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Factors Influencing the Decline in Use of The Nebengers Application

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Abstract

Nebengers is a popular ride-sharing application that helps many users find traveling companions and reduces the use of private vehicles in several regions in Indonesia. In 2022, there has been an increase in travel requests but a decrease in trip completion; in fact, only twenty-five percent of travel requests have been completed. This research aims to analyze the factors influencing the decline in trip completion in the Nebengers application based on the user's perspective. The identification process was carried out by conducting interviews with guided questions referring to the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) Model and the Systematic Literature Review (SLR) results. Thematic analysis was used to identify factors discovered during the interviews. The results of the thematic analysis are four themes of factors that influence the decline in use of the Nebengers application: Effort Expectancy, Facilitating Conditions, Hedonic Motivation, and Habit.

Keywords: Ride-sharing, Nebengers, SLR, Thematic Analysis, UTAUT2

Introduction

The Indonesian government is implementing various policies to create a more sustainable, healthy, and economically efficient urban environment. One of these policies aims to reduce the use of private vehicles (Regulation, 2018). Vehicles contribute significantly to air pollution, particularly exhaust emissions. The increase in motor vehicles also correlates with population density, which reduces open space and deteriorates the quality of the urban environment (Nguyen-Phuoc et al., 2022).

Based on data from the TomTom Traffic Index Ranking 2022, the capital city of Indonesia, Jakarta, ranks as the second most congested city in Southeast Asia and 29th out of 389 cities worldwide (TomTom Traffic Index Ranking 2022, 2023). Despite this, several government programs have successfully reduced congestion over the past few years by providing affordable public transportation for residents in major cities. Railways, Bus Rapid Transit (BRT), Mass Rapid Transit (MRT), city transport services, and some online vehicle services are integrated to meet the public's transportation needs and reduce traffic congestion (Regulation, 2018). The government also supports ride-sharing applications such as Nebengers, encouraging people to share rides and reduce the number of vehicles on the road.

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Nebengers is an application that originated from a Twitter community in 2011 (Nebengers, 2016). Its purpose is to enable vehicle owners with empty seats to share rides with others with the same destination, as developed by PT. Suitmedia Kreasi Indonesia, through its CSR program, this application aims to help urban residents share vehicles and support Smart City transportation solutions. Launched in August 2015, Nebengers has become one of Indonesia's most popular ride-sharing applications. The application helps users find travel companions and reduce the use of private vehicles. Nebenger users are spread across several major cities, such as Jakarta, Surabaya, Bandung, Yogyakarta, Bali, and Semarang. To improve security, the application features a verification system and user feedback.

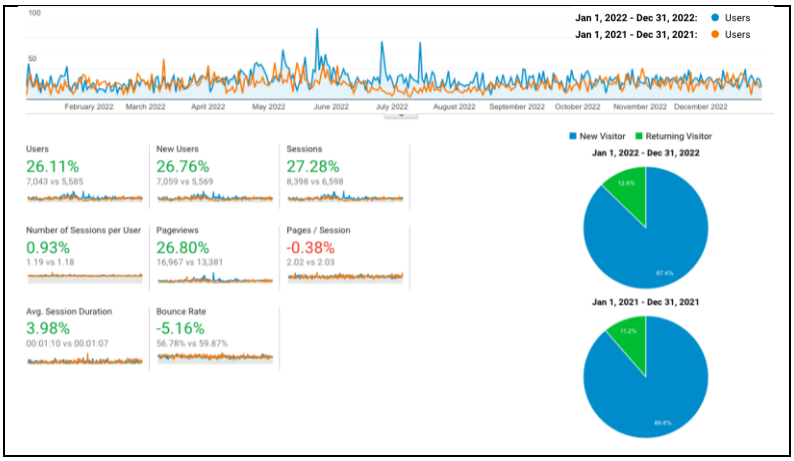

Figure 1. Visitors of nebengers.com

Source: (Google Analytics, 2022)

Despite its numerous benefits, the Nebengers application experienced a decline in users in 2022 compared to 2021. As shown on Figure 1, website visitors decreased in 2022, with only 7,000 visitors, and peaked at 77 on May 25, 2022. The total number of users who installed the application from January 1, 2021, to December 31, 2022, was 18,815,000 Android users and 5,235,000 iOS users. However, active users in 2022 reached only 24,000, marking a 17.3% decrease from the previous year. The most active day was July 8, 2022, with 652 users, a 161.8% increase from 2021, while the least active day was February 15, 2021, with 232 users. The period from February to March 2022 recorded the lowest application usage, whereas usage remained stable from July to December 2022. User engagement duration fluctuated from January 1, 2021, to December 31, 2022

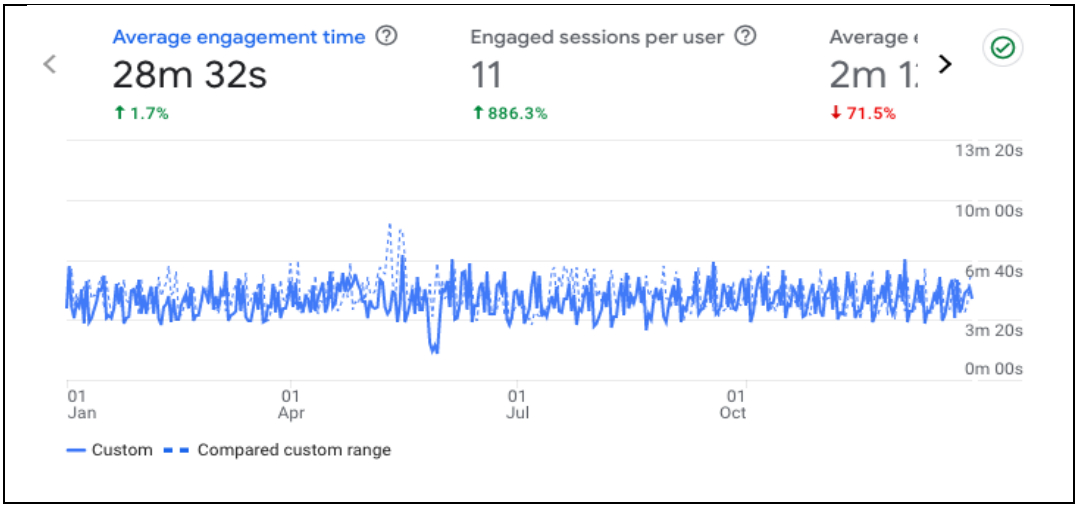

Figure 2. User Engagement of the Nebengers Application 2021-2022

Source: **(Google Analytics, 2022)**

Figure 2 shows on active days, users of the Nebengers application stay on the app for approximately 132 seconds. The longest engagement duration was recorded on May 11, 2021, with users staying for

over 231 seconds (3 minutes and 51 seconds). Ride request engagement, which indicates how many users clicked or requested to join a ride, reached 37,000 events with 4,200 users from January to December 2022. Although users decreased by 20%, ride requests in 2022 slightly increased compared to 2021. In the first half of 2022, the number of events and users was lower than in 2021, but this trend reversed in the second half of 2022.

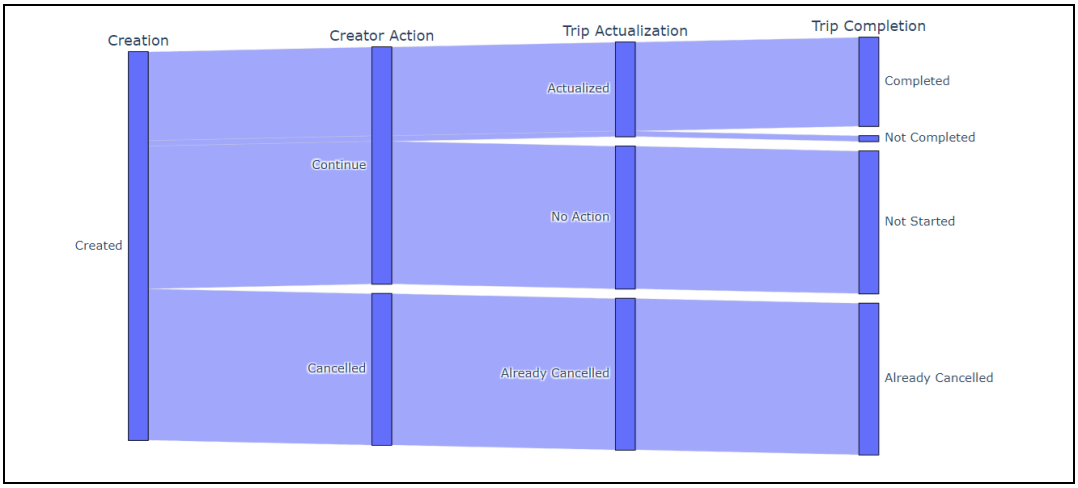

Figure 3. Nebengers Application Ride Report 2021-2022

Source: **(Google Analytics, 2022)**

Based on the analytics report in Figure 3, despite numerous ride requests made on the Nebengers application, only about a quarter of these requests result in completed journeys, with many trips not being started despite not being canceled. The report also indicates that out % of the total ride requests approved in 2022, only 66% were completed without cancellation. Overall, the total number of ride requests in 2022 was lower than the previous year, indicating a decline in Nebengers application usage.

We have conducted a search for previous studies and found no research related to Nebengers in Indonesia. Then we conducted a global search using the SLR method and found several studies related to ride hailing. Previous studies have shown factors that influence customer loyalty in using ride hailing, but still have some shortcomings. For example, the sample of respondents who did not fully involve ride-hailing users conducted by Nguyen-Phuoc et al. (2021) can affect the validity of the results obtained. In addition, several studies also do not provide recommendations for further research. Then the scope of the research space is still limited to certain countries/regions so that it cannot represent other areas such as research conducted by Belgiawan et al. (2022) and Nguyen-Phuoc et al. (2022).

In this study, the research question is: "What are the factors influencing users' decisions not to complete ride requests on the Nebengers application?". Factors such as timing suitability, driver or passenger availability, service reliability, and social or psychological factors such as trust and comfort may be exciting areas to investigate. The model used in this selection is UTAUT2, which is a development of the UTAUT model, with the addition of new constructs and focusing on consumers by understanding the adoption and use of technology in the consumer context, in line with this research which aims to find out how customers respond to the use and impact of the Nebengers application. This is why UTAUT2 was chosen and is more relevant for research related to the Nebengers application.

Literature Review

This study uses a Systematic Literature Review (SLR), which involves a straightforward research question, a systematic search process, data extraction, and data presentation, regardless of whether researchers explicitly label their study as a systematic literature review. According to Kitchenham and Charters (2007), searching using SLR involves several steps:

a. Defining the research question
   The research question for this study is: What are the factors influencing users' decision not to complete ride request on the Nebengers application?

b. Selecting journal databases as the sources of search by determining keywords
The related research search uses databases IEEE Explorer, ScienceDirect, Scopus, and Emerald Insight. The keywords used are "Ride Hailing Loyalty", "Ride Hailing Cancellation".
c. Establishing search criteria (Inclusion and Exclusion Criteria)
The criteria used are publication in Indonesian or English, in the form of journals or proceedings published in the last five years, can be downloaded in full text and are peer-reviewed papers.

The document search was conducted using pre-determined databases on December 9th, 2023, with two specified keywords, yielding diverse results. From each database used, the search results for the keyword "Ride-hailing loyalty" were as follows: IEEE Explore yielded four documents, ScienceDirect yielded 210 documents, Emerald Insight yielded 89 documents, and Scopus yielded 17 documents, totaling 320. Subsequently, the database search with the keyword "Ride-hailing cancellation" produced the following results: IEEE Explore yielded five documents, ScienceDirect yielded 137 documents, Emerald Insight yielded 13 documents, and Scopus yielded five documents, totaling 160. Therefore, the total number of documents obtained using these two keywords was 480 documents. The next step is selecting documents relevant to the research questions as shown in Figure 4.

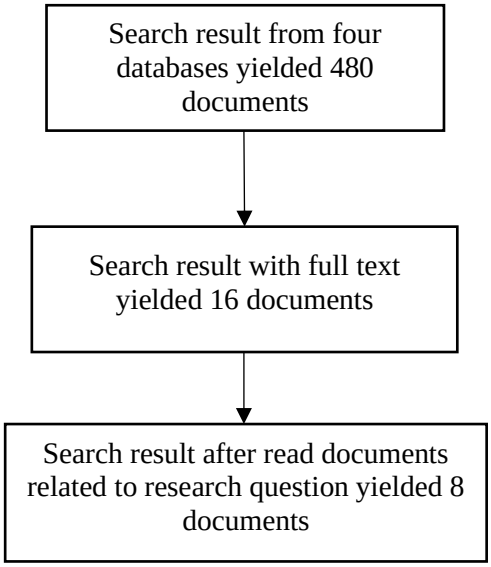

Figure 4. Documents Search Results

Based on these 8 documents, we performed a 3C + 2S analysis: Compare, Contrast, Criticize, Synthesize, and Summarize to find out the relevance between previous studies. The results of the analysis will be explained in Table 1.

Table 1. 3C+2S Analysis

Process	Description
Compare	All studies focus on customer satisfaction and loyalty towards using ride-hailing. (Belgiawan et al., 2022; Loa & Habib, 2021). Nguyen-Phuoc et al. (2020); Nguyen-Phuoc et al. (2021) examine the factors that influence customer loyalty towards using ride-hailing such as risk, cost, waiting time. Research (Li et al., 2023; Loa & Habib, 2021) examines factors that influence the rate of order cancellation and the effectiveness of imposing order cancellation penalty fees in increasing customer loyalty. Furthermore, research by Azzahro et al., (2020) discusses factors that can increase the loyalty of online motorcycle taxi drivers (partners).
Contrast	• Belgiawan et al. (2022); Nguyen-Phuoc et al. (2021); and Nguyen-Phuoc et al., (2022) conducted research by considering factors that influence customer loyalty, such as psychological factors, travel time, risk, price and green values, while Loa & Habib (2021)) compared factors by considering old and new users,

Process	Description
	• Li et al., (2023) and Wang et al. (2020) conducted research focusing on the effect of penalties on transaction cancellations by customers on increasing loyalty, while Azzahro et al. (2020) conducted research focusing on loyalty drivers factors. • The eight studies used different techniques, such as Belgiawan et al. (2022) using the Hybrid Choice Model (HCM), then Loa & Habib (2021) using the Zero-inflated ordered probit (ziop) method, Li et al. (2023) and Wang et al. (2020) using the Modeling Framework while Azzahro et al. (2020), Nguyen-Phuoc et al. (2020), Nguyen-Phuoc et al. (2021), and Nguyen-Phuoc et al. (2022) using the CEB-SEM and PLS-SEM methods. • Although all studies assume that the factors that influence customer loyalty are cost, risk and waiting time, Li et al. (2023) and Wang et al. (2020) state that cancellation penalties are also very important.
Criticize	Although the eight studies provide very important views and insights into the needs of this research, this study is still considered to have several shortcomings. For example, the sample respondents who have not fully involved ride-hailing users conducted by Nguyen-Phuoc et al. (2021) can affect the results' validity. In addition, several studies also do not provide recommendations for further research. Then, the scope of the research space is still limited to certain countries/regions so that it cannot represent other areas such as the research conducted by Belgiawan et al. (2022) and Nguyen-Phuoc et al. (2022).
Synthesize	Overall, several factors influence ride-hailing user loyalty: psychological factors, risk perception, cost, waiting time, driving time, application usability, post-order support, service quality, comfort, reliability, and promotion. However, priorities and impacts can vary depending on context and circumstances.
Summarize	These eight studies provide useful insights into customer loyalty in using ride-hailing services that can help companies improve their services so that development focuses more on customer needs. Although there are some differences in methodology and research focus, the findings of the eight studies show that psychological support, risk perception, cost, waiting time and service quality are some of the main factors influencing customer loyalty.

Ride Hailing and Ride Sharing

With rapid advancements in GPS technology and wireless communication, on-demand ride-sourcing applications such as Uber and DiDi have swiftly expanded and gained global popularity (Wang et al., 2020). Ride-hailing is "a platform that enables individuals to book and pay for transportation services from professional or part-time drivers through a mobile application" (Nguyen-Phuoc et al., 2020). Also known as ride-sourcing, ride-hailing refers to services for individuals book transportation via online booking applications. Urban mobility in many cities worldwide has been influenced by the flexibility and convenience offered by services like taxis alongside public transportation such as trains and buses. During peak hours, when demand exceeds available vehicles, users face challenges in booking rides even though ride-hailing offers significant advantages (Nguyen-Phuoc et al., 2022).

Ride-hailing services provide users with comprehensive information about their journey, including price and duration, by using booking applications equipped with user-friendly interfaces. Consequently, this capability has empowered ride-hailing services to transform and redefine how individuals travel within urban environments. The global surge in ride-hailing service usage has been remarkable, benefiting millions of passengers. It is projected that this market will grow to approximately $47 billion from 2020 to 2024, with an annual growth rate of 15% based on analysis covering 25 different service providers such as Lyft, Uber, Grab, or Carshare (Nguyen-Phuoc et al., 2021).

Perspective on the Use of Ride-Hailing Services

In the study conducted by Nguyen-Phuoc et al. (2021), five key factors underpinning customers' continued use of ride-hailing services were identified: the quality of the booking application, perceived quality of post-booking services, value benefits of use, intention for continued use, and word-of-mouth promotion (WOM). Human actions, including the decision to use ride-hailing services, can be understood through the Theory of Planned Behavior (TPB), a psychosocial model explaining human behavior. The core idea is that attitudes, subjective norms, and perceived behavioral control influence the intention to behave, directly determining the behavior itself. Intention reflects the extent to which a person is willing to engage in or undertake an action (Nguyen-Phuoc et al., 2022).

The research by Nguyen-Phuoc et al. (2022) explains that two psychological factors influence human behavior in using ride-hailing services: perceived risk and price sensitivity. Traffic congestion challenges in metropolitan cities like Jakarta and Surabaya have compelled urban dwellers to seek alternative solutions. Ride-hailing services have emerged as an effective answer due to their speed and affordable fares (Azzahro et al., 2020). Customer satisfaction in public transportation is measured based on their evaluation of the service compared to their prior expectations. At the same time, loyalty is defined as the intention to reuse the service based on previous positive experiences (Lierop et al., 2018).

Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh and colleagues introduced the Unified Theory of Acceptance and Use of Technology (UTAUT) in 2003, integrating eight major technology adoption theories. These include the Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), TPB and TAM Integration (C-TAM-TPB), Theory of Reasoned Action (TRA), Motivation Model (MM), and others within this category (Patil & Undale, 2023). The model has been widely recognized for explaining how users adopt technology (Patil & Undale, 2023; Venkatesh et al., 2003). It has been tested in various contexts and effectively predicts technology adoption (Patil & Undale, 2023).

UTAUT consists of four primary constructs, namely: 1. Performance Expectancy (PE) determines the extent to which an individual believes using the system will enhance their job performance; 2. Effort Expectancy (EE) measures how easily individuals believe they can use information technology; 3. Social Influence (SI) measures how individuals perceive social pressure from influential people to use information technology; and 4. Facilitating Conditions (FC) measure individuals' belief that support from the organization and available infrastructure facilitates or supports the use of information technology.

The three primary constructs, Behavioral Intention (BI) and Use Behavior (UB), predict Intention to Use Technology (ITU). The model has been tested in various situations and has proven effective in explaining how users adopt technology. It has been reported that these four constructs are moderately influenced by gender, age, experience, and voluntariness of use.

Unified Theory of Acceptance and Use of Technology Extended (UTAUT2)

In 2012, Venkatesh et al. conducted research introducing UTAUT2, an adaptation of the UTAUT model focused on consumer contexts. This extension incorporated three additional constructs: Hedonic Motivation, Price Value, and Habit. It was demonstrated that hedonic motivation significantly influences behavioral intention, moderated by age and gender. Similarly, within the same demographic variables, price also impacts behavioral intention. Habit directly and indirectly affects technology usage, illustrating individual consumer variations (Venkatesh et al., 2012).

From the UTAUT 2 model by Venkatesh et al. (2012), three additional factors are elucidated: Hedonic Motivation, Price Value, and Habit.

Hedonic Motivation is the satisfaction derived from using technology, which plays a significant role in technology adoption. Research in Information Systems indicates that Hedonic Motivation directly influences the acceptance and use of technology. Price Value, which combines product or service quality with its monetary cost, is also crucial in determining the perceived value of a technology. Habit

shape user behavior toward technology, where experience reflects the duration from initial use to habit formation over a specific period, such as three months.

Methodology

Research Design

Research design is a plan or scheme designed to collect, calculate, and analyze data to answer research questions. (Sekaran & Bougie, 2016). The research design is described in Table 2.

Table 2. The Research Design

Element	Information
Classification	Case study
Research methods	Qualitative
Types of research	Applied research
Object of research	Nebengers application
Research instrument	Interview questions
Data source	Primary and secondary data
Data collection	Literature study, observations, and interviews with Nebengers application users.
Data analysis	Thematic Analysis

Research Model

The research framework used as the theoretical basis is crucial. The researcher employed the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) in this study. Developed by Venkatesh et al. (2012), UTAUT2 represents an advancement from UTAUT, incorporating additional constructs and focusing on consumer contexts to better understand the adoption and use of technology. UTAUT2 is particularly relevant for research concerning applications like Nebengers.

Research Instrument

The research instrument used in this research is the interview. The questions given are open-ended questions with references to previous research. The readability test is carried out to minimize ambiguous questions. The list of research instruments can be found in Table 3.

Table 3. The Research Questionnaire

No.	Questionnaire	Reference
1	What is your experience using the Nebengers application? Is there anything that is missing or even makes you not interested in using the application again?	(Venkatesh et al., 2012; Lierop, Badami, & El-Geneidy, 2018; Ma, Xin Zhang, & Wang, 2019)
2	Have you ever had an unpleasant experience while traveling using Nebengers?	(Venkatesh et al., 2012; Lierop, Badami, & El-Geneidy, 2018)
3	Are there any technical problems you feel need to be improved when using the Nebengers application?	(Venkatesh et al., 2012; Lierop, Badami, & El-Geneidy, 2018; Ma, Xin Zhang, & Wang, 2019)
4	Are you overall satisfied with the Nebengers application? Are there any factors that reduce your comfort or interest in using Nebengers again?	(Venkatesh et al., 2012; Lierop, Badami, & El-Geneidy, 2018)
5	Do you think the prices at Nebengers are commensurate with the benefits you get? Are there things that make the costs incurred not worth it?	(Venkatesh et al., 2012; Lierop, Badami, & El-Geneidy, 2018)
6	Has there been a change in your habits of using the Nebengers application? What caused the shift and	(Venkatesh et al., 2012; Lierop, Badami, & El-Geneidy, 2018;

No.	Questionnaire	Reference
	influenced you to stop using Nebengers or cancel the trip?	Nguyen-Phuoc et al., 2022; Nguyen-Phuoc et al., 2020)
7	What is your experience using the Nebengers application? Is there anything that is missing or even makes you not interested in using the application again?	(Ma, Xin Zhang, & Wang, 2019)

Research Participant

Research participants were determined using a purposive sampling technique because it follows qualitative research, and the assessment results are considered appropriate for answering research questions and producing research objectives (Saunders et al., 2023). The minimum sample size that must be met when using a qualitative interview approach is 5-25 respondents (Saunders et al., 2016). We conducted contextual interviews with five respondents willing to conduct interviews online via the Zoom Meeting application. The criteria for selecting sources were respondents who had or were currently using the Nebengers application and, in their history of use, had experienced problems related to completing travel requests, whether cancellation or no action. Respondent contact was obtained through PT Suitmedia Kreasi Indonesia and the distribution of Google forms on social media. The respondent profiles can be seen in Table 4.

Table 4. Respondent Profiles

Code	Gender	Age (y.o)	Occupation
WP	Male	30	Project Manager
HG	Male	42	BUMD Employee
RE	Male	37	Private Employee
RF	Male	35	Private Employee
RS	Female	31	Business Owner

Data Collection

Data collection was carried out using primary and secondary data. Primary data was obtained through interviews with sources with specific requirements according to research needs. Secondary data was obtained from document studies and observations of Nebengers. The interviews conducted were contextual interviews with five respondents who had a history of decreasing use of the Nebengers application, especially trip completion. This interview took place for one day on June 15, 2024, with a duration for each respondent ranging between 28 – 70 minutes and was documented in the form of an interview transcript.

Data Analysis

Data analysis will be conducted using thematic analysis. The thematic analysis aims to find themes or patterns in data collection (such as interviews, observations, documents, or diaries) (Saunders et al., 2023). In this research, thematic analysis can be used to understand the factors underlying human attitudes and actions, especially concerning decreasing trip completion in the Nebengers application. We do six steps to analyze data including data familiarization, data coding, initial theme generation, theme development and review, theme refining, defining, and naming, and writing up. In this study, data analysis is conducted by Atlas.ti software. The output of this phase is the factors that influence the decline in the use of Nebengers applications.

Result

Validation of the research results was carried out with the owner of the Nebengers application. The results of the interview are included in the interview transcript for analysis. Thematic analysis was

chosen for this qualitative research. It produced a theme of factors that influence the use of the Nebengers application. The research result can be seen in Table 5.

Table 5. The Research Result

Theme	Subtheme	Description
Effort Expectancy	Interface Clarity	The ease factor of using the Nebengers interface
Facilitating Conditions	Accessibility	The ease factor of getting a vehicle
	Resource Availability	Resource availability factor (hardware, software)
	Support Availability	Factor in the availability of technical support
	Infrastructure Support	Organizational support factor for the use of Nebengers
Hedonic Motivation	Convenience	Ease of service factor
Habit	Financial risk	Risk factors for cost aspects

Effort Expectancy

On the theme of effort expectancy, respondents agreed that there were problems with the display of notifications and location. Problems with them include the notification display causing delays in finding important information on the Nebengers application. Quoted from an interview with one of the respondents as follows:

"The downside is that it can be updated. It's the same as it is now. Sometimes, when there's an incoming message on the application, there's no notification, so the person requesting the application doesn't get caught, so they have to answer immediately. For example, if you open the application, you will see an incoming message." [W0305]

Meanwhile, problems with location made it difficult for respondents to create a meeting point for drivers and users who use the Nebengers application. Quoted from an interview with one of the respondents as follows:

"At least this is the only thing that seems to get lost if we search for the starting point and ending point, like that; if we open a trip like that, usually if we type one word, it will come out of the locations that we usually use as points. start, that's it." [W0202a]

"Sometimes at the end of the month, I type Semanggi, it doesn't come out, so we have to go back to the map, we look for it, the point is on the map, then we mark it ourselves, sometimes the shape isn't a word, it's like a coordinate like that. Maybe it's a bit difficult for the passenger who is used to it; for example, they complained several times, Bang Riko, how come the point has changed?" [W0202b]

Facilitating Conditions

On the facilitating conditions theme, respondents agreed that there were problems with the facilities provided by the Nebengers application and technical support from PT Suitmedia Kreasi Indonesia. Respondents complained about obstacles in application development. They even considered the application's sustainability because they saw no income for the operational costs. The following are excerpts from interviews with several respondents.

"For the application itself, this is the term because, at the moment, it doesn't hold anything; yes, the term doesn't pay much attention to awareness. So it's just like that, there's no development." [W0302]

"But not satisfied with the development of the application because it was never developed" [W0105]

"Hopefully this is sustainable, the CSR is sustainable, the operators too, the developers for this maintenance are also sustainable too" [W0207]

Respondents also complained about the lack of a reporting feature to report users or adverse events in Nebengers' operations. Several obstacles, such as sexual harassment, blocked users, and incidents while traveling, require users to use the report feature. The following are excerpts from interviews with several respondents.

"*What is surprising is that there is no Report feature yet. So, who do you report to? This is a big question, considering the prevalence of sexual harassment in Indonesia. Just in case a passenger or driver does this, there is someone you can rely on. The thing is, I've seen drivers who only accept female passengers. "So, yes, you can report it directly, and then the complaint can be handled by Nebengers." [W0103]*

"But recently, I have encountered a passenger who I could say was blocked; blocked means he often cancels suddenly for various reasons. Usually, I don't approve the application" [W0201]

"For all this time, what, during, maybe that time, when my car was carrying Nebengers, it broke down in the middle of the road. Fortunately, there is a Nebengers Whatsapp group, too, right? When I broke down in the middle of the journey, I immediately called them to ask if there were any that were still behind or not, if there were any that were empty or not, and if you pass them on to those that were empty. So we can communicate with each other. Sometimes, at Nebengers, the captain also shares it live. So you know where this one is, where this one is, you know that. So, who is still behind, just in case, for example, if there is trouble at the front, those at the back can help each other. Thank God we were united all this time." [W0301]

Then, respondents also complained about the absence of the community column that previously existed in the application. The following are excerpts from interviews with respondents.

"In the early days of Nebengers, there was a community column. Now the community column has been removed." [W0402]

Meanwhile, respondents also need a waiting list, reschedule, and payment features when using the Nebengers application. Until now, the absence of the following three features has been communicated manually via short message. The following are excerpts from interviews with respondents.

"Well, if someone cancels suddenly like that, then that's the waiting list; you can tell us that someone has canceled. Can I come? Oh yes, I can come. So there's news like that." [W0303]

"Usually, I inform passengers if the time will be canceled or the time will be rescheduled." [W0407]

"What needs to be improved is the chat and payment features. Until now, as far as I know, because there is no third party, Nebengers do not receive any commission, and payments are made manually between the driver and the passenger. "For now, because we are used to cashless or no cash, it would be better if we added a direct payment feature to the driver, maybe Nebengers could also make a profit from there" [W0504]

Regarding travel availability, respondents complained about the problem of seat slots on vehicles that needed to match the application and reality, resulting in trips that were ultimately carried out without the application or the term' private route'. The following are excerpts from interviews with several respondents.

"Regarding the availability of Nebengers, when we need something urgently, sometimes it's available, sometimes it's not there, or sometimes it can be canceled. For example, we have confirmed with the driver, but on the one hand, it turns out that the driver can suddenly, unilaterally cancel. Maybe he initially set a seat slot, for example, 4, but it turned out that his friend was joining Nebengers, so he prioritized someone he knew first, right? "Finally, people who have already joined may be unilaterally canceled by the Driver" [W0105b]

"Most of those who already know, mostly don't use applications and choose direct conversation by WhatsApp" [W0302b]

Hedonic Motivation

Regarding the hedonic motivation theme, respondents agreed that an SOP (standard operating procedure) is needed when using the Nebengers application. They stressed the importance of clear communication, and the absence of an SOP disrupts user comfort. SOPs are required for passengers and drivers. The following are responses from respondents during interviews when discussing driver SOPs.

"For example, we have confirmed with the driver, but on the other hand it turns out that the driver can also suddenly, unilaterally cancel. Maybe he initially set a seat slot, for example, 4, but it turned out that his friend was joining Nebengers, so he prioritized someone he knew first, right? "Finally, people who have already joined may be unilaterally canceled by the Driver" [W0105b]

"Yes, more than one post, one trip, more than that. Vehicle one at one o'clock, for example, first post at 5 o'clock, second post at 6 o'clock, second post, third post again and again. The term is spam, so those who use Nebengers are too lazy to search and scroll down because most of them are close to that one person. Most of it comes from travel. I already know the Nebengers, too. So make more than one schedule, even more than five, it could be five" [W0302c]

Meanwhile, the responses from respondents during interviews when discussing passenger SOPs were as follows.

"At Nebengers, we use a booking system; I remember that booking at Nebengers doesn't limit the number of people riding, so it can be in two or three different cars; from my understanding, it can be more than one." [W0107]

"Because if not, maybe the driver will be harmed if that happens. He applied, and there was no punishment for the passenger; he applied to everyone first. Then, in the end, he canceled at the last minute." [W0202c]

Habit

On the Habit theme, respondents complained that the habit of unilateral cancellation of the use of the Nebengers application resulted in financial losses for respondents. Respondents stated this during the interview in the following quote.

"The biggest thing is that it's a sudden cancellation like that, right? "The thing is, we also give savings to others." [W0303]

"The issue is, if the driver of the bet doesn't apply, he could suffer a loss. He applies, no punishment for the passenger, and then suddenly cancels at the last minute." [W0202c]

Discussions

The frequency of construct emergence during thematic analysis can be seen in Table 6.

Table 6. Number of Initial Theme in the Construct

No.	Construct	Frequency
1	There is a unilateral cancellation	15
2	Travel availability constraints	9
3	There is no payment feature	11
4	There is no reschedule feature	1
5	There is no waiting list feature	1
6	There is no reporting feature	5
7	The community column does not exist	1
8	Application development constraints	15
9	Problematic chat feature	3
10	Problematic location feature	14
11	Problematic notification feature	2

No.	Construct	Frequency
12	There is no SOP for travel drivers	6
13	There is no SOP for traveling passengers	13

After doing thematic analysis, the result shows that the final result of factor mapping consists of 4 factors, which can be seen in Table 7.

Table 7. The Factor Mapping

Factors	Subtheme	Initial Theme
Effort Expectancy	Interface Clarity	Problematic chat feature; Problematic location feature; Problematic notification feature
Facilitating Conditions	Accessibility	Travel availability constraints
	Resource Availability	There is no payment feature; There is no reschedule feature; There is no waiting list feature
	Support Availability	There is no reporting feature; The community column does not exist
	Infrastructure Support	Application development constraints
Hedonic Motivation	Convenience	There is a unilateral cancellation
Habit	Financial risk	There is no SOP for travel drivers; There is no SOP for traveling passengers

Meanwhile, the other three factors, Performance Expectancy, Social Influence, and Price Value, do not influence the decline in the use of the Nebengers application. The comprehensive factor mapping research has provided us with a clear understanding of the factors influencing the decline in trip completion in the Nebengers application. The results are detailed in Figure 5.

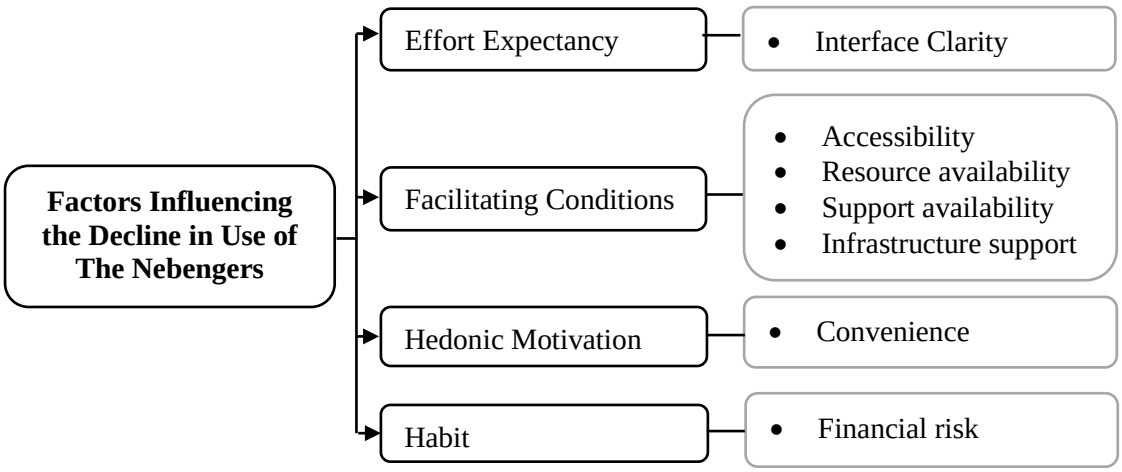

Figure 5. Final Result of Mapping Factors Influencing the Decline in Use of The Nebengers

The first study conducted on Nebengers application users showed similarities in the negative perceptions experienced by each user and their desires for application improvements. Nebengers users prioritize interface clarity, application support, convenience, and, in this case, the implementation of standard operating procedures and financial risk. The clarity of the interface of this transportation application has been discussed by Nguyen-Phuoc et al. (2021), who agrees with the importance of application quality as a whole process for continuous usage intention. The process in question is the

quality when ordering in and after ordering in the application. Meanwhile, regarding order cancellation, which causes a lack of user convenience (Wang et al., 2020), supported by the creation of the Confirmed-Order Cancellation Rate (COCR) shows similarities with this study, including suggestions for potential improvement by appropriately designed penalty or compensation strategies (Li et al., 2023) which Nebengers owners can implement.

Research by Nguyen-Phuoc et al. (2022) states that three factors, namely perceived benefits of the booking app, perceived sales promotion, and perceived service quality, which affect customer loyalty in ride-hailing Vietnam, turn out that only two are related to Nebengers in Indonesia. The perceived sales promotion factor is not included among the factors influencing the decline in using the Nebengers application. This is directly proportional to research by Belgiawan et al. (2022) that shows that cost is negatively significant in ride-sourcing choice. The comfort and reliability variables are significant, so application support for user comfort is important. Ultimately, this study shows that to maintain users, Nebengers owners ensure their service quality meets users' expectations to increase trust and satisfaction, which affects users' loyalty.

Conclusions

The study identified themes of factors that influence the use of the Nebengers application, namely: (1) Effort Expectancy Factor Theme with the sub-theme Interface Clarity, (2) Facilitating Conditions Factor Theme with sub-themes Accessibility, Resource availability, Support availability, and Infrastructure support, (3) Hedonic Motivation Factors theme with Convenience sub-theme, (4) Habit Factors Theme with Financial risk sub-theme.

The theoretical implications of this study lie in its contribution to the growing body of knowledge surrounding ride-sharing platforms and user experience design. By identifying critical features such as notifications, location services, payment systems, and community engagement, the research provides a framework for understanding how these elements influence user satisfaction and adoption. Furthermore, it highlights the importance of integrating user-specific needs, such as distinguishing between driver and passenger roles, to refine theoretical models of user behavior in shared mobility ecosystems. This study also underscores the intersection of technology and policy, emphasizing the need to examine governmental measures and their theoretical impact on user behavior and market dynamics in the ride-sharing industry.

The practical implications of the study are particularly relevant for developers and policymakers. For Suitmedia, the findings provide actionable insights to enhance the Nebengers app by prioritizing features that meet user needs and align with operational policies and resources. Implementing Standard Operating Procedures (SOPs) for users can also improve platform reliability and user trust. Additionally, understanding the role of marketing strategies in increasing user numbers offers a strategic direction for application promotion. Lastly, the study suggests that policymakers should consider how regulations to reduce private vehicle use could indirectly boost ride-sharing adoption, enabling a more sustainable transportation system in Indonesia.

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Data Protection Impact Assessment Framework in the Banking Sector in Indonesia to Implement Law of Personal Data Protection

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Abstract

Indonesia's banking industry is evolving in personal data management due to technological advancements, presenting opportunities and challenges. Influenced by global standards like the General Data Protection Regulation (GDPR), Indonesia's Law No. 27 of 2022 on Personal Data Protection incorporates similar principles, including the Data Protection Impact Assessment (DPIA) for high-risk data processing, though implementation regulations are pending. This research develops and validates a tailored DPIA framework for the Indonesian banking sector. It offers practical solutions such as risk identification, assessment, and mitigation measures, alongside recommendations for staff training, localized assessment tools, IT integration, and continuous monitoring mechanisms to ensure compliance. By addressing unique challenges like balancing innovation with compliance and safeguarding consumer trust, this study contextualizes global best practices within Indonesia's regulatory framework, providing valuable insights for policymakers, practitioners, and researchers while emphasizing the critical role of DPIAs in enhancing personal data protection and fostering a culture of privacy in the banking sector.

Keywords: Data Protection Impact Assessment, DPIA, Law No. 27/2022, Indonesian Banking, General Data Protection Regulation, Risk Management, Personal Data, IT Application.

Introduction

In a global context, data is often heralded as the new oil, creating a critical importance and a top priority for protecting personal data. Organizations across the globe collect, store, and process vast amounts of personal information, necessitating robust mechanisms to ensure this data is handled responsibly and securely. One such mechanism is the Data Protection Impact Assessment (DPIA), a vital tool designed to help organizations identify and mitigate risks to data privacy and security; this also includes banks that highly value their customer's data.

The banking sector is uniquely positioned as a critical industry that manages susceptible personal and financial information, including account details, transaction histories, credit information, and

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identification documents. This data is fundamental to the functioning of financial systems and the provision of services such as loans, payments, and investments. Mismanagement or breaches of this data can lead to severe consequences, including identity theft, financial fraud, loss of customer trust, and legal or regulatory repercussions. As financial institutions operate in a highly regulated environment, effective data management is crucial to ensure compliance, safeguard consumer rights, and mitigate risks associated with financial crimes. Maintaining strong data protection practices upholds regulatory standards and strengthens public confidence in the banking system.

The banking industry in Indonesia has faced significant transformation in managing its users' personal data. Such transformation is also triggered by the vast development of information and communication technology (ICT) that enables transboundary connections. In this context, ICT has greatly benefited every sector, including e-commerce, e-education, e-health, e-government, and other sectors. The vast technological improvement that has expanded many opportunities also challenges personal data protection.

Following the European Union (EU) enacting the GDPR, in 2022, Indonesia successfully enacted its data protection regulations through the Law No. 27 of 2022 on Personal Data Protection (Law No. 27/2022). This is a significant game-changer for Indonesia to provide robust protection of one's data. In Law No. 27/2022, Indonesia integrates the GDPR principles as its primary reference in personal data protection. One is the Data Protection Impact Assessment (DPIA), further regulated under Article 35 of GDPR.

The assessment process in the DPIA includes four important components: system description evaluation of processing operations in line with the specified objectives, risk assessment to protect the rights and freedoms of data subjects, and anticipated steps to address identified risks (Article 35 GDPR). DPIA functions as a risk mitigation method arising from data processing activities. Under the GDPR, DPIA is essential in personal data protection regulations. It enables organizations, including the banking sector, to identify potential risks associated with personal data processing. In this way, DPIA plays a crucial role in maintaining individual privacy and managing risks that may threaten public trust and regulatory compliance.

In Indonesia, the regulations explicitly addressing DPIA in the banking sector are also outlined in POJK No. 11/POJK.03/2022, which mandates that banks must implement personal data protection principles when processing personal data. Should conditions arise that potentially increase risks to personal data owners, banks must conduct an impact assessment regarding applying personal data protection principles as stipulated.

Based on the author's research, previous studies have not explicitly focused on the banking sector. For instance, research by López et al. (2021) focused on identity management technology, while Yungratog et al. (2022) discussed data protection risks in the maritime industry. Therefore, this study is among the first to develop and test a DPIA framework specifically tailored for the banking sector in Indonesia.

The regulations in Indonesia, specifically in the Indonesian banking sector regarding DPIA, or in Indonesian known as *Penilaian Dampak Perlindungan Data Pribadi*, are found in the statutory provisions and applicable regulatory provisions, including, among others, Law No. 27 of 2022 concerning Personal Data Protection and POJK No. 11 of 2022 concerning the Implementation of Information Technology by Commercial Banks.

In Law No. 27/2022, the regulation of DPIA is stipulated under Article 34, which mandates that Personal Data Controllers must conduct a DPIA when the processing of Personal Data carries a high potential risk to Personal Data Subjects. The law further explains that further provisions regarding the impact assessment of Personal Data Protection will be regulated in Government Regulations. As of today, the said Government Regulation has yet to be enacted. However, the said bill of the Government Regulation has been provided for a public review. The bill has outlined several minimum requirements that must be included in the DPIA.

This paper will discuss the development of a DPIA framework in the Indonesian banking sector under Law No. 27/2022. The objective is to uncover best practices in conducting DPIA as a framework for managing and protecting customer personal data. This paper will analyze the component of Law No.

27/2022 in the banking sector and combine the current best practices experience and assessment tools for GDPR with a specifically developed framework to measure the preparedness and readiness of Indonesian banking in compliance with Law No. 27/2022. This will help banking sectors understand the requirements under Law No. 27/2022, identify which area needs to be improved and enhance their compliance with Law No. 27/2022. The systematic literature review (SLR) is based on the following questions:

1. What components constitute the framework for DPIA in Indonesian Banking under the UU PDP?
2. How can the framework instruments measure Data Protection Impact Assessment in Indonesian Banking under the UU PDP?
3. How can these instruments be validated through case studies in Indonesian banking?

Literature Review

DPIA: Views From the European Union and Indonesia

DPIA in the European Union

DPIA, under Article 35 of the GDPR, is a process that systematically examines how personal data is processed and evaluates the potential risks that such processing may pose to the privacy and security of individuals (General Data Protection Regulation, n.d.). This assessment is not just a regulatory checkbox but a proactive approach to data protection, emphasizing the need for privacy by design and default. By conducting a DPIA, organizations can foresee potential privacy issues before they become problematic, allowing them to implement measures that protect personal data effectively. Under Article 35 of the GDPR, a DPIA must include a detailed description of the intended processing activities and their purposes, an evaluation of the necessity and proportionality of these activities about their goals, an assessment of the potential risks to individuals' rights and freedoms, and the measures planned to mitigate these risks. These measures should ensure personal data protection, demonstrate compliance with the GDPR, and consider the rights and legitimate interests of the affected individuals and other stakeholders.

The concept of DPIA has been significantly highlighted by the General Data Protection Regulation (GDPR) that took effect in May 2018. Under the GDPR, DPIAs are mandatory for processing activities that are likely to result in a high risk to the rights and freedoms of individuals. This includes large-scale processing of sensitive data, systematic monitoring of public areas, and any other operations that could potentially have significant privacy implications. By requiring DPIAs, the GDPR aims to ensure that data protection is an integral part of the data processing lifecycle rather than an afterthought. The DPIA is required if the controller uses the latest technologies in consideration of the nature, scope, contexts, and objectives of the processing, which may create a high risk to one's freedom and rights.

DPIA Guidelines Under the Article 29 Data Protection Working Party

Before the establishment of the European Data Protection Board and the enactment of the GDPR, the Article 29 Working Party (the A29WP), which dealt with issues relating to the protection of privacy and personal data, issued data protection directives (The European Data Protection Board, 2018).

The A29WP created a guideline on the DPIA and determined whether the data processing is considered "likely to result in high risk" by the GDPR 2016/679 in the EU. The basic principle of DPIA in GDPR is shown in the following scheme as shown in Figure 1.

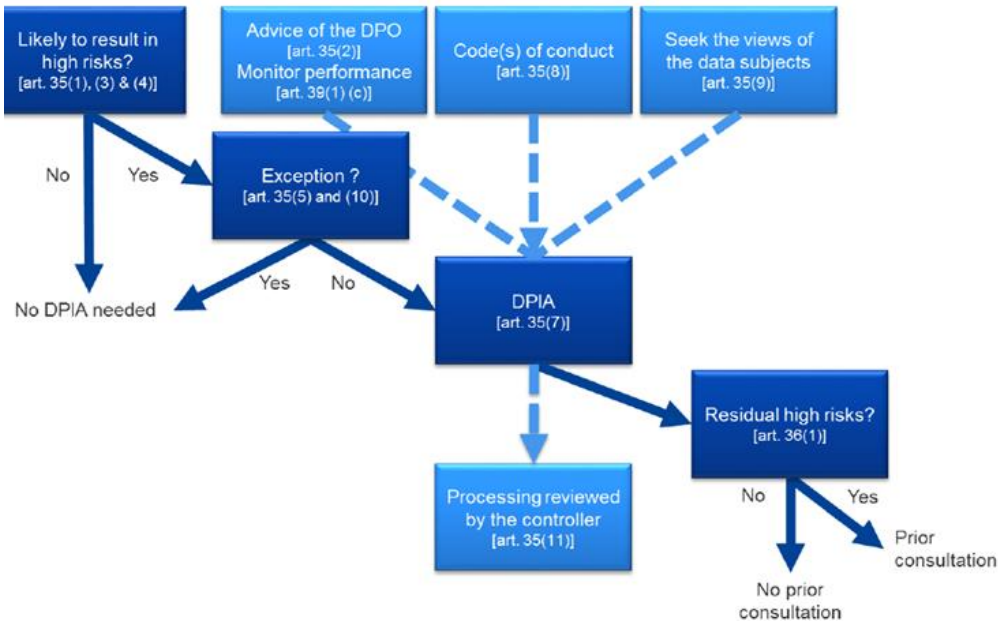

Figure 1. Fundamental DPIA Principle under the GDPR

DPIA on Law No. 27/2022 on Personal Data Protection and Bill of Government Regulation on Personal Data Protection

Law No. 27/2022 obligated the data controller to assess the impact of Personal Data Protection (or, in short, the DPIA) if processing such personal data has a high-risk potential to the Personal Data subject. Law No. 27/2022 provides a threshold for processing personal data that is considered high-risk and further mandates that any technical implementations regarding personal data processing shall be regulated under specific Government Regulations. However, to this date, the Indonesian Government is still carefully deliberated the bill.

Even though the bill has yet to be enacted, the bill is available for the public to see the latest updates (Bill of Indonesian Government Regulation on Personal Data Protection, 2024). The bill has included the proposed obligations to conduct DPIA before processing high-risk personal data. The DPIA further must consist of the following:

1. A systematic description of the Personal Data processing activities and the purposes of Personal Data processing, including the interests of the Personal Data Controller in this processing;
2. An assessment of the necessity and proportionality between the purposes and the Personal Data processing activities;
3. An assessment of the risks to the protection of the rights of Personal Data Subjects and
4. Measures the Personal Data Controller uses to protect Personal Data Subjects from the risks of Personal Data processing.

Regulation of the Financial Services Authority (Otoritas Jasa Keuangan) of the Republic of Indonesia No. 11/POJK.03/2022 on the Organization of Information Technology by Commercial Banks

Regarding data protection, banks are obligated to manage data effectively to support the achievement of business objectives of such banks (OJK Regulation No. 11/POJK.03, 2022). Further, under OJK Regulation No. 11/POJK 03 (2022), banks must implement personal data protection principles in processing personal data. They shall also conduct an impact assessment upon implementing personal data protection principles in which, in certain conditions, such data can potentially increase the risks of personal data owners.

The OJK Regulation No. 11/2022 commentary states that personal data protection principles must comply with the current laws and regulations on personal data protection. Additionally, the commentary on Article 44 paragraph (2) outlines specific conditions that must be met, which include actions such as the use of new technologies, tracking customers' locations and behaviors, large-scale monitoring of public facilities, and processing sensitive personal data related to ethnicity, religion, race, and intergroup relations.

Methodology

Research Database Search and Keywords

The research targets international studies on frameworks or readiness assessment instruments related to technology and information systems. Databases used include Google Scholar, Science Direct, ACM Digital Library, and Elsevier (Scopus), with keywords: ("assessment" OR "tools" OR "framework") AND (“Data Protection Impact Assessment” OR “DPIA”) AND (“Banking” OR “Financial”).

Criteria for selecting research include:
1. Publications from the last five years (2019-2023).
2. Publications in journals or proceedings.
3. Full-text publications.
4. Publications in English.

3,564 documents were obtained: 144 from ScienceDirect, 62 from Elsevier Scopus, 3,320 from Google Scholar, and 38 from ACM Digital Library. The documents were then screened according to the above criteria, resulting in six documents relevant to the research questions, which can be seen in López et al. (2021), Demetzou et al. (2019), Horák et al. (2019), Chatzipoulidis et al. (2019), Dashti and Ranise (2020) and Yungratog et al. (2022).

We conducted a Literature Review using the PRISMA methodology. PRISMA is a widely used health and social sciences method for conducting literature reviews. This method is an organized and transparent approach with guidelines for performing and reporting systematic reviews. The process involves several stages, such as identifying and selecting relevant studies, extracting and analyzing data, synthesizing findings, assessing the quality of evidence, and presenting results as shown in Figure 2.

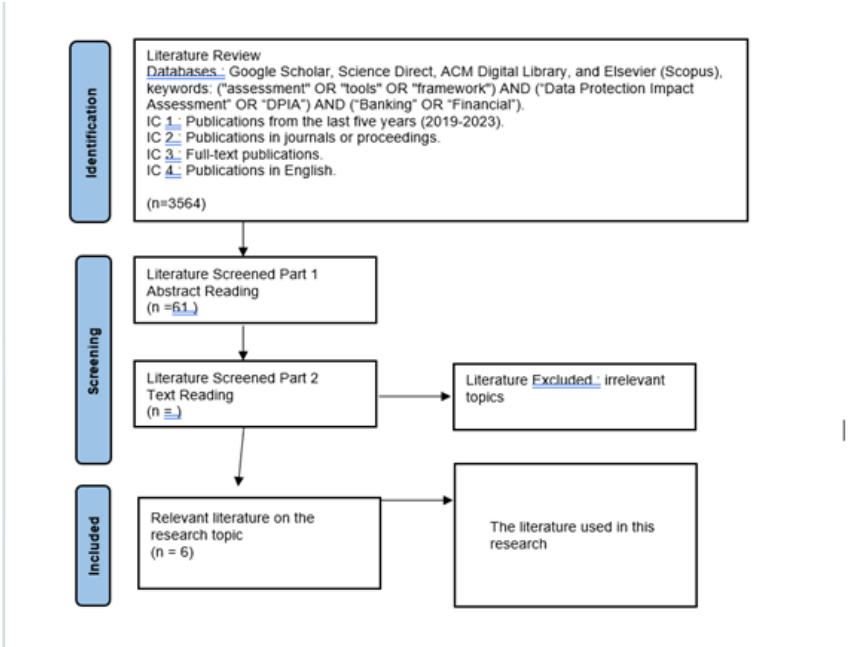

Figure 2. PRISMA SLR (Modified)

The results from the obtained documents, along with a case study referring to primary and secondary sources (e.g., writing references, documents, observation, and interviews), are utilized to analyze the

issues arising from the DPIA under Law No. 27/2022 to address the research questions. After obtaining the abovementioned instruments, the 3 (three) independent raters will be measured using Inter-Rater Reliability with Fleiss' Kappa. Inter-rater reliability (IRR) is a crucial component in qualitative research to ensure consistent interpretation of data among multiple raters. Fleiss' Kappa is one of the statistics used to measure IRR, especially when there are more than two raters.

Fleiss' Kappa is a statistical measure used to evaluate the level of agreement between multiple raters when assigning categorical ratings to a set of items. Unlike Cohen's Kappa, which is suitable for two raters, in the context of validating the framework instrument developed for the Personal Data Protection Impact Assessment (DPIA) in the banking sector in Indonesia, the Fleiss Kappa method was implemented to measure the level of agreement between raters. Fleiss 'Kappa accommodates assessments by more than two raters, making it an appropriate choice for this study, where three experts evaluated the proposed framework.

Fleiss' Kappa ensures the instrument's reliability by quantitatively measuring the consistency of ratings among the legal expert, the Data Protection Officer (DPO) from Bank XYZ, and the academic researcher. This method highlights areas of agreement and disagreement, providing insights into the clarity and robustness of the framework.

Fleiss' Kappa is particularly suited for studies that involve subjective assessments and qualitative judgments, as it accounts for the possibility of agreement occurring by chance. Its application in this research aligns to ensure a robust and validated framework for conducting DPIAs in the Indonesian banking sector.

The following are the steps for calculating Fleiss' Kappa that will be carried out by the author based on the method described in Cole (2023):

1. Determining the Experts as the Independent Raters

   The Independent Raters chosen are the DPO of Bank XYZ, the Legal of Bank XYZ, and Academics.

2. Data Preparation

   Collection of evaluation by the Independent Raters which is a table consisting of the Independent Experts' rates with the categories of "Suitable" and "Not Suitable".

3. Calculating Frequencies

   Further will calculate the total rates of every question given to the Independent Raters.

4. Calculating Proportions

   After calculating the frequency, the next step is to calculate the proportion. Proportion describes the share of raters who chose each answer category for each question to obtain a more detailed picture of the distribution of answers among raters.

   In calculating the proportion, the first step is to calculate the actual proportion of agreement ($\bar{P}$), namely the average agreement between raters for each question *i*, the proportion of agreement *Pi*.

$$Pi = \frac{1}{n(n-1)} \sum_{k=1}^{k} nik\ (nik - 1)$$

   Information:

   - *n* is the number of raters
   - *k* is the number of answer categories
   - *nik* is the number of raters who chose answer category k for question i.

   After calculating *Pi* for all questions, further is to calculate the average ($\bar{P}$)

$$\bar{P} = \frac{1}{N}\sum_{i=1}^{N} Pi$$

Information:

- *N* is the number of questions

Then, calculate the expected proportion of agreement by chance ($\overline{(Pc)}$), namely the average of the expected proportion of answers based on the frequency of answer categories in all questions.

The proportion for each answer category is calculated by dividing the number of assessors who chose that category by the total number of assessments using the following formula:

$$Pj = \frac{1}{Nn}\sum_{i=1}^{N} nij$$

Information:

- *Pj* is the proportion of answer *j*
- *N* is the number of questions
- *n* is the number of questions
- *nij* is the number of raters who chose category j for question i.

Then calculate ($\overline{(Pc)}$) by adding the squares of all Pj as follows:

$$\overline{Pc} = \sum_{j=1}^{k} Pj^2$$

By calculating frequencies and proportions, researchers can understand how answers are distributed among raters and prepare data for the next step in calculating Fleiss' Kappa.

5. Calculating Kappa Value

After obtaining the actual agreement proportion and the proportion expected by chance, the next step is to calculate the Kappa value using the following formula:

$$k = \frac{\bar{P} - \overline{Pc}}{1 - \overline{Pc}}$$

Information:

- $\bar{P}$ is the proportion of actual deals
- $\overline{Pc}$ is the proportion expected by chance?

6. Interpretation of Results:

The last step is to interpret the Fleiss' Kappa values to determine the level of inter-rater agreement:

- 0.01–0.20: Slight agreement
- 0.21–0.40: Fair agreement
- 0.41–0.60: Moderate agreement
- 0.61–0.80: Substantial agreement
- 0.81–1.00: Almost perfect agreement.

Discussion

Connections between A29WP and the European Data Protection Board

As previously mentioned, before the establishment of the European Data Protection Board (EPDB), the independent *advisory body* function done by the A29WP which was established under the directives of Article 29 Directive 95/46/EC back in 1995. With the GDPR fully enacted, the A29WP became the EPDB as of 25 May 2018. Even though the advisory body has changed, all the prior guidelines, recommendations, and documents produced under the A29WP are still in force and have been endorsed by the EPDB through its first plenary on 25 May 2018. Currently, the DPIA Guidelines are still in force and the legit reference for the enforcement guidelines for DPIA practices by data controllers under the GDPR.

Current Status of Government of Indonesia's Regulation Bill on Personal Data Protection

Article 34 paragraph (3) Law No. 27/2022 mandated the Government to create an implementing regulation on the practice of the DPIA and other aspects of Personal Data Protection. However, up to this date, the current bill is still undergoing internal consultation within the ministries; the public does have access to the bill based on the draft as of September 2023. The draft has identified and inserted the criteria for conducting DPIA, such as the GDPR's DPIA requirements and guidelines.

Comparison between Indonesia and EU's Practices on DPIA

After carefully analyzing and comparing both regulations between Indonesia's Law No. 27/2022 and its bill of Government Regulation with the GDPR and DPIA Guidelines, Table 1 describes the main framework of both regulations.

Table 1. Comparisons between Indonesia and the EU on DPIA

Indonesia **(Law No. 27/2022 and Bill of Govt Reg)**	**European Union** **(GDPR and A29WP)**
Provide a systematical description of personal data processing	A systematic description of the processing is provided (Art. 35(7)(a)): ▪ Nature, scope, context, and purpose of the processing are taken into account (recital 90); ▪ Personal data recipients and period for which the personal data will be stored and recorded; ▪ A functional description of the processing operation is provided; ▪ the assets on which personal data rely (hardware, software, networks, people, paper or paper transmission channels) are identified; ▪ compliance with approved codes of conduct is taken into account (Article 35(8) ;
Assessment of necessity and proportionality of the objectives and activity of personal data processing	Necessity and proportionality are assessed (Article 35(7)(b)):

Indonesia **(Law No. 27/2022 and Bill of Govt Reg)**	**European Union** **(GDPR and A29WP)**
	▪ measures envisaged to comply with the Regulation are determined (Article 35(7)(d) and recital 90), taking into account: o measures contributing to the proportionality and the necessity of the processing based on: • specified, explicit and legitimate purpose(s) (Article 5(1)(b)); • lawfulness of processing (Article 6); • adequate, relevant, and limited to what is necessary data (Article 5(1)(c)); • limited storage duration (Article 5(1)(e)); o measures contributing to the rights of the data subjects: • information provided to the data subject (Articles 12, 13 and 14); • right of access and to data portability (Articles 15 and 20); • right to rectification and to erasure (Articles 16, 17 and 19); • right to object and to restriction of processing (Articles 18, 19, and 21); • relationships with processors (Article 28); • safeguards surrounding international transfer(s) (Chapter V); • prior consultation (Article 36).
Inclusion of risk assessment for protecting the rights of Personal Data Subject	Risks to the rights and freedoms of data subjects are managed (Article 35(7)(c)): ▪ origin, nature, particularity, and severity of the risks are appreciated (cf. recital 84) or, more specifically, for each risk (illegitimate access, undesired modification, and disappearance of data) from the perspective of the data subjects:

Indonesia (Law No. 27/2022 and Bill of Govt Reg)	European Union (GDPR and A29WP)
	○ Risk sources are taken into account (recital 90); ○ potential impacts on the rights and freedoms of data subjects are identified in case of events including illegitimate access, undesired modification, and disappearance of data; ○ threats that could lead to illegitimate access, undesired modification, and disappearance of data are identified; ○ likelihood and severity are estimated (recital 90); ▪ measures envisaged to treat those risks are determined (Article 35(7)(d) and recital 90);
Measures used by the Personal Data Controller to protect Personal Data Subject from the risks of personal data processing activity	Interested parties are involved: ▪ The advice of the DPO is sought (Article 35(2)); ▪ The views of data subjects or their representatives are sought where appropriate (Article 35(9)).

Components in the DPIA Framework for Banks in Indonesia on the Implementation of Law No. 27/2022

To address the first research question, the author developed the framework components based on the discussions presented in Chapter 2 and the points outlined in sections 1 and 2 above. This development refers to POJK No. 11/POJK.03/2022, which mandates that in circumstances with the potential to increase risks for personal data owners (as per this regulation, referring to bank customers and/or prospective customers), banks must conduct an impact assessment on the implementation of personal data protection principles. These principles and personal data definitions align with the provisions of personal data protection regulations. Such conditions include using new technologies, tracking customer locations and behavior, monitoring large-scale public facility locations, and processing sensitive personal data about ethnicity, religion, race, and intergroup affiliation.

The methodology used to analyze the components of the Personal Data Protection Impact Assessment (DPIA) framework consists of three steps based on the approach outlined by Dashti et al. (2019): Processing Analysis, Risk Analysis, and Execution Time Analysis. This three-step grouping is not only informed by Dashti et al. (2019) but also by the guidelines in the *"Guidelines on Data Protection Impact Assessment (DPIA) and determining whether processing is 'likely to result in a high risk' for Regulation 2016/679."* These guidelines emphasize a structured approach to ensure comprehensive risk assessment and mitigation.

1. The first step, Processing Analysis, aligns with Article 35(7)(a) of the GDPR.
2. The second step, Risk Analysis, corresponds to Articles 35(7)(c) and (d) of the GDPR.
3. The third step, Real-Time Execution Analysis, involves continuous monitoring and review, as Article 35(11) of the GDPR mandates.

These steps were adopted and adjusted to the Indonesian Personal Data Protection Law (UU PDP) provisions and its Draft Government Regulation (RPP PDP) to ensure a comprehensive and iterative approach to PDPDP. This approach integrates legal and technical aspects of data protection as required by the UU PDP, ensuring the effective identification and management of relevant risks and providing a robust framework for protecting the rights and freedoms of data subjects. Figure 3 shown the proposed framework.

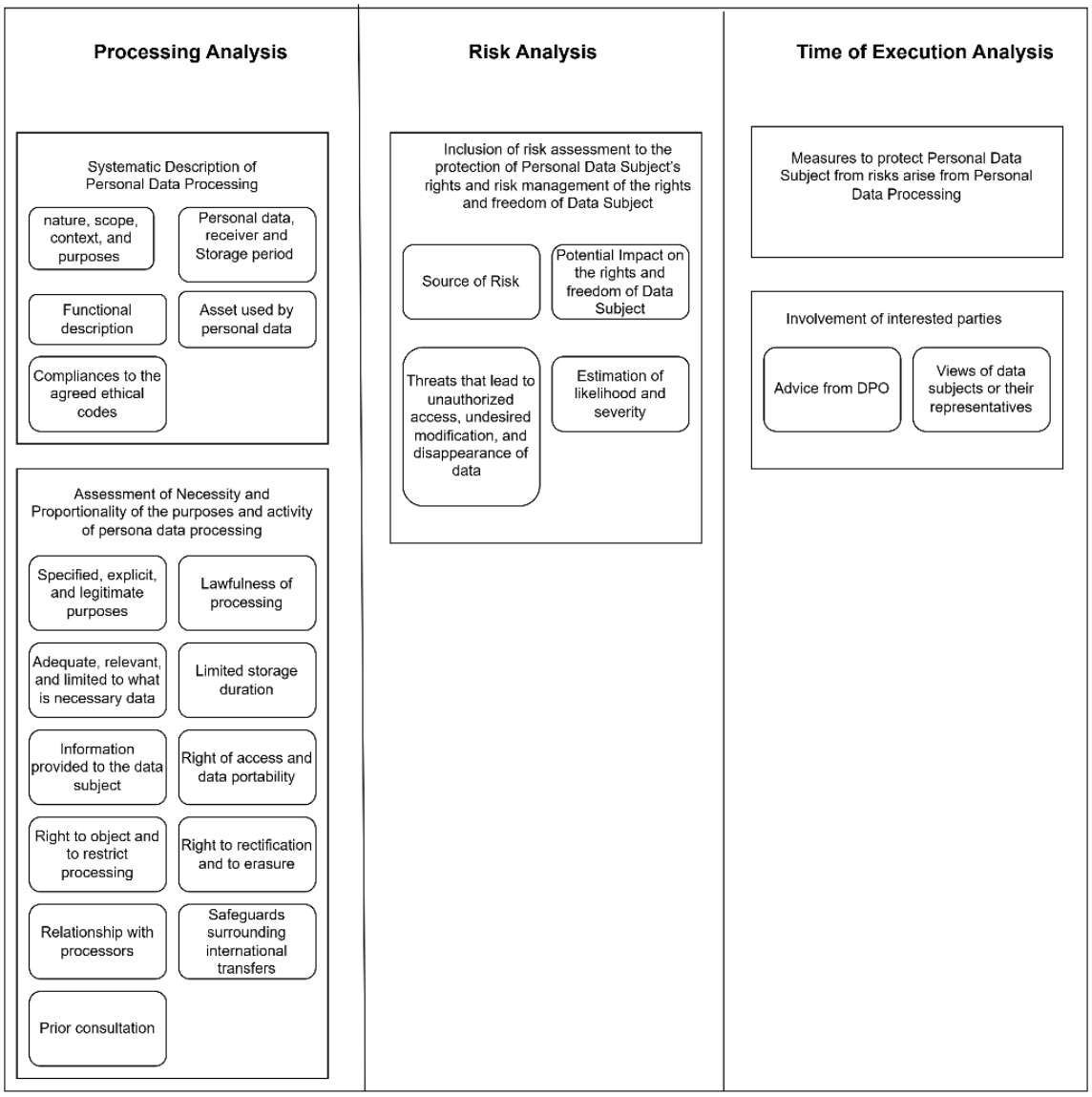

Figure 3. Proposed Framework of DPIA in Indonesia

Instruments derived from the Framework of DPIA and the Applicability to measure DPIA in Indonesian Banks

After determining the above-mentioned framework, the next step is to create an instrument by applying a layered DPIA methodology. The first layer ensures whether the processed data is categorized as personal data or risk analysis (multiplication of probability times impact). The second layer consists of a review of compliance levels with data protection principles within the specific scope of data processing.

After the abovementioned analysis, the following are the combined instruments from Law No. 27/2022 and Bill of Government Regulation on Personal Data Protection with the GDPR and A29WP, which can be seen in Table 2.

Table 2. Instruments to Measure DPIA in Indonesian Banks

Scope	Instrument	Measuring Questions
First Layer: **Fulfillment of criteria of processed data that can be categorized as personal data, risk analysis (multiplication of probability times impact)**	Initial Assessment: In this initial assessment process, the Personal Data Controller must conduct an assessment on DPIA if the said processing has a potential of being high risk to the Personal Data Subject, in line with the criteria mentioned under Law No. 27/2022.	Is DPIA necessary to be done in line with Law No. 27/2022 and the Bill of Government Regulation on Personal Data Protection?
	1. Automatic decision-making that can cause legal consequences or significant impact on the Personal Data Subject.	1. Does Personal Data Processing involve automated decision-making that could have legal consequences or significantly impact the Personal Data Subject?
	2. Personal Data Processing with specific personal data.	2. Does the Personal Data Processing use specific personal data?
	3. Large-scale Personal Data Processing.	3. Is the Personal Data Processing carried out on a large scale?
	4. Processing of personal data that includes systematic evaluation, scoring, or monitoring activities of Personal Data Subject.	4. Does the processing of personal data include systematic evaluation, scoring, or monitoring activities of the Personal Data Subject?
	5. Data Processing includes activities of matching or combining groups of personal data.	5. Does processing personal data involve matching or combining groups of personal data?
	6. Usage of the latest technology in personal data processing	6. Does the processing of personal data use the latest technologies?
	7. Processing of personal data limits the exercise of the Personal Data Subject's rights.	7. Does the processing of personal data limit the exercise of Personal Data Subjects' rights?

Scope	Instrument	Measuring Questions
Personal Data Processing Activity	Systematic Description of the processing and the purposes of the processing, including the interest of the Personal Data Controller.	8. What purpose will be achieved by processing the Personal Data? 9. Has the lawful processing basis for processing such activities been determined?
	Calculation of nature, scope, context, and purpose of processing	10. Who is the Data Subject in Personal Data Processing? 11. What kind of Personal Data is used in Personal Data Processing?
	Recording of personal data, recipients, and storage period of personal data	12. Has there been a scheduled deletion for data and/or information that has exceeded the Personal Data storage period?
	Provision of functional description of processing operations.	13. Are the functional descriptions and processing operations available?
	Identification of assets that personal data is used on (hardware, software, networks, people paper, or similar transmission channels).	14. What assets will use the personal data?
	Compliance with the agreed ethical code	15. Is the Personal Data Processing for the stated and specified purposes not in conflict with the prevailing laws, code of conduct, or any public policy?
Purpose and Activity of Personal Data Processing	Assessment of the need and proportionality between the purposes and activities of Personal Data Processing	16. Is the Personal Data Processing carried out according to the purpose and needs conveyed to the Personal Data Subject, and are there no other needs?
	Specified, explicit, and legitimate purposes	17. Is the collection of Personal Data carried out for stated, specified, explicit, and legitimate purposes? 18. Is the Personal Data Processing carried out by the consent of the Personal Data Subject?
	Lawfulness of processing	19. Is there a process to ensure that the Personal Data used remains accurate and complete?

Scope	Instrument	Measuring Questions
	Adequate, relevant, and limited to what is necessary data	20. Is there a process to ensure that the Personal Data used is adequate, accurate, and limited to what is necessary?
	Limited storage duration	21. Will the processing of Personal Data follow the Personal Data retention schedule that applicable internal rules or regulations have determined? 22. Describe the appropriate steps to destroy or de-identify Personal Data if it is no longer needed.
	Information provided to the data subject	23. In Personal Data Processing activity, does the Data Subject request information regarding clarity of identity, the basis for legal interest, the purpose of requesting and using Personal Data, and the responsibilities of the party requesting Personal Data?
	Right to access and to data portability.	24. In Personal Data Processing, can the Data Subject obtain access and a copy of his/her Personal Data by the prevailing laws and regulations?
	Right to rectification and to erasure	25. In Personal Data Processing, whether the Data Subject makes corrections (completing, updating, and/or correcting errors and/or inaccuracies in their own Personal Data) and/or deletes/destroys Personal Data provided to the Personal Data Controller?
	Right to object and to restrict processing.	26. In Personal Data Processing, whether the Data Subject can object to or limit the processing of Personal Data?
	Relationships with processors	27. Does the Personal Data Subject know the identity of the data controller or the organization or entity that processes their Data?
	Safeguards surrounding international transfers	28. Whether the processing of Personal Data only include sending data within the domestic area or include transboundary?
	Prior Consultation	
Risk Assessment	Risk Assessment of the protection of Personal Data Subject's rights	29. Are Personal Data Subjects aware of the risks that may occur and the security measures taken in processing their Data?

Scope	Instrument	Measuring Questions
	Risk management of the rights and freedom of Data Subject	30. How do we manage risks to the rights and freedom of Data Subjects?
	Tally of Source of Risks	31. Are there any security issues previously occurring in processing Personal Data?
	Identification of threats that could lead to illegitimate access, undesired modification, and disappearance of data	32. Is Personal Data processed on this system encrypted in transit or stored?
	Identification of threats that could lead to illegitimate access, undesired modification, and disappearance of data	33. Is there any identification of risks that lead to illegitimate access, undesired modification, and disappearance of data?
	Estimation of severity	34. Is there any review of the incident to be used as a learning material and update the related system/program?
Protection of the Personal Data Subject from Risks	Measures to be taken by the Personal Data Controller to protect Personal Data Subject from risks of personal data processing	35. Have the data security principles been implemented in Personal Data Processing? 36. Is there any regular training for staff regarding data security?
	Determining anticipated measures to handle risks	37. Have any anticipatory steps been determined to handle risks?
	Involvement of interested parties, such as: ○ Advice from Data Protection Officer ○ Views of Data subjects or their representatives, where appropriate.	38. Are the Personal Data Subjects provided with information on how to contact the Data Protection Officer (DPO)? 39. Does Personal Data Processing involve the Data Protection Officer (DPO)?

Instruments Validation Through Case Study in The Banking Sector in Indonesia

The abovementioned instruments are validated through the Fleiss Kappa method, which is depicted in Table 3.

Table 3. Results of Validation of Instrument Using Fleiss' Kappa Method

Question(s)	Rater 1	Rater 2	Rater 3	Total Suitable	Total Not Suitable	*Pi*
1	Suitable	Suitable	Suitable	3	0	1
2	Suitable	Suitable	Suitable	3	0	1
3	Suitable	Suitable	Suitable	3	0	1
4	Suitable	Suitable	Suitable	3	0	1
5	Suitable	Suitable	Suitable	3	0	1
6	Suitable	Suitable	Suitable	3	0	1
7	Suitable	Suitable	Suitable	3	0	1
8	Suitable	Suitable	Suitable	3	0	1
9	Suitable	Suitable	Suitable	3	0	1
10	Suitable	Suitable	Suitable	3	0	1
11	Suitable	Suitable	Suitable	3	0	1
12	Suitable	Suitable	Suitable	3	0	1
13	Suitable	Suitable	Suitable	3	0	1
14	Suitable	Suitable	Suitable	3	0	1
15	Suitable	Suitable	Suitable	3	0	1
16	Suitable	Suitable	Suitable	3	0	1
17	Suitable	Suitable	Suitable	3	0	1
18	Suitable	Suitable	Suitable	3	0	1
19	Suitable	Suitable	Suitable	3	0	1
20	Suitable	Suitable	Suitable	3	0	1
21	Suitable	Suitable	Suitable	3	0	1
22	Suitable	Suitable	Suitable	3	0	1
23	Suitable	Suitable	Suitable	3	0	1
24	Suitable	Suitable	Suitable	3	0	1
25	Suitable	Suitable	Suitable	3	0	1

Question(s)	Rater 1	Rater 2	Rater 3	Total Suitable	Total Not Suitable	*Pi*
26	Suitable	Suitable	Suitable	3	0	1
27	Suitable	Suitable	Suitable	3	0	1
28	Suitable	Suitable	Suitable	3	0	1
29	Suitable	Suitable	Suitable	3	0	1
30	Suitable	Suitable	Suitable	3	0	1
31	Suitable	Suitable	Suitable	3	0	1
32	Suitable	Suitable	Suitable	3	0	1
33	Suitable	Suitable	Suitable	3	0	1
34	Suitable	Suitable	Suitable	3	0	1
35	Suitable	Suitable	Suitable	3	0	1
36	Suitable	Suitable	Suitable	3	0	1
37	Suitable	Suitable	Suitable	3	0	1
38	Suitable	Not Suitable	Not Suitable	1	2	0.33333333
39	Suitable	Suitable	Suitable	3	0	1
				115	2	0.98290598
				0.966104	0.00029221	0.96639638
				fleiss kappa		**0.49130435**

The results show a Fleiss Kappa value of 0.491, which indicates a moderate level of agreement. This indicates that although there is substantial agreement in many aspects, some areas still require improvement in terms of consistency between raters.

Another thing that affects the value of Fleiss Kappa is that the more answers are concentrated in one column, the higher the expected probability, which is undesirable. The more answers are concentrated in the same column for each row, the higher the observed agreement, which is the goal—finally, the greater the difference between the expected and observed probability, the better. In the Validity test carried out in this research, this became an obstacle because the answer choices were only "Suitable" and "Not Suitable," the answers were concentrated in one column; namely, for each rater, there were many.

One of the important findings in this validation process was identifying significant disagreement on the specific question: "*Are Personal Data Subjects provided with information on how to contact the Data Protection Officer (DPO*)?" From these results, two of the three raters expressed disagreement with the instrument.

Factors that influence the rater's perception and assessment include this disagreement originating from variations in the implementation of bank XYZ's policies, where banking institutions in Indonesia have different policies regarding the function and affordability of DPOs, which directly impacts how the raters assess the availability of this information to the subject. Data, in this case, there is a possibility that at Bank XYZ, the DPO is not directly related to the Personal Data Subject, so the measurement question is not appropriate.

Alignment with Previous Research

This study emphasizes the critical role of Data Protection Impact Assessments (DPIAs) in ensuring compliance with data protection regulations, such as the GDPR and Indonesia's Personal Data Protection Law (UU PDP). López et al. (2021) highlight DPIAs' importance in implementing privacy by design within identity management systems, aligning with our findings demonstrating DPIAs' effectiveness in identifying and mitigating risks in Indonesia's banking sector.

Employing a methodology inspired by Dashti et al. (2019), we analyzed DPIA framework components through processing, risk, and execution time analysis, providing a comprehensive evaluation basis. Consistent with prior research, including Yungratog et al. (2022), our study underscores risk analysis as a pivotal DPIA component for managing personal data processing risks within Indonesia's banking industry. These insights contribute to the broader understanding of DPIA implementation, offering practical guidance for enhancing data protection practices in sector-specific contexts.

Divergence from Previous Research

The Indonesian banking sector faces significant shifts in personal data management driven by technological advancements, requiring alignment with global standards like the GDPR. Law No. 27 of 2022 on Personal Data Protection (UU PDP) adopts similar principles, including the mandate for a Data Protection Impact Assessment (DPIA) for high-risk data processing, although specific implementation guidelines remain absent. This study develops and validates a DPIA framework tailored to Indonesia's banking sector. It provides a structured risk assessment and mitigation approach alongside recommendations for localized tools, staff training, process integration, IT automation, and continuous monitoring. This research contextualizes global best practices within Indonesia's legal framework by addressing unique sectoral challenges, such as balancing compliance with innovation and safeguarding consumer trust. It highlights the critical role of DPIAs in fostering a culture of privacy while ensuring regulatory compliance. Additionally, limitations in the validation process, mainly restricted response options, emphasize the need for more nuanced methodologies to enhance accuracy and applicability in future research.

Suggestions

The following suggestions are provided for future researchers:

1. Future researchers are encouraged to use a variety of validation instruments and not rely solely on one method, such as Fleiss' Kappa. Employing multiple validation methods can offer a more comprehensive view and ensure that research results are more accurate and reliable.
2. Future studies should be conducted across various banking institutions in Indonesia, including large and small banks and Islamic banks. This is important to ensure that the findings are generalizable and relevant to the entire banking sector in Indonesia.
3. Future researchers may consider conducting comparative studies between the implementation of DPIA in banking and other sectors, such as healthcare, e-commerce, and telecommunications. Such comparative studies could reveal differences and similarities in implementing DPIA across industries and provide broader insights into best practices for personal data protection.
4. Given the rapid technological advancements, future research should explore the impact of new technologies, such as Artificial Intelligence (AI), on implementing DPIA. These technologies can potentially enhance the accuracy and efficiency of risk assessments and personal data management.

Conclusion

This study successfully develops a comprehensive framework for the Personal Data Protection Impact Assessment (PDPIA), addressing the specific needs of Indonesia's banking sector in alignment with the Personal Data Protection Law (PDP Law). The framework is structured around three core components: processing analysis, which systematically examines the necessity and proportionality of personal data processing activities; risk analysis, which identifies and mitigates risks to the rights and freedoms of data subjects; and execution time analysis, which focuses on implementing protective measures and involving relevant stakeholders during the data processing lifecycle. These components provide a structured approach to understanding and managing data protection obligations.

The proposed methodology integrates these components into a practical, multi-layered system. At the initial stage, the framework ensures the processed data qualifies as personal data and evaluates associated risks based on likelihood and impact. In subsequent phases, compliance with data protection principles is reviewed in the context of the specific processing activities. These instruments are critical tools for enabling Indonesian banks to implement DPIAs effectively and address sector-specific challenges under the PDP Law.

To validate the framework, assessments were conducted by three experts—a legal representative, a Data Protection Officer (DPO) from Bank XYZ, and an academic. Fleiss' Kappa was employed to measure inter-rater agreement, yielding a moderate score of 0.491. While this result confirms the framework's reliability, it also highlights opportunities to enhance the consistency of evaluations. Despite these challenges, the framework offers a practical solution to facilitate compliance with the PDP Law, ensuring the protection of personal data subjects while maintaining operational efficiency.

The study further underscores the importance of integrating IT tools to improve the accuracy and efficiency of the assessment process. It also emphasizes the need for ongoing monitoring and evaluation to sustain compliance and adapt to evolving regulatory requirements. By contextualizing global best practices within Indonesia's regulatory framework, this research provides valuable insights for improving personal data protection in the banking sector. It contributes to the broader discourse on privacy and data governance.

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The Effectiveness of Bank Indonesia's SME Development Strategies, Policies, and Support in Financial Technology

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Abstract

This study aims to assess the effectiveness of strategies, policies, and support offered by Bank Indonesia for the growth of Small and Medium Enterprises (SMEs) in the Financial Technology (FinTech) sector. Using qualitative methods, thematic analysis, and frequency analysis, this study highlights the existing gaps in research on institutional support for SMEs during the digital era, especially within the Indonesian framework. A significant contribution of this research is the detailed exploration of SMEs' perspectives on the support they receive, focusing on areas such as infrastructure, digital literacy, and regulatory frameworks. Findings show that SMEs are generally positive about Bank Indonesia's initiatives, despite challenges in technical, administrative, and networking aspects. In addition, this research proposes actionable recommendations for Bank Indonesia and other relevant bodies to improve FinTech infrastructure, increase awareness and education, and revise regulations to better facilitate SME development. In addition, this research lays the groundwork for future longitudinal and comparative analyses to measure the long-term impact of Bank Indonesia's policies and to create predictive models that can pinpoint important elements that influence the use and success of digital payment solutions among SMEs. In addition to offering policy insights for Indonesia, this research also contributes to the broader global context by understanding the role of institutional support in advancing SMEs in the FinTech industry.

Keywords: bank indonesia, digital payment, financial technology, SMEs, technology adoption, thematic analysis, frequency analysis

Introduction

As the trend of shopping through digital platforms grows, technology, especially in the financial sector, provides many conveniences. Making transactions is now easier, and consumers can now make

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payments without using physical money, simply by using a smartphone to access payment applications or digital wallets (Mansour, 2022). The reason for this rising trend is also driven by its practicality and widespread adoption, becoming a way of payment on various buying and selling platforms (Antareza et al., 2021). Figure 1 (Septiani, 2023) shows that digital payment transactions using e-wallets (such as OVO, GoPay, ShopeePay, DANA, LinkAja, Sakuku, iSaku, JakOne Mobile, and Doku) are the most popular among the public in 2023.

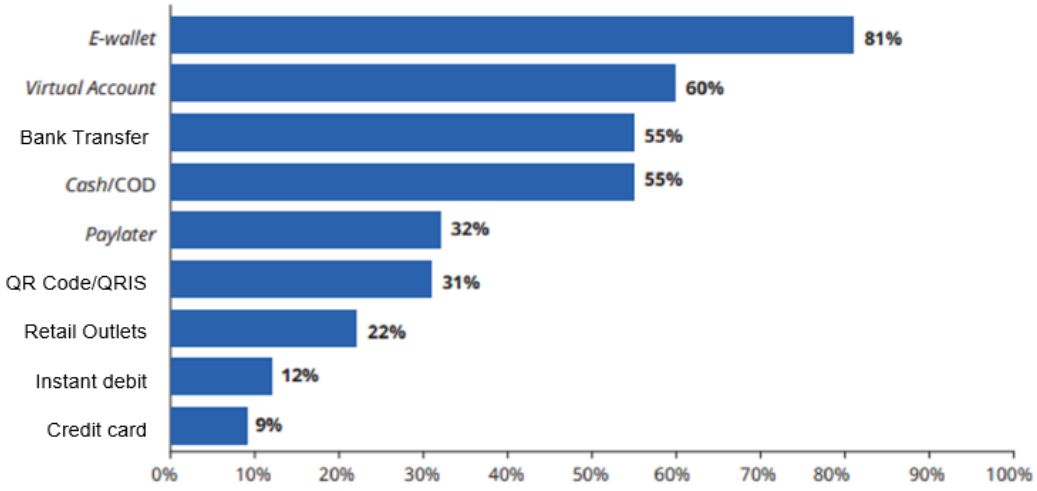

Figure 1. Indonesia's Digital Payment Trends in 2023 (Septiani, 2023)

The emergence of new services in the banking and finance industry has been heavily influenced by telebanking, online/mobile banking, and other financial technologies (fintech). These developments have enabled the industry to meet the common challenges associated with facilitating cross-industry transactions, thanks to improvements in affordability, speed, efficiency, effectiveness, and information disclosure (Mbaidin et al., 2023). Mobile devices such as cell phones, PDAs, wireless tablets, and similar devices that can connect to mobile telecommunications networks facilitate payments. Also, the mobile payment industry has undergone rapid changes, characterized by the emergence of new technologies, different business models, new applications, and fluctuations in business development (Au & Kauffman, 2008).

MSMEs are one of the main pillars in the Indonesian economy. According to data from the Ministry of Cooperatives and SMEs, there are currently around 64.2 million MSMEs that contribute 61.07% to GDP, or around 8,573.89 trillion rupiah. In addition, MSMEs also have a major role in absorbing labor, employing around 117 million people, which covers 97% of the total workforce in Indonesia, and are able to attract around 60.4% of total investment in the first semester of 2021 (Junaidi, 2023). Bank Indonesia also encourages the digitalization of MSMEs as one of the strategic steps to expand financial access and improve the competitiveness of MSMEs amid the development of the digital era (Departemen Komunikasi, 2022). For this reason, the SME sector was chosen as the object of this research.

Other factors driving the increasing utilization of digital money are the conditions of the COVID-19 pandemic and restrictions on social interaction, which encourage people to switch to online transactions to reduce the risk of spreading the virus through paper money (Rosmayanti, 2021). Perry Warjiyo, Governor of Bank Indonesia, revealed that there was an increase of 30.84% in electronic money transactions in 2022, reaching a value of IDR 399.6 trillion compared to 2021. For 2023, it is estimated that there will be a surge of around 23.9% in electronic money transactions, reaching a value of IDR 495.2 trillion. Meanwhile, digital banking transactions also experienced a 28.72% increase in 2022, to IDR 52,545.8 trillion, compared to the previous year. Bank Indonesia projects that by 2023, the value of digital banking transactions will grow by 22.13%, reaching Rp 64,175.1 trillion (Jannah, 2023). Bank Indonesia plans to prioritize digital finance by 2025, including converting the banking sector to digital and unifying the digital economy and finance at the national level. However, based on a report from the Indonesian Payment System Association (ASPI) for the first quarter of 2021, transactions using QRIS in 2020 only reached 123.92 million, with a total value of around IDR 8182 trillion. This number is still

lower when compared to transactions using debit cards, which in the same year were recorded at 6658 million transactions with a total value of IDR 6243 trillion, of which 3999 million were cash withdrawal transactions worth IDR 2991 trillion. This condition is of particular concern given Bank Indonesia's goal to make digital financial transactions a top priority by 2025 (Tenggino & Mauritsius, 2022).

The banking industry continues to transform digitally in line with the changing mindset within the sector (Malinka et al., 2022). However, despite the increasing use of digital money, many businesses in Indonesia, especially SMEs, have yet to fully utilize this payment method. Despite the government's target of 30 million SMEs going digital, including in terms of payments (Kemenkop UKM, 2021); (Rizkinaswara, 2020), only about 21% have made the switch by 2021. So far, the transformation has mainly focused on adding facilities rather than full integration as the main strategy. This suggests that Small and Medium Enterprises (SMEs) in Indonesia have yet to optimize the possibilities offered by digital payment systems. As a result, they are becoming more vulnerable to competition from faster-adapting businesses. It is important to emphasize that SMEs are the backbone of the Indonesian economy. Without an increase in digital adoption, negative impacts are likely to occur on the national economy and potentially harm SMEs themselves. The success of businesses often depends on their ability to adjust to the evolution of technology and changing consumer needs (Gunawan, 2021). As one of the country's financial supervisors, Bank Indonesia plays an important role in stimulating the use of fintech, especially to support SMEs. The title of this paper, reflects the way the policy was developed and its effect on SME growth, one of which is in 2022 through an MSME onboarding program including the adoption and utilization of QRIS (Departemen Komunikasi, 2022).

QR Code is a series of codes that can be scanned using a special device and contains data or information, the identity of the merchant or user, the amount of payment, and the type of currency (Sofwatunnisa et al., 2023). From another perspective, QR Codes are a data storage method that utilizes a dot matrix or two-dimensional bar code, developed by Denso Wave. These codes can be printed or displayed on a screen and read by a specialized scanner, providing more detailed information than traditional barcodes (Liébana-Cabanillas et al., 2015). Quick Response Code Indonesian Standard, known as QRIS (pronounced as 'KRIS'), is an integration of various types of QR codes from various Payment System Service Providers (PJSP) through the use of QR Codes. QRIS is jointly designed by the payment system industry and Bank Indonesia to facilitate, accelerate, and maintain the security of QR Code transactions. All PJSPs that want to utilize the QR Code for payments must implement QRIS. With QRIS, payment applications from all PJSPs, including banks and non-banks, used by the public, can be used in various places such as shops, merchants, stalls, parking areas, tourist ticket purchases, and donations that have the QRIS logo, even though the QRIS provider at the merchant is different from the application used by consumers. Merchants only need to open an account or account with one of the QRIS providers that has received permission from BI. After that, they can accept payments from various payment applications regardless of the provider (Bank Indonesia, 2022).

To understand the factors that influence the adoption of financial technology by MSMEs, this study uses the Technology Acceptance Model (TAM) as a framework. This model has been proven effective in analyzing how users' perceptions of the benefits and ease of use of technology influence adoption decisions. In the context of SMEs in Indonesia, TAM is very relevant because it can evaluate how SMEs accept and use financial technology, such as digital payment systems. Some previous studies, such as Thathsarani & Jianguo (2022), Nugraha et al (2022), and Wiradinata (2018), have also used TAM to evaluate technology adoption in the SME and fintech/digital sectors, which confirms the relevance of this model in the context of this study.

Based on the background described above, the research questions to be answered in this paper can be formulated, namely: (1) How do SMEs respond to the policies and support provided by Bank Indonesia for the adoption of financial technology by SMEs in Indonesia? (2) What are the factors that encourage SMEs to switch to digital payment methods and what are the perceived impacts? (3) What are the main barriers faced by SMEs in the process of financial technology adoption? (4) What is the role and effectiveness of QRIS implementation in supporting the adoption of financial technology by SMEs in Indonesia?

The problem limitations in this study are: (1) The unit of analysis in this study is SMEs. (2) The context of adoption of SMEs that have applied digital payment methods. (3) The research was conducted qualitatively. (4) The factors explored fall within the TAM framework.

The purpose of this research is to explore and analyze: (1) Find out how SMEs in Indonesia respond to policies and support provided by Bank Indonesia for the adoption of financial technology. (2) Identify the factors that encourage SMEs to switch to digital payment methods and assess the perceived impact of the transition. (3) Identify the main barriers faced by SMEs in the fintech adoption process. This research is expected to provide theoretical and practical benefits as follows:

1. Theoretical benefits.
    a. Contribute to the academic literature on how policies and financial institution support affect technological adaptation among SMEs, especially in the context of developing economies such as Indonesia, and contribute to filling the knowledge gap that so far there has never been literature that discusses SME digitalization from the point of view of SME entrepreneurs themselves and from the point of view of central bank officials/experts.
    b. Enrich the existing literature with empirical data related to the factors that encourage SMEs to switch to digital payments, as well as the impacts arising from such adoption.
    c. Contribute to the theory on the challenges and barriers in the adoption of financial technology, particularly in the context of SMEs in developing countries.
2. Practical benefits (contributing to the practical-knowledge gap).
    a. The research findings can be used by Bank Indonesia and other relevant institutions to design and implement more effective policies and support for SMEs in the adoption of financial technology.
    b. SMEs can use the results of this study to understand the benefits and challenges of switching to digital payment methods, facilitating better decision-making in technology adoption.
    c. The results of the study can provide practical guidance for SMEs on how to overcome the barriers they may face in the process of financial technology adoption, including strategies to overcome technical and regulatory challenges.

Literature Review

Technology Acceptance Model

The questionnaire development stage in this study was carried out by adopting the dimensions of the Technology Acceptance Model (Wicaksono, 2022), which is an effective method for evaluating how and why SMEs accept and use FinTech technology supported by Bank Indonesia policies, so TAM can be very relevant. TAM will help in analyzing factors such as perceived usefulness and perceived ease of use that influence technology acceptance. A typical TAM model is shown in Figure 2 below (Wicaksono, 2022).

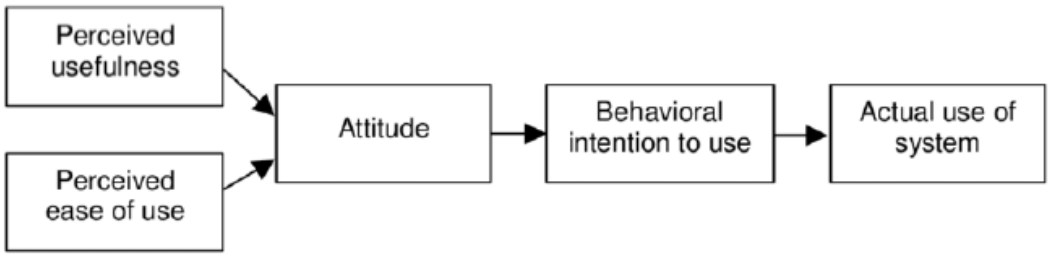

Figure 2. TAM Model

Perceived Usefulness is the extent to which SMEs feel that the use of financial technology will benefit their business, including ease of payment and financial management. This includes various aspects that help improve operational efficiency and effectiveness. Whereas Perceived Ease of Use is the extent to which SMEs feel that the use of financial technology is easy and can be integrated with their business (Wicaksono, 2022). The choice of the Technology Acceptance Model (TAM) over other frameworks

that are more specific to switching intention, such as the Push-Pull-Mooring Model (PPM) (Fan et al., 2021), is based on its ability to more broadly identify factors that influence technology adoption, such as perceived usefulness and perceived ease of use. This research focuses not only on switching intention, but also on how MSMEs accept and utilize digital payment technology, so TAM is seen as more comprehensive in this context.

Financial Technology

Regulations related to payment services are determined based on the principles of business law applicable in each country. These types of services and transactions include Real-Time Gross Payment System (RTGS), electronic payments, local and international card usage, as well as mobile and e-wallet payments (Simatele & Mbedzi, 2021). Digital-based financial services also have the potential to help customers increase their income through service offerings such as loans and savings, more practical payment methods, and others (Hao & Yin, 2023). The main feature of digital payments is that they are cash-free. This cashless payment method varies from country to country. These cashless solutions can be categorized based on the level of digitization required for implementation, the payment technology as the latest solution, and the supporting infrastructure available (Rafferty & Fajar, 2022).

Financial Technology (FinTech) is a combination of financial services and technology that has changed the business model from conventional to modern. Initially, to make a payment, one had to meet face-to-face and carry cash, but now, transactions can be done remotely in a matter of seconds. The emergence of FinTech is in line with the changing lifestyle of people who are currently dominated by the use of information technology, which demands everything to be faster. FinTech helps overcome problems in buying and selling transactions and payments, such as difficulty finding goods in physical stores, needing to go to a bank or ATM to transfer funds, or avoiding visits to certain places due to unsatisfactory service. In other words, FinTech improves efficiency and economy in buying and selling and payment transactions, while maintaining their effectiveness. FinTech is also capable of replacing the role of formal financial institutions such as banks. In the context of payment systems, FinTech plays a role in providing a market for businesses, being a tool for payment, settlement, and clearing, helping to make investments more efficient, reducing the risks of conventional payment systems, and helping individuals save, borrow, and invest (Departemen Komunikasi, 2018).

As conventional financial institutions increase their investment in FinTech, the combination of the latest technology and traditional financial services is becoming more integrated, which will create a technological domino effect to improve the efficiency of financial institutions (Wu & Chen, 2023). One of the bottlenecks in the payment system is transaction costs. These include the cost of sending money across borders through correspondence banks, fees associated with using international credit cards, as well as various other costs arising from foreign currency exchange and physical cash management (Yamaoka, 2023).

FinTech has become a key innovation in the financial sector, expanding at a remarkable pace. This growth is largely fueled by economic progress, favorable regulations, and advances in internet technology. Fintech today offers the potential for fundamental change in the financial world by improving service efficiency, cutting costs, opening new markets, and contributing to a more inclusive and stable financial landscape. Developments in IT infrastructure, big data analytics, and advances in mobile devices have provided opportunities for fintech startups to challenge traditional financial institutions by offering more innovative, customized, and personalized services (Wiradinata, 2018). The benefits of FinTech for consumers, businesses, and countries are (Departemen Komunikasi, 2018):

1. For consumers:
    a. Improved service quality.
    b. A wider variety of choices.
    c. More affordable costs.
2. For business people (product or service providers):
    a. Simplify the flow of transactions.
    b. Reduction of operational and capital costs.
    c. Stopping the movement of information.

3. For a country:
    a. Encourage the spread of economic policies.
    b. Increase the rate of money circulation, which in turn can spur economic growth.
    c. In Indonesia, FinTech also supports the achievement of the National Strategy for Financial Inclusion (SNKI).

Bank Indonesia

As the central bank, Bank Indonesia aims to achieve rupiah stability, maintain Payment System stability, and maintain Financial System Stability to support sustainable economic growth. To achieve these objectives, Bank Indonesia is responsible for three areas, namely Monetary, Payment System, and Financial System Stability. Integration of these three areas of duties is required so that the single goal can be achieved effectively and efficiently. The strong impetus from technological developments in the payment system motivates Bank Indonesia, which is the central bank of the Republic of Indonesia, to ensure that payment traffic affected by technology continues to operate with high order and security, and provides support for the achievement of Bank Indonesia's vision and mission.

In the context of providing a platform for business actors, Bank Indonesia ensures the protection of consumers with a primary focus on maintaining the confidentiality of consumer data and information through the use of a reliable cybersecurity system. Meanwhile, in the aspects of payment, settlement, and clearing processes, Bank Indonesia ensures the protection of consumer interests, especially by prioritizing the confidentiality of consumer data and information through a strong cyber security infrastructure. Bank Indonesia ensures security and regularity in payment traffic with the following roles (Departemen Komunikasi, 2018):

1. As a facilitator, Bank Indonesia facilitates the provision of infrastructure for payment traffic.
2. As an intelligent business analyst, Bank Indonesia collaborates with international authorities and partners to analyze the FinTech industry and provide guidance to businesses on how to develop a safe and orderly payment system.
3. Bank Indonesia monitors and assesses every business activity that uses FinTech technology in the payment system.
4. Bank Indonesia coordinates with relevant authorities and communicates actively to support the development of FinTech payment systems in Indonesia. In addition, Bank Indonesia is also committed to providing periodic guidance to businesses in Indonesia regarding FinTech.

Digital Payments

The transition to digital payment systems has resulted in the widespread adoption of artificial intelligence (AI) technologies, including machine learning, neural networks, and adaptive algorithms (Miglionico, 2023). These innovations automate decision-making and accelerate the provision of financial services, playing an important role in strengthening and streamlining national payment systems. This, in turn, supports sustainable development and contributes positively to Gross Domestic Product (GDP) growth (Lutfi et al., 2021).

In the current era, digital payments and online banking are ubiquitous due to the surge in digital and online services coupled with the decline in cash usage. Therefore, access to payments must evolve simultaneously to remove barriers to public participation (Dai et al., 2023). The ever-evolving landscape of the digital ecosystem is pushing the banking sector to adapt to new business models that meet digital demands and re-evaluate their fundamental services and processes to improve interactions with customers (Stefanelli & Manta, 2023).

Banks are increasingly focusing on digitizing their service offerings, moving away from traditional physical services. Key strategic approaches include reducing physical service counters, expanding ATM services, and improving customer interfaces, such as increasing electronic payment devices. This shift has been further accelerated by the pandemic, which has led to a decline in physical banking activities and an increase in consumer preference for digital and mobile banking (Stefanelli & Manta, 2023).

Digital payments streamline the role of intermediaries in assessing customer profiles and product suitability. This makes the assessment process more efficient and accurate. These changes are part of the wider impact of technology on the financial industry and public services, demonstrating how payment systems are integral to this transformation (Miglionico, 2023).

Methodology

This chapter describes the research methodology used, including the approach, target respondents, stages, research flow, instruments used, data collection and analysis methods.

Research Approaches

The purpose of this study is to identify and explore the effectiveness of SME development strategies, policies, and support that have been or are being conducted by Bank Indonesia in the FinTech field. There are many factors that may hinder or encourage SME entrepreneurs in adopting and implementing FinTech in their daily operations. This research uses a qualitative method with a case study approach, which is an in-depth and detailed research method on individuals or groups that focuses on exploring and describing a phenomenon (Forman et al., 2008). The selected case studies are SMEs in the Jakarta area and its surroundings, as well as outside Jakarta, especially those engaged in the trade and service sectors. We focus on SMEs that have started implementing digital payment technologies such as QRIS. This region was chosen due to its high technology adoption rate and adequate infrastructure, making it suitable for evaluating Bank Indonesia's policy. Data was obtained through interviews with SME owners as well as representatives from Bank Indonesia, to dig deeper into their experiences and challenges in using digital payment technology.

Target Respondents

In this study, the selected respondents consisted of representatives of SMEs and Bank Indonesia officials who have an important role in the adoption and implementation of digital payment technologies. The criteria for selecting respondents from among SMEs was quite selective. The SMEs selected are those that have been using digital payment methods, specifically QRIS, for at least 1 year. This ensures that the interviewees have enough in-depth experience to provide valuable insights. Also, the interviewees were owners or managers who play an active role in technology-related decision-making in their business, so their views reflect the strategic decisions of the SMEs. The SMEs involved come from various sectors such as trade, services, and manufacturing, and are spread across the Greater Jakarta area as well as several other regions in Java and outside Java. Thus, the perspectives obtained were diverse and representative.

On the other hand, resource persons from Bank Indonesia were selected based on strict criteria. Respondents are officials with a minimum position of Assistant Director in the Department of Payment System Policy (DKSP). They have long working experience, at least 5 years, in the field of financial technology and financial inclusion policy development. This ensures that they have a good understanding of the dynamics and challenges faced in implementing related policies. In addition, they have also been directly involved in the implementation and supervision of the QRIS program and other policies that support SMEs. With this background, their views are highly relevant and reliable in the context of this study.

Research Flow

The flow of research conducted by researchers begins with identifying problems, studying literature to build a theoretical framework, interviewing respondents, collecting data, analyzing and calculating data, and developing conclusions and suggestions.

In this qualitative research, data collection was carried out through semi-structured interviews. For sample selection, a purposive sampling strategy was used, meaning that samples were selected based on specific objectives (Amin, 2023). The respondents consisted of Bank Indonesia officials in the Department of Payment System Policy (DKSP), and SME entrepreneurs who want to/have already implemented digital payment methods. In this case, Bank Indonesia plays a crucial role in expanding SMEs' affordability and access to financial services by developing SMEs as a strategic step to support

financial system stability, improve people's welfare, and encourage sustainable economic growth (Bank Indonesia, n.d.). Meanwhile, SME entrepreneurs play a role as parties who directly benefit and other impacts from various supports provided by Bank Indonesia. To make it easier to understand the research flow in this paper, it can be seen in Figure 3 below:

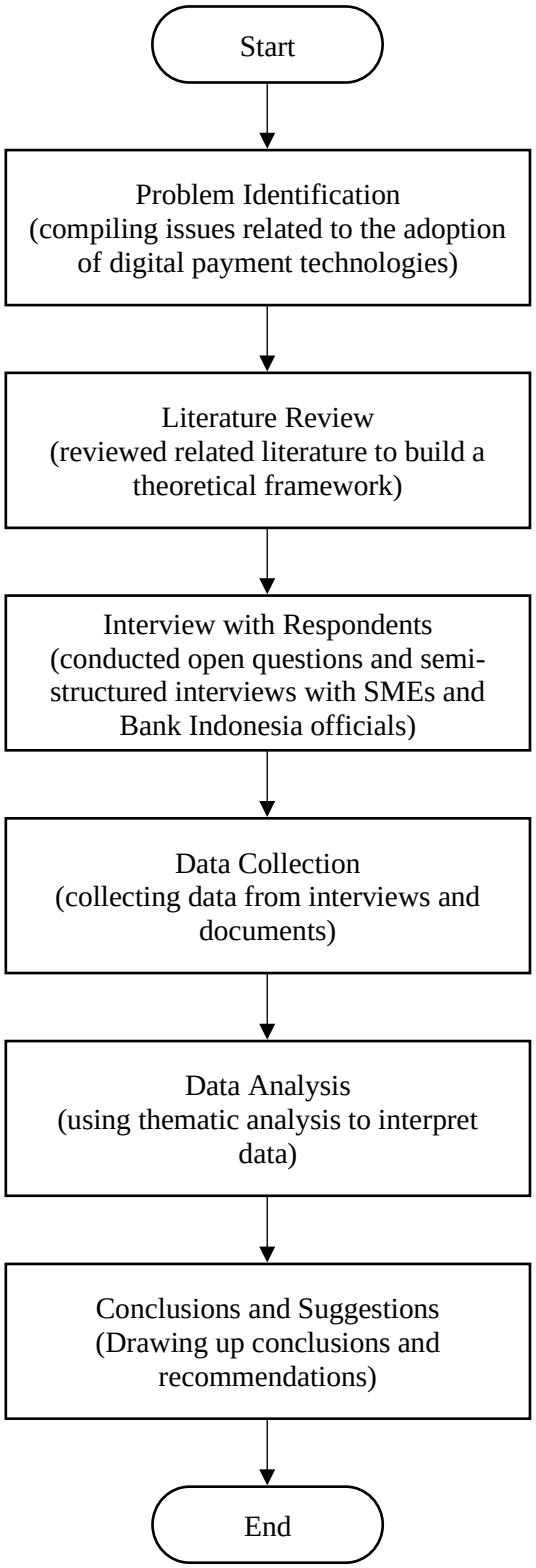

Figure 3. Research Flow Diagram

The results of this stage include interview transcripts and supporting documents relevant to the case. Once the data was collected, the next stage was data analysis, using the thematic analysis and frequency

analysis method. Text data from interview transcripts were categorized and irrelevant ones were reduced, followed by data analysis and presentation according to the research model to facilitate interpretation. The final step is the interpretation of the data that results in the research findings. The findings of the analysis are described in detail, followed by conclusions that answer the research question or problem. This stage also discusses the limitations of the research and the possibility of further study.

Research Instruments

In this study, the instruments used included open-ended research questions. In addition, a semi-structured interview draft was used for interaction with respondents. Detailed questions and interview drafts were developed to ensure consistency and completeness of the data collected. The interviews were semi-structured with an in-depth approach, so some open-ended questions would arise based on the answers provided by the respondents. The list of interview questions used for SME entrepreneurs and Bank Indonesia officials can be seen in Table 1 and Table 2 in the appendix. These questions are designed to answer research questions related to financial technology adoption and the TAM framework, such as Perceived Usefulness and Perceived Ease of Use.

Data Collection

The data collection method is by doing:

1. Interviews with SMEs entrepreneurs who want to or have already implemented digital payment methods, using an open question questionnaire distributed via WhatsApp from November 29 to December 11, 2023.
2. Interviews with Bank Indonesia officials/experts, Jakarta, in the Department of Payment System Policy (DKSP), with the rank of Assistant Director through online interviews conducted using the Microsoft Teams application on December 11, 2023.

This method is very relevant to the research question because it is expected to be able to answer research questions both from the point of view of SME entrepreneurs who experience the impact of policies and support from Bank Indonesia themselves, as well as from the point of view of Bank Indonesia as the Central Bank that issues policies and support to SMEs. Qualitative data collection steps with the TAM method (Wicaksono, 2022):

1. Determine the survey objectives to be achieved, such as knowing the factors that affect technology acceptance in respondents, evaluating the effectiveness of technology implementation, or knowing the problems faced by users in using technology. The survey objectives will serve as a reference in designing questions and conducting the survey.
2. Determine the group of respondents to be studied, namely employees from Bank Indonesia appointed by Bank Indonesia, and several SMEs until saturation of their answers is found.
3. Design questions that are relevant to the objectives of the survey and the respondents studied, using open or semi-open questions that allow respondents to answer freely and in detail about their views on the technology used.
4. Start interviewing the interviewees.
5. Ensure that respondents clearly understand the survey questions and objectives.
6. Analyze the data.

Data Analysis

The researcher will analyze the data using Thematic Analysis, a method for examining data to identify patterns or themes from the data that has been collected (Braun & Clarke, 2006). This method is particularly effective when the research objective is to dig deeper and understand the relationship between various patterns in a phenomenon, as well as to understand the phenomenon from the researcher's perspective (Fereday & Muir-Cochrane, 2006). It has been successfully employed in previous studies on banking and FinTech in Indonesia (Indriasari et al., 2022) and (Suryono et al., 2020). Thematic analysis is basic in qualitative research (Holloway & Todres, 2003). The stages, namely (Heriyanto, 2018):

1. Understanding the data.

In qualitative research, interview recordings and transcripts are rich sources of information and should be scrutinized in depth to understand their content. The researcher needs to reread, listen to, or watch the recordings to fully understand the data. It is important for the researcher to listen to the recordings again and make personal notes about important aspects or meanings contained in them. The purpose of this stage is to ensure that the researcher fully understands the data and finds its relevance to the research question.

2. Coding.
   The second stage in Thematic Analysis is coding. This process is similar to determining the subtitle in a book or finding the main idea in a paragraph. Codes are labels assigned to data elements that are relevant to the research question. These codes are then checked for relevance. There are two types of coding: semantic, which captures what is explicitly visible in the data; and interpretive, which seeks to understand the meaning behind participants' words. Once codes were developed, those with similar meanings were grouped together and named accordingly.
3. Searching for themes.
   At this stage, the researcher's focus shifts from searching for codes to searching for themes that are in line with the research objectives. Themes are important aspects of the data related to the research problem, representing patterns of the phenomenon under study. The process is not to look for hidden themes, but rather to choose a way to interpret the data. Provisional themes were determined based on the similarity in meaning of the code groups. During this process, interview transcripts were reviewed to ensure consistency, and provisional themes were compared to determine their significance, relevance and uniqueness.

Results

In this study, the first step in data analysis was data transformation and selection, which involved the process of cleaning the data to ensure the accuracy and relevance of the information obtained. Next, the data was coded by grouping similar answers into common themes. This process enabled the identification of significant patterns in respondents' answers. Finally, data visualization was conducted to facilitate interpretation of the analysis results. This process provides an effective graphical representation of the research findings (Klepek & Bauerová, 2020).

Questionnaire Results and Thematic Findings

From the questionnaire results, 39 respondents were obtained, their responses on the effectiveness of Bank Indonesia's strategies, policies and support in FinTech resulted in 19 thematic units, as listed in Table 3 (see Appendix). The majority of respondents from SMEs are from the Small Business category as much as 92.3% whose business locations are in the Jakarta, Bogor, Depok, Tangerang, Bekasi (Jabodetabek) area as much as 76.9%. The payment methods they use daily are mostly through bank transfers 84.6%, and there are still many who use cash as much as 74.4%, followed by QRIS with 64.1%, and e-wallets as much as 46.2%, as illustrated in Figure 4 below:

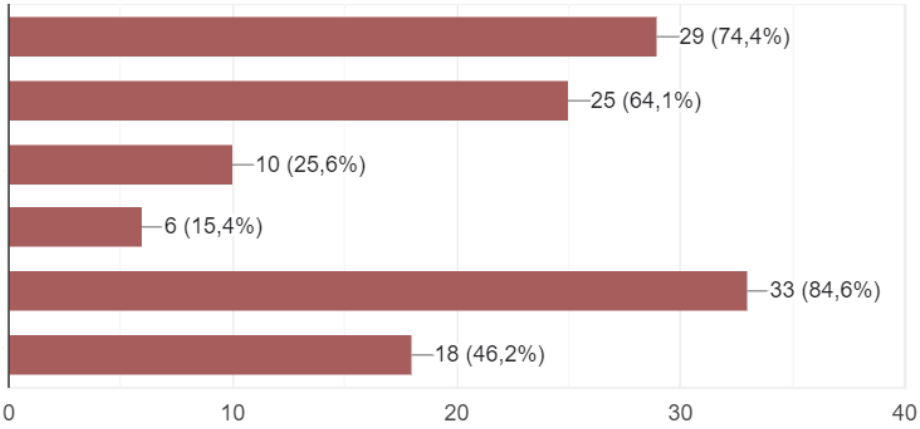

Figure 4. Demographic Questionnaire for Payment Method of Business Daily

Legend of Figure 4:

74,4%: Cash money

64,1%: QRIS

25,6%: Debit card

15,4%: Credit card

84,6%: Bank transfer

46,2%: E-Wallet (such as OVO, GoPay, etc)

From the interview results summarized in Table 3, there are some important findings related to SMEs' perceptions towards the implementation of digital payment technologies such as QRIS. If generalized from the results of the Table 3 analysis, SME entrepreneurs prefer digital payments due to practicality, efficiency, security, and ease of supervision, despite technical and administrative constraints. They perceive great benefits in the form of increased efficiency and ease of transactions.

The majority of SMEs appreciate Bank Indonesia's role in supporting the adoption of this technology, but expect improved socialization, education, and related regulations, as well as reduced transaction costs. The main challenges faced by some SMEs are lack of technical knowledge and network infrastructure issues, especially in less developed regions.

Furthermore, Table 3 shows that nearly 80% of the respondents feel that the adoption of this technology adds value to their customers, while another 20% are still hesitant due to technical barriers. They also emphasized the importance of improved infrastructure and access to digital payment services, including wider networks and instant transactions. Perceived ease of use and perceived usefulness are the main drivers of the adoption of digital payment technology by SMEs.

Frequency Analysis Process

Frequency analysis of SMEs' responses to the impact of Bank Indonesia's policies and support for fintech answered the research questions. To answer the first, second, and third research questions, the data collected showed varied perceptions among SMEs regarding Bank Indonesia's support. This result illustrates that although policies and support are in place, their effectiveness is perceived differently by each SME depending on their context and situation.

To answer the first research question, 56.41% of SME responses had a Positive Perception, indicating that more than half of the SME respondents expressed a positive perception of the support provided by Bank Indonesia. This perception can indicate the real benefits felt by SMEs from various programs and policies implemented. Then as many as 35.90% of SME responses responded Negatively or Don't Know. A significant proportion, indicating a negative response or ignorance of the programs organized by Bank Indonesia. This may indicate a lack of information or socialization about the programs, or perhaps the programs are less relevant to the specific needs of certain SMEs. A further 7.69% of responses or a small proportion of respondents chose to be neutral. This attitude could reflect a lack of direct experience with the Bank Indonesia program in question or it could be uncertainty about the benefits of the program.

To answer the second research question, SME respondents identified several drivers for switching to digital payment methods and the perceived impact of Bank Indonesia's policy. The driving factor is that 58.06% of SME responses consider practical value and efficiency as their main reason for utilizing FinTech technology, while 20.97% of responses consider it because of the ease of monitoring and control of cash flow, then 17.74% of responses are interested in the security aspect, and there are 3.23% of responses because they follow digital trends. On the impact or benefits they feel, as many as 65.45% of responses feel the benefits of security and accessibility from using digital payment technology, and as many as 34.55% of responses rate practicality and efficiency as the main benefits.

To answer the third research question, where SME respondents also revealed obstacles and provided input for improving Bank Indonesia's policies and strategies, as follows:

1. Obstacles faced:
   a. A total of 48.98% of SME responses considered technical and administrative constraints as the main problem.
   b. 40.82% of responses faced network and signal problems.
2. Suggestions and feedback from SMEs:
   a. 46.81% of responses suggested infrastructure and accessibility improvements.
   b. 31.91% of responses emphasized the need for improved socialization, education, and regulation.
   c. 19.15% of responses suggested reducing or eliminating administrative fees.

Through the completion of the three research questions, key elements in the TAM framework such as Perceived Usefulness and Perceived Ease of Use became clearer in this study. These findings allow researchers to not only ascertain the importance of these elements in the technological application domain under study, but also to investigate their interactions with different variables in a given environment. Such an approach facilitates a deeper understanding of users' reasons and behaviors for adopting and using technology in a particular context, while offering guidance for adaptation or enhancement of the TAM model to better align with the different conditions or situations being analyzed.

Interviews with Bank Indonesia Officials

An interview with the Assistant Director of the Payment System Policy Department of Bank Indonesia revealed the strategic aspects and challenges faced:

1. BI's Digital Payment Strategy for SMEs:
   a. Focus on QRIS as the main payment system, replacing the term 'Fintech' with 'Non-Bank Payment Service Provider'.
   b. Target 2023: 45 million users and 1 billion QRIS transactions, more efficient than EDC systems.
2. Challenges in the adoption of digital payment technology by SMEs:
   a. Improve technology literacy and education.
   b. Socialization of digital payments to older SME owners.
   c. Determination and socialization of service fees, or what is commonly called the Merchant Discount Rate (MDR).
   d. Accelerate the settlement of funds to the merchant's account.
   e. Address network and signal issues, in collaboration with the Ministry of Communications and Informatics.
3. Digital Payment Regulation.
   Merchants are prohibited from charging consumers a surcharge.
4. BI Collaboration for SME Digitalization:
   Cooperate and elaborate with various ministerial agencies and communities/associations for the expansion of SME digitalization, such as the Coordinating Ministry for Maritime Affairs and Investment, Coordinating Ministry for Economic Affairs, Ministry of Trade, Ministry of Communication and Informatics, Indonesian Retailers Association (Aprindo), National Amil Zakat Agency (Baznas), Indonesian Mosque Council (DMI).
5. Integration of Digital Payment Systems in BI-assisted SMEs:
   The Go-Digital MSME program successfully integrated digital payment systems.
6. BI's 2024 Targets:
   a. Encourage the use of QRIS: 55 million users, 2 billion transactions.
   b. New QRIS features: MPM, CPM, TTM, and cross-border.
   c. Cross-border QRIS opens up international markets, especially in Japan, UAE, India, and China.

Table 4 (see appendix), shows the frequency analysis and ranking of the themes that get the most responses from 39 respondents, from the previous 19 themes can be simplified into the top 7 themes based on responses from respondents in this study. From the top 7 themes, it is known that respondents positively welcome FinTech technology in digital payments, because it is cashless, practical and

efficient, and in terms of security and accessibility it can be more reliable than conventional payment methods using cash. Although technical and administrative constraints are the main highlights, they still consider FinTech in digital payments a positive thing that needs to be maintained and even improved by stakeholders and regulators in the government, especially improvements in terms of infrastructure and access. The frequency analysis is also presented in graphical form as seen in Figure 5, which allows comparison of the results from Table 4.

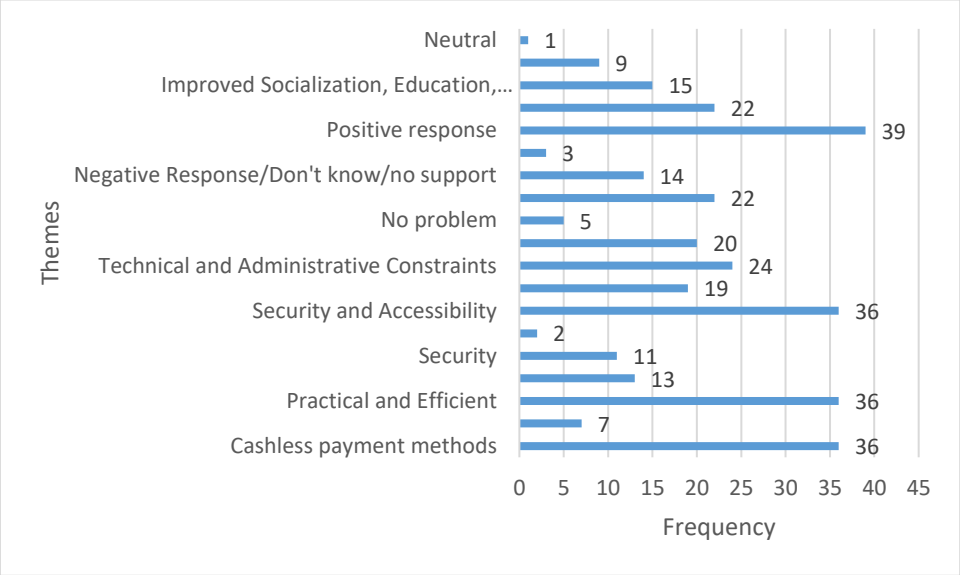

Figure 5. Graph of Frequency Analysis

Discussion

In analyzing the results of this study, it is important to highlight the profound implications of Bank Indonesia's support for SMEs in the context of using digital payment technologies. The positive response of the majority of SMEs to the initiative reflects an awareness and willingness to adapt to technological change. However, the challenges faced, including technical and administrative constraints, suggest that there is still considerable room for improvement. The importance of Bank Indonesia's initiative lies not only in the implementation of technology, but also in the aspect of digital education and literacy. This is critical, given that one of the main obstacles is the lack of understanding and readiness of SMEs in adopting new digital payment systems.

Furthermore, transaction security is a major highlight in SMEs' choice to use digital payments. This is in accordance with what Verma et al (2022), said that the surge in the use of digital payments has led to an increase in cyber attacks, so transaction security is a major concern (Verma et al., 2022). This signals a growing awareness of cybersecurity risks, as well as an important indicator for Bank Indonesia to continuously improve and ensure security in digital payment systems. Moreover, the finding that digital payments make it easier to monitor and manage cash flow for SMEs provides insight that this technology is not only a transaction tool, but also an effective financial management tool, where this is in accordance with what Najib and Fahma (2020), said that the various things that drive the adoption of this technology include how people see the ease of use, the benefits obtained, their views on digital payments, and the extent to which they trust it. (Najib & Fahma, 2020). When SMEs join digital payment systems, they not only make financial processes simpler, but also improve their ability to compete in the international market (Febrianto et al., 2023).

From a policy perspective, these findings encourage Bank Indonesia to review and update existing regulations. This could include initiatives to improve digital infrastructure, especially in areas with limited internet access, as well as reducing administrative barriers perceived by SMEs. Such an approach will not only help SMEs transition to the digital economy, but will also strengthen the FinTech ecosystem as a whole.

On the other hand, the study also highlights the importance of digital literacy for SMEs. Upgrading these skills will not only enable SMEs to fully utilize the benefits of digital payment technologies, but also to protect them from the associated risks. Broader and deeper education and training for SME owners and employees will be key in driving successful digital transformation. Digital understanding influences SMEs' shift towards digitalization by encouraging them to leverage digital technology. (Zahoor et al., 2023).

Finally, the results of this study pave the way for further studies. For example, future research could focus on evaluating the long-term impact of Bank Indonesia's policies and strategies on the growth and sustainability of SMEs in the FinTech sector. Comparative research involving SMEs in different regions and sectors would be valuable to identify best practices and highlight areas that require specific interventions. Research on fintech and financial inclusion in Indonesia shows that financial literacy can strengthen fintech's impact on financial inclusion. This financial inclusion, in turn, can drive improvements in SMEs' financial performance and help their businesses grow in the future (Mutamimah & Indriastuti, 2023). As such, the findings of this study not only provide important insights into the current situation, but also open up a range of opportunities for future research and policy, all aimed at increasing SME engagement in the ever-evolving digital economy.

Conclusion

This study explores how strategies, policies, and support from Bank Indonesia affect Small and Medium Enterprises (SMEs) in the fintech sector. The results show that most SMEs have a positive view of the support from Bank Indonesia, with 56.41% of respondents indicating a positive response to the policies provided. Nonetheless, some technical and administrative challenges remain. The findings answer the question of how SMEs respond to the policies and support provided by Bank Indonesia.

The main factors that encourage SMEs to switch to digital payment methods are practicality, efficiency, and ease of monitoring and managing cash flow. A total of 58.06% of respondents considered practical value and efficiency as the main reasons for using FinTech, while 65.45% perceived benefits in terms of security and accessibility. This answers the question of the factors that drive SMEs to adopt digital payment methods and the perceived impact.

The biggest challenges faced by SMEs are technical and administrative barriers, especially network and connectivity issues. About 48.98% of respondents cited technical constraints as the main problem they face. While SMEs generally welcomed the initiative from Bank Indonesia, these challenges show that there is still room for improvement, especially in terms of infrastructure, digital literacy, and regulation. This answers the question of the main barriers in the process of fintech adoption by SMEs.

Bank Indonesia's implementation of QRIS has been effective in supporting the adoption of fintech by SMEs. As many as 80% of respondents feel that the adoption of this technology adds value to their customers. However, there is a need to improve infrastructure and better regulation for more optimal results to be achieved. These findings answer the question of the role and effectiveness of QRIS implementation in supporting the adoption of financial technology by SMEs in Indonesia.

Limitations and Future Works

In addition to the limitations mentioned in the Introduction regarding the unit of analysis, the context of technology adoption, the qualitative approach, and the use of the TAM framework, this study also has some additional limitations. First, the majority of this research was conducted on SMEs in the Greater Jakarta area and several other regions in Java. This means that the results of this study may not be representative of SMEs in other parts of Indonesia, especially in areas where technological infrastructure is still not well developed.

Second, the approach used in this study was qualitative, with semi-structured interviews as the data collection method. While this approach provides in-depth insights, the limited number of respondents may not cover a wider variety of perspectives among SMEs. In addition, results from qualitative methods cannot always be generalized to a larger population.

Third, technical constraints such as network or signal issues reported by respondents are based solely on their personal experiences. This means there is no direct verification of the actual infrastructure conditions on the ground, so the information obtained may not be entirely accurate. Other external factors such as social conditions, government policies, or cultural aspects are also not explored in depth in this study.

Finally, this study is limited by the use of the Technology Acceptance Model (TAM) framework, which focuses on the ease-of-use and perceived benefits factors in technology adoption. Other aspects that might influence SMEs' decision to adopt technology, such as competitive pressure or regulatory push, were not explored in detail. These limitations provide opportunities for further research that is more in-depth and broader in scope.

From these insights, several recommendations are proposed for Bank Indonesia and related entities:

1. Improve Infrastructure and Accessibility: Bank Indonesia's primary focus should be on improving infrastructure to facilitate widespread adoption of digital payment technologies.
2. Intensify Socialization and Education Efforts: A high commitment to socializing and educating digital payments is essential to increase understanding and adoption among SMEs.
3. Revise and Update Regulations: It is imperative to reassess and modify existing regulations to ensure that they support the growth of SMEs and are not a hindrance.

This study paves the way for various future research opportunities by conducting long-term studies to assess the long-term impact of Bank Indonesia's strategies and policies on SMEs in the FinTech sector, by conducting comparative analyses through comparative investigations among SMEs in different regions or sectors to see the different impacts of Bank Indonesia's policies based on different environments, or by conducting the development of predictive models to identify important factors that influence the adoption and success of digital payments in SMEs. In addition, further research could examine specific aspects of the policy that are most effective in supporting SMEs. In summary, this study offers valuable insights into how SMEs perceive and experience support from Bank Indonesia in the FinTech sector, providing important guidance for refining strategies and policies to foster SME growth in the digital age.

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Appendix

Table 1. Open-ended Questionnaire Questions with SME Entrepreneurs

Inquiry	**Revised**	**Data Collection Procedure**
Demographics		
Current email (if any)	Email (Optional)	Short Answer Text
Phone number for reward purposes (Optional)		Short Answer Text
Business Category	Radio Button: ○ Small Business (Definition according to the 2008 MSME Law: Those with annual sales of Rp300 million to Rp2.5 billion) ○ Medium Enterprises (Definition according to the 2008 MSME Law: Those with annual sales of IDR 2.5 billion to IDR 50 billion)	
Domicile of place of business	Radio Button: ○ Jakarta, Bogor, Depok, Tangerang, Bekasi (Jabodetabek) ○ Java island (Non-Jabodetabek) ○ Others: ...	-
Payment method for buying and selling at your place of business on a daily basis (the answer can be more than 1 option)	Check Box: □ Cash □ QRIS □ Debit card □ Credit card □ Bank transfer □ E-Wallet (such as OVO, GoPay, ShopeePay, DANA, LinkAja, Sakuku, iSaku, JakOne Mobile, and Doku) □ Others: …	-
INTERVIEW QUESTIONS (Free form, can be filled in as completely as possible)		
As with the previous question about payment methods (cash, QRIS, Debit Card, Credit Card, Bank Transfer, E-Wallet, etc.), which payment method do you prefer to use as an SME entrepreneur?		Long Answer Text
What are some of the reasons you would use digital (non-cash) payment methods?		Long Answer Text
What are some of the benefits you feel most from using digital (non-cash) payments?		Long Answer Text
What problems might or often do you face in using digital (non-cash) payments?		Long Answer Text

Inquiry	Revised	Data Collection Procedure
How have programs or support from Bank Indonesia helped you overcome these issues?		Long Answer Text
How do you see the role of digital (non-cash) payment technology for your business growth?		Long Answer Text
What advice or input can you give to Bank Indonesia to improve their programs or support to SMEs, especially in relation to digital (non-cash) payments?		Long Answer Text

Table 2. Online Interview Questions with Bank Indonesia Officials

Inquiry	Data Collection Procedure
Are there any specific strategies that Bank Indonesia has implemented to encourage the integration of SMEs into the payment system fintech ecosystem?	Interview answers (semi-structured)
Can you share the challenges faced by SMEs in adopting payment system fintech and how BI is helping to overcome those challenges?	Interview answers (semi-structured)
What do you think about merchants charging consumers a surcharge, and are there any sanctions against them?	Interview answers (semi-structured)
How does Bank Indonesia collaborate with other stakeholders, such as government or financial institutions, to support the development of SMEs in the payment system fintech sector?	Interview answers (semi-structured)
Are there any case studies or successful examples of SMEs that have been well integrated in the payment system fintech ecosystem due to policies from BI?	Interview answers (semi-structured)
What are the next steps planned by BI to continue supporting SMEs in the utilization of financial technology, especially in digital payment systems?	Interview answers (semi-structured)

Table 3. Most Frequent Responses in Thematic Units (Source: Own Research) (Klepek & Bauerová, 2020)

Num.	Inquiry	Thematic Unit	Typical Responses
1	Preferred payment method	Cash payment method	Cash
			All
			Cash and QRIS
			Cash & bank transfer
		Cashless payment method	QRIS
			All
			Bank transfer

Num.	Inquiry	Thematic Unit	Typical Responses
			QRIS, E-Wallet
			Transfer, Debit/Credit card, QRIS
			QRIS and bank transfer
			Bank transfer or e-wallet
			Cashless (non-cash)
2	Reasons for using digital (non-cash) payment methods	Practical and efficient	More practical and recorded if cash risk is used outside of business purposes.
			Easy, can be tracked if there is an error, no need to look for change.
			More practical & directly into the Company's account.
			Practical, fast, no hassle carrying large amounts of money.
		Security	Safer and more practical.
			Avoiding crime by not needing to carry cash, making it easier because there is no need to prepare change.
			No need for change, avoiding counterfeit money.
			Safer because it goes directly to the bank account and can be monitored.
		Ease of monitoring and control	Easy, can be tracked if there is an error, no need to look for change (small cash).
			Make it easier to verify/check transactions anywhere, especially when we are not standby at the store, no need to bother providing petty cash for change transactions etc.
		Adaptation to the times	Keep up with the times.
			Simpler and customers are more familiar with digital money.
3	Most perceived benefits of using digital (non-cash) payments	Safety and accessibility	Securely accessible anytime and anywhere.
			Safe & in the current era it is easier to record mutations in the account.
			Safe because it avoids counterfeit money and does not need to provide change.
		Practical and efficient	Practical, real time, no need for change.
			Easy because everything is well recorded, starting from the type of payment, customer data, tracking if there is an error in the transaction.
			More effective and efficient.
4		Network and signal issues	Network, balance

Num.	Inquiry	Thematic Unit	Typical Responses
	Problems faced when using digital (non-cash) payments		Signal, payment does not enter the bank account mutation and the customer is no longer recorded
			Signal that is sometimes less supportive and the entry of funds for QRIS is delayed for several hours
			Provider signal or interference from m-banking
			Slow network
			Depends on the quality of the buyer's wifi signal/cellphone data package
			Server disruption, no signal
			Maybe when constrained by offline networks, or transaction limits
		Technical and administrative constraints	Quite large QRIS deductions
			Funds do not enter or double cut
			Unavailability of cash when needed suddenly
			Delayed payments from customers (debt) and if there are technical problems / signal disturbances it is rather difficult to transact
			QR is not read, customers still use a lot of cash
			Delay in funds entering the account
			Sometimes it takes a long time when doing interbank transactions in large amounts
			Bank differences, sometimes customers do not want to be charged interbank transfer fees
			In terms of sellers, merchants from EDC have deductions for the seller for each transaction, if you can eliminate this fee it's better but if you can't as maintenance costs etc. it's not a problem actually, it's just that it is emphasized that the maintenance service is also improved sometimes if there are complaints related to stuck funds, or EDC machines with problems (often low battery and no signal) also the process is a bit long.
			Wrong transfer, long time for payment to arrive, large deduction fee
		No problem	None
			There are no problems yet

Num.	Inquiry	Thematic Unit	Typical Responses
5	The role of Bank Indonesia's programs or support in overcoming problems	Positive response	Many benefits and modern
			Very good because the socialization of the program is very often held and facilitated by Bank Indonesia.
			Bank Indonesia's policy of not charging transaction fees for purchases through QRIS will help MSMEs entrepreneurs
			With the existence of BI fast it is very helpful in reducing costs because there are so many transactions between banks
			Currently, due to the existence of BI Fast, transaction costs are cheaper than real time, others don't know yet.
		Neutral	Enough
			N/A
		Negative response/do not know/no support	No idea
			None
			Not yet
			I don't know the action yet
			Deactivation of personal QRIS adds to the problem
			Apart from determining interest rates, I have not been able to see the role of Bank Indonesia in MSME transactions. It could be due to lack of socialization or MSMEs that have not been educated.
			Yes, even though there is already fast, sometimes there are still problems with customers, there is a flip application, but it is still not familiar to the public.
6	The role of digital (non-cash) payment technology for business growth	Positive response	Good and needs to be developed, but in practice there are still many who have not felt the benefits, especially small businesses.
			Very good & the era of digitalization is needed in the development of the MSME sector.
			Very rapidly growing, and helps in the process of running a business (convenience & security)
			Very important and influential because it helps facilitate transactions so that customers are happier.
			Good because more and more people are lazy to carry large amounts of cash.

Num.	Inquiry	Thematic Unit	Typical Responses
7	Suggestions to Bank Indonesia to improve programs or support to SMEs related to digital (non-cash) payments	Improved socialization, education, regulation	This program should be more focused on SMEs located in areas that have minimal knowledge about digital payments. It is also necessary to conduct a survey to see the level of readiness of the area in using digital payments.
			Widespread education to the public about digital payments and their convenience, as well as providing the best service in terms of information technology, so as to overcome the technical problems that often occur.
			More socialization because not everyone dares to use non-cash transactions (especially for non-city communities)
			So far, it's been pretty good, maybe the suggestion is for QRIS registration to be made easier for SMEs that don't have a store/store because when registration is required to provide a photo of the store, it is sometimes rejected by the bank.
			Create policies that help the growth of SMEs through digital payment methods
		Cost reduction or elimination	If possible, the 0.3% margin should not be charged to MSMEs/merchants
			BI-FAST 0 Rupiah
			MDR QRIS small businesses & the provision of EDC debit/credit cards are still quite costly because many suppliers still use cash as well considering that small business suppliers are other MSME grocery stalls.
			As much as possible, we try not to have inter-bank transfer fees, because if we transact more than 20 times in 1 day, how much does it cost? While our margins are limited, as a result we will cover the costs from our business margins.
		Infrastructure and access improvement	Hopefully there will be more convenience for digital payments and can be directly entered into the account without a lot of time lag like money transfers
			Input for bank QRIS to enter accounts per transaction to make it easier and more precise in recapitulation (currently cumulative)

Num.	Inquiry	Thematic Unit	Typical Responses
			My suggestion is to be able to present innovations in flexible integration for interbank transactions, so as to reduce the waiting time to be delivered.
			Increase digital services throughout Indonesia, especially those living in villages or remote areas who have difficulty accessing the internet due to limitations on the internet network.
		Neutral	Enough

Table 4. Frequency Analysis (Source: Own Research) (Klepek & Bauerová, 2020)

Code	Thematic Unit	Freq.	Rank.	Percentage
1a	Cashless payment methods	36	1	83,72%
1b	Cash payment methods	7	2	16,28%
2a	Practical and Efficient	36	1	58,06%
2b	Ease of monitoring and control	13	2	20,97%
2c	Security	11	3	17,74%
2d	Age Adaptation	2	4	3,23%
3a	Security and Accessibility	36	1	65,45%
3b	Practical and Efficient	19	2	34,55%
4a	Technical and Administrative Constraints	24	1	48,98%
4b	Network and Signal Issues	20	2	40,82%
4c	No problem	5	3	10,20%
5a	Positive Response	22	1	56,41%
5b	Negative Response/Don't know/no support	14	2	35,90%
5c	Neutral	3	3	7,69%
6	Positive response	39	1	100,00%
7a	Infrastructure and Access Improvement	22	1	46,81%
7b	Improved Socialization, Education, Regulation	15	2	31,91%
7c	Fee Reduction or Elimination	9	3	19,15%
7d	Neutral	1	4	2,13%

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Patterns and Best Practices of Knowledge Sharing among Programmers on Stack Overflow: A Qualitative Study

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Abstract

This research explores knowledge-sharing patterns and best practices among programmers on the Stack Overflow platform. Using a qualitative approach, the study analyzes interviews with seven programmers to identify user behavior and contributions to knowledge sharing. The findings reveal that most users exhibit passive usage, seeking solutions without actively participating due to introverted tendencies, time constraints, and concerns about redundancy and confidentiality. However, Stack Overflow remains a valuable resource for problem-solving. Best practices identified include using multiple forums, ensuring detailed and clear questions, and encouraging active participation. These strategies can enhance the quality of shared knowledge and create a more comprehensive and reliable knowledge base for the programming community. The study also suggests that addressing psychological barriers and integrating knowledge-sharing activities into routine work processes can increase active participation. These insights are essential for improving user engagement and the overall effectiveness of online knowledge-sharing platforms.

Keywords: best practice, knowledge sharing, pattern of users, programmers, stack overflow

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Introduction

Knowledge sharing is a critical process in professional communities, enabling the exchange of expertise and the accumulation of collective knowledge (Xia & Yang, 2020). Knowledge sharing is crucial for creativity, problem-solving, and maintaining a competitive edge overall, highlighting the value of cooperative learning and information sharing in a variety of settings (Mwawasi, 2022). In the digital age, online forums and communities have become vital platforms for knowledge sharing, providing spaces where individuals can ask questions, share solutions, and collaborate on complex problems. Among these platforms, Stack Overflow stands out as a leading Q&A site for programmers, boasting millions of users and a vast repository of programming knowledge. Understanding posting behavior on online platforms is a topic that has been researched by experts from different fields and traditions. When activities on online platforms are considered as knowledge sharing or the platform itself is seen as a space for learning, posting behavior is of particular interest in the tradition of computer-assisted collaborative learning (Hillman et al., 2023). From the viewpoint of complexity science, online Q&A communities are dynamic and open systems. This open system, which interacts with its environment through the exchange of matter and energy, will exhibit the characteristics of a dissipative structure under the influence of nonlinear actions (Shi et al., 2024).

Stack Overflow is a technical Q&A site where users can ask questions, provide answers, and discuss topics related to programming and software development. The site has been widely accepted by the software engineering community and has become the largest public knowledge base for programming questions. As of December 2021, there were 21.9 million questions and 32.7 million answers on Stack Overflow (Zhu et al., 2022). However, maintaining quality, relevance, and effective utilization of the answers on this site remains a challenging issue that warrants further investigation (Meldrum et al., 2020).

The question-and-answer process on Stack Overflow begins when a user posts a question related to programming or a similar technical topic. At that point, other users can get involved by submitting answers or participating in the discussion through comments or chat rooms. Discussions can be attached to the original question (called question discussions) or to the submitted answer (called answer discussions). If the answer provided resolves the question, the asking user can select that answer as the accepted answer. Once an answer is accepted, users can still contribute to the question thread by adding new answers or editing existing content, but user activity on the question tends to drop dramatically. Please note, that Stack Overflow uses the term "post" to refer to questions or answers, but not discussions (Zhu et al., 2022).

Stack Overflow provides a wealth of programming-related information in a variety of ways, making it an essential destination for software engineers to share knowledge. By helping users edit postings more effectively, Mondal et al. want to improve the quality of shared information, which will decrease the number of rejected alterations and raise user happiness (Mondal et al., 2023). Stack Overflow promotes knowledge sharing among users through various mechanisms. To increase their knowledge of programming, users commonly exchange external links; 82.5% of link-sharing activities involve external resources (Liu et al., 2022). Furthermore, commenting activities add a great deal to the knowledge acquired through crowdsourcing, as insightful remarks elevate responses from many viewpoints (Hillman et al., 2021). Additionally, the platform facilitates large-scale informal learning by enabling users to communicate and record knowledge, which produces a tension that members find both intriguing from an analytical perspective and concerning (Zhang, Wang, Chen, & Hassan, 2021).

There are studies examining the phenomenon of "obsolete answers" that continue to receive attention due to various factors, such as difficulties in editing and reevaluation (Zhang, Wang, Chen, Zou, et al., 2021). Similarly, the importance of healthy discussions for improving answer quality. Discussions related to questions offer deeper clarification and context while fostering a collaborative learning environment (Zhu et al., 2022). In "Reading Answers on Stack Overflow: Not Enough!", Zhang et al argue that simply reading answers on Stack Overflow isn't always sufficient. Their study indicates that learning effectiveness improves when users actively engage in discussions, answer evaluations, or contribute their responses (Zhang, Wang, Chen, & Hassan, 2021). Thus, understanding how platforms like Stack Overflow can foster deeper, more meaningful user participation is essential.

Understanding knowledge sharing behavior on Stack Overflow is crucial as the platform has become one of the largest sources of knowledge for the worldwide community of programmers. Stack Overflow serves as a collective knowledge hub where programmers from different backgrounds contribute to solving complex problems. Some of the reasons that underlie the importance of this research include:

1. The Ultimate Source of Information for the Programming Community.

   Stack Overflow has millions of users and is the primary source for programmers to get solutions to technical problems. There are 21.9 million questions and 32.7 million answers on this platform (Zhu et al., 2022). Given its scale and impact, understanding how knowledge sharing behavior occurs on this platform is highly relevant as it will affect the quality of knowledge accessed by millions of users.

2. Quality of Knowledge Shared.

   Inactive or passive knowledge sharing behavior can reduce the potential benefits to be gained from platforms such as Stack Overflow. Hillman et al (2023) mentioned that active participation is essential to ensure rich discussions and deeper knowledge. This study highlights the importance of addressing the issue of passive participation to improve the quality of knowledge available. While Stack Overflow has become a major platform for knowledge sharing among programmers, a pattern that often emerges is the passive use by most of its users. Many users prefer to search for solutions without actively contributing to the discussion or providing answers. This passive usage pattern has serious implications for the quality of knowledge shared, as well as reducing the potential collaborative learning benefits that can be gained. Therefore, it is important to study the factors that drive passive usage and develop strategies to increase active participation.

3. Impact on Innovation and Technology Development.

   This research contributes to improving the quality of knowledge sharing on digital platforms that ultimately supports innovation in the technology industry. Kim (2021) stated that effective knowledge sharing can improve innovation performance in organizations. By better understanding the factors that influence sharing behavior on Stack Overflow, we can identify ways to improve collaboration and innovation in the software industry.

4. The Role of Digital Platforms in Collaborative Learning.

   Stack Overflow is not just a Q&A forum, it is also a globally recognized collaborative learning space. According to research by Mwawasi (2022), digital platforms like Stack Overflow play an important role in promoting informal and collaborative learning. By studying the sharing behavior on these platforms, this research can help improve learning methods in the wider community of programmers.

5. Opportunities to Increase Active Participation.

   This research not only aims to describe sharing behavior, but also offers practical recommendations that can increase user engagement on Stack Overflow. By addressing psychological and social barriers, as well as improving platform features, active user participation can increase, which in turn enriches the knowledge base and quality of discussions in this community.

For these reasons, this research is important to study because its contribution is not only academic, but also has an impact on real practices in software development and collaboration around the world. This study aims to find answers to the research questions, namely: (1) What is the pattern of users in doing knowledge sharing on the Stack Overflow site? (2) What is the best practice in doing knowledge sharing on the Stack Overflow site?

This study looks at how various user types participate in knowledge sharing on Stack Overflow with an emphasis on user behavior and contribution patterns. This research makes a significant contribution to understanding knowledge-sharing patterns and best practices among programmers on the Stack Overflow platform. Through a qualitative approach and in-depth interviews with seven programmers,

this research uncovers the dominant use of passivity on Stack Overflow, as well as identifies key factors such as programmers' introverted nature, time constraints, and the belief that most problems have been solved before. The research also provides practical insights into best practices in effective knowledge sharing, such as using multiple forums, ensuring clear and detailed questions, and encouraging active participation. These findings are valuable for improving user engagement and the quality of knowledge shared on Stack Overflow and similar platforms. In addition, this study also recommends further areas of exploration, including psychological and social factors that influence active participation, thus providing a comprehensive basis for future research in this area.

The novelty of this research lies in the in-depth examination of Stack Overflow's passive usage patterns and the identification of specific best practices to improve knowledge sharing among programmers. In contrast to previous research that has focused more on the general benefits and challenges of online forums, this study examines programmers' behaviors and attitudes in detail, providing a detailed analysis of their interactions with the platform. Previous research such as Prescott et al (2019) have examined the general benefits and challenges of online forums, such as user participation in mental health forums. Prescott highlighted the challenges of maintaining safety and user expectations. The emphasis on programmers' introverted nature as an important factor influencing their level of participation offers a unique perspective that has not been widely explored in the existing literature. In addition, the qualitative approach used in this research, involving in-person interviews and thematic analysis, adds depth to the understanding of user behavior on Stack Overflow, differentiating it from more quantitative or survey-based research. This research not only enriches the academic discourse on online knowledge-sharing communities but also provides practical recommendations that can be implemented to improve user engagement and the overall effectiveness of these platforms.

Literature Review

Knowledge Sharing

Knowledge sharing has now become an important element in organisations (Halisah et al., 2020), because effective strategies in knowledge sharing have the ability to improve innovation performance (Scuotto et al., 2020). Recent research emphasises the importance of collaborative knowledge translation practices in supporting the internationalisation of research and development teams and the improvement of innovation quality (Serino et al., 2020). Knowledge sharing is key for organisations that want to exist in a highly competitive and dynamic environment. Experts have identified that knowledge sharing contributes significantly to innovation and improved performance (Kim, 2021).

Among academics and practitioners, continuous knowledge sharing has been recognised as a beneficial behaviour. In recent years, rapid advances in information technology have made the Internet a major platform for information exchange (Nie et al., 2024). The way we share knowledge has changed significantly from physical environments to digital platforms, with online media being the main evidence of this shift (Yoshikawa et al., 2023). Disseminating information via the Internet is now a common activity, where individuals can safely and efficiently provide answers to questions or share items of interest (Nguyen et al., 2019). This not only strengthens interpersonal trust, but also contributes to increased well-being and individual contentment (Nie et al., 2024).

However, given the privacy offered by the Internet, people who share information online may be driven by different motivations and obtain outcomes that are not the same as those who share information offline (Nguyen & Fry, 2022). In the online world, the influence of managerial and organisational factors is smaller, while individual factors become more dominant. As a result, online sharing behaviour is more related to meeting the internal needs of each individual (Kumi & Sabherwal, 2019).

They expect the satisfaction derived from helping others through online platforms (Nguyen & Malik, 2022), and improve their reputation by contributing knowledge (Shehab et al., 2023). They can receive more feedback and comments on their uploaded content or answers. This online sharing process significantly contributes to their improved well-being and self-confidence (Zheng et al., 2023). Unlike offline knowledge sharing which is private, social media allows transparency in all interactive

information. Users can observe how others behave and respond. Interacting with strangers positively on these platforms can also help fulfil their social needs (Kang, 2020).

Stack Overflow

Stack Overflow (SO) as a technical Q&A site has become an important centre for software developers to exchange information and support their community. Despite SO's popularity and success, understanding and finding information on it remains a big challenge (Nadi & Treude, 2019). To ensure posts are easy to understand, Stack Overflow allows users to use Markdown and HTML in editing. This allows them to apply various formats such as bold, italicised, and coded text, so they can highlight important parts and draw other users' attention to crucial information in the post (Ahmed et al., 2024).

A review of software engineering literature revealed that Stack Overflow is highly effective in deepening users' understanding of various software engineering topics (Haque et al., 2020). As one of the largest and most popular online Q&A forums, Stack Overflow provides a platform for developers to get answers from fellow professionals and also answer other people's questions, thus enriching their knowledge in the field (Silva et al., 2021).

To help developers craft high-quality questions, Stack Overflow has provided its community with in-depth quality assurance guidelines. However, many questions submitted do not meet the platform's quality standards. These questions are often vague, inaccurate, or do not provide adequate solutions, making it difficult for experts to provide appropriate answers.

As a result, knowledge sharing and progress within the SO community is hindered (Yang et al., 2024). One of the reasons for the low quality of questions is the inability of users to create informative titles. This could be due to their lack of familiarity with related knowledge and terms, or their poor writing skills (Gao et al., 2020).

Qualitative

A qualitative approach is a method used to understand social phenomena from the perspective of the people who experience them (Creswell & Creswell, 2018). This approach focuses on an in-depth exploration of the experiences, perceptions, and behaviors of individuals in a particular social context, which cannot be explained with quantitative data. Therefore, in this study, a qualitative approach was used to deeply explore the patterns of knowledge sharing behavior at Stack Overflow. The Focus Group Discussion (FGD) method was used in this study to facilitate interactive discussions between participants, all of whom were programmers with experience using Stack Overflow. FGDs allow participants to share their experiences and perspectives, as well as bring up ideas that may not come up in individual interviews. This method is very effective in exploring the factors that influence passive and active knowledge sharing behaviors on online platforms (Schulze et al., 2022). After the data was collected through FGDs, the Thematic Analysis method was used to analyze the data. Thematic Analysis is a technique that allows researchers to identify recurring patterns in the data and organize them into themes relevant to the research question (Kiger & Varpio, 2020). In this study, Thematic Analysis was used to find the main themes related to passive and active knowledge sharing behaviors on Stack Overflow, as well as the factors that influence them. Using FGDs and Thematic Analysis, this research was able to reveal the psychological, social, and practical factors that influence knowledge sharing patterns on Stack Overflow. This approach provides a richer and deeper understanding of how and why users tend to be passive or active in knowledge sharing.

Qualitative research encompasses a variety of approaches that produce findings without relying on quantitative measurements or statistical analyses. These methods often involve personal interviews, group discussions, participant observation, ethnography, and several others. Traditionally, qualitative research has been used in a variety of fields to describe specific phenomena. For example, in early cultural anthropology, participant observation was used to record the beliefs and practices of specific cultural groups (Hamilton & Finley, 2020).

Qualitative research is ideal for addressing uncertainty and limited predictability in socioeconomic interactions and understanding the specific context of economic phenomena. It emphasises an in-depth

understanding of the complex interactions of various factors that shape social phenomena and structures. This is particularly important in polycrisis situations, where it is important to understand both the crisis event and the underlying structure. Qualitative methods also allow for open and flexible analyses of new phenomena and contexts (Porak & Reinke, 2024).

The qualitative research approach assumes that the phenomenon under study is influenced by context, evolving, and open to multiple interpretations. These factors cannot be simplified into independent variables and cannot be investigated with controlled scientific precision. Qualitative methods bring researchers closer to participants, rejecting the idea that researchers are completely independent and objective observers. Instead, researchers must consider the influence of their presence through reflexivity. This approach, which also involves broader social theories, highlights social and ethical issues in robotics research. It encourages researchers to take a more critical stance towards issues within the field (Veling & McGinn, 2021).

This study required a qualitative method as it aimed to gain an in-depth understanding of knowledge sharing patterns and best practices among programmers on Stack Overflow. Through in-depth interviews, the researcher was able to uncover the reasons behind passive use and factors such as introverted tendencies, time constraints, and concerns about confidentiality. Qualitative methods also allowed for more detailed contextual analyses, identification of psychological and social barriers, and the discovery of practical strategies to improve the quality of questions and active participation. This approach encourages reflexivity and flexibility, allowing researchers to adjust the focus according to evolving findings and providing comprehensive insights into knowledge sharing behaviour on digital platforms.

Methodology

This research adopts a qualitative approach to explore the use of Stack Overflow in the programmer community. Qualitative research is an approach to exploring and understanding the meaning individuals or groups ascribe to a social or human problem. Emerging questions and methods, data acquired in the participant's environment, inductive data analysis that builds from specifics to broad themes, and the researcher's interpretations of the data's significance are all part of this research process (Creswell & Creswell, 2018). This approach was chosen for its ability to provide an in-depth and contextualized understanding of social phenomena regarding programmers' perspectives on using Stack Overflow as a knowledge-sharing media.

Research Approaches

In the qualitative analysis, we conducted a manual study to get user patterns in sharing knowledge on the Stack Overflow website, then we will make clusters according to the similarity of user behavior. In addition, based on the results of interviews that we conducted with several respondents, we will conduct an in-depth analysis so that we can get best practices in sharing knowledge on the Stack Overflow website. The term 'manual study' in the context of this research refers to the process of data collection and analysis that was conducted manually by the researcher, without the use of automated data analysis software. All data from the Focus Group Discussions (FGDs) were organized and analyzed directly using traditional methods, such as in-depth reading of transcripts, identifying emerging themes, and manual coding using Microsoft Word and Excel. The manual approach was chosen in this study due to the relatively small number of respondents, as well as the need to conduct a more flexible and in-depth analysis of the respondents' behavior patterns (Hillman et al., 2023). With a manual approach, the researcher can get closer to the data and be more responsive to nuances and details that automated software might miss. While data analysis software such as NVivo can help analyze qualitative data, the manual approach still provides advantages in flexibility of analysis, especially for small samples and for research that requires more in-depth interpretation.

Target Respondents

The target respondents in this study are programmers who either actively or inactively use Stack Overflow in their daily lives. This research focuses on their experiences and perceptions regarding the use of the Stack Overflow website in knowledge sharing to ensure that the data collected covers a wide

range of user perspectives. This selection of respondents aims to gain a comprehensive picture of the acceptance and influence of the Stack Overflow website in users' daily lives in sharing knowledge about the world of programming. All respondents interviewed in this study are domiciled in Indonesia. The selection of respondents from one country was done to ensure cultural homogeneity and work context in identifying knowledge sharing patterns at Stack Overflow.

Research Stages and Flow

The research process consists of several important steps, starting with a clear and defined problem formulation. After that, a literature review was conducted to build a strong theoretical basis and construct the research model. The data collection stage involved direct interaction with respondents, followed by rigorous and structured data analysis. The research ended with the formulation of logical conclusions and practical suggestions. The research began with a clear identification of the problem and a literature review to gain an in-depth understanding of the topic. A framework was then created to guide data collection. Data collection was conducted through semi-structured interviews using the Microsoft Teams virtual platform. Once the data was collected, analyses and calculations were conducted to develop valuable conclusions and recommendations.

Data Collection

At the data collection stage, interviews were conducted with seven respondents who all work as programmers. This study only involved seven respondents because the results obtained were sufficient to answer the research questions, providing important insights into knowledge sharing on the Stack Overflow forum by programmers. Data collection took place from 16 to 17 May 2024, using the Focus Group Discussion (FGD) method. FGD involves collecting data through group interactions on a topic determined by the researcher (Creswell & Creswell, 2018). FGD is used because FGD can encourage participants who are reluctant to be interviewed alone, and also encourage participants who feel they have nothing to say (Kulkarni & Dandekar, 2021). This method is very suitable for use with programmer respondents, who are known to be quiet and rarely talk. This study used a purposive sampling method with the criteria that respondents must have worked or are currently working as programmers, participating in the development of applications, websites, or software systems, especially in the coding stage. The similarity of these roles allows researchers to obtain more focused information about programmers' perceptions of the Stack Overflow forum in sharing knowledge. The diversity of each participant's industry sector allows this study to have a broader understanding of their background, regulations, and company culture. The profiles of the participants are presented in Table 1.

The FGDs were conducted online to overcome logistical challenges arising from the geographical limitations of the respondents (Shaheen & Ibrahim, 2022), who came from different cities and different industries. In addition, this choice was also driven by the time constraints and flexibility of the respondents (Stewart et al., 2022), who often have busy work schedules. By using a virtual platform such as Microsoft Teams, we can ensure that all respondents can participate without having to physically travel, which may be difficult to schedule. However, online FGDs also have some limitations. One of them is the lack of non-verbal observations that are often more obvious in face-to-face FGDs (Daniels et al., 2019). Non-verbal signs such as body language or facial expressions may not be optimally visible on an online platform. Also, social interactions that are usually more dynamic in face-to-face sessions may become a bit limited in the online format (Daniels et al., 2019). Technical glitches such as an unstable internet connection can also affect the course of the discussion (Halliday et al., 2021). To overcome these limitations, we made sure that each participant was familiar with the platform before the FGD started, and provided technical guidance if needed. We also facilitated more personalized interactions by asking each participant to actively contribute and allowing sufficient time for each respondent to speak without rushing. In addition, the recording session also helped in capturing audio details that may have been missed during the session, allowing for a thorough analysis. While online FGDs have some limitations, the steps taken to mitigate these challenges ensure that the data collection process continues to work well and yield deep insights. Therefore, online FGDs were a suitable and effective option for this study, considering the logistical limitations and the needs of the respondents.

Table 1. Profile of the Interview Participants

No.	Role	Educational Background	Work Experience (years)	Industry Sector	Domicile
1	Application Operation Support	Bachelor of Informatics Engineering	2+	Government and Information Technology	Jakarta, Indonesia
2	Application Operation Support	Bachelor of Computer Science	2+	Government and Information Technology	Jakarta, Indonesia
3	Application Operation Support	Bachelor of Informatics Engineering	2+	Government and Information Technology	Jakarta, Indonesia
4	Ex-Freelancer Fullstack Developer	Bachelor of Informatics Engineering	5	Information Technology	Depok, Indonesia
5	iOS Developer	Bachelor of Computer Science	3	Information Technology	Depok, Indonesia
6	Ex-Automation System Engineer	Bachelor of Electrical Engineering	8	Manufacturing and Automation Technology	Depok, Indonesia
7	The first Researcher of Remote Sensing Data	Bachelor of Physics	5	Government and Information Technology	Depok, Indonesia

In qualitative research, as explained by Creswell & Creswell (2018), sample size is not determined by the number of participants but rather by the achievement of data saturation, which is when no new information or themes emerge from additional interviews. In this study, seven respondents were considered sufficient because at that point, key patterns related to knowledge sharing behavior on Stack Overflow had emerged consistently, and additional interviews did not provide new insights. According to Braun & Clarke (2021), data saturation is often achieved with a relatively small number of respondents, usually between 6 to 12 people, depending on the complexity of the phenomenon under study. In this study, seven respondents were sufficient to achieve data saturation, as additional interviews no longer provided new themes related to knowledge sharing behavior on Stack Overflow. This research uses a qualitative exploratory approach that focuses on an in-depth understanding of respondents' experiences and behaviors. In a qualitative context, the number of respondents does not have to be large, as the purpose of the research is to explore deep understanding, not to make generalizations. Therefore, the seven respondents selected were sufficient to provide rich and deep insights into the usage patterns of Stack Overflow. Although only seven respondents were involved, this sample was chosen with diversity in mind, in terms of industry, role, and experience in using Stack Overflow. This ensures that a variety of relevant perspectives can be accommodated in the analysis, so that the research results include a more comprehensive picture of knowledge sharing behavior on this platform.

In this study, all respondents gave their informed consent prior to participation. Before the FGD session began, the researcher explained the purpose of the study, the methods used, and how their data would be managed and protected. The respondents were given the opportunity to ask questions and understand the implications of their participation in the study before agreeing to be involved. As the study was

conducted virtually through the Microsoft Teams platform, consent was obtained verbally and recorded as part of the FGD session. Each respondent clearly expressed their willingness to participate after hearing an explanation of the study and their rights as a participant. All consent recordings were securely stored in accordance with research data storage procedures. The study was conducted in compliance with the principles of research ethics set out by the university and relevant research institutions. Respondents were informed that their participation was voluntary, their data would be kept confidential, and they could withdraw from the study at any time without consequences. In addition, respondents' real names were not used to maintain their confidentiality.

The interview was divided into four parts as shown in Table 2. The first part includes background information on the respondents, including programming projects they have worked on or are currently working on. The second parts focus on questions about the coding process, delving into the problems that respondents often face when working on application development projects, as well as how they solve them. The third parts ensures that respondents are actively sharing knowledge in their field. The fourth parts examined the respondents' interaction in sharing knowledge through discussion forums between programmers on the internet, such as Stack Overflow or other platforms, and their reasons for using these platforms. In this section, the information obtained reveals the respondents' behavior and views on the effectiveness of these discussion forums, in formulating best practices for all members in sharing knowledge.

Table 2. Interview Questions List

Interview Sections	**Questions**	**Caption**
Background Information	What is your role or title at your current workplace?	-
	How long have you been working at your current workplace?	
	What is your educational background?	
	Can you mention your work history before your current workplace?	
	How long have you been working as a programmer?	
	What programming languages are you proficient in?	
	In your opinion, what is your level of proficiency in programming?	
	How many applications/websites/programs have you developed, either by yourself or with a team?	
	Can you tell us about the development process of one of the applications/websites/programs that you have worked on or are currently working on?	
Coding Process	Have you ever experienced problems in developing an application/website/program, especially in the coding section?	This interview question is to answer the first research question
	What do you usually do if you experience problems with the code you write?	
Knowledge Sharing	As a programmer, do you often share knowledge of the latest knowledge in the field of programming languages, such as informing the latest updates, or sharing fix codes with colleagues?	
	How do you see the role of a programmer in developing and spreading knowledge in the field of programming?	
	What do you think programmers can do to develop new knowledge in the field of programming?	

Interview Sections	**Questions**	**Caption**
Personal Inquiries	Have you ever used knowledge-sharing forums dedicated to programmers? For example, like Stack Overflow, or other forums. - If "YES", how was your experience when using them? - If "YES", are there any features you would like that are not available on these forums? - If "NO", why don't you use these forums?	
	What do you do in the forum?	
	How important do you think the Stack Overflow website is for knowledge sharing?	This interview question is to answer the second research question
	What do you think is the most effective way to share knowledge on the Stack Overflow website?	

This FGD was divided into two sessions and was conducted online using the Microsoft Teams platform, and the sessions were recorded using the same platform. The first FGD was conducted with P1, P2, and P3, and the other was conducted with P4, P5, P6, and P7 as respondents. These FGDs are designed with open-ended questions to ensure the answers from respondents are not limited to a set of defined answers. The authors determined the seven respondents based on several reasons that support the purpose of the study, namely to gain comprehensive insights into knowledge sharing patterns among programmers at Stack Overflow. The following are the justification sentences for the selection of the seven respondents:

1. **Diversity of Professional Backgrounds:** The respondents were selected because they come from various industry sectors, including information technology, government, manufacturing, and automation. This diversity allows the research to cover a wide range of perspectives and knowledge sharing practices that may differ between sectors.
2. **Relevant Work Experience:** Each respondent has significant work experience in programming, with the duration varying from 2 to 8 years. This experience ensures that they have sufficient depth of understanding and practice in knowledge sharing in online communities.
3. **Adequate Education Level:** All respondents have a strong educational background in informatics engineering, computer science, or electrical engineering. This adequate education ensures that they have a strong theoretical and practical basis for participating in knowledge sharing discussions.
4. **Diverse Roles and Responsibilities:** Respondents have various roles such as Application Operation Support, Fullstack Developer, iOS Developer, and System Engineer. This diversity of roles helped the researcher to understand the knowledge sharing patterns from different job perspectives.
5. **Experience Using Stack Overflow:** Respondents were selected because they had both active and passive experience in using Stack Overflow as a knowledge sharing platform. This is important to identify usage patterns and best practices in knowledge sharing on the platform.
6. **Appropriate Data Collection Methods:** The selection of respondents was also based on their availability to participate in Focus Group Discussions (FGDs) and semi-structured interviews, which are the data collection methods used in this study. This ensures the data collected is relevant and in-depth.
7. **Focus on Practical Experience:** Respondents were selected based on their ability to provide practical insights into the app development process and programming troubleshooting. This supports the research objective of identifying best practices in knowledge sharing on Stack Overflow.

These criteria aim to ensure that each respondent has sufficient experience to provide rich and relevant insights into knowledge sharing patterns on Stack Overflow. The respondent recruitment procedure was

conducted through a purposive sampling approach, where the researcher intentionally selected individuals who fit the inclusion criteria (Campbell et al., 2020). Respondents were contacted through professional networks and communities of programmers on platforms such as technology-related online discussion groups. The research invitation was sent via email, explaining the purpose of the research, the procedure, and their rights and obligations as participants. After receiving responses from interested potential respondents, the researcher conducted further verification to ensure that they met the predetermined inclusion criteria. This verification was done through an initial communication session, where the researcher ensured that each respondent had experience using Stack Overflow and was in a relevant industry. Only respondents who met all the criteria were invited to participate in the FGDs.

In formulating the interview questions, we followed an approach that focused on the research objective, which was to explore knowledge sharing patterns at Stack Overflow. The process of formulating these questions did not require an in-depth theoretical foundation, as the main focus was on ensuring that each question was able to help answer the research questions that had been set. The interview questions were structured to explore respondents' experiences, behaviors, and views regarding the use of Stack Overflow. The main focus is on the relevance of data that can support the answers to the research questions, so the questions are more directed at the respondents' real practices and experiences, without necessarily involving certain theories. In a qualitative approach, flexibility is key (Olsen, 2019). Therefore, the interview questions were structured to remain open-ended, allowing respondents to provide in-depth and exploratory answers. We focused on constructing questions that could directly provoke rich discussions, without requiring references from journals or rigid theories. With this approach, we ensured that the interview questions could elicit deep and relevant insights to answer the research questions, without the need to refer to specific theories or journals. This approach is consistent with the qualitative methods we studied, which emphasize flexibility and relevance to the research objectives.

The FGDs were conducted through the Microsoft Teams platform and moderated directly by the researcher. The discussion lasted about 60 to 75 minutes, with pre-prepared main topics related to knowledge sharing patterns on Stack Overflow. The moderator played a role in guiding the discussion, ensuring each respondent participated, and keeping the discussion focused on the research objectives. During the FGD, the moderator ensured that each respondent got a chance to speak and answer questions. We used a round-robin approach, where each respondent was given time to express their opinions in turn. If any respondents seemed passive, the moderator directly asked them questions to encourage active participation. In this way, each respondent had a fair chance to contribute to the discussion. The main purpose of this FGD was not solely to reach a consensus, but rather to explore the diverse views and experiences of respondents regarding knowledge sharing behavior on Stack Overflow. However, in some topics, such as technical barriers faced by users when sharing knowledge, respondents reached an agreement that concerns about the confidentiality of personal information is one of the main factors that hinder active participation. The FGD process went well, with each respondent having the opportunity to contribute, and a variety of views were uncovered. Although consensus was not always achieved, the research objective of exploring diverse perspectives and experiences was well met.

Data Analysis

In this study, data analysis was conducted using the thematic analysis method. This technique is used to evaluate qualitative data by looking for recurring patterns in the data set and reporting the results. Thematic analysis is a method for understanding data by using interpretation during the process of code selection and theme generation (Kiger & Varpio, 2020).

The steps of thematic analysis in this study consisted of six stages (Kiger & Varpio, 2020). In the first stage, researchers transcribed the audio interviews that had previously been conducted, helping them to make sense of all the data collected. Additionally, in this stage, the data was translated into English as the interviews were initially conducted in Indonesian. The second step involved initial coding, with codes being created to facilitate grouping and organizing the data. In the third stage, the search for themes was conducted by re-evaluating the data that had been grouped by code, to find potential themes. In the fourth step, the discovered themes were reviewed for congruence with the underlying codes. In

the fifth step, the themes were named and aligned with the research questions. Finally, in the sixth step, the results of the thematic analysis were presented in sentence form. The whole process of thematic analysis was done manually with the help of Microsoft Word and Microsoft Excel and involved researcher interpretation.

Results

This section presents the data collected, the data analysis process, and the findings of this research, by the methodological steps previously described, and incorporates the theories discussed in the literature review chapter.

Theme 1 – Usage Pattern in Stack Overflow

Passive Usage

Across both Focus Group Discussions (FGDs), it was observed that the questions respondents wanted to ask were often already available or had already been asked by another user. Consequently, the respondents did not feel it necessary to pose questions that were already present. This redundancy reduced the inclination to create new threads, as participants preferred to refer to existing discussions rather than initiate repetitive inquiries.

"For me, I usually read the existing ones first. But if there is something specific and there is no solution, then I try to ask." - *P6*

"I can answer up to 70% from Stack Overflow." - *P1*

Programmers, who are mainly quiet and passive people often lack the confidence to participate in the discussion on Stack Overflow. This hesitation can stem from a fear of making mistakes or being judged by other users. Additionally, the high standards and detailed knowledge expected in responses can be intimidating, further discouraging active participation.

"... maybe this is more personal since I happen to be a passive person." - *P3*

"... like answering on Stack Overflow or something like that, I'm not too sure yet, I'm not very confident yet." - *P4*

Programmers, especially those working in high-pressure environments, often lack the time to actively participate in threads on Stack Overflow. The demanding nature of their jobs leaves them with little opportunity to engage in online discussions, even when they recognize the potential benefits of knowledge sharing. The constant pressure to meet deadlines and the need to focus on immediate tasks take priority over contributing to forums. As a result, their participation in such communities is limited, which can impact the overall exchange of valuable information and support among programmers.

"Maybe I'm confident that if we want to share, it could help even more people. However, it might just be that I don't have the time for it yet." - *P3*

Passive in Stack Overflow but Active in Other Forums

While many programmers are not active on Stack Overflow, they are often more active on other forums. One of the interviewees, P1, stated that they use Telegram more because it is more flexible and does not require a complicated login process. Active engagement in other forums could be due to the convenience and ease of access offered by these platforms compared to Stack Overflow.

"... I am usually active on Telegram because it is more flexible, only need to chat, no need to log in..." – P1

Confidentiality Concern

Concern about the confidentiality of information is also a reason why some programmers are reluctant to share on Stack Overflow. P7 mentioned that sharing information regarding internal organizational issues on public platforms is not allowed due to the confidential nature of the information. This shows that the confidentiality factor can be a major barrier to knowledge sharing on public platforms.

> *"For sharing, if you go anywhere, to the website, no, because it's a matter of internal affairs, within the state, so you can't." – P7*

Always check from Google first

Before looking for answers on Stack Overflow, many programmers first look for solutions through Google. This habit is due to the speed and efficiency offered by the search engine. Google often directs users to Stack Overflow or other relevant sources, making it a quick first step in solving programming problems.

> *"The first time I do it, I usually search for the error on Google, because it's the fastest." – P4*

> *"Usually if it's like that, at first I will just search from Google first, then from Google it will also be directed to Stack Overflow." – P6*

Theme 2 - Importance of Stack Overflow as a Knowledge-Sharing Platform

Stack Overflow is The Swiss Army Knife of Programming Knowledge

Programmers now consider Stack Overflow to be a priceless resource due to its extensive collection of tools and solutions. It aids on a wide array of topics, from specific code-related issues to broader operating system problems. Because of the platform's vast knowledge base, developers may easily locate solutions to their queries, making it a valuable resource for both seasoned and inexperienced programmers. In the programming community, Stack Overflow promotes effective problem-solving and ongoing learning by making such a plethora of information accessible.

> *"I can find the solution to almost every problem I face on Stack Overflow. It's very helpful in my daily work." - P1*

> *"Stack Overflow is very, very useful because it has everything." - P2*

Stack Overflow is The First Gateway to Problem-Solving

Stack Overflow, as a knowledge-sharing medium, has become the go-to resource for programmers to solve any problems they encounter during the coding process. Its extensive database of questions and answers covers a vast array of topics, making it an indispensable tool for developers seeking solutions. This platform's role in fostering a collaborative and supportive community has solidified its place as a top resource in the minds of programmers worldwide, significantly enhancing productivity and efficiency. As mentioned by some participants:

> *"... before there was ChatGPT, Stack Overflow is the first gateway to finding solutions." - P4*

> *"Very important, because now Stack Overflow has become quite vital in terms of solving problems, becoming guidelines or the main reference place for getting solutions." - P6*

Theme 3 - Learning and Problem-Solving Processes

Self-exploration is The Key to Learning New Technologies

Programmers are often inclined to independently explore new technologies at first. This initial phase of solo experimentation allows them to develop a personal understanding and hands-on experience with the latest tools, frameworks, or programming languages. Once they have gained sufficient insight and confidence, they are more likely to share their discoveries and insights with their peers. This sharing can take various forms, such as informal conversations, detailed blog posts, or participation in online forums. When programmers join platforms like Stack Overflow to start discussions, it catalyzes a broader process of knowledge sharing. These interactions lead to a collaborative environment where ideas are exchanged, problems are solved collectively, and the overall knowledge base of the programming community is enriched. This cycle of exploration, sharing, and discussion not only helps individual programmers but also drives the continuous evolution and improvement of technological practices within the community.

> *"For new technology, I usually first explore it myself because I was a beginner fresh graduate you could say. So first I explore myself after that if I have stuck or the knowledge I have learned or the technology I have learned is by my limits, then I will discuss with my office mates about the new technology." - P1*

> *"Usually, if I have something new, I try to study it myself first, then if I get stuck, I ask my seniors or co-workers." - P2*

Reliance on Online Forums to Solve Problems

When facing issues, such as coding-related problems, programmers tend to use online forums like Stack Overflow, often through Google, to find solutions. However, when very specific problems occur or when there is a need to maintain secrecy around certain code or algorithms, programmers prefer to discuss these problems internally with their peers rather than post them on online forums. This approach ensures confidentiality while still leveraging collective expertise.

> *"For coding problems, I usually look for myself on Google or Stack Overflow, but if the problem is a bit heavy, I usually discuss the logic with the team or seniors first." - P5*

Theme 4 - Best Practices in Knowledge Sharing on Stack Overflow

Utilize as Many Online Forums as Possible

Some programmers may prefer to search multiple forums to find the best solution to a specific problem. This best practice method allows them to acquire as much knowledge as possible. By exploring a variety of sources, they can compare different approaches and select the most effective one. This thorough research process not only helps in solving the immediate issue but also broadens their understanding and skill set, making them more adept at tackling future challenges.

> *"For Java itself, I usually use Stack Overflow, then in telegram there are also many forums, then in hack rank, there are also forums ... it is quite helpful for new features in Java or SQL or whatever" - P1*

The Key is in The Details

When asking in Stack Overflow, there is a need to give a detailed context of the question. Also, make a clear end goal of the code provided. With this, respondents will fully understand the issue and the context of the problems so they can be more active in the forums.

"We must specify what the problem is. We also give what the evidence is like. So, it must be clear in advance what the problem being asked is. So that the party answering will understand the details of the problem." - P5

"The explanation of the problem must be as detailed as possible. Then for those related to hardware, the specifications of the hardware or software are also explained. So that those who answer can know the context of the system error as a whole." - P6

Be More Active

Participation of programmers is essential to ensure the quality of knowledge shared on Stack Overflow. By being active in the forums, they contribute their expertise, validate solutions, and provide valuable feedback. This active engagement helps maintain the accuracy and relevance of the information available, fostering a reliable resource for the entire programming community. Moreover, their involvement encourages a culture of collaboration and continuous learning, benefiting both novice and experienced developers.

"It's best to create a thread if the issue doesn't exist yet. We fill in the description available to create a thread and create a new post. We also adjust the tags. But if it's an old issue, then it's best if we can give an opinion or solution, by replying to other people's posts. If for example in the post there is already a solution and the solution can be used by us, then we give an upvote to the answer, the value is getting bigger, also giving a reward to the answer giver." - P4

Table 3 below summarizes the main themes that emerged during the FGDs. Each theme is associated with a respondent who mentioned the theme during the discussion. For example, the theme 'Passive Usage Patterns' was identified by four respondents who acknowledged that they often search for information on Stack Overflow without actively contributing.

Table 3. Summary of Key Themes and Respondents in FGDs

No.	Main Theme	Theme Description	Respondents who Mentioned Themes
1	Passive Usage Patterns in Stack Overflow	Users often search for information already available on Stack Overflow without actively participating, such as asking questions or answering questions.	P1, P3, P6
2	Concerns about Confidentiality	Concerns over the confidentiality of information prevent some users from sharing knowledge on open platforms such as Stack Overflow	P2, P7
3	Use of Other Forums (Telegram, etc.)	Some users are more active on other platforms such as Telegram due to ease of access and flexibility	P1
4	Learning Process and Problem Solving	Users tend to do independent exploration in learning new technologies before sharing their findings	P1, P2, P5
5	Best Practices in Knowledge Sharing on Stack Overflow	Ensure there is clear detail in the question and use various forums to find the best solution.	P4, P5, P6

The results of this study were obtained through several analytical steps. First, data was collected through Focus Group Discussions (FGDs) with seven respondents who have experience using Stack Overflow. Second, the data obtained from the FGDs were transcribed and analyzed using the Thematic Analysis method, where key themes were identified and grouped. Each emerging theme was identified based on

its frequency of occurrence in the discussion, as well as its relevance to the research questions. Third, these themes were then presented and further analyzed to understand the patterns of knowledge sharing in Stack Overflow. In the process of analysis, preliminary findings showed that most respondents engaged in passive usage patterns, which were then further analyzed to identify factors influencing such behavior. Factors such as concerns about confidentiality and lack of motivation to actively participate emerged as key themes that helped the researcher understand the challenges faced by Stack Overflow users. Ultimately, these findings provide the basis for recommendations on how the platform can increase active participation. By presenting a table of themes and respondents supporting each theme, as well as explaining the steps taken during the analysis process, the results of this research become more structured and easier to understand. It also provides a more complete picture of how the final insights were derived from the data collected.

Discussion and Implications

This research reveals two main aspects of knowledge sharing patterns in Stack Overflow, namely the pattern of users in sharing knowledge and the best practices that can be done to share knowledge effectively. Only two aspects of knowledge sharing were covered in the discussion as these themes directly address the research questions. Theme 1 reflects users' patterns of knowledge sharing, while theme 4 focuses on best practices, which are particularly relevant for answering the second question. Thus, the discussion centered on these two themes to keep the focus on the main objective of the research. Theme 1, which focuses on passive usage patterns, answers the first research question of what are the user patterns in knowledge sharing. This pattern emerged as dominant in the data and reflects passive engagement on Stack Overflow. Meanwhile, theme 4 on self-learning processes and knowledge sharing best practices on Stack Overflow answered the second research question.

User Patterns in Knowledge Sharing on Stack Overflow

Meanwhile, all FGD participants agree that Stack Overflow is their main source of problem-solving solutions to all their code-specific problems as stated by the second theme. However, all participants still lack the motivation to be active in knowledge sharing especially in Stack Overflow. These usage patterns can be caused by many factors like the nature of stack overflow itself, the quiet and introverted nature of programmers, and time constraints.

Based on the interview results and thematic analysis, the main pattern identified is the passive use of the Stack Overflow site. Most respondents use the site to find solutions to programming problems they face but rarely actively participate by posting questions or answers. For example, some respondents stated that they often rely on Stack Overflow to find solutions but do not actively contribute by providing answers or asking questions. One of the main reasons for this passive usage is that programmers believe many of their problems have already been asked and solved in the forums, so they don't feel the need to ask the same questions. These findings are similar to the study conducted by Nguyen (2021), which indicates that people tend to be 'lurkers' because they think just reading and browsing is enough. This suggests that many lurkers can get their needs met through observation rather than public participation.

The nature of programmers themselves is another factor contributing to the passive usage of Stack Overflow. Since programmers are frequently introverted, quiet, and passive people, they are more prone to absorb information than actively contribute to knowledge sharing. This introverted tendency means they prefer to observe and learn from existing discussions rather than engage in them. They might find it more comfortable to absorb knowledge in private than to participate in public forums. They might stay in the background and learn silently out of fear of receiving unfavorable comments or condemnation from more seasoned peers. These findings have similar results to the research conducted by Lv et al (2022), who conducted similar research in the healthcare context. Their research found that introverted users are more likely to engage in knowledge-sharing forums passively rather than actively contributing. The same result was also highlighted by Jami Pour and Taheri (Jami Pour & Taheri, 2019), who found that a lack of trust in introverted individuals affects their willingness to share knowledge. This tendency to observe rather than participate actively highlights a common behavior pattern across

different fields, where introverted individuals prefer to absorb information quietly instead of publicly sharing their insights and experiences.

Passive usage can also be caused by time constraints. Programmers, who frequently work in high-pressure environments with limited time, often find it challenging to share their knowledge. The demanding nature of their jobs leaves them with little energy or opportunity to engage in online discussions or contribute to forums like Stack Overflow. Consequently, while they may benefit greatly from the resources available on such platforms, their contributions remain minimal due to these constraints. These findings can also be found in the research conducted by Li et al (2023), who found that time pressure negatively impacts knowledge-sharing intention because it increases emotional exhaustion. Costin et al (2023), also found time constraint is a significant barrier that affects physicians' intention to share knowledge.

In addition, some programmers were more active in other forums for reasons of convenience and ease of access. For example, P1 stated that they use Telegram more often because it is more flexible and does not require a complicated login process. This active engagement in other forums could be due to the convenience and ease of access offered by these platforms compared to Stack Overflow. This suggests that programmers are looking for platforms that are more user-friendly and efficient in sharing knowledge.

Concerns about the confidentiality of information are also a reason why some programmers are reluctant to share on Stack Overflow. P7 mentioned that sharing information related to internal organizational issues on public platforms is not allowed due to the confidential nature of the information. This suggests that the confidentiality factor could be a major barrier to knowledge sharing on public platforms. Therefore, it is important for platforms like Stack Overflow to consider features that can keep user information confidential.

The habit of searching for answers through Google before searching on Stack Overflow reflects the efficient use of online resources by programmers. This habit is due to the speed and efficiency offered by search engines. Google often directs users to Stack Overflow or other relevant resources, making it a quick first step in solving programming problems. This suggests that better integration between search engines and Stack Overflow could improve information accessibility.

Best Practices in Knowledge Sharing on Stack Overflow

Meanwhile, all participants agree that Stack Overflow is an invaluable asset to programmers as a problem-solving tool. There is also some emphasis on self-exploration of new technology, this exploration aims to increase self-expertise, which in turn can improve the quality of knowledge shared on Stack Overflow. This has been explained by Al Mamun & Lawrie (2023), who stated that people who engage in deep self-exploration of new knowledge tend to have better learning outcomes and are more likely to share their knowledge effectively.

After self-exploration, the next step is to share the knowledge. All participants have developed their way of sharing knowledge effectively in online forums. Their 'best practices' have their benefits and step back. But every 'best practice' can lead to a better knowledge-sharing experience and a better quality of the knowledge shared.

The best practices identified in this study include several strategies that can improve the effectiveness of knowledge sharing on Stack Overflow. The first best practice proposed will be using multiple forums/websites instead of only using Stack Overflow. Integrating Stack Overflow with any outside resources like another forum, tutorials on YouTube, or any other sites, and official documentation of the programming language will enrich the knowledge acquired by the programmer. This can lead to a better solution to a code and will improve decision-making. A similar finding can also be found in the research conducted by Samuelsen et al (2019), who found using multiple learning sources improves the knowledge-sharing experience by providing richer insights. Kirk et al (2022), also found that using multiple knowledge sources will improve learning efficiency.

Another best practice identified is that the more active you are in the forums, the better your knowledge-sharing experience becomes, which in turn improves the quality of the shared knowledge. Active

participation allows individuals to engage in discussions, ask questions, and provide answers, fostering a collaborative environment. This continuous interaction not only enhances personal expertise but also contributes to the overall richness and accuracy of the information available on the platform. By regularly participating, users can stay updated with the latest developments, refine their understanding, and help create a more comprehensive and reliable knowledge base for the entire community. The same results were also found in the research conducted by Marco-Fondevila et al (2022), who found that the students who have more active interaction in a forum will have improved knowledge, which improves academic performance and motivation to share their knowledge. Similar results were also found by Khan et al (2021), who found that being more active in forums and social media platforms enhances the knowledge-sharing experience by improving communication, increasing engagement, enhancing learning performance, and boosting motivation and enjoyment.

The final best practice identified from the FGDs is that when asking a question in a forum, it needs to be detailed, clear, and provided with context. Doing so improves the quality of the question, making it easier for respondents to understand. This clarity helps ensure that the answers provided are more accurate and helpful, ultimately enhancing the overall effectiveness of the knowledge-sharing process. The same results are also being discussed by de Lima et al (2019), who found that detailed questions in online forums enhance the knowledge-sharing experience by providing clarity, encouraging in-depth discussions, improving engagement, and facilitating better learning. These factors collectively contribute to a richer, more effective knowledge-sharing environment. This was also proved by Zou et al (2023), who showed that detailed questions can improve the knowledge-sharing experience by encouraging in-depth discussion. Which in turn, can improve the knowledge acquired.

While none of the seven programmers explicitly mentioned using AI such as ChatGPT as a replacement for Stack Overflow, global trends show an increase in the use of AI tools. According to a report by Stack Overflow (2023), 70% of developers already use or plan to use AI tools in their workflows, suggesting that AI is growing in popularity as an alternative to getting quick answers. AIs like ChatGPT allow programmers to get instant answers without the need to wait for a response from the community, which can reduce active interaction on platforms like Stack Overflow. However, research by Kabir et al (2024) found that 52% of answers generated by ChatGPT contained errors, even though users appreciated the readability and clarity of the answers. This suggests that while AI provides quick solutions, the quality of answers from the community on Stack Overflow still provides value.

This research reveals five key aspects or implications of knowledge sharing patterns on Stack Overflow. These aspects include various factors that influence user engagement, both in active and passive contributions on the platform. Each of these aspects plays an important role in understanding the dynamics of information sharing among users, as well as the factors that can enhance or hinder their participation.

Increasing Active Participation

The findings from this study reveal a significant gap between passive and active participation on Stack Overflow. Although the platform is widely used to search for solutions, the low level of active contributions hinders the potential for richer knowledge exchange (Mahbub et al., 2021). To increase active participation, Stack Overflow could consider strategies such as gamification and recognition systems to motivate users. Awards for valuable contributions and public recognition of participation can encourage more users to actively participate. Additionally, creating a more supportive environment for beginners with helpful guides and tutorials could increase new user engagement.

Overcoming Psychological Barriers

The introverted nature of many programmers combined with the fear of negative feedback greatly affects their desire to engage in active discussions. Overcoming these psychological barriers is important for building more inclusive and collaborative online communities. Platforms like Stack Overflow can implement an anonymous posting option to alleviate users' concerns about public criticism. While anonymity can encourage more users to share their knowledge, it can also lead to irresponsible behavior and disruptions, such as cyberbullying (Lee et al., 2020). In addition, providing

mentoring programs where more experienced users can help and guide beginners can encourage more active participation. Encouraging a culture of positive and constructive feedback can also reduce the fear of negative feedback and increase users' confidence to share knowledge.

Time Management and Knowledge Sharing

Time constraints are a significant barrier to active participation. Programmers often struggle to balance demanding work schedules with the time required to make meaningful contributions on the forum. Organizations and platform administrators can play a role in addressing this issue by integrating knowledge sharing activities into routine work processes (Shi et al., 2020). For example, encouraging employees to allocate dedicated time to contribute on forums such as Stack Overflow can improve both individual and organizational knowledge bases. Providing tools and resources that make it easy to share knowledge efficiently can also help overcome time constraints.

Improving Question Quality

This research emphasizes the importance of formulating detailed and contextualized questions to improve the quality of answers on Stack Overflow (Galappaththi et al., 2022). Educating users on best practices in asking questions, such as providing clear context, being specific about the problem, and outlining solutions that have been tried can improve the overall effectiveness of the knowledge sharing process. Stack Overflow can provide guidance and examples of good questions to help users understand how to ask more effective questions. By improving the quality of questions, the community can provide more accurate and useful answers, thus improving the overall knowledge sharing experience.

Implications for Platform Design

The findings of this study also have implications for the design of the Stack Overflow platform and similar forums. Features such as better integration with search engines (Chen et al., 2019), anonymization options, and tools to make knowledge sharing easier could increase user engagement. In addition, platforms may consider developing features that allow users to share knowledge more efficiently, such as automated tools to identify similar questions or personalized recommendation features. By continuing to innovate and customize platform features based on user feedback and research findings, Stack Overflow can improve the effectiveness and efficiency of knowledge sharing in the community of programmers.

In terms of theoretical implications, this study found that privacy concerns and passive usage patterns play an important role in inhibiting active participation in Stack Overflow, something that has not been widely discussed in previous research. Studies such as Zamiri & Esmaeili (2024) focused more on the technology use and social aspects of knowledge sharing, but did not touch on the psychological aspects related to privacy. As such, this study offers a novel contribution to the literature, by highlighting how privacy concerns can affect user engagement on knowledge sharing platforms. These psychological factors expand the understanding of the barriers faced in online communities, which have previously focused more on social and technical motivations.

Conclusion

This research reveals two main aspects of knowledge sharing patterns on Stack Overflow, namely user patterns in knowledge sharing and best practices that can be done to share knowledge effectively. The main usage pattern identified was passive use of the Stack Overflow site. Most respondents use the site to find solutions to programming problems they face but rarely actively participate by posting questions or answers. Factors such as programmers' introverted nature, time constraints, and the belief that their problems have been addressed before contribute to this passive use. In addition, concerns about the confidentiality of information and a preference to search for solutions through Google before Stack Overflow also influenced this usage pattern.

On the other hand, all participants agreed that Stack Overflow is a very valuable asset for programmers as a troubleshooting tool. Best practices identified to improve the effectiveness of knowledge sharing

include using forums or websites other than Stack Overflow, active participation in forums, and asking detailed and clear questions. These practices can improve the quality of knowledge shared and help create a more comprehensive and reliable knowledge base for the entire community of programmers.

This research also highlights the importance of addressing the psychological barriers and time constraints that programmers face to increase their active participation on Stack Overflow. Strategies such as gamification, recognition systems, and creating a more supportive environment for beginners can motivate users to participate more actively. Additionally, the implementation of anonymous posting options and mentoring programs can alleviate concerns about negative feedback and confidentiality of information.

Overall, this study provides deep insights into Stack Overflow usage patterns and best practices in knowledge sharing. The findings can be used to improve user engagement and the quality of knowledge shared on this platform, and encourage further research into the psychological and social factors that influence active participation in online forums such as Stack Overflow.

Limitation and Future Work

This study has several limitations. Firstly, the relatively small number of respondents may limit the generalizability of the findings. Secondly, this study only involved respondents who already had experience using Stack Overflow, so it may not represent the perspective of programmers who have never used this platform. Thirdly, this study uses a qualitative approach that relies on the researcher's interpretation, so there may be subjectivity bias in the data analysis. Lastly, this study did not explore in-depth external factors such as company policies or organizational culture that might influence knowledge-sharing behavior.

Future research can expand the scope by involving more respondents from various industry backgrounds and different experience levels to get a more comprehensive picture of knowledge-sharing patterns. In addition, research can be conducted to explore the psychological and social factors that influence active participation in online forums such as Stack Overflow. Further studies could also develop interventions or tools designed to encourage active participation and improve the quality of knowledge shared on these platforms.

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How People Recognize Dark Pattern in E-Commerce?

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Abstract

In the digital era, many manipulative design tactics, commonly referred to as 'dark patterns', have emerged. These tactics aim to conceal, mislead, deceive, and even exploit users during their use of an application. This study explores how users in Indonesia recognize dark patterns on e-commerce platforms, contributing to understanding of user perceptions in this context. The study involved evaluating 11 participants through in-depth interviews and exposure to 12 screenshots from Indonesian e-commerce platforms containing these design tactics. Thematic analysis was used to analyze qualitative data, identifying recurring themes and user challenges in recognizing dark patterns. Not all participants were able to recognize dark patterns in screenshots. Those who were able often attributed their awareness to personal experiences, highlighting the importance of experiential learning in identifying and understanding deceptive interface elements. Unclear interface information, user trust in the interface, and the conflation of marketing strategies with dark patterns were identified as key barriers to recognition. Beyond Indonesia, the findings of this study have broader implications for countries with similar digital ecosystems or socio-economic contexts. Understanding how users in Indonesia perceive dark patterns can provide valuable insights for countries with comparable characteristics, particularly in terms of digital literacy levels, trust in online platforms, and regulatory frameworks, where similar manipulative tactics may be prevalent. This study highlights the role of ethical and transparent UX design principles in reducing the harm caused by manipulative tactics and increasing user trust and satisfaction. Stricter regulations and clear guidelines are needed to protect consumers from unethical, manipulative tactics.

Keywords: Dark Patterns, Ethical Issues, User Interface, E-Commerce, Indonesia.

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Introduction

Dark patterns in user interface (UI) design are to manipulate users into unintended actions, such as automatically adding items to their shopping carts or subscribing them to newsletters without clear consent. These tactics, defined by Brignull (2010) on darkpatterns.org, include sneaking unwanted items into shopping baskets and adding hidden costs to subscriptions. Mathur (2021) defines dark patterns as UI choices that benefit online services by coercing or tricking users into making unintended, often harmful decisions.

These deceptive tactics have evolved over the last three decades. Trends in retail, research, public policy, and design have influenced them (Karagoel & Nathan-Roberts, 2021). Particularly in e-commerce, dark patterns have become widespread, designed to encourage purchases and generate profits (Narayanan et al., 2020). An online experiment by Di Geronimo (2020) involving 589 users found that many struggled to identify dark patterns in apps, demonstrating that these tactics are ingrained in everyday use. Moser (2019) identified 64 elements that encourage impulse buying, such as product reviews and quick add-to-cart buttons, on 200 shopping sites. Kim et al. (2021) analyzed dark patterns in travel agency websites, showing how they exploit users' cognitive biases.

Di Geronimo (2020) highlights the difficulty users have in detecting deceptive UI interactions, a concept termed "dark pattern blindness." This concept highlights the need for greater transparency due to users being unaware and manipulated. Voigt (2021) suggests that users may remain unaware of these tactics because hidden actions lead to unanticipated costs. Designed awareness programs could help users recognize and avoid these hidden strategies (Gunawan et al., 2021). The consequences of engaging with dark patterns in e-commerce include financial losses, such as unintentional purchases and unexpected fees, and emotional tolls, such as frustration and distrust in online platforms (Kim et al., 2021). These losses erode user satisfaction and trust, impacting their relationship with e-commerce platforms (Gray et al., 2018).

This study focuses on Indonesia, which is a rapidly growing e-commerce market and is expected to become the largest digital economy market in this region (Google and Temasek, 2020). E-commerce has become an integral part of the digital economy, with millions of Indonesians engaging in online shopping regularly (Lestari, 2019). The rapid adoption of smartphones and the increasing affordability of mobile data have accelerated the growth of online shopping (Tarhini et al., 2019). The examination of why individuals recognize manipulative patterns in e-commerce reveals that users initially view interfaces positively and often overlook the manipulative elements. This conclusion is drawn from qualitative methods, including in-depth interviews and image analysis. Sazid (2024) explored dark patterns in the local context of Bangladesh, analyzing data from 715 e-commerce websites and uncovering dark patterns in 18.3% of the websites. This study introduced the categorization of dark patterns into two groups: 'Passive Dark Patterns' and 'Active Dark Patterns,' with the majority being passive. The findings also indicated that users with backgrounds in technology education were more aware of and concerned about dark patterns than others. Bangladesh, as a developing country, has quickly embraced digitalization, which has recently led to significant growth in its e-commerce sector. Similarly, Indonesia, another developing country, is experiencing rapid expansion in e-commerce. Examining dark patterns in the e-commerce industry provides valuable insights into the extent to which local users are exposed to these manipulative design strategies. Additionally, exploring local user perceptions of dark patterns is a crucial area of study.

Understanding how dark patterns are perceived by users in Indonesia also provides valuable insights for other developing countries with similar digital ecosystems. Heeks (2021) identified countries with emerging digital markets, and the widespread use of tactics can have similar impacts on user trust and satisfaction. By comparing the perceptions and challenges faced by users in Indonesia with those in similar countries, this study offers a broader understanding of the global impact of dark patterns. This knowledge is critical for policymakers, designers, and consumer protection agencies to develop effective strategies to mitigate these manipulative tactics, ensuring fairer and more transparent digital markets worldwide.

The following sections make up this article. The first section presents the study's background. This

portion is followed by the base literature, which is explained in section 2. Section 3 then provides a detailed description of the research method. Next, section 4 presents the research results. Section 5 provides a detailed discussion based on the findings. Finally, conclusions, including research implications and limitations of this review study, are presented in section 6, followed by a bibliography.

Literature Review

Terminologies of Dark Patterns

Key contributions from influential researchers have enriched the landscape of dark patterns terminology. Brignull (2010), a leading figure in the field, introduced the term' dark patterns' to capture various deceptive design tactics used in digital interfaces. This term describes a spectrum of manipulative practices aimed at influencing user behavior. In addition, Geronimo's concept of 'dark pattern blindness' highlights the phenomenon of users unintentionally overlooking or failing to recognize manipulative design elements within interfaces (Di Geronimo et al., 2020). This highlights the importance of awareness and education in combating such practices. Taking together, these terms provide a nuanced framework for understanding the breadth and intricacies of manipulative design, allowing for a more comprehensive examination of its impact on user experiences in digital environments.

Many types of dark patterns are illegal in some regions, such as the European Union and the United States (Brigull, 2010). In the European Union, there are provisions in the General Data Protection Regulation (GDPR) that indirectly prohibit certain dark patterns by requiring clear and informed consent from the user. For example, pre-checked boxes for marketing consent or the use of misleading language to obtain consent are not permitted under the GDPR. Similarly, in the US, the Federal Trade Commission (FTC) has acted against companies that use dark patterns to deceive consumers, such as hidden subscription fees or misleading advertising tactics (Kawaf et al., 2023).

Outside of these regions, the legal status of dark patterns remains less clear, with many countries lacking specific regulations to address these deceptive practices (Luguri & Strahilevitz, 2021). The lack of standardized terminology and legal frameworks further complicates the problem, making it difficult to universally define and regulate dark patterns (Bongard-Blanchy et al., 2021). As understanding of the patterns grows, so does the need for a global definition and implications. Many researchers have suggested that creating a unified set of terminology and classifications could facilitate international cooperation in addressing these practices. For example, building on Brignull's original framework (Brigull, 2010), researchers have proposed different categories of dark patterns, such as 'forced continuity' or 'Zuckering privacy,' each with its own specific impacts on user autonomy. This terminology helps not only identify and categorize dark patterns but also raise awareness and guide regulatory efforts in different countries.

Dark Patterns Tactics in E-Commerce

Somehow, the user interface was intentionally embedded with manipulative design tactics to influence user behavior (Gao et al., 2023). In the context of e-commerce, these tactics are widely used to force users to do things that they are not aware of. This manipulation has become a prevalent issue in the highly competitive landscape of a rapidly growing internet user base and the exponential rise of e-commerce companies (Balasubramanian & Parayitam, 2023). The pattern of these manipulative tactics does allow e-commerce businesses to achieve marketing goals that users may fail to recognize or remain unaware of the manipulative dark patterns used on e-commerce platforms (Isuwa et al., 2023). Moreover, societal tolerance for aggressive marketing practices creates legal gray areas in addressing dark patterns, as consumers often accept or overlook unethical and deceptive strategies used in online shopping environments (Singh et al., 2024).

Scarcity is a widely recognized dark pattern tactic often employed in e-commerce platforms to create a sense of urgency among consumers (Luguri & Strahilevitz, 2021). Specifically, limited-time messages have been shown to outperform other types of dark patterns in driving consumption decisions, such as "Only two items left in stock!" or "Offer ends in 1 hour!" to exploit psychological

biases like the fear of missing out (FOMO). Empirical research supports the effectiveness of scarcity tactics, demonstrating their ability to significantly increase product selection and purchase rate (Hamilton & Shaheen Hosany, 2023; Sunstein, 2022; Xu et al., 2015). Scarcity messages are more effective in influencing purchase intention when users have low product knowledge or high involvement with the product category.

Another prevalent strategy is upselling, where users are encouraged to add complementary or premium items to their purchases through suggestive prompts or bundles (Park & Yoon, 2022). This commonly used strategy in e-commerce platforms encourages users to purchase complementary or premium items through suggestive prompts or promotional bundles (Gray et al., 2024). Research highlights that upselling promotions can stimulate customer exposure to higher-end products, which might result in brand-switching behavior under certain circumstances (Ahn et al., 2022; Kovacheva & Nikolova, 2024; Park & Yoon, 2022; Sher, 2011). Customers of lower-end brands who take advantage of upselling discounts and find satisfaction with higher-end products may develop increased reference quality, leading to dissatisfaction with the lower-end brand (Park & Yoon, 2022). Consequently, these customers are more likely to defect to competitors if they can afford the higher-end brand only during promotional periods. This phenomenon creates a risk for retailers as it increases customer attrition over time (Yu et al., 2022).

Many tactics, commonly known as dark patterns, support manipulative practices in e-commerce, designed to exploit user psychology and influence decision-making. Examples include pre-checked boxes for additional services (Sunstein, 2022), forced continuity with unclear cancellation processes (Mathur et al., 2019), and hidden costs that appear at checkout (Monge Roffarello et al., 2023), all of which undermine user autonomy and transparency. Other tactics subtly manipulate user decisions, promoting actions that prioritize business goals over user intent and autonomy. The ethical implications of such practices show the importance of prioritizing transparency and fairness in e-commerce design to ensure user trust and long-term loyalty (Wu et al., 2024).

End User Perceptions of Dark Patterns

People are always facing digital products in their lives. Users' interactions with digital products significantly influence their trust, satisfaction, and decision-making processes, often entwined with their encounters with manipulative design tactics (Adar et al., 2013). In the realm of user perception, dark patterns are often regarded as deceitful elements strategically embedded in interfaces, aiming to coerce or mislead users into unintended actions or choices (Gunawan et al., 2021). Such perceptions typically stem from experiences where users feel trapped, misled, or manipulated due to the deceptive nature of these designs.

However, perceptions of dark patterns vary considerably among users, influenced by factors such as digital literacy, prior experiences, and individual awareness levels (Keleher et al., 2022). While some users exhibit adeptness in identifying and circumventing these manipulative tactics, others may remain unaware of their existence, attributing their encounters to standard online practices (Nazarov & Baimukhambetov, 2022). This variability in perception underscores the complexity of users' interactions with dark patterns and emphasizes the need for a nuanced understanding of how these tactics impact users across diverse backgrounds and experiences (Keleher et al., 2022).

Understanding these diverse perceptions of dark patterns is pivotal in unraveling their nuanced impact on users' digital experiences. It sheds light on the multifaceted nature of user interactions within digital interfaces and underlines the importance of ethical design practices to promote transparency, trust, and user empowerment (Nazarov & Baimukhambetov, 2022). Moreover, by acknowledging and addressing users' perceptions, designers and platforms can strive to create interfaces that prioritize user well-being and foster a more positive online experience for all (Mildner & Savino, 2021).

Categorization of Dark Patterns

Researchers have been defining and consolidating terminologies related to dark patterns. Several follow-up initiatives concentrated on dark patterns within sets of applications or systems. Gray (2023)

categorized dark patterns into five distinct classifications, encompassing strategies like nagging, obstruction, sneaking, forced action, and interface interference. Brignull (2010) categorized dark patterns into 16 classifications, which are shown in Table 1. These can serve to delineate and identify various manipulative design tactics prevalent across digital interfaces, providing a comprehensive framework to analyze and understand the diverse spectrum of deceptive practices within user experiences.

Table 1. Taxonomies of Dark Patterns (Brigull, 2010)

Taxonomies	Definitions
Comparison Prevention	Users struggle when comparing products; this enables them to be guided toward a choice that boosts income but might not align with the user's optimal outcome.
Confirm shaming	Users feel uncomfortable with triggered guilt or shame to influence decision-making.
Disguise Ads	Ads that looked like elements of the interface that made users click on them.
Fake Scarcity	Instilling a false perception of scarcity regarding a product or service, compelling users to take immediate action due to the fear of losing the opportunity.
Hard to Cancel	Users had difficulty getting back to us when they were on checkout pages.
Forced Action	Users want to do something, but they must do something else before.
Fake Urgency	Users were pressured to complete actions like flash sale discounts.
Fake Social Proof	When users believe those products are more popular or cheaper than they really are because they were shown by activity writing, testimonials, etc.
Hidden Costs	Users did not expect additional fees and charges when they checked out.
Hidden Subscriptions	When users don't know that they subscribed or pay additional fees automatically.
Nagging	Interruption of the user's intended task by unrelated tasks causes disruption or distraction from the primary focus.
Obstruction	Create obstacles in the user's pathway when using the products.
Visual Interference	When users expect the information on the interface to be clear, it's manipulated by lower contrast, small text, etc.
Trick Wording	The user is deceived into action because of the use of unclear or deceptive language in the presentation.
Sneaking	Where items are surreptitiously added to a user's shopping cart or basket without their explicit consent or clear notification
Preselection	When users had presented an automated selection of the checkboxes.

Each classification captures a specific type of interface and experience manipulation. For example, 'nagging' refers to persistent prompts that interrupt the user experience, urging them to make decisions they might otherwise avoid. 'Obstruction' involves creating deliberate barriers to hinder users from completing a desired action, such as making it difficult to cancel a subscription. 'Sneaking' involves hiding or misrepresenting information, such as automatically adding items to a shopping cart without the user's consent. As the digital environment continues to evolve, these

terminologies and classifications are important to keep pace with other new forms of manipulation that emerge as technology advances.

Methodologies

Literature Review

For the methodology section, the first step involves conducting a systematic literature review using the Kitchenham method. This review will systematically search and analyze relevant literature from various databases, including ACM, ScienceDirect, Scopus, Taylor & Francis, IEEE, Sage Journal, and Emerald Insight. The process began with the identification of keywords related to the research objectives, such as "dark patterns," "e-commerce," and "user behavior." The review was followed by the development of inclusion and exclusion criteria to ensure the relevance and quality of the selected studies were established:

Inclusion Criteria:

1. Studies published between 2018 and 2023.
2. Articles focusing on dark patterns in e-commerce platforms.
3. Research that evaluates the impact of manipulative design tactics on user trust, behavior, and decision-making.

Exclusion Criteria:

1. Articles published in languages other than English.
2. Papers that do not provide empirical evidence or a clear methodological framework.

The selected articles focused on the area of Human-Computer Interaction (HCI), resulting in the inclusion of 13 articles for analysis. These articles were extracted and analyzed based on their relevance to the research objectives. The extraction process examined specific elements, including the interplay between digital marketing tactics and dark patterns such as scarcity tactics, upselling, and pre-checked boxes, which are commonly employed to increase sales or subscriptions. Each database was queried separately, and the results were combined and filtered according to the predefined criteria. The findings were then synthesized to identify patterns, gaps, and emerging themes in the research landscape. This rigorous approach ensured a comprehensive and unbiased review of the existing knowledge, providing a robust foundation for further analysis and discussion.

Table 2. Methodology Based on Literature

Methodology	Reference(s)
Investigation & Observation	(Baroni et al., 2021; Bongard-Blanchy et al., 2021; Gray et al., 2018; Kim et al., 2021; M. Bhoot et al., 2021; Moser et al., 2019; Nimkoompai, 2022)
Web Crawler	(Nazarov & Baimukhambetov, 2022; Mathur et al., 2019; Voigt et al., 2021)
Online Survey	(Karagoel & Nathan-Roberts, 2021; Narayanan et al., 2020)
Interviews	(Keleher et al., 2022)
Focus Group Discussion	(Keleher et al., 2022)

As in Table 2, the methodologies employed in the selected studies included various approaches to thoroughly investigate dark patterns in e-commerce platforms. These methodologies provided a multifaceted perspective on the phenomenon of dark patterns, enabling researchers to analyze their prevalence, user impact, and potential countermeasures. Investigation and observation allowed for the in-depth exploration of real-world user interactions and the implementation of manipulative tactics. Web crawlers automated the detection of dark patterns across a wide range of e-commerce platforms,

ensuring comprehensive coverage and consistent data collection. Online surveys offered valuable quantitative data on user perceptions and behavioral responses to dark patterns, complementing the findings from observational studies. Expert interviews provided critical professional insights, shedding light on the ethical responsibilities of designers and strategies for mitigating manipulative practices. Lastly, focus group discussions facilitated collaborative exploration of user experiences, revealing nuanced perspectives on how dark patterns influence decision-making and trust in e-commerce platforms.

The study of dark patterns in digital interfaces has revealed various impacts on user experience and design. One key finding is that dark pattern strategies differ across platforms, showing the need for platform-specific analysis and solutions (Nazarov & Baimukhambetov, 2022; Gray et al., 2021). Looking ahead, the need for rules to limit deceptive practices reflects growing concerns about their impact on user trust and online businesses. Research could explore how effective these regulations might be and their influence on users and digital platforms. Additionally, creating user-focused tools and strategies to help people recognize and resist dark patterns could promote a more transparent and ethical digital environment. We employed the interview method in this research to investigate users' comprehension of dark patterns in e-commerce platforms. This qualitative approach aims to gain deeper insights into whether users can recognize manipulative design tactics and how these patterns influence their decision-making and trust in e-commerce platforms. By directly engaging with users through interviews, the study seeks to uncover nuanced perspectives, enabling a comprehensive analysis of the cognitive and behavioral responses triggered by dark patterns. This method complements the findings from the literature review and provides a user-centered understanding of the phenomenon.

Data Collection

1. **Recruitment**

   We recruited participants and sent a survey to social media to gather mobile numbers and profiles of each user. We used Google Forms to create the screening survey questions, which included closed-ended questions, multiple choices, and radio buttons. We sent the survey from November 17th to December 2nd, 2023. Users had to be at least 18 years of age, live in Indonesia, and have used e-commerce at least once time in a month. We received 91 responses but discarded 31 responses where participants rejected the request for an interview. We retained 60 responses for subsequent screening.

2. **Participants**

   After the screening, a total of 11 participants, seven males, and four females, were selected from the last education and wage range. Most participants ranged between 18 and 25 years old, the latest education mostly a bachelor's degree, with the salaries between 6.9 and 17.9 million rupiah. 2 of the participants had education related to computer science or information technology, and the rest were from other backgrounds. 9 out of the participants lived on Java Island, and others came from Kalimantan and Sumatra Island.

3. **Interview Design**

   The interview was conducted online and offline. To make it easier for participants to understand dark patterns, we used the term 'manipulative design' so they could easily understand the meaning, as Keleher (2022) mentioned. The questions contained three main sections:

   a. Demographics: we asked questions related to participants' demographics and activities.

   b. Dark Pattern Knowledge: we asked open questions to gather participants' knowledge and opinions about dark patterns.

   c. Interface Images: we show 12 screenshots of interface e-commerces that aligned with various types of dark patterns defined in the literature. These images were selected to

ensure comprehensive coverage of 16 categories. For each image, participants were asked to answer with 'Yes' if there were any dark patterns, 'No' if there were no dark patterns, or 'Maybe' if they were confused with their choices. Each answer must be accompanied by a reason. Figure 1 shows the example of the images that were asked to participants.

The interviews ranged in duration from 15 to 20 minutes and were conducted using Microsoft Teams for online sessions and recorded via mobile phones for offline interviews. There is no difference in treatment between online and offline interviews. The flexibility in the interview process, whether online or offline, provided a comprehensive understanding of user interactions with e-commerce interfaces across different scenarios and contexts.

Figure 1. Example of An Interface Image that Containing Dark Patterns Such as Fake Social Proof

Data Analysis

We conducted the analysis process using a thematic analysis approach. After the transcription of interviews was completed, the initial step involved familiarizing data comprehensively to understand the context (Hambraeus et al., 2020). Subsequently, the coding process commenced using Atlas.ti, wherein relevant segments of text related to the research topic were identified, labeled, and grouped into broader categories or themes. Figure 2 shows the codes that were used in this study.

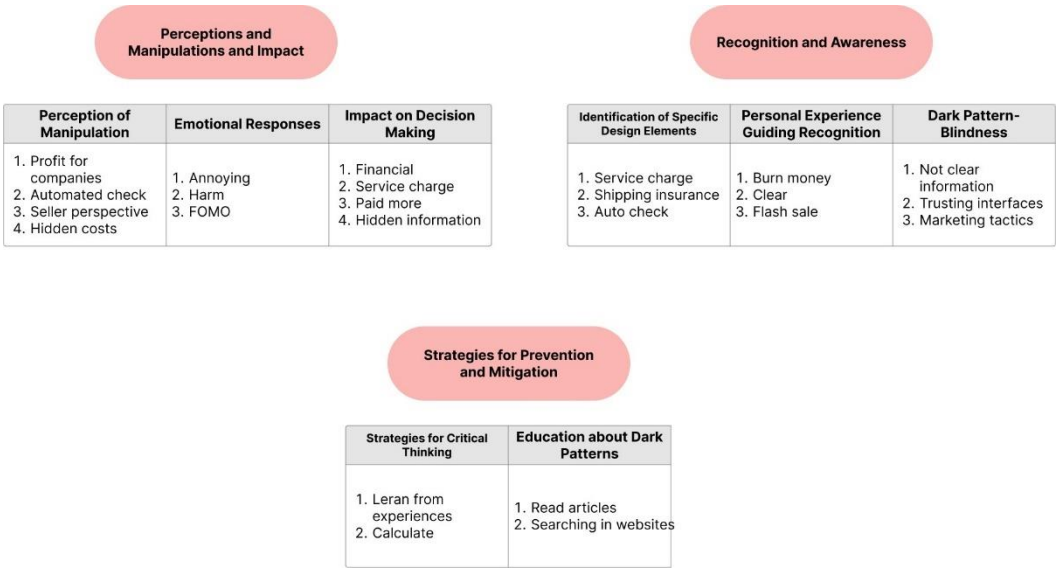

Figure 2. Thematic Codes Used

We organized these codes into three main themes: Perceptions and Manipulations and Impact, Recognition and Awareness, and Strategies for Prevention and Mitigation. Each theme has multiple

subcategories that capture specific elements of how users perceive, recognize, and respond to dark patterns in digital interfaces. Each of the main themes has distinct subcategories to provide a comprehensive analysis of the interview.

The first theme, Perceptions, and Manipulations and Impact, captures how users perceive manipulative tactics in e-commerce interfaces. Subcategories such as profit for companies, automated checks, seller perspectives, and hidden costs reflect participants' recognition of these tactics as mechanisms prioritizing business interests. Emotional responses, including feelings of annoyance, harm, and fear of missing out (FOMO), further emphasize the psychological impact of these manipulations. Decision-making processes were also affected, with issues such as financial loss, unexpected service charges, overpayment, and hidden information highlighting the influence of dark patterns on user behavior.

The second theme, recognition and awareness, examines how participants identify specific manipulative design elements. Subcategories such as service charges, shipping insurance, and auto-checked options illustrate the common elements recognized by participants. Personal experiences, such as dealing with flash sales or encountering unclear information, guided recognition of these patterns. However, instances of dark pattern-blindness, including trusting interfaces and misunderstanding marketing tactics, underline the challenges users face in identifying manipulative practices.

The third theme, Strategies for Prevention and Mitigation, explores how users can protect themselves from dark patterns. Participants emphasized the importance of critical thinking, including learning from past experiences and carefully evaluating costs. Additionally, education about dark patterns, through reading articles or researching websites, was highlighted as a key strategy to increase awareness and resilience against manipulative designs. It is important to educate users to increase critical awareness in combating manipulative design.

Results

Perceptions of Manipulations

The study involved 11 participants, selected based on their varying backgrounds and interactions with e-commerce platforms and familiarity with digital interfaces. The participants were a diverse group, including both professional and regular users, to provide a comprehensive view of how different user profiles recognize dark patterns. Of 11 participants, only three have heard about dark patterns or manipulative designs. The rest of the users have never heard about dark patterns or manipulative designs, so the authors tell the definition about it so they can easily understand the purpose of this interview.

"*I believe manipulative design is profitable for the company, but not for users*" -P6.

"*Most dark patterns had the purpose of manipulating their users to make them buy something they weren't aware of."* -P4.

Several categories of dark patterns emerged from the discussions. Participants highlighted hidden costs, such as unexpected service charges or fees appearing at checkout, as a major source of frustration. Preselection, where optional services like shipping insurance were automatically selected, was another commonly cited example, with participants expressing annoyance over having to manually deselect unwanted options. Fake scarcity, such as messages like "Only two rooms left!" or "Limited time offer," created a sense of urgency that led to rushed and sometimes regrettable decisions. For example, P4 shared, "It traps people by making them think the price will increase." Another tactic mentioned was forced action, which required users to take unnecessary steps, such as agreeing to additional terms, to proceed with their purchase. From this perspective, participants perceive dark patterns as harmful and annoying. Despite this, the participants' knowledge of dark patterns is limited to instances where companies steal their money or privacy without consent. Participants who knew more about dark patterns were UX practitioners or worked in digital companies.

Emotional Responses

Participants felt annoyed when they had experiences with dark patterns. Their frustration stemmed from having to spend more money, even though it wasn't a significant amount. It makes them not enjoy scrolling in e-commerce applications because of dark patterns.

"*It makes me FOMO. When I wanted to book a hotel to treat myself, I searched for a hotel in an application like Agoda, and it said, 'Only 2 Rooms Left,' and then offered me an 80% discount. I think that is exactly the normal price. It can cause panic, FOMO, and a sense of being trapped.*" -P4.

Participants expressed that dark patterns create a sense of urgency and fear of missing out (FOMO), leading to rushed and often regrettable decisions. This manipulation leads to a negative user experience, diminishing their trust in the platform. The pressure from these tactics makes it difficult for users to make informed and calm decisions.

Impact on Decision Making

The participants had no decision when they were manipulated by design except to accept it with annoyance. Most participants said the applications should provide clear information, so users feel fair. So, users feel like things are fair, they say the apps should give clear information. Because these manipulations made people feel like they needed to act quickly, they often felt trapped and couldn't calm. This pressure was made worse by methods like confirmshaming, which made users feel bad about not buying, and forced action, in which users had to agree to extra terms in order to finish their transactions. These feelings show how dark patterns have a big effect on user trust and satisfaction. This shows how important it is to use ethical design methods that put user autonomy, clarity, and transparency first.

"*Actually, when the checklist is not automatically checked, it's not harmful for me*" -P6.

"*Most of them were insurance and service charges. On one side it was understandable, but on the other side it was annoying....*" -P9.

P6 highlighted a lack of clarity in app communications, expressing a desire for clear explanations regarding additional features such as insurance. P9 provides a detailed example, illustrating how manipulative practices inflate the total cost, leading to a sense of annoyance, especially when not relevant services, like shipping insurance for digital products, are automatically selected without user consent. Their dissatisfaction comes from a lack of choice, unclear communication regarding additional costs, and automated implementation of services. In addition to these tactics, participants also pointed to hidden costs as a source of frustration. They frequently encountered unexpected charges, such as additional service fees or preselected optional services like shipping insurance, which inflated their total expenses without prior consent. This manipulation was often paired with trick wording, where unclear or ambiguous language misled users into agreeing to unwanted purchases. These practices not only irritated users but also instilled a sense of deception, thereby reducing their trust in the platform.

Recognition and Awareness

According to Figure 3, participants are able to completely identify dark patterns in Photos 8 and 9. They perceive manipulation due to the automatic selection of service charges and shipping insurance. In contrast to Photo 1, the majority of participants indicated that there are no dark patterns present in those images. Many participants believe they were not subjected to manipulation, or they are uncertain whether the design is manipulative or merely conventional.

"*There is no information regarding the payment; I am confused because the the monthly deductions are clear but not specify the duration in months or years*." -P10.

In the remaining photos, some participants stated that they did not recognize the manipulation or were unsure whether the design was manipulative or not. This finding reflects a common issue associated with trick wording and visual interference, where unclear communication or deceptive visual cues obscure the manipulative intent P10 expresses his confusion regarding payment information,

particularly the clarity surrounding monthly deductions, which lacked details on duration and terms. This illustrates the potential for confusion when communication is ambiguous in e-commerce interfaces.

Moreover, participants had difficulty identifying and distinguishing manipulative design from design, especially when the interface used hidden advertising or coercive actions, which required users to take unnecessary steps to complete a transaction. This further complicates their ability to identify fraudulent practices, underscoring the need for clearer communication and transparency in interface design. Overall, the findings highlight that while obvious manipulation is easy to spot, more subtle dark patterns remain difficult for users to detect, underscoring the importance of addressing these tactics within e-commerce platforms to build user trust and satisfaction.

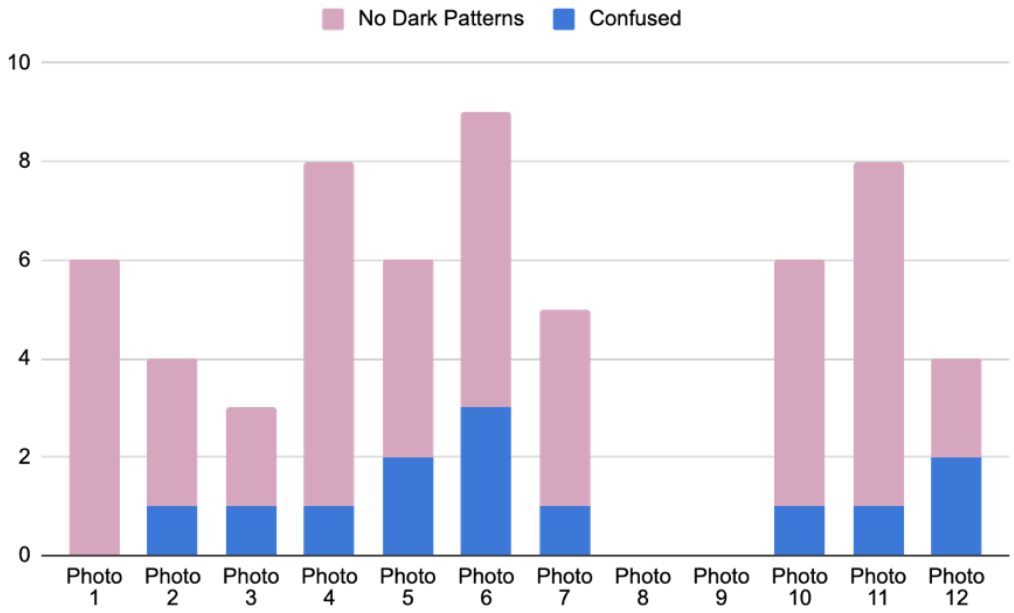

Figure 3. Comparison Between Interface Images That People Can Recognized and Confused

Personal Experiences Guiding Recognition

Numerous participants are unsure of their choices when they see dark patterns in photos. Numerous users pick the interfaces with dark patterns based on their online shopping experiences. There are people who change their answers because they don't know what "dark patterns" in displays really mean.

"*I think donation of Rp 5000 is a dark pattern. The option of getting money back if it doesn't work makes it look like it does, but it doesn't. Also, shipping insurance makes it hard for me to complain*" -P11

Those who had looked at the screenshots had a range of responses, and many of them were hesitant because they didn't know what to say. Many of them thought they saw manipulative design elements because they had seen them before while shopping on e-commerce platforms. People who were interviewed changed their answers right away because they weren't sure what they thought or felt about "dark patterns." P11 wasn't sure how to tell that dark patterns were tricks. In his own experience, the seller refused to pay for a broken item even though he had video evidence of the item being unboxed, which he used to show how frustrating it can be to deal with shiny insurance problems. These different answers and readings show how hard and subjective it is for users to spot dark patterns in e-commerce interfaces. This strategy makes things harder for users, which hurts their trust in and happiness with the site. Confirmshaming, a tactic that gently pushes people to make choices they don't want to, also came up repeatedly, making people even more unsure and hesitant. These different reactions show how hard and personal it can be to spot dark patterns. Overt tricks, like

fake scarcity or secret costs, were easier to spot. But subtler tricks, like using trick words or interfering with the way things look, were often not noticed.

Discussions

This study employed an interview by predefining a collection of e-commerce pages. These deceptive design tactics not only induce irritation and financial strain but also substantially undermine decision-making processes and trust in digital platforms. Keleher (2022) showed that end-users learn from their past experiences to detect manipulative tactics on the interfaces. In this research, the interview focused on how people recognize dark patterns in each picture. Consequently, it was determined that the majority of individuals are unable to identify dark patterns; this indicates that although dark patterns are crafted to be invisible, their impact on user behavior is substantial, gradually influencing decisions in ways that users frequently fail to consciously see. The absence of acknowledgment is concerning, as it suggests that users are often manipulated without their awareness.

From 12 pictures, only pictures 8 and 9 clearly mentioned that the pictures contained dark patterns. Participants were not recognized for many reasons, called dark patterns-blindness. Dark patterns-blindness are phenomena where individuals, often unintentionally, overlook or fail to recognize manipulative design tactics or dark patterns within user interfaces (Di Geronimo et al., 2020). Based on interview results, many factors that made participants not recognize dark patterns such as unclear information, trusting interfaces, confusing with marketing tactics, and limited awareness. According to the interview results, participants were unable to recognize dark patterns due to various factors, including unclear information, trusting interfaces, confusion with marketing tactics, and limited awareness. Although users cannot recognize dark patterns, they feel that the information presented to them is ambiguous or unclear. It makes them choose to answer with “unclear information” instead of “no dark patterns.” The participants expressed confusion and stressed that while they did not see any clear dark patterns that were alike from Keleher (2022) and Di Geronimo (2020) in that the participants do not recognize the dark patterns because they feel the interfaces are normal things that they usually see.

The blindness of dark patterns shows that the participants feel it is not caused based on their education, sex, or wages. Participants with a master’s degree or higher income levels also struggle to identify interfaces with dark patterns. Keleher (2022) who tested experts and end-users with dark patterns, the differences not significantly statistical between those two groups. Users are not always aware of dark patterns in mild cases. In this study, users are not aware if there is so much information in some interfaces like at homepage. Participants reflect on their struggle, expressing confusion due to the abundance of information, which hampers their ability to focus on specific elements. This aligns with existing literature that suggests users might overlook mild cases of dark patterns when interfaces inundate them with excessive information (Bongard-Blanchy et al., 2021; Keleher et al., 2022; Voigt et al., 2021).

Every participant has many ways to prevent them for effective prevention and mitigation strategies. Participants learn from their experiences to help themselves prevent dark patterns in e-commerce. The participants have developed a valuable sense of awareness through their encounters with dark patterns in e-commerce. Their experience has become a guiding principle, allowing them to navigate the platform more carefully and intelligently. In Keleher (2022), the end-users learn from their past experiences to detect manipulative tactics in the interfaces. This insight equips them to research payment accuracy, resist the FOMO-inducing appeal of flash sales, and detect hidden fees in granular details. The knowledge empowers them to approach digital shopping with caution, verify costs, and cross-reference information to prevent potential manipulative tactics (Bongard-Blanchy et al., 2021).

The role of ethical UX design is crucial in addressing and preventing the implementation of dark patterns in digital interfaces. Ethical design principles prioritize transparency, fairness, and user trust, which can effectively counter manipulative tactics such as preselection, hidden fees, and false scarcity. However, manipulative design practices, such as those highlighted by Hamilton (2023), demonstrate how brands strategically exploit product scarcity by repeatedly generating demand and releasing limited editions. While such practices may align with short-term business goals, ethical UX design

advocates for minimizing these tactics and addressing the most egregious cases, drawing up categories for regulation to ensure fairness and accountability.

Ethical design also aligns with the legal frameworks that regulate e-commerce practices in Indonesia. The Indonesian legal system enforces consumer protection through several key regulations, including Law Number 19 of 2016 (the amendment to the Information and Electronic Transactions Law), which governs electronic transactions and ensures secure and transparent digital interactions. Furthermore, Law Number 8 of 1999 on Consumer Protection mandates businesses to prioritize consumer rights, ensuring fair treatment and clear communication in all transactions. Complementing these is Government Regulation Number 80 of 2019 (PP 80/2019) on Trading through Electronic Systems, which aims to foster a safe and open e-commerce ecosystem to strengthen the industry's transparent growth. Additionally, Law Number 7 of 2014 on Trade includes provisions for electronic trade systems, emphasizing accountability and compliance to promote user trust.

While ethical UX design voluntary adherence to principles of transparency and fairness, legal frameworks in Indonesia offer a robust foundation to address manipulative practices. These laws not only aim to mitigate the harm caused by dark patterns but also ensure businesses adopt user-centric practices that align with ethical and legal standards. Manipulative practices, akin to lies or false advertising, can be considered a form of theft that exploits users for business gains. As highlighted in Hamilton's work, when manipulative practices cause significant harm, legal interventions become essential to prevent exploitation and uphold fairness in the digital economy. Elaborating the ethical design and legal frameworks synergistically can create a safer and more equitable digital environment for all users.

Based on the interview, participants shared valuable insights about their strategies for preventing manipulative designs encountered in e-commerce interfaces. These narratives explain their experiences and methodology, providing an education on the ins and outs of recognizing and avoiding dark patterns in online transactions. They dedicated their time to reading and learning to use the features in the application or used QnA features to ensure steps and increased user awareness while navigating the e-commerce platforms.

Conclusion

The result of this highlights user perceptions and recognition of dark patterns, especially in Indonesia's e-commerce. It is highlighted that the prevalent limitation among users in identifying and categorizing dark patterns shows widespread deficiencies in recognizing manipulative design tactics. Moreover, those capable of recognizing such patterns on the interface often attribute their awareness to personal experiences, highlighting the significance of experiential learning in understanding and identifying deceptive interface elements. Participants were unable to recognize dark patterns on the interface due to many factors. Normalization led to the belief that they were unaffected by the interface or that the encountered elements were standard practices. Other factors, such as unclear information, trust in the interface, and confusion between marketing strategies and those of factors, contribute to what can be termed 'dark pattern-blindness.'

Findings from the interview are important not only to identify and differentiate dark patterns but also to spotlight the urgent need for user education to increase awareness initiatives. This is crucial to giving users the power to navigate digital interfaces more confidently, fostering transparency, and promoting ethical design practices for a more trustworthy digital ecosystem. This study suggests a stricter regulatory framework to address ethical concerns around dark patterns that, if left unchecked, could proliferate unchecked. Implementing clear guidelines and enforcing regulations can help reduce the prevalence of dark patterns and ensure that digital platforms adhere to ethical standards.

This research contributes to the growing body of knowledge by offering empirical insights into user awareness of dark patterns, particularly in the context of emerging markets like Indonesia. It highlights how sociocultural and digital literacy factors influence user perceptions, extending the applicability of existing frameworks on dark patterns to new contexts. Practically, this study provides actionable insights for designers, developers, and policymakers. Designers and developers will need to adopt ethical design practices that prioritize transparency and fairness. For policymakers, the study

advocates for stricter regulatory frameworks to address the ethical concerns posed by dark patterns. Implementing clear guidelines and enforcing regulations can help reduce the prevalence of these tactics, fostering a trustworthy digital ecosystem. Next, this research could expand on these findings by examining the geographical influences of user recognition and interaction with dark patterns. Comparative studies across diverse regions, including other emerging markets, could uncover how variations in sociocultural, economic, and digital literacy contexts impact user awareness and susceptibility to manipulative design tactics. Such research would provide valuable insights into how geographic and cultural factors shape perceptions and behaviors in e-commerce environments. Additionally, since this study primarily focused on analyzing user responses to static screenshots, it should adopt a more immersive approach by allowing participants to interact directly with e-commerce applications. This hands-on exploration could provide deeper insights into how users experience and respond to dark patterns in real-time scenarios, enhancing the understanding of their decision-making processes and challenges. These advancements would not only refine theoretical frameworks but also offer practical recommendations for designing more transparent and user-friendly digital platforms.

Limitations of this study include various aspects that may influence the findings. First, the sample size consisted of participants under 35 years of age, potentially limiting the generalizability of conclusions across different age groups or demographics and failing to see potential differences in recognizing and understanding dark patterns among older users or individuals from different countries or cultural backgrounds. Second, the geographical concentration of participants from the island of Java indicates a regional bias, which has the potential to ignore the various perspectives and experiences that are common in other geographic regions in Indonesia. Lastly, the scope of the research only focuses on desktop and mobile applications, thereby potentially ignoring the existence of dark patterns on other digital platforms such as web browsers, game consoles, or other platforms, thereby limiting a comprehensive understanding of the prevalence of dark patterns. in the digital landscape. Next, research research could explore several ways to improve understanding and mitigation of dark patterns in e-commerce interfaces. First, there is a need to study regulatory frameworks to establish guidelines that encourage user trust and ethical design practices, which can effectively protect individuals from fraudulent elements in digital platforms. Second, the formulation of comprehensive ethical design guidelines or frameworks can provide insight into integrating persuasive elements in interfaces without resorting to manipulative tactics. This approach aims to balance user involvement without sacrificing their autonomy or trust. Additionally, it investigates differences in perception and response to dark patterns among different age groups, such as Baby Boomers, Generation X, Millennials, or Generation Z. This comparative analysis across generations can tell diverse perspectives and help adapt strategies to cater to different user demographics more effectively

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