis (1989) and Christiani et al. (2024), the indicators for actual system use are habits of using technology and depend-

ence on technology.

A study by Venkatesh & Davis (2000) shows that Intention to Use directly influences AU. The study found that users who have a positive attitude and intention to use a particular technology are more likely to use it regularly. These results indicate that intention is not just a desire, but also serves as a driver that encourages individuals to take concrete action in using the technology.

In addition, research by Kizgin et al. (2021) also supports the relationship between Intention to Use and AU in the context of mobile applications. The study's results show that users' intention to use mobile applications directly affects the frequency of their use. Therefore, service providers must consider not only user intention but also other factors that can influence the user experience to ensure successful technology adoption. Based on the above discussion, the following hypothesis is proposed:

H7: The intention to use biometric technology has a significant positive effect on actual system use in the use of digital banking services.

3. RESEARCH METHODS

This study used a survey method with electronic questionnaires distributed to respondents who are Generation Z and Millennials in Indonesia aged between 18 and 44 years old who use biometric digital banking. This study utilized a non-probability sampling method with convenience sampling. The use of convenience sampling allows for quick data collection from easily accessible participants. In addition, this method is ideal for exploratory research, where new ideas or phenomena can be explored in greater depth. Furthermore, convenience sampling provides flexibility in selecting respondents based on availability, making it an effective choice when accessibility and speed are priorities. Following Hair et al. (2017), this study collected responses with a total of 10 times the largest number of formative indicators used to measure one construct, or 10 times the largest number of structural paths directed at a particular construct in the structural model. Therefore, the required sample size was a minimum of 70 samples, both according to the largest number of formative indicators or according to the largest number of structural paths, which were both 7.

A total of 367 respondents' data were obtained. Of this total, 326 respondents were considered complete and ready to be processed. This number was obtained after eliminating 24 respondents who did not meet the criteria, such as those outside the age range of 18 to 44 years old (17 respondents) and those who did not use biometric technology in their digital banks.

A 5-point Likert scale was used to collect measurements for the model's primary dependent and independent variables. The data was analyzed using descriptive and statistical methods in PLS-SEM using the outer and inner models. The inner model examines the influence of latent variables, whereas the outer model examines the validity and reliability of the indicators on the latent variables. The indicator is deemed legitimate if the average variance extracted (AVE) value is

greater than 0.5 and the indicator's loading factor value, which measures the latent variable, is more than 0.4 (Hair et al., 2017).

4. DATA ANALYSIS AND DISCUSSION

This study employs a quantitative approach to data processing and testing in order to draw results and explore difficulties related to the herding of biometric technology, utilizing the TAM (Technology Acceptance Model) approach. The data analysis include data from 326 respondents who meet criteria and provide complete responses. The respondents' description is as follows:

Table 2
Respondent Description

Demographics	Category	Frequency	Percentage
Gender	Male	191	58.59%
	Female	135	41.41%
Age	18 to 22 years	57	17.48%
	23 to 28 years	59	18.10%
	29 to 33 years	60	18.40%
	34 to 38 years	68	20.86%
	39 to 44 years	63	19.33%
	More than 45 years	19	5.83%
Domicile	Surabaya	61	18.71%
	Jakarta	54	16.56%
	Medan	34	10.43%
	Pekanbaru	43	13.19%
	Makassar	33	10.12%
	Bojonegoro	45	13.80%
	Samarinda	24	7.36%
	Bandung	5	1.53%
	Banjarmasin	5	1.53%
	Malang	5	1.53%
	Magetan	4	1.23%
	Kudus	3	0.92%
	Ternate	3	0.92%
	Jember	3	0.92%
	Bekasi	2	0.61%
	Denpasar	2	0.61%
Occupation	Student	55	16.87%
	Self-employed	95	29.14%
	Private employees	82	25.15%
	Government employees	64	19.63%
	Other	30	9.20%
Monthly Income	Less than IDR 1.000.000	55	16.87%
	IDR 1,000,000 to IDR 2,999,999	80	24.54%

	IDR 3,000,000 to IDR 4,999,999	79	24.23%
	IDR 5,000,000 to IDR 6,999,999	87	26.69%
	More than IDR 7,000,000	25	7.67%
Name of the Digital Bank used	Seabank	72	22.09%
	Jago	36	11.04%
	Blu BCA	96	29.45%
	Allobank	64	19.63%
	BNC	14	4.29%
	Jenius	28	8.59%
	Other	16	4.91%
Types of Bio-metrics Used	Fingerprint	292	89.57%
	Face recognition	34	10.43%

Sourece: Processed questionnaire results

A hundred and ninety-one respondents are males (58.59%). Most respondents are between 34 and 38 years old (68, 20.86%) and reside in Surabaya (61, 18.71%). The majority are self-employed, totaling 95 individuals, or approximately 29.14% of the total. The most prevalent monthly income is in the range between IDR 5,000,000 to IDR 6,999,999, totaling 87 respondents (28.43%). Approximately twenty-nine percent of the total (96 respondents) are Blu BCA digital banking users, and mostly (89.57%) use fingerprint recognition as their preferred biometric method for digital banking.

Statistical Results

Using WarpPLS version 8.0, the data were processed in stages using path estimation and the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique. The coefficients of the structural paths, the R-squared value, and the percentage of variance are examined in order to assess the inner model.

Outer Model

A key component of PLS-SEM is the outer model, which plays an important role in linking latent variables with their measurement indicators. The outer model refers to the relationship between latent variables, which are theoretical constructs that cannot be measured directly, and observable indicators. These indicators serve as measures of latent variables.

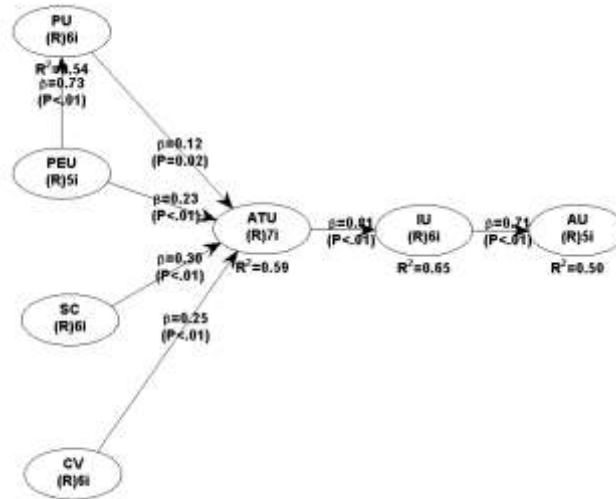The Partial Least Squares regression gave the following result:

Figure 2
PLS-SEM Model

Based on the results shown in Table 3 and Table 4, it can be seen that all factor loading values of the indicators are above 0.7. Meanwhile, the AVE value is more than 0.5 (Table 4). Table 4 also shows that the composite reliability and Cronbach's alpha (CA) values are above 0.7, indicating that the reliability criteria have been met. It can be concluded that all indicators are able to measure all variables well with loading factors above 0.7, thereby effectively measuring the variables of attitude toward use, intention to use, perceived usefulness, actual system use, perceived ease of use, security, and convenience.

Inner Model
The structural model suggests the the adjusted R-squared values for perceived usefulness, attitude toward use, intention to use, and actual system use are 0.535, 0.581, 0.648, and 0.496, respectively, as shown in Table 4. The corresponding R-squared values are 0.536, 0.586, 0.649, and 0.498, and the corresponding p-values are less than 0.05. The effect of perceived usefulness on attitude towards use is significant with a coefficient of 0.116 and a p-value of 0.017 (<0.05). Therefore, hypothesis 1 was supported, suggesting that there is a positive and significant effect between the perceived usefulness of biometric technology and attitude towards use in the use of digital banking services.

Table 3
Validity and Reliability Test Results

Variables	Indicator	Item	Loading Factor	Composite Reliability
Perceived Usefulness	Reliability	PU 1	0.807	0.932 (Reliabel)
		PU 2	0.872	
	Benefits	PU 3	0.890	
		PU 4	0.808	
	Efficient	PU 5	0.766	
		PU 6	0.854	
Perceived Ease of Use	Easy to use	PEU 1	0.759	0.885 (Reliabel)
		PEU 2	0.757	
	Easy to learn	PEU 3	0.846	

		PEU 4	0.838	
	Quick to learn	PEU 5	0.685	
Security	Transaction security	SC 1	0.832	0.941 (Reliabel)
		SC 2	0.924	
	Data privacy	SC 3	0.931	
		SC 4	0.849	
	Safe from scams	SC 5	0.892	
		SC 6	0.659	
Convenience	Transaction convenience	CV 1	0.662	0.890 (Reliabel)
		CV 2	0.760	
	Application convenience	CV 3	0.802	
		CV 4	0.853	
	Pleasure	CV 5	0.767	
		CV 6	0.788	
Attitude Towards Use	Cognitive	ATU 1	0.812	0.937 (Reliabel)
		ATU 2	0.775	
	Affective	ATU 3	0.894	
		ATU 4	0.813	
		ATU 5	0.881	
	Conative	ATU 6	0.786	
		ATU 7	0.799	
Intention to Use	Intention to use technology	IU 1	0.799	0.924 (Reliabel)
		IU 2	0.844	
		IU 3	0.893	
	Intention of continued use	IU 4	0.799	
		IU 5	0.775	
		IU 6	0.791	
Actual System Use	Habits of using technology	AU 1	0.810	0.900 (Reliabel)
		AU 2	0.803	
		AU 3	0.789	
	Reliance on technology	AU 4	0.869	
		AU 5	0.738	

Source: Data Processed, 2025

Table 4
Outer Model

Variables	CA	AVE	Full VIFs	R-squared	Adjusted R-squared
Perceived Usefulness	0.912	0.695	2.858	0.536	0.535
Perceived Ease of Use	0.836	0.607	2.641		
Security	0.922	0.727	1.853		
Convenience	0.850	0.579	2.902		
Attitude Towards Use	0.921	0.679	2.651	0.586	0.581
Intention to Use	0.900	0.669	4.147	0.649	0.648
Actual System Use	0.861	0.645	2.387	0.498	0.496

Source: Data Processed, 2025

Table 5
Hypothesis Testing

Path	Coefficients	P-Value	Effect	Hypothesis
Perceived Usefulness → Attitude Towards Use	0.116	0.017	0.075	Supported
Perceived Ease of Use → Attitude Towards Use	0.231	<0.001	0.153	Supported
Perceived Ease of Use → Perceived Usefulness → Attitude Towards Use	0.085	0.014	0.056	Supported

Biometric Technology	Security → Attitude Towards Use	0.303	<0.001	0.188	Supported
	Convenience → Attitude Towards Use	0.248	<0.001	0.170	Supported
	Attitude Towards Use → Intention to Use	0.806	<0.001	0.649	Supported
52	Intention to Use → Actual System Use	0.705	<0.001	0.498	Supported

Source: Data Processed, 2025

These results show that users who believe that biometric technology provides real benefits, such as increased security and ease of transactions, will have a more positive attitude towards its use. The effect size value shown in Table 5 is 0.075, indicating that there is a moderate influence between the variables of perceived usefulness and attitude towards use. In other words, the higher the perceived usefulness of users, the more positive their attitude towards the use of this technology. The effect identified also shows that this relationship is not merely coincidental but is supported by statistical analysis demonstrating consistency and reliability. Therefore, enhancing the perceived usefulness of biometric technology can contribute to improving users' positive attitudes, which in turn can drive broader adoption in digital banking services. The findings of this study align with those from Davis (1989), Gupta & Varma (2019), Wang et al. (2023) and Nguyen (2020) which shows that perceived usefulness has a significant positive effect on attitude towards use, but this result differs from Jayawardhena & Foley (2000), Vahdat et al. (2021), and Raksadigiri & Wahyuni (2020).

The influence of perceived ease of use on attitude towards use is positive and significant, with a coefficient of 0.231 and a p-value of 0.007 (<0.05). The effect size shows a value of 0.153 (Table 5), indicating a moderate influence between the perceived ease of use variable and the attitude towards use variable. Based on these findings, hypothesis 2 is supported, which means that there is a positive influence of between the perceived ease of use of biometric technology on the attitude towards use in the use of digital banking services.

The results of this study support the findings of previous research by Taylor & Levin (2014), Vahdat et al. (2021), Wang et al. (2023), and Raksadigiri & Wahyuni (2020) that perceived ease of use has been proven to be a predictor of attitude towards use, where the perception of ease of use influences users' attitudes towards the use of biometric technology in digital banking. The results of this study differ from the results by Julia et al. (2024) which found that perceived ease of use does not influence attitude towards use, these different results are possible because users do not consider digital banking to be an easy tool based on several measurements conducted in the study. The fact that Generation Z grew up with the Internet, mobile devices, and other connected technologies may have "normalized" the innovations they witnessed, so that these different results reverse the original TAM.

The influence of perceived ease of use through perceived usefulness on attitude toward use was found to be positive and significant, with a coefficient of 0.085 and a p-value of 0.014 (<0.05). The effect size

shows a value of 0.056 (Table 5), indicating a sufficiently strong and significant influence on the Perceived Ease of Use variable of biometric technology through perceived usefulness, which has a positive and significant effect on attitude towards use. These findings provide support for Hypothesis 3, indicating that there is a positive influence of perceived ease of use of biometric technology through perceived usefulness on attitude towards use in the use of digital banking services, particularly in biometric technology.

The results of this study support Mróz-Gorgoń et al. (2022) and Julia et al. (2024) which shows that the perceived ease of use of biometric technology through perceived usefulness has a significant positive effect on attitudes towards use. This positive and significant relationship indicates that factors such as intuitive interfaces, processing speed, and minimal technical barriers can make users feel more positive about the technology. As a result, this positive attitude can encourage them to be more willing to adopt and use biometric technology in their banking activities.

The effect of security on attitude towards use is positive and significant, with a coefficient of 0.303 and a p-value <0.001 (<0.05). The effect size shows a value of 0.188 (Table 5), indicating a fairly strong and significant influence between the security variable and the attitude towards use variable. Based on these findings, Hypothesis 4 is supported, confirming that there is a positive influence of the security of biometric technology on attitude towards use in the use of digital banking services.

The results support Hosseini & Mohammadi (2012), Liang et al. (2020) and Baraba & Mahmudi (2023) which demonstrates support for the importance of security related to authentication in digital banking services. Data and user information protection are crucial aspects in maintaining trust and integrity in the banking system.

Different results with Saripudin et al. (2024) which shows that there is no relationship between security and attitude towards use in one of the digital banking technologies, namely QRIS. This condition can be caused by several interrelated factors. Users' perceptions of the security of QRIS technology may already be quite positive, so they do not feel worried or hesitant to use it.

The increasing widespread use of QRIS in everyday transactions may lead users to begin viewing this technology as a safe norm, thereby reducing their uncertainty and concerns. However, in a publication by Saripudin et al. (2024) does not explain why the perception of security does not influence attitude towards use. Based on these findings, Hypothesis 5 is supported, suggesting that there is a positive influence of the convenience of biometric technology on attitude towards use in the use of digital banking services. This implies that users perceive biometric technology as providing ease and convenience in conducting banking transactions.

These results align with Hossain & Phoha (2021) and Wu et al. (2016) which shows that convenience in using biometric technology has a positive effect on attitudes towards use in banking services and differs from the results of Nguyen (2020) where convenience does not in-

fluence attitudes toward the use of digital banking services. These differences indicate that convenience does not contribute significantly to users' views or evaluations of biometric technology in the banking context.

The influence of attitude towards use on intention to use is positive and significant, with a coefficient of 0.806 and a p-value <0.001 (<0.05). The effect size showed a value of 0.649 (Table 5), indicating a fairly strong and significant influence between the attitude towards use variable and the intention to use variable. These findings confirm support for Hypothesis 6 that there is a positive influence between Attitude towards use of biometric technology and intention to use in the use of digital banking services. This indicates that users' positive attitudes toward biometric technology contribute to their desire to adopt and use the technology. These results are in line with Davis (1989), Gupta & Varma (2019), Mróz-Gorgoń et al. (2022), Raksadigiri & Wahyuni (2020), and Julia et al. (2024) who show that attitude toward use has a strong positive influence on intention to use biometric technology.

The influence of intention to use on actual system use is positive and significant, with a coefficient of 0.705 and a p-value <0.001 (<0.05). The effect size showed a value of 0.498 (Table 5), indicating a sufficiently strong and significant influence between the intention to use variable and the actual system use variable. Therefore, Hypothesis 7 is supported, confirming that there is a positive influence of the intention to use biometric technology on actual system use in the use of digital banking services.

These results support Davis (1989) who demonstrates the relationship between intention to use and actual system use, where when individuals have a strong intention to use a technology, they are likely to actually use it because intention reflects an individual's commitment and desire to engage with the technology. In addition, empirically, these results support Kizgin et al. (2021) which provide evidence that the intention is not merely a desire, but also a powerful driver for concrete actions in using technology.

5. CONCLUSION, IMPLICATIONS, SUGGESTIONS, AND LIMITATIONS

Based on the results of the research conducted, this study concludes that the variables of perceived usefulness, perceived ease of use, security, and convenience have a significant effect on attitude towards use, intention to use, and actual system use of biometric technology in digital banking. This means that when users perceive biometric technology as useful, easy to use, secure, and convenient, they are more likely to have a positive attitude toward using the technology. This positive attitude, in turn, increases their intention to adopt biometric technology in digital banking activities. If this intention is strong, the likelihood of users actually using the system in their daily practices also increases. The significant influence of these variables indicates that banking service providers need to consider and optimize each aspect to enhance the adoption of biometric technology.

The findings on biometric technology in digital banking contribute

significantly to theoretical frameworks in several aspects. These findings enrich existing technology adoption models, such as the Technology Acceptance Model (TAM). By incorporating variables such as security and convenience, this research creates a more comprehensive model for understanding the factors influencing technology adoption, showing that adoption is not only influenced by technical aspects but also by user perceptions.

Additionally, the finding that perceptions of ease of use and usefulness positively influence attitudes highlights the importance of psychological factors in the decision-making process. This indicates that how users perceive technology significantly influences their attitudes, which in turn affect their intention to use it.

The findings of this research may have implications for practitioners, particularly in digital banking. The results indicate that users consider performance, intermediary channels, trust in organizational infrastructure, and technical support for digital banking services—these factors form the basis for the behavioral intentions of Generation Z and millennials to adopt biometric technology. It is important to note that users consider the ease of using the service when deciding to adopt biometric technology, so digital banking can strengthen its support system and improve service support, although this still requires further in-depth research.

Future research could explore additional variables, such as social and cultural factors, that may influence the adoption of biometric technology. Understanding the interaction between these variables could provide more comprehensive and in-depth insights into user behavior.

This study on biometric technology in digital banking has several limitations that need to be considered. First, this study may be limited to the subjective perceptions and experiences of respondents, which may vary based on their social, educational, and cultural backgrounds. This may result in bias in the research results, as not all individuals from Generation Z and Millennials have the same access to or experience with biometric technology. Second, respondents who are more familiar with technology may have different views than those who are less familiar. Furthermore, geographical limitations can also affect the results of the study. Future research may consider a longitudinal approach to monitor changes in perceptions and adoption of biometric technology over time.

REFERENCES

Agidi, R. . (2018). Using biometric in solving terrorism and crime activities in Nigeria. *Techsplend Journal of Technology*, *1*(12), 91–105.

Ahmad, S. M. S., Ali, B. M., & Adnan, W. A. W. (2012). Technical issues and challenges of biometric applications as access control tools of information security. *International Journal of Innovative Computing, Information and Control*, *8*(11).

Baraba, R. A. A., & Mahmudi, M. (2023). Understanding The Millennial

Generation Behavior In Using Digital Banking. *Asean International Journal of Business*, 2(1), 1–13. https://doi.org/10.54099/aijb.v2i1.394

Cahyono, D., Fahrudin, R., Alwiyah, & Sinclair, A. (2024). Pentingnya Edukasi dalam Mengatasi Keamanan Data Mobile Banking di Indonesia. *Jurnal MENTARI: Manajemen, Pendidikan Dan Teknologi Informasi*, 3(1), 81–89. https://doi.org/10.33050

Christiani, N., Anggela, P., Uslianti, S., Industri, J. T., Teknik, F., & Tanjungpura, U. (2024). Penerapan technology acceptance model (tam) pada penggunaan aplikasi seabank. *INTEGRATE: Industrial Engineering and Management System*, 8(2), 218–224.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems*, 13(3), 319–340. https://doi.org/10.2307/249008

Gartner. (2024). *2025 Top Strategic Technology Trends*.

Gupta, R., & Varma, S. (2019). A structural equation model to assess behavioural intention to use biometric enabled e-banking services in India. *International Journal of Business Information Systems*, 31(4). https://doi.org/10.1504/IJBIS.2019.101586

Hair Jr., J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: Updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, 1(2), 107–123. https://doi.org/10.1504/ijmda.2017.10008574

Hossain, M. S., & Phoha, V. V. (2021). Enhancing performance and user convenience of multi-biometric verification systems. *Pattern Analysis and Applications*, 24(4), 1569–1582. https://doi.org/10.1007/s10044-021-01008-5

Hosseini, S. S., & Mohammadi, S. (2012). Review Banking on Biometric in the World's Banks and Introducing a Biometric Model for Iran's Banking System. *J. Basic. Appl. Sci. Res*, 2(9).

Huda, N., Ayu, D., & Septyarini, R. (2024). *Digital Economy Outlook 2025*. Center of Economic and Law Studies (Celios).

Jayawardhena, C., & Foley, P. (2000). Changes in the banking sector - The case of Internet banking in the UK. *Internet Research*, 10(1). https://doi.org/10.1108/10662240010312048

Julia, L., Linggam, P. S., Hibatullah, R., & Justianto, J. S. (2024). The Impact of Perceived Risk and Technology Acceptance Model on Gen Z's Adoption of Digital Banking. *WSEAS Transactions on Computer Research*, 12(1), 1–18.

https://doi.org/10.37394/232018.2024.12.1

Kariuki, P., Ofusori, L. O., & Goyayi, M. L. J. (2025). Internet of Things on Banking Processes in South Africa: A Systematic Reflection on Innovations, Opportunities and Challenges. *Digital Business*, *5*(1), 100097. https://doi.org/10.1016/j.digbus.2024.100097

Kim, S. J., Wang, R. J. H., & Malthouse, E. C. (2015). The effects of adopting and using a brand's mobile application on customers' subsequent purchase behavior. *Journal of Interactive Marketing*, *31*(1), 28–41. https://doi.org/10.1016/j.intmar.2015.05.004

Kizgin, H., Jamal, A., Dwivedi, Y. K., & Rana, N. P. (2021). The impact of online vs. offline acculturation on purchase intentions: A multigroup analysis of the role of education. *Journal of Business Research*, *130*. https://doi.org/10.1016/j.jbusres.2020.05.011

Liang, Y., Samtani, S., Guo, B., & Yu, Z. (2020). Behavioral Biometrics for Continuous Authentication in the Internet-of-Things Era: An Artificial Intelligence Perspective. *IEEE Internet of Things Journal*, *7*(9). https://doi.org/10.1109/JIOT.2020.3004077

Lim, A. C. M., Ng, L. H. X., & Taeihagh, A. (2025). Biometric data landscape in Southeast Asia: Challenges and opportunities for effective regulation. *Computer Law and Security Review*, *56*(December 2024), 106095. https://doi.org/10.1016/j.clsr.2024.106095

MarketsandMarkets. (2025). *Biometrics-As-A-Service Global Market Report 2025*.

Mróz-Gorgoń, B., Wodo, W., Andrych, A., Caban-Piaskowska, K., & Kozyra, C. (2022). Biometrics Innovation and Payment Sector Perception. *Sustainability (Switzerland)*, *14*(15). https://doi.org/10.3390/su14159424

Muhammad, H. G., & Khalaf, Z. A. (2025). A Survey Of Fingerprint Identification System Using Deep Learning. *International Journal of Computing and Digital Systems*, *17*(1), 1–17. https://doi.org/10.12785/ijcds/1571022983

Nguyen, O. T. (2020). Factors affecting the intention to use digital banking in Vietnam. *Journal of Asian Finance, Economics and Business*, *7*(3), 303–310. https://doi.org/10.13106/jafeb.2020.vol7.no3.303

OJK. (2023). Statistik Perbankan Indonesia - Januari 2023. *Statistik Perbankan Indonesia*, *21*(2), 1–136.

Populix. (2024). *Studi Analisis Ekosistem dan Persepsi terhadap Bank Digital di Indonesia*.

Raksadigiri, M. W., & Wahyuni, S. (2020). Perceived Ease of Use Effect on Perceived Usefulness and Attitude Towards Use and Its Impact on Behavioural Intention To Use. *International Journal of Advanced Research*, *8*(12), 439–444. https://doi.org/10.21474/ijar01/12167

Saputri, V. D. (2023). Implementation Of Biometric-Based Security System On Mobile Banking Application. *Jurnal Komputer Indonesia*, *2*(1), 25–32. https://doi.org/10.37676/jki.v2i1.565

Saripudin, S., Ernawati, D., & Yuniarti, R. (2024). Exploring the Impact of Attitudes, Behavior, and Perceptions on Millennials' Adoption of QRIS Payment Systems. *Journal Of Economics, Finance and Management Studies*, *7*(9), 1035–1043. https://doi.org/10.47191/jefms/v7-i2-22

Taylor, D. G., & Levin, M. (2014). Predicting mobile app usage for purchasing and information-sharing. *International Journal of Retail and Distribution Management*, *42*(8), 759–774. https://doi.org/10.1108/IJRDM-11-2012-0108

Vahdat, A., Alizadeh, A., Quach, S., & Hamelin, N. (2021). Would you like to shop via mobile app technology? The technology acceptance model, social factors and purchase intention. *Australasian Marketing Journal*, *29*(2), 187–197. https://doi.org/10.1016/j.ausmj.2020.01.002

Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*, *46*(2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Wang, C., Ahmad, S. F., Bani Ahmad Ayassrah, A. Y. A., Awwad, E. M., Irshad, M., Ali, Y. A., Al-Razgan, M., Khan, Y., & Han, H. (2023). An empirical evaluation of technology acceptance model for Artificial Intelligence in E-commerce. *Heliyon*, *9*(8). https://doi.org/10.1016/j.heliyon.2023.e18349

Wu, W.-T., Chen, C.-B., & Chang, C.-C. (2016). Applying the Analytic Hierarchy Process Decision Analysis to Better Understand Adoption Intentions of Mobile Banking. *Business and Economic Research*, *6*(1), 431. https://doi.org/10.5296/ber.v6i1.9621

Zhong, Y., Oh, S., & Moon, H. C. (2021). Service transformation under industry 4.0: Investigating acceptance of facial recognition payment through an extended technology acceptance model. *Technology in Society*, *64*. https://doi.org/10.1016/j.techsoc.2020.101515

* Corresponding Authors:
Penulis dapat dikontak pada e-mail: herwin.ardianto@perbanas.ac.id