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TABLE OF CONTENTS

Usability Evaluation of the Restaurant Finder Application Using Inspection and Inquiry Methods

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Abstract

Restaurant Finder application is a mobile application that helps users to find restaurants according to their requirements. One of the most well-known and widely used restaurant finder apps is Zomato. Zomato ranks first in the food and delivery category websites from around the world. However, the number of users of a product or application certainly does not guarantee the satisfaction of the user experience of apps. A system that is poorly designed will make it difficult for users, which results in the system being rarely or misused so that the costs to the organization become high and dangerous to the reputation of the company. The purpose of this study was to evaluate the usability of the restaurant finder application using inspection and inquiry methods. Inspection method using the Enhanced Cognitive Walkthrough method, and for inquiry methods using the User Experience Questionnaire method and the System Usability Scale. The inspection method results identified seven serious problems. Recommendations for improvement based on inspection method are focused on login tasks, reviews, and food promo information. The inquiry methods result identified five aspects that needed improvement. The five aspects consist of novelty, stimulation, learnability, consistency, complexity. The results of this study are expected to provide input and suggestions to the Zomato company for future development of the Zomato app.

Keywords: usability evaluation, inspection method, inquiry method, Enhanced Cognitive Walkthrough, System Usability Scale, User Experience Questionnaire

Introduction

Culinary tourism (CT) is becoming an important subject area, and its development is increasingly documented. Currently, culinary tourism is widely developed into a medium, a vehicle, and a tourist destination (Alonso et al. 2018). According on research conducted by (Stone et al. 2019) most respondents (80.2%) agreed that food and drink experiences are important to the trip satisfaction. Positive food and drink experiences influenced a tourist's likelihood of returning to a destination (81.3% agreed). The problem of every culinary tourism connoisseur who wants to make a culinary tour visit usually requires information that can support a trip. Some of them are information about culinary destinations and travel routes (Hermawan et al. 2017). Management of the information and proper promotion will help increase business in the culinary field. Providing information about culinary tourism that is easily accessible to the public will provide very good promotional value (Suciyono et al. 2019) .One of them is by using a restaurant finder application that is easily accessible by the public. Restaurant Finder application is a mobile application that helps the users to find the restaurants

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according to their requirements (Parne 2010). One example of an application that is a restaurant finder is Zomato.

Zomato is a restaurant finder application that has gained immense popularity in a relatively short period of time (Sharma and Abdul Waheed 2018). In Zomato, The users could post reviews of the restaurant stating about their experience and visit. The app shows us the existence of air conditioning, Wi-Fi, outdoor seating, smoking area, and whether the restaurant served vegetarian or non-vegetarian and alcohol (Salunkhe and Singh 2019). However, among the several advantages of Zomato, there are still many weaknesses, including the research written by Sihombing et al. (2020) that on the Zomato app, there is no division of halal and non-halal food types. The rating system used by this website has weaknesses because the website provides recommendations based on ratings given by other application users who are unknown to the user, so the level of trust of the rating is very weak (Sihombing et al. 2020). In addition, based on reviews written by Zomato users on Google Playstore, some users have complained that the review system in the Zomato application is not working properly, the location and menu are not updated, the application hangs frequently and others. Furthermore, in October 2020, it was quoted from Tempo.com that Zomato has decided to stop its operations in Indonesia. Even though it has closed its office in Indonesia, Zomato has ensured that its app is still accessible to local users and manages the platform remotely in India (Akbar 2020). The closure of the Zomato office in Indonesia implies that there is a significant decrease in Zomato's users.

Usability has become a central and superior pointer to mobile application design and quality. Looking at the user's perspective, the interface of a mobile application is one of the most significant components, as it constitutes users' main avenue of interaction with the application (Hussain and Mkpojiogu 2016). Several methods exist for evaluating the usability evaluation. They can be mainly categorized as inspection, testing, and inquiry methods (Gulati and Dubey 2012). According to (Gómez et al. 2014) the best alternatives are evaluations conducted by experts (evaluators), also known as Inspection Methods, or evaluations involving users, which are divided into inquiry methods and testing methods depending on the methodology adopted (Gómez et al. 2014). Therefore, this study uses the inspection method for expert-based evaluation and the inquiry method as a representative for user-based evaluation. For the inspection method using the enhanced cognitive walkthrough method and for the inquiry method using a questionnaire. The questionnaires used in this study are the User Experience Questionnaire (UEQ) and the System Usability Scale (SUS).

Previous research conducted by (Scholtes et al. 2020) on Comparison of Formative Evaluation Methods in the Usability Process on the examples of medical app. This study using two expert-based methods and two user-based methods were compared regarding effectiveness in finding issues, the level of detail, and the temporal effort. The results of the study show that the heuristics and the isometrics, both showed a significant advantage regarding the effectiveness and similarity in level of detail and temporal effort. Unfortunately, this research doesn't explain in detail what problems are found in each method and what recommendations the research can provide for the research object.

Based on the description above, research is needed to evaluate the usability of the restaurant finder application using inspection and inquiry method. The restaurant finder application used in this research is the Zomato app. The method used in the inspection method is the Enhanced Cognitive Walkthrough method, while the methods used in inquiry method are the UEQ and SUS. The results of this study are expected to provide input and suggestions to the Zomato company for future development of the Zomato app.

Literature Review

Zomato App Overview

Zomato is an increasingly sophisticated mobile application development to help people find restaurants based on certain categories. Zomato can be used via mobile and can also be accessed through the Zomato application. This application makes it easy for people, especially in big cities to find restaurants, coffee shops, live music, and so on from the selected city (Paramitha et al. 2019).

Unfortunately, as explained above, there are several problems with the Zomato app. In questionnaires distributed online to all respondents, one of the questions is to ask respondents to mention reusability issues in the Zomato application. Some of the problems with the Zomato application experienced by respondents include reviews that do not appear in the review column, the absence of telephone contact from the restaurant, the menu is not updated, the maps are inaccurate, the location of the restaurant is not updated, there is no rating feature per food menu, and etc.

In 2019, a UX researcher from India named Rishav Kumar discovered several user experience problems in Zomato India. Some of the problems include there is the Debug log from the IDE on the notification, searching and viewing restaurants in map view is missing, the removal of the level of foodie feature from the profile has disturbed the foodie ecosystem in the Zomato, and etc. (Kumar 2019). This issue was then assigned to Zomato as a suggestion to the app.

Usability Evaluation

Usability evaluation focuses on how well users can learn and use a product to accomplish their goals. Usability evaluation is related to user satisfaction to utilization process of those products (Sharfina and Santoso 2017). Usability evaluation assesses the ease of use of a app's functions and how well they enable users to perform their tasks efficiently (Gómez et al. 2014). Usability evaluation can be processed using two different approaches, namely inspection methods (conducted by experts) and inquiry methods (conducted by users). Usability evaluation method classification can be seen in Figure 1.

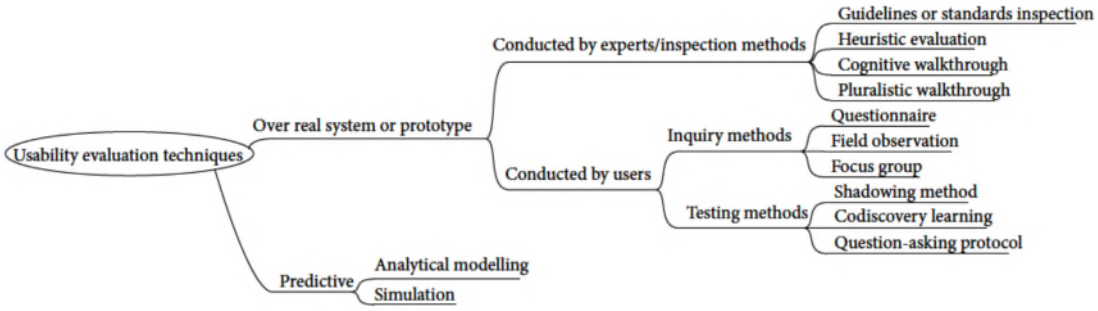

Figure 1. Classification of some usability evaluation techniques (Gómez et al. 2014)

Inspection and Inquiry Methods

Usability inspection technique focuses on usability experts/ specialists, and sometimes software developers or professionals to examine the usability of user interface design. It is performed before usability test to detect or resolve the obvious problems. Widely used UI methods are Cognitive Walkthrough and Heuristic Evaluation (Satapathy et al. 2014). An inspection entails an evaluator using a set of criteria to identify potential usability problems in an interface. Inspection methods have several advantages and disadvantages. According to (Fernandez et al. 2011). Inquiry or user-based evaluation is an evaluation method to get information about behavior, thoughts, and user interface usage (Cinar 2015). The inquiry method is done by asking users to evaluate a system and provide feedback after interacting with the interface; this feedback is typically achieved via interviews, surveys, or ratings (Unrau and Kray 2019). Inquiry methods focused on gathering subjective data from users, the majority were used in combination with other types of methods such as testing or inspection to perform a more complete evaluation.

Enhanced Cognitive Walkthrough

Enhanced Cognitive Walkthrough is an alternative version of Cognitive walkthrough 3.0. It was proposed by Bligard and Osvalder (2013) and is used as an analytical approach for predicting and identifying use errors and usability problems (Mahatody et al. 2010). The goal was to develop a method that can better detect and identify given presumptive usability problems in an interface and also provide an overview of which types of problems exist (Bligård and Osvalder 2013). The enhanced cognitive walkthrough is used because it is easy to implement and does not require a lot of time and also concentrates on the ease and understanding of the user with exploration (Ulinuha et al. 2020). However,

Enhanced Cognitive Walkthrough cannot evaluate the attractiveness, efficiency, and user satisfaction of a product (Bligård and Osvalder 2013). The weakness of the Enhanced Cognitive Walkthrough can be overcome using user-based evaluations. Examples of user-based evaluation methods are the User Experience Questionnaire and the System Usability Scale.

User Experience Questionnaire

The UEQ is an established and frequently used questionnaire for the evaluation of the UX of interactive products (Hinderks et al. 2018). It should allow the users to express feelings, impressions, and attitudes that arise when experiencing the product under investigation in a very simple and immediate way (Schrepp et al. 2017). UEQ contains six scales of a total of 26 items, consists of attractiveness, efficiency, perspicuity, dependability, stimulation, and novelty (Schrepp 2019). The research questionnaire for UEQ can be seen in the Figure 2.

	1	2	3	4	5	6	7		
annoying	○	○	○	○	○	○	○	enjoyable	1
not understandable	○	○	○	○	○	○	○	understandable	2
creative	○	○	○	○	○	○	○	dull	3
easy to learn	○	○	○	○	○	○	○	difficult to learn	4
valuable	○	○	○	○	○	○	○	inferior	5
boring	○	○	○	○	○	○	○	exciting	6
not interesting	○	○	○	○	○	○	○	interesting	7
unpredictable	○	○	○	○	○	○	○	predictable	8
fast	○	○	○	○	○	○	○	slow	9
inventive	○	○	○	○	○	○	○	conventional	10
obstructive	○	○	○	○	○	○	○	supportive	11
good	○	○	○	○	○	○	○	bad	12
complicated	○	○	○	○	○	○	○	easy	13
unlikable	○	○	○	○	○	○	○	pleasing	14
usual	○	○	○	○	○	○	○	leading edge	15
unpleasant	○	○	○	○	○	○	○	pleasant	16
secure	○	○	○	○	○	○	○	not secure	17
motivating	○	○	○	○	○	○	○	demotivating	18
meets expectations	○	○	○	○	○	○	○	does not meet expectations	19
inefficient	○	○	○	○	○	○	○	efficient	20
clear	○	○	○	○	○	○	○	confusing	21
impractical	○	○	○	○	○	○	○	practical	22
organized	○	○	○	○	○	○	○	cluttered	23
attractive	○	○	○	○	○	○	○	unattractive	24
friendly	○	○	○	○	○	○	○	unfriendly	25
conservative	○	○	○	○	○	○	○	innovative	26

Figure 2. UEQ Questionnaire (Schrepp 2019)

System Usability Scale

The SUS was developed in 1986 by John Brooke and its value is to provide a single reference score for participants' view of a product's usability (Sharfina and Santoso 2017). SUS is an inexpensive, yet effective tool, for assessing the usability of a product, as well as a wide range of user interfaces, including standard operative system based software interfaces, web pages, cell phones, landline phones, speech systems, or video delivery hardware and software (Martins et al. 2015).

A recent study shows that it can be divided into two sub-scales of usability and learnability: usable (item 1, 2, 3, 5, 6, 7, 8, and 9) and learnable (item 4 and 10) (Sharfina and Santoso 2017). Other attributes, such as perceived complexity (Item 2), perceived ease-of-use (Item 3), perceived consistency (Item 6), perceived learnability (Item 7), and confidence-in-use (Item 9) do appear in the SUS (Lewis and Sauro 2018). The ten questions are closely related and are employed for the comprehensive evaluation of a product. A higher SUS score indicates better product usability (Liang et al. 2018). The Items of System Usability Scale can be seen in the Table 1.

Table 1. Question items of the System Usability Scale

No	Items
1.	I think that I would like to use this system.
2.	I found the system unnecessarily complex.
3.	I thought the system was easy to use.
4.	I think that I would need the support of a technical person to be able to use this system.
5.	I found the various functions in the system were well integrated.
6.	I thought there was too much inconsistency in this system.
7.	I would imagine that most people would learn to use this system very quickly.
8.	I found the system very cumbersome to use.
9.	I felt very confident using the system.
10.	I needed to learn a lot of things before I could get going with this system.

Methodology

Research Subject

The research subjects divided into two types consist of evaluators and end-users. Evaluator is for someone who knows deeper about usability and user experience of apps, and end-users are people who use the Zomato app. The number of evaluators used was five people. Rahadiasta et al. (2019) said that the recommended participants for usability evaluation in qualitative case studies were 5 people. If the research involves more than one user group or category, the participants can be adjusted into 3 to 4 people per group or category (Rahadiasta et al. 2019). The evaluator criteria used in this study are someone who has a background in computer education or digital design, has knowledge of UI / UX Design, Human-Computer Interaction, and usability testing, and has experience working in the UI / UX field.

For inquiry method, the number of respondents is determined using the Lemeshow Formula. Based on the Lemeshow formula, the result obtained is 96.04 or 97 respondents. That means in this study the researcher must take data from a sample of at least 100 respondents. This sampling was shown to people who were over 17 years old and had used the Zomato application.

Research Design

The research methods are a sequence of research steps that will be carried out starting from the literature study. At this stage, it is done by reading related research through journals, articles, papers, internet, and reference books. The second is preparing for evaluation, at this stage, it is used to identify the data needed for research. The next process is data collection, data collection on the Enhanced Cognitive Walkthrough method is by conducting interviews and questionnaires with the evaluator about the usability problems that exist in the task scenario. Meanwhile, in the data collection stage for UEQ and SUS, the questionnaires were distributed online via Google form. The next process is Data Analysis, at this stage, the data that has been collected from the evaluators and respondents will be analyzed. In the enhanced cognitive walkthrough, the information gathered from the evaluators is organized into a matrix to emphasize various aspects of the analysis. Meanwhile, In the User Experience Questionnaire and System Usability Scale, the data collected will be tested for validity and reliability first. After that, UEQ data will be processed using UEQ analysis tools and SUS data will be processed using weighting the SUS score. The last process is the recommendation. At this stage, for the Improvement of the Zomato app, the result of the data analysis had come to conclusions that were used as a reference to propose a recommendation for improvement of Zomato app. The research design can be seen in Figure 3.

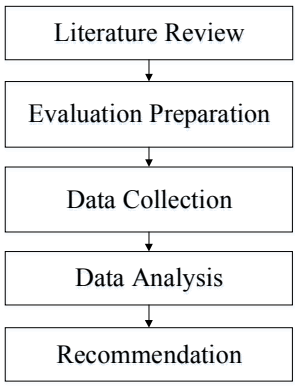

Figure 3. Research Design

Results

Enhanced Cognitive Walkthrough

The first stage of the enhanced cognitive walkthrough is to define the task scenario, then determine the task scenario specification using HTA. The task scenario can be seen in Table 2. Grade 1 is the most important task or must be done, which means that other tasks cannot be done if grade 1 tasks have not been done. Grade 2 is the second important task that must also be done. Grade 3 is a task that is not very important but supports users in using the application. Grade 4 and Grade 5 are the least important tasks.

Table 2. Task Scenario of the Enhanced Cognitive Walkthrough

Num	Task Scenario	Grading Task
1.	Login to the Zomato app	1
2.	Look at the restaurant menu	2
3.	Find Out Food Promos	4
4.	Write a review about the restaurant	3
5.	Filtering the restaurant	3
6.	Edit Profile	5

In the Enhanced Cognitive Walkthrough method, evaluators are asked to answer two levels of analysis, namely analysis of functions and analysis of operations. Then the participants will answer the level 1 question (function analysis) according to the hierarchical order of the HTA (top to bottom). And at the lowest level participants will answer new questions at level 2 (analysis of operations).

The following are questions that must be answered at level 1 (analysis of function):

1. Will the user know that the evaluated function is available?
2. Will the user be able to notice that the function is available?
3. Will the user associate the clues with the function?
4. Will the user get sufficient feedback when using the function?
5. Will the user get sufficient feedback to understand that the function has been fully performed?

Then the participants will answer these questions in order of the Hierarchy Task Analysis (HTA) from top to bottom. The following are questions that must be answered at level 2 (analysis of operations):

1. Will the user try to achieve the right goals of the operation?
2. Will the user be able to notice that the action of the operation is available?
3. Will the user associate the action of the operation with the right goal of the operation?
4. Will the user be able to perform the correct action?
5. Will the user get sufficient feedback to understand that the action is performed, and the goal is achieved?

The above questions will be answered by the respondent and then given a value between 1 and 5. These values will represent the respondent's level of success in carrying out each task as shown in Table 3.

Table 3. Level of Success

Grade	Grade in Words	Explanation
5	Yes	A Very Good Chance of Success
4	Yes, probably	Probably Successful
3	Do not Know	Impossible to decide if success or not
2	No, uncertain	Small chance of Success
1	No	A Very small chance of success

After grading the level of success, then the problems are put into different categories. Based on the appearance and tasks the respondent performed in the walkthrough, several different types of problems can be defined (Table 4).

Table 4. Problem Type

Problem Type	Explication
User (U)	The problem is due to the user's experience and knowledge, possibly because the user is accustomed to different equipment.
Hidden (H)	The interface gives no indications that the function is available or how it should be used.
Text and Icon (T)	Placement, appearance and content can easily be misinterpreted or not understood.
Sequence (S)	Functions and operations have to be performed in an unnatural sequence.
Physical Demands (P)	The interface sets too high demands on users' physical speed, motoric skill and force.
Feedback (F)	The interface gives unclear indications of what the user is doing or has done.

If the level of seriousness of the problem is between 1 until 4, it means that there is a usability problem in the task. So that further explanation is needed about the problems found by the evaluator. This is to get a deeper knowledge about the problem. From the questionnaire filled out by the evaluator, data on the seriousness of the problem and the types of problems of each task will be obtained. The data will be processed into the matrix. The goal is to find usability problems that arise using the five matrices in the ECW method, which consists of:

1. Matrix A: Problem seriousness versus task importance (PS vs TI)
2. Matrix B: Problem type versus problem seriousness (PT vs PS)
3. Matrix C: Problem type versus task importance (PT vs TI)
4. Matrix D: Problem seriousness versus task number (PS vs TN)
5. Matrix E: Problem type versus task number (PT vs TN).

User Experience Questionnaire

UEQ data will be processed by entering the results of the questionnaire data into the UEQ analysis tool. The UEQ count tool was created using a Microsoft Excel tool and can be downloaded together with a questionnaire file. The 3 stages of UEQ's assessment in terms of the Data Analysis Tool, namely:

a. Data Transformed

   Respondent result data entered into UEQ's calculating tool undergoes a data transformation process, namely a randomized order of values in a questionnaire to minimize the tendency for answers. Respondents rated each item on a 7-point Likert scale. Respondents' answers were given a scale from -3 (completely agree with negative terms) to +3 (completely agree with positive terms). Half of the items started with positive terms, and the others with negative terms (in random order). The transformed data will produce an average value for each respondent. Then the data will be grouped based on a predetermined scale, namely the scale of Attractiveness, Efficiency, Perspicuity, Dependability, Stimulation, and Novelty.

b. Main Results
The result of data transformation is managed to get the main result. The main result is the UEQ result which will serve as a guideline for the next calculation, namely the Benchmark Data Set. Here the overall scale and the scale of assumptions (Attractiveness, Pragmatic and Hedonic quality) are determined by calculating the mean and variance of the average data conversion results that have been obtained at the specified scale. The determination of the mean per scale results has a standard, namely the average impression value between -0.8 and 0.8 is a normal evaluation value, if the value> 0.8 is a positive evaluation, and if the value <-0.8 is a negative evaluation.

c. Benchmark Data Set
UEQ uses the Benchmark standard. This data set contains data from 20190 persons from 452 studies concerning different products (business software, web pages, webshops, social networks). Benchmark standard calculations are used to describe the comparison of the quality of the Zomato application with 246 products from UEQ evaluation data.

System Usability Scale

After the data is tested for validity and reliability, the data will be entered into Microsoft Excel to be processed. The data will be calculated using a weighted SUS score. However, there are rules in calculating the weighting of the SUS score. The following are the rules for weighting the scores on the questionnaire:

1. For every odd-numbered question, the final score is the result of subtracting the user's score (x) minus 1.
2. For every even-numbered question, the final score is the result of subtracting results from 5 minus the user's score (x).
3. The weighting of the SUS score is obtained from the sum of the overall user scores multiplied by 2.5.

After that, the SUS score of each respondent is calculated the average score by adding the overall score and divided by the total number of respondents. The results of the calculation are divided into 5 Letter Grades from A, B, C, D, and F with a choice of ratings of Excellent, Good, OK, Poor, and Awful.

Data Analysis

1. Enhanced Cognitive Walkthrough

The matrices in ECW are employed to present an overview picture of problems in the interface. These types of matrices can also be employed to compare different interfaces and see which interface has the least serious problems or whether there are different problem types between interfaces. Problems that are considered serious for important tasks should then be further investigated to decide if they are also potential usability problems in real situations of handling. The results of the user experience evaluation using the enhanced cognitive walkthrough method explained that in general there were not many serious problems affecting the main task of the Zomato application. The number of problems identified by the evaluators was 114 problems. However, several evaluators identified the same problem. If removing data duplications, then left 42 unique problems. Of the 42 problems identified, 7 of them are serious problems based on the matrixes. The following is a summary of the matrices that have created.

a. Matrix A

Matrix A shows the general condition of the interface. In general, most of the problems in the interface are not serious, serious problems were found on the login screen, OTP Code, and mismatched button placement.

b. Matrix B

Matrix B shows the overall problems with the interface. Generally, the most problems in the Zomato app are problems in the fourth level of seriousness. It means that most of the problems in the Zomato app are problems that do not have a direct impact on the main function of the application. However serious problems are also found in this app. these problems are at the second seriousness level with problem types consisting of Hidden (H), Text and Icon (T), Sequence (S),

and Feedback (F). So, it can conclude most of the problems are related to reviews, such as reviews that cannot be fully viewed, reviews that are lost when the number of stars is changed, and reviews that do not appear in the review list. Thus, the task of writing reviews on restaurants needs to be examined further.

c. Matrix C

Matrix C to shows which problems are most important to rectify. The most important problems to fix based on the C matrix table are problems that exist in task importance one and two with the user (U), Text and Icon (T), Physical Demand (P), and Feedback (F) problem types.

d. Matrix D

Matrix D shows which task had the most problems. Based on the D matrix that has been made, the task that has the most problems is the fourth task number, which is writing restaurant reviews, and then the fifth task number, which is doing restaurant filtering.

e. Matrix E

Matrix E shows which problems are most common in the task. In general, the most common problems are problems with the Text and Icon (T) type. It means most of the issues regarding placement, appearance, content, and color that can easily be misinterpreted or not understood.

f. User Experience Questionnaire

User Experience evaluation of the restaurant finder application using the User Experience Questionnaire shows that users get enough of what they want in terms of attractiveness, system functionality, and in terms of appearance that makes users comfortable. The results of UX evaluation shows that the aspect that must be examined is the novelty aspect which gets a score of 0.683. It indicates that the user has not found the novelty in the offered app. The result of the UEQ benchmark also shows that the results from the Novelty aspect are close to below average. The scale denoting the novelty aspect consist of Creative to Dull, Inventive to Conventional, Usual to Leading Edge, and Conservative to Innovative. These scales indicate that respondents consider the Zomato app to be quite monotonous, conventional, usual, and conservative. It means an upgrade to the Zomato app is needed.

Besides, when viewed based on the results of the Hedonic Quality and Pragmatic Quality groups. Pragmatic Quality is a positive evaluation result and Hedonic Quality is a neutral evaluation. The assessment of hedonic quality comes from the aspects of stimulation and originality. In Figure 4, 2 out of 4 items in the stimulation aspect get a neutral result instead of a positive result. It means the stimulation aspect needs to be examined further. Two question items from the Stimulation aspect that get normal results are Boring to Exciting and Motivating to Demotivating.

Item	Mean	Variance	Std. Dev.	No.	Left	Right	Scale
1	1.4	1.0	1.0	100	annoying	enjoyable	Attractiveness
2	1.7	0.9	0.9	100	not understandable	understandable	Perspicuity
3	0.6	1.1	1.1	100	creative	dull	Novelty
4	1.4	1.3	1.1	100	easy to learn	difficult to learn	Perspicuity
5	1.0	1.1	1.1	100	valuable	inferior	Stimulation
6	0.8	0.8	0.9	100	boring	exciting	Stimulation
7	1.0	0.8	0.9	100	not interesting	interesting	Stimulation
8	1.1	1.2	1.1	100	unpredictable	predictable	Dependability
9	1.0	1.1	1.0	100	fast	slow	Efficiency
10	0.7	0.8	0.9	100	inventive	conventional	Novelty
11	1.6	0.9	1.0	100	obstructive	supportive	Dependability
12	1.7	0.9	0.9	100	good	bad	Attractiveness
13	1.5	1.0	1.0	100	complicated	easy	Perspicuity
14	1.4	0.8	0.9	100	unlikable	pleasing	Attractiveness
15	0.7	1.1	1.1	100	usual	leading edge	Novelty
16	1.4	0.8	0.9	100	unpleasant	pleasant	Attractiveness
17	1.2	0.9	1.0	100	secure	not secure	Dependability
18	0.8	0.6	0.8	100	motivating	demotivating	Stimulation
19	1.0	0.9	0.9	100	meets expectations	does not meet expectations	Dependability
20	1.4	0.8	0.9	100	inefficient	efficient	Efficiency
21	1.4	1.1	1.1	100	clear	confusing	Perspicuity
22	1.5	0.9	0.9	100	impractical	practical	Efficiency
23	1.2	0.7	0.8	100	organized	cluttered	Efficiency
24	1.3	1.0	1.0	100	attractive	unattractive	Attractiveness
25	1.3	0.9	0.9	100	friendly	unfriendly	Attractiveness
26	0.7	0.9	1.0	100	conservative	innovative	Novelty

Figure 4. The result of UEQ

g. System Usability Scale

The System Usability Scale can be used as an evaluation tool for evaluating software interfaces that are measured and structured accurately. Based on the results of the Usability evaluation using the System Usability Scale (Figure 5), the Zomato app gets a score of 71 with a "Good" rating, Letter Grade "C", and included in the "Acceptable" category. From these results, it can be concluded that the Zomato application fulfills the Usability element, although there are still some weaknesses. When viewed on a per-item basis, the tenth item (I needed to learn a lot of things before I could get going with this app) has the highest number of negative scales with a total of 93 answers from 100 respondents. The second position with the highest number of negative scales is the sixth item (I thought there was too much inconsistency in this app) with a total score of 92. The third position is the second and eighth items because they both have 90 negative scales. The negative scale is calculated from the sum of the scores 1, 2, and 3 on the weighted SUS score.

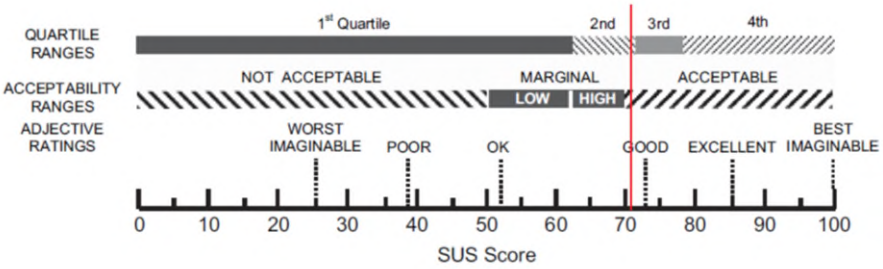

Figure 5. SUS Score Interpretation Scale (Bangor et al. 2008)

Inspection and Inquiry Methods

At this stage, it will explain and compare the results of the evaluation from inspection and inquiry methods. This study compared the 3 methods in terms of the number of identified usability problems, problem description, and level of details. Comparing the number of usability problems that have been done before in research conducted by (Khajouei et al. 2017). To compare the number of usability

problems is to count the number of problems identified. For inquiry methods cases, the author breaks down the results of the evaluation to get the reason why the evaluation results cannot achieve the maximum results. After that, the results of the number of usability problems spelled out in the problem description.

To compare the level of details using the theory employed in the research conducted by Scholtes et al. (2020). Scholtes et al. (2020) said the authors can determine the level of detail. The level of details was defined as low, if the method reflects only the opinion of the test person, as moderate, if the method also describes the problem, and as high, if it also describes the possible location effects of the problem (Scholtes et al. 2020). Table 5 shows the evaluation results between inspection and inquiry methods.

Table 5. Evaluation results

Categories	Inspection Method	Inquiry Method	
	ECW	UEQ	SUS
Evaluation Results	The evaluation results were based on matrix A. In general, most of the problems in the interface are not so serious and do not affect the main function of the app. But need to be considered for the perfection of the app.	Most of the aspects showed positive evaluation results.	The evaluation results get a "Good" rating, Letter Grade "C", and were included in the "Acceptable" category.
Number of Usability Problems	114 problems identified. If remove data duplications, then left 42 unique problems. Of the 42 problems, 7 of them are serious problems based on the matrixes.	Two of the six aspects of UEQ need to be examined further, namely the Novelty aspect and Stimulation aspect.	4 out of 10 question items have the greatest number of negative scales.
Problem Description	1. It will be more familiar if the first page contains login and register options (3U). 2. Several buttons on the login clipped (3T) 3. There is an overlapping button (3T) 4. Promo information that is difficult to find (3H) 5. Reviews do not appear in the review list (2F) 6. Reviews that have been written will be lost if we make changes to the star rating (2S) 7. When users write long reviews, they can't be seen completely (2T)	Novelty Aspect: • Creative to Dull • Inventive to Conventional • Usual to Leading Edge • Conservative to Innovative Stimulation Aspect : • Boring to Exciting. • Motivating to Demotivating	10th item: I needed to learn a lot of things before I could get going with this app. 6th item: I thought there was too much inconsistency in this app. 2nd item: I found the system unnecessarily complex. 8th item: I found the system very cumbersome to use.
Level of Details	High	Low	Low

In general, the evaluation results show that the application is quite good in terms of usability. Also, it doesn't find any significant problems in the application. When viewed from the side of effectiveness. Effectiveness was measured by counting the number of errors that occur while the evaluator completes the task. The number of errors identified was 42 out of 195 questions in inspection method. It means the percentage of effectiveness is 78.46%. Thus, it can be concluded that this restaurant finder application can be said to be quite effective.

In the inquiry method results, five aspects need to be improved from the Zomato application. Two aspects come from the evaluation results of the UEQ, namely novelty and stimulation. Three aspects come from the evaluation results of the SUS, namely learnability, consistency, and complexity. The learnability aspect is based on the tenth question on the SUS. The consistency aspect is based on the sixth question on the SUS. The complexity aspect is based on the second and eighth questions on the SUS. Based on the UEQ evaluation results, the application gets a positive evaluation. Meanwhile the SUS evaluation results, the application gets a 'Good' rating, a 'C' letter grade, and included in the 'Acceptable' category. Thus, it can be concluded that user satisfaction towards the restaurant finder application is good.

Implications

Based on the results of the inspection method, recommendations for improvement the Zomato app are focused on login tasks, reviews, and food promo information. Besides, most of the problems that exist in this restaurant finder application were related to text and icon problems where there are many placements, appearance, content, and buttons that can be easily misinterpreted or not understood by users. Improvement was done by making a prototype of the login screen, main menu, and review screen. Meanwhile, based on inquiry results, recommendations for improvement are focused on aspects of novelty, stimulation, learnability, consistency, and complexity. Thereby, the focusing of problems between five attributes can be more optimal to the usability side and improve user experience to Zomato Application. The following is a recommendation improvement for any serious problems identified using the inspection method.

1. Unfamiliar Login Page

Some users may be unfamiliar or inexperienced with the type of login. Maybe it would be better if the first page contains the options for login and registration because it is more familiar to users instead of contains the type of login via email and phone number.

2. Improper placement of buttons

Although it seems trivial, improper placement of buttons is one of the important problems that need to be fixed. Improper placement of buttons needs to be corrected so that users are not confused and do not choose the wrong button (Figure 6). One of the contents of the usability guidelines made by (Shitkova et al. 2015) is place content in the central part of the screen. Placement of content that is leaning to the right or left can make the interface look unattractive; thus, the design should be improved as shown in Figure 7.

Figure 6. Login screen

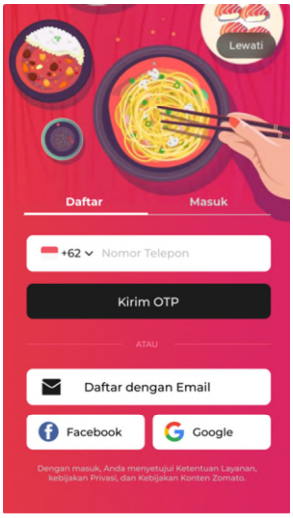

Figure 7. Design improvement of Figure 6

3. Improper placement of buttons

Although it seems trivial, improper placement of buttons is one of the important problems that need to be fixed. Improper placement of buttons needs to be corrected so that users are not confused and do not choose the wrong button. One of the contents of the usability guidelines made by Shitkova et al. (2015) is to place content in the central part of the screen. Placement of content that is leaning to the right or left can make the interface look unattractive. Figure 8 is an example of improper button placement in the Zomato app. In Figure 8, the button name is too long, and the buttons are overlapping which makes the buttons difficult to read; thus, the design improvement can be seen in Figure 9.

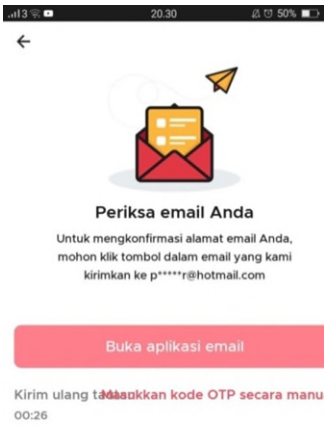

Figure 8. Improper placement of button

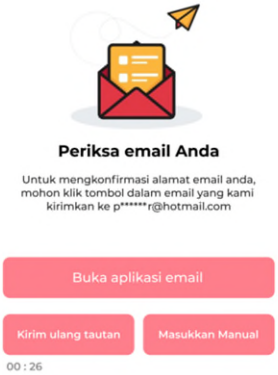

Figure 9. Design improvement of Figure 8

4. Promo's button is very hard to find.

The promos button is difficult for users to find. In the main menu of the Zomato app, users need to scroll down many times to find the promo button. The promo should be an interesting thing to see for the first time. It would be better if the promotion button is placed in a place that is easily visible to the user. In line with contents of the usability guidelines made by Shitkova et al. (2015) said that important pages should be reachable from the home page.

5. Reviews that cannot be fully viewed

When a user writes a review that is longer than four lines, the review is not scrollable. So, the review cannot be seen in full. Users will find it difficult to see all the reviews that have been written.

6. Reviews that have been written will be lost if changes the star rating.

When a user has written a review and wants to change the number of stars, the review that has been written will disappear and must write a review again. It makes users must rewrite the review. So, maybe some users will discourage to write a review again. It would be better when users change their star rating, the reviews that have been written are not deleted.

7. No Feedback in Reviews

After giving a review, the review that the evaluator wrote did not appear in the review list even after the evaluator tried it twice, the review still did not appear. Application response to the reviews was bad. This is a quite serious problem and needs to be fixed immediately as it can discourage users from writing restaurant reviews.

Discussion

According to Mahatody et al. (2010), the Cognitive Walkthrough method has undergone nine changes and the last change is the Enhanced Cognitive Walkthrough version. Thus, it can be said that the Enhanced Cognitive Walkthrough method is the latest version of the Cognitive Walkthrough method. Enhanced Cognitive Walkthrough has several advantages over its predecessors, namely (i) ECW has a high level of perspective in user interface evaluation, which can be manifested. (ii) Descriptions of success or failure yield adequate information about the difference in problem severity between different operations. (iii) The general description of the results can be explained well because of the matrices. However, among its strengths, the Enhanced Cognitive Walkthrough also has weaknesses including the inability of the method to evaluate user satisfaction, user attractiveness, efficiency, etc. (Bligård and Osvalder 2013). The weakness of the Enhanced Cognitive Walkthrough can be overcome using user-based evaluations. Examples of user-based evaluation methods are the UEQ and the SUS.

The results of the evaluation of the three methods show similar results, where the Zomato application is quite good in terms of usability, although there are still some weaknesses. These weaknesses are explained in the problem description in Table 5. Each method identifies a different problem. Therefore, all of the methods are interrelated and complement each other. This can be a good recommendation for Zomato company regarding usability issues in their application because the problem is not only seen from the point of view of the evaluator but also the users. This is in line with the statement by Jaspers (2009), each method both inspection and inquiry methods have its own advantages and disadvantages, and no single method reveals significant results which show that it is very effective in all circumstances. A complementary combination of usability analysis techniques should preferably be used because the collective application will be more powerful than those used separately.

Conclusion

Research on usability evaluation of restaurant finder applications using inspection and inquiry methods has been done. The restaurant finder application used in this study is the Zomato app. This study uses two types of usability evaluation methods, namely Inspection and Inquiry methods. The number of methods used in this study was three methods, namely Enhanced Cognitive Walkthrough, UEQ, and SUS. In the evaluation results of the Enhanced Cognitive Walkthrough method, there were no significant problems that could interfere with the main functions of the application. The number of problems identified by the evaluators was 114 problems. However, several evaluators identified the same problem. If removing data duplications, then left 42 unique problems. Of the 42 problems identified, 7 of them are serious problems based on the matrixes. The results of the Usability evaluation using the System Usability Scale, the Zomato app gets a score of 71 with a “Good” rating, Letter Grade “C”, and included in the “Acceptable” category. From these results, it can be concluded that the Zomato

application fulfills the Usability element, although there are still some weaknesses. For user Experience evaluation of the restaurant finder application using the User Experience Questionnaire shows that users get enough of what they want in terms of attractiveness, perspicuity, efficiency, dependability, stimulation, novelty and in terms of appearance that makes users comfortable.

The results of the usability evaluation of the restaurant finder application using inspection and inquiry methods are that the Zomato application is good, but there are still several tasks that need to be improved for the perfection of the application. Based on the inspection method, recommendations for improvements are focused on login tasks, reviews, and food promo information. Besides, based on inquiry methods, recommendations for improvement also need to be emphasized on aspects of novelty, stimulation, learnability, consistency, and complexity. The limitation of this study is that this study cannot compare the attributes for each method. Future research can use methods that have the same attributes, so that the results of the comparison can be more accurate.

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Exploring the Misalignment between Business and Information Technology on the Implementation of Balanced Scorecard: Case Study of State-Owned Telecommunication Companies in Indonesia

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Abstract

Many organizations around the world have faced misalignment in attaining the alignment between business and Information Technology (IT). The positive effect of alignment on overall company success has been focused on previous research. On the other hand, the misalignment in the implementation of a balanced scorecard was primarily unexplored. This study aimed at identifying and evaluating the factors that contribute to a misalignment of businesses and IT. The case study methodology is conducted in two state-owned telecommunication companies in Indonesia. The telecommunication industry's selection as the case study is because of their nature closely related to technology development and implementation. Five semi-structured interviews, field notes and business records are used to produce the data, which have been thematically analyzed and further follow by cross-case analysis to compare the thematic analysis result from each company. This study has resulted in 12 factors of misalignment between business and IT that can inhibit achieving alignment in implementing a balanced scorecard. The main findings showed that human factors, enterprise architecture, and IT project implementation factors could be three main source themes that can potentially contribute to misalignment. The findings may allow researchers to devise frameworks for how misalignments can be minimized to align business and IT better. This finding also useful in practice for companies that are seeking to achieve business-IT alignment by focusing on human factors, enterprise architecture factors, and IT project implementation factors.

Keywords: Misalignment, business-IT alignment, IT strategy, Balanced Scorecard, a state-owned telecommunications company

Introduction

The Society for Information Management's (SIM) annual Chief Information Officers (CIOs) surveys has consistently placed the IT alignment amongst the top three challenges by Information Technology (IT) managers since 2009. The new 2019 SIM survey also listed IT alignments as the third big concern

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or worry field of CIOs, with responses from 1033 IT executives representing 618 organizations and 376 CIOs (Kappelman et al. 2019). For over 20 years, many researchers have tried to overcome this gap and introduce various framework steps to reach a better business-IT alignment. Past findings suggested that some factors exist impeding business and IT alignment. One solution to improve business-IT alignment is to recognize management activities that hinder business-IT alignment (Luftman and Brier 1999).

Therefore, to better understand the business-IT problem, it is necessary to know the factors that cause misalignment between business and IT. It becomes important because if the company can identify the list of misalignment factors, then the management, which includes business and IT, can fix it to help the business achieve its business goals. Luftman (2000) points out that the fulfilment and persistence of alignment demand optimize enablers and eliminates alignment inhibitors. Without a complete understanding of the factor that can cause misalignment between business and IT, the company will find difficulties in achieving alignment. Studies on factors that cause misalignment have not yet studied empirically, especially within the Indonesian context (Chan and Reich 2007; Leonard and Seddon 2012).

Our study's starting point is that the misalignment factors between business and IT remain fragmented in the literature. In the literature, we found that three main sources cause misalignment between business and IT. There are human factors (Corsaro and Snehota 2011; Dulipovici and Robey 2013; Handley 2017; Leonardi 2009), enterprise architecture factors (Alhassan and Ochoche 2013; Fichman and Melville 2014; Ori 2017a), and IT project implementation factors (Heath et al. 2013; Soh and Sia 2004; Wei et al. 2005). Previous studies on misalignment have focused on either human factors, enterprise architecture factors, or IT project implementation factors. This fragmented misalignment factor theme and remained unclear on pointing put what sub-factors contributing to the misalignment in the literature will only look at misalignment as a standalone theme without considering that it is better to see all three misalignment factor themes as a comprehensive framework for understanding business-IT complexity alignment.

Therefore, this research has focused on combining the three main source of misalignment factor fragmented in the past literature to be the comprehensive framework for exploring the misalignment factors between business and IT on implementing a balanced scorecard. We are exploring the misalignment using a comprehensive framework that includes human factors, enterprise architecture factors, and IT project implementation factors to understand misalignment as a whole system better. This study's main objective is to explore the misalignment factors between business and IT that inhibit achieving alignment on balanced scorecard implementation in two state-owned telecommunication companies in Indonesia.

Literature Review

Human Factors as a Misalignment Source

Concerning human factors, misalignments will occur when workers perceive the IT resources and their strategic role in the organization differently (Dulipovici and Robey 2013). Human factors suggest companies' need to verify that there are sufficient verification procedures to identify misalignment that might occur (Corsaro and Snehota 2011). Also, misalignment can occur due to social interaction differences, especially in using or implementing new technology between business and IT. Leonardi (2009) added that how new technology is interpreted among employees focuses on the social interaction that can cause possible misalignment. Another human factor that can also cause misalignment is the incapacity of IT employees while doing a job. For example, in relationship with the outsourcing of information management activities implemented by administrators, the expertise in which workers will work IT can influence outsourcing efficiency and the connection to corporate governance (Handley 2017). Additionally, Chief Executive Officers (CEOs) and IT executives' skills of understanding the new technology are also considered critical in achieving business-IT alignment (Coltman et al. 2015).

Enterprise Architecture as Misalignment Source

Enterprise architecture (EA) contains many business processes, IT structures and application systems (Alhassan and Ochoche 2013). Enterprise architecture applies architectural concepts and practices to drive companies around the improvements in business, method, and technology required to enforce their strategies. EA is a critically beneficial feature since it has many advantages, such as increased business agility, reduced business & IT risks and cost management. However, it implicitly complicates business goals, which presents a challenge for many CIOs and Chief Technology Officers (CTOs) seeking to create a consistent connection between EA and business goals. Misalignment arises where the company does not implement the appropriate EA to meet business needs (Ori 2017b). The company act to an IT innovation can also contribute to the misalignment between business and IT. If the company does not react to IT innovation, it cannot achieve its competitive advantage in the digital era (Fichman and Melville 2014).

IT Project Implementation as a Misalignment Source

For the IT project implementation issue, the main emphasis is on the lack of comprehension of what the business intends with what IT employees do about the business strategy. For instance, when the business manager and IT employee have different views about something that should be defined as done when creating a business project solution, there is likely misalignment. Also, the IT project implementation misalignment can occur when there is a mismatch between the company's existing IT core infrastructure with the expected results from the business side (Heath et al. 2013). In another research from Wei, Wang and Ju (2005), they give an example in their research that the misalignment can occur because of disruptive transformation by launching a new system between an Enterprise Resource Planning (ERP) system's implementation. From a systemic standpoint, business-IT misalignment could occur due to conflicting IT activities with other divisions (Soh and Sia 2004). Their research gave an example that misalignment is most likely to arise if any IT project is forced to be implemented by management and IT by not allowing all employees to accept that new IT implementation.

The IT Balanced Scorecard

Since Kaplan and Norton introduced a balanced Scorecard in 1998, the concept has been applied to other departments in the company, with no exception to the IT department. However, since the nature of the IT acts as internal service support inside the company, Martinsons, Davison and Tse (1999) proposed the perspectives and measures suggested by Kaplan and Norton to be considerably adjusted. The customised four perspectives for an IT Balanced Scorecard (IT BSC) were proposed by Martinsons, Davison and Tse (1999): Customer Perspectives becomes User Orientation, Financial Perspective becomes Business Value or Corporate Contribution Perspective, Internal Business Perspective becomes Operational Excellence, and Learning and Growth Perspective becomes Future Readiness. Kaplan and Norton also emphasize the value of sticking three principles to translate the strategy into action. These principles consist of building cause-effect-linkages, choosing appropriate performance drivers, and providing a linkage to financial measures (Kaplan and Norton 1996).

Research Methodology

The case study method was chosen for this study. A case study is well adapted for studying the complexity of processes in natural environments (Benbasat et al. 1987; Yin 1984) and the rich dynamics of a particular environment (Eisenhardt 1989). Case study research is aimed to develop a theory that includes validity strength (Eisenhardt 1989). It is designed to fulfil the need to maximize the research quality through validity and reliability (Yin 1984). In this study, validity and reliability tests were done using the selected case study tactics. The construct validity was applied by using multiple sources of evidence. The internal validity procedure was established to ensure an underlying theory used in the study. The underlying theory was used for the thematic analysis and cross-case analysis technique. If possible, the external validity process would be applied to generalize the research findings in a different context. However, in this study, the external validity relied on theory in two case studies. The reliability

procedure was performed to make that the study's result could be reproduced under a similar methodology. To increase the reliability and to reduce bias in data collection, a case description was prepared for the case organization in a case study setting. A protocol was developed to test the reliability of the case study research.

The complexity of their administrative systems, operations, services, and accessible information makes the business-IT alignment demanding for large corporations. Consequently, it was also essential to select a large corporation to get an in-depth analysis and view of misalignment factors. For this research, the case study was conducted at two of the state-owned telecommunication companies in Indonesia. It has been deemed eligible for this research because it is a multinational corporation and has a complicated company hierarchy structure. It fulfils the International Standard Industrial Classification criteria of all Economic Activities' regulations for large businesses with more than 100 employees (UN 2008). Also, the telecommunication companies were chosen because their business is very closely related to technology. Hence, we assume that the company should be more aware of the new technology used for business transformation. The selection was also based on the condition that both companies have the same business in the telecommunication sector. Their IT department also acts as an enable and driver for business. Hence, we assume that the company should be more aware of the new technology used for business transformation. The detail about the company profile describes below:

Company A is one of the Indonesian state-owned enterprises engaged in telecommunications, which has served as the leading supplier for developing the national telephone network for more than three decades. Since the convergence trend between telecommunication technology and information technology, Company A has changed business orientation from being based initially on pure manufacture to an industry based on system solutions, particularly in information and communication systems and technology integration. The company was considered fit for the case study because IT become the core of the business. IT acts as a driver and enablers for business to achieve a portfolio that the company wants, especially in the digital service and system integrator portfolio. It also can be seen from the organizational structure that places the IT department under the business directorate.

Company B is a state-owned enterprise engaged in the telecommunications and network services sector in Indonesia. The company has significant businesses in fixed-line telephony, internet and data communications. The company grew up with more than 24.000 employees in 2019. With fast-growing and robust business in digital and telecommunication, the company has a mission to grow and sustain its digital service innovation with an agile and robust network and IT infrastructure.

Interviews were deemed the most effective method to obtain practical experience, in-depth insight and more information in specific, nuanced ways, pursuing the research issue that demanded interaction with numerous interviewees from various positions. The interview structure questions addressed in this research were based on the literature review presented in section two concerning misalignment factors. For this research, five interviewees from two state-owned telecommunication companies were chosen. Related to the number of interviewees, then it is related to data saturation. Saunders et al. (2018) conclude that it might be better to think about rich and dense data rather than the sample size. The best way to distinguish between rich and thick data is to think of rich as quality and thick as quantity. Rich data is multi-layered, intricate, informative, complicated, and more than thick data. One can have much dense data, but not a lot of it, or one can have a lot of rich data but not a lot of it. Therefore, to ensure data saturation and validity, the researcher conducted purposive sampling. Each interviewee was selected based on their knowledge and directly engaged in creating and executing business and IT strategies and affecting business and IT alignment. It is aligned with (Yin 1984) that the interviewees should be closely linked to the research subject and familiar with the research field. The list of the interviewee and other information are presented in Table 1.

An analysis of case studies shows that case studies using several evidence sources have, as far as their overall quality is concerned, been rated more highly than studies using only one data source (Yin 1984). In this study, the triangulation used consisted of three triangulation types: data or source triangulation, theory triangulation, and methodological triangulation. Triangulation of data or sources in this study will focus more on using different informants to show consistency in the misalignment factors found in the company. These different informants were obtained by interviewing employees of different levels.

There are differences in position and seniority, including top management (such as vice president) and middle manager (project manager or IT manager). Data triangulation was conducted until the researcher got complete data and found saturated data validation from the source. So, it could be the source to find the result and conclusion. The researcher expected that with this technique, collected data could fulfil the conclusions construct.

Table 1. Interviewee information

Company	Interviewees	Job responsibilities	Interview Date	Interview duration (min)
Company A	Interviewee 1 (I1)	Vice President of Information Technology (VP of IT)	2020-06-17	67
Company A	Interviewee 2 (I2)	Information Technology Infrastructure Manager	2020-06-04	54
Company B	Interviewee 3 (I3)	Executive General Manager Information Technology (EGM of IT)	2020-04-28	37
Company B	Interviewee 4 (I4)	Manager of IT Planning and Architecture	2020-05-20	36
Company B	Interviewee 5 (I5)	Senior Manager of C/FU Support and ITSM	2020-06-10	65

Then, using archival documents obtained from each company, the methodological triangulation process is also carried out by matching the misalignment factors obtained from interviews with the company documents under study. From Company A, the researcher received seven documents. Meanwhile, from Company B, the researcher received eight documents. With the existence of company documents that support the respondent's statement, the misalignment factor results can further explain the misalignment phenomenon that occurs. Finally, theory triangulation is carried out by explaining theories regarding misalignment factors that come from previous research. This theory triangulation process also aims to compare the findings in the form of factors that cause misalignment with the relevant perspective theory. Researchers are expected to avoid the researcher's bias. It will result in the process of generalization and validity of the data generated.

The thematic analysis in this study has been seen as more relevant for discovering new perspectives on the research subject. As for coding technique, the coding be done manually. The guidelines for the thematic analysis in terms of manual coding proposed by Braun and Clarke (2006) with the steps as following: (1) familiarizing with the data; (2) generating initial codes; (3) searching for themes; (4) reviewing themes; (5) defining and naming themes; and (6) producing the report. Therefore, the process began with the reading of transcribed interviews, internal documents and other documents to get general insights. In this research, after we generated the thematic analysis based on each company's alignment conditions, we compared the two case studies to articulate a chain of reasoning for the differences and similarities in each case study's results. By analyzing each case before comparing various cases, the researcher can detect specific patterns of cases, thereby deepening his understanding of the cases and facilitating cross-case comparisons (Sato 2016). Here, the researcher tries to describe in detail the events, processes, or stages of each case that originate from direct interviews with respondents and observations. Each detail of the incident is written along with excerpts from interviews with respondents to strengthen the empirical evidence. In supporting validity and reliability, comparisons with previous studies as a process of triangulation will be presented so that it is found that solid theoretical explanations support the misalignment factors that occur. Cross-case analysis enhances the researchers' ability to understand how relations between discrete cases can exist, accumulate actual knowledge, refine and develop concepts (Ragin 1997), and build or test theory (Eckstein 2002). However, due to

the limitation of the pages for this research, the results in this section will be shown in cross-case analysis result as the final result for showing the misalignment factors found in this study.

Results and Analysis

Human Factors as a Misalignment Source

1. Business-IT Communication Only Happen at the Top-Level Management

At Company A, communication is not structured through the formal channel when involving employees but mainly flows through informal networks. Formal communication only occurs in business directorate meetings and board meetings. It has resulted in disseminating information regarding the business strategy that will only rotate at the top management.

"Where am I going to speak? There are two media that can be used, internal business directorates and board meetings." (Interviewee 1)

On the other hand, at Company B, to communicate business directions that will be carried out and develop ideas from employees, the business strategy explanation process is carried out by the Vice President of IT, then packaged in two-way communication with the IT employee.

"The IT division has events, for example, Leader Talks Value, where VP of IT explained or gave a presentation to all of his IT division employees when it was not a pandemic. VP of IT conveyed strategic matters that need to be shared with each employee. That is one example of a training process for disseminating strategic programs' socialization, and there are several other methods. So, the point is that there is a top-down socialization mechanism at the bottom level of employee." (Interviewee 5)

The misalignment factor found in this study is consistent with past research, which found that the communication gap between business and IT is the main reason why the misalignment factors happen (Alaceva and Rusu 2015; Alghazi et al. 2020; El-Mekawy et al. 2015; Ullah and Lai 2013). According to Sauer & Yetton (1997), the basic concept is that IT should maintain communication to represent the business's management needs. In a nutshell, alignment is a way of strengthening coordination between corporate leaders who make strategic decisions and IT employee who control technical operations.

2. Lack of Business Executive Visionary

Without a clear view of corporate direction, CIOs and IT managers often perceive run IT organizations as cost centres. As a result, alignment remains one of the top IT management issues (Kappelman et al. 2019). It also happened to Company A, where the board of directors did not yet have clear directions regarding how IT could provide significant changes for the company's profits.

"So, from the business, we do not know the business roadmap". (Interviewee 1)

The company's strategic plan that has been made in the form of nine core competence directives that must be mastered is useless because there is no further definition of the target market for the product that is being made.

"It is true that we have entered into digital service but which digital service that we enter in then has not been defined. The current digital service at Company A only supports all internal lines. When talking about digital service, there are so many branches, which have not been defined." (Interviewee 1)

On the other hand, IT Executives at Company B always try to get a vision related to IT technology that would drive business through research elsewhere. One of the ways is holding gatherings with vendors related to the latest technology that can be applied in the company to support the company going forward.

"I started, of course, from CSS (Corporate Strategic Scenario), but i is not enough; CSS is just an initiative business. I also have to research in other places for the technology that can support CSS. As a business initiative, we follow CSS, but I have to research elsewhere if it is related to technology. I

have my partner as a reference, including many vendors. Therefore, we conduct gathering with our vendors. It means that I need to know what latest technology or upgrades I need to adopt for the company?" (Interviewee 3)

This study's misalignment factor is compatible with previous studies, which showed that a business executive often made IT choices with no IT experience, potentially causing the corporation to be misaligned (Gerow et al. 2014; Ullah and Lai 2013). IT awareness is essential to business management because few resources in every company, and IT expenditure are typically expensive with a high risk of failure. This IT knowledge includes the prospective and shortcomings of the enterprise's IT technology, the use of IT by competitors, and the prospects for new technology to increase business (Chedrawi and Howayeck 2019). The lack of business executive visionary in Company A is also because they are not well informed with the standard best practices that should be looked at to achieve the competitive advantage such as Gartner. They have not overlooked Gartner as the best industry practices to be implemented as their future investment. Again, it contrasts with Company B when the business executive is exposed to the next technology in the next five years. Company B's business executive uses the Gartner as the guideline for achieving competitive advantage results for the next 3 or 5 years.

3. Lack of Business Executive Commitment

Without a top management sponsor, likely, that initiative in a company will not be achieved. Niven (2005) emphasizes that the top management initiative is crucial for implementing the balanced scorecard. He claims that if the BSC program is not sponsored by top management and its position in addressing actual problems is not acknowledged, it will produce poor results and fail. Company A's vision and mission are outlined in a strategic plan in the form of nine core competencies. However, in practice, the Board of Directors does not commit to creating nine core competencies, causing managers to feel astonished and question the board of directors' commitment.

"So sometimes I feel a little confused too. Because the company's vision and mission are posted on websites everywhere, right? It means that when the vision has been approved, it means we all have to go there. It must be aligned." (Interviewee 2)

At Company A, this made the VP of IT angry and often questioned Company A core competence which had never been upgraded. As time went on, he gave up on the BOD decision while still trying to remind him of the directorate meeting.

"I know that there are nine core competencies that we have to create for our employee and our business in the future. I already convinced them that we have to develop our nine core competencies that have been formulated, but if they do not want to, then it is ok." (Interviewee 1)

This study's misalignment factor is consistent with past research, which found that insufficient management commitment towards IT planning will give rise to misalignment between business and IT (Lucke et al. 2010; Luftman et al. 1999; Seppänen et al. 2009). IT's strategic value is influenced by executives' commitment to IT investments and IT's corporate productivity role (Neirotti and Paolucci 2007). Thus, fail to commit to IT planning will therefore influence the business strategy. Furthermore, "the greater the commitment of top management, the greater effectiveness of IT Governance" (Buchwald et al. 2014). Solid and committed management promotes IT governance development by specific organizational guidance or strategies (Willson and Pollard 2009). It is further stressed by highlighting the importance of top-level management commitment to IS issues and initiatives, such as getting a business sponsor while preparing IT projects (Stoel and Muhanna 2012).

4. Lack of transfer knowledge from senior IT to junior

At Company A, the misalignment factor is also caused by the large number of senior employees who will soon retire so that the knowledge transfer process does not run smoothly. This process begins with an employment gap between seniors and juniors due to employee recruitment that has stopped for several years.

"Because many of our employees have retired, want to retire, or will retire, then the transfer of knowledge from them to juniors is too far away. It was also coupled with the recruitment process that has stopped for several years. So, when there is a gap too far, then it makes transferring knowledge difficult." (Interviewee 2)

The misalignment factor found in this study is supported by past research that found that knowledge sharing barriers will impact the company's performance (Qureshi and Evans 2015; Santos et al. 2012; Veer Ramjeawon and Rowley 2017). Levy (2011) and Wong (2009) even state that knowledge loss is a severe threat. The danger in the baby-boomers retirement is that they take away their knowledge, experience and vital skills about managing and handling IT projects. Knowledge of the older employees cannot easily be replaced because they acquired much different knowledge and their expertise is closely connected to themselves over the years of their working life. Implementing a structured program to transfer vital information is one way to counteract this challenge (Maruta 2012). It is not possible to collect and transmit all information, but that is not the aim. The goal is to pass only the essential organizational information specific to the job, which would jeopardize an organization's ability to function if lost.

5. Low Level of IT Education and Certification

The effect of a low level of IT education and certification is intensely felt in terms of getting IT-related projects. Some certifications can even be a tender requirement that will facilitate the company's credibility to win the tender project. However, the certification process is not an obligation formulated by Company A. The IT Manager later regretted this.

"The certification will only be obliged when there is a tender that we want to get. When there is a project or tender that requires certification in RKS (Work Plan and Conditions) document, for example, the requirement is that one engineer has certification in network, for example, CCIE (The Cisco Certified Internetwork Expert). If that is the case, then the certification will be mandatory to take." (Interviewee 2)

The misalignment factor found in this study is consistent with past research, which found that lack of IT skills results in the misalignment occur between a business and IT (Alghazi et al. 2018; Carañana et al. 2016; Coltman et al. 2015; El-Mekawy et al. 2015; Kurti et al. 2013; Weiss and Anderson 2004). Weiss & Anderson (2004) concluded that the failure to develop, sustain and get the necessary expertise is a significant obstacle in aligning business and IT. Research from El-Mekawy et al. (2015) also stated that a low level of IT understanding and knowledge cause uncertainty on business strategies towards IT. According to Alghazi et al. (2018), if there is no concrete strategy to develop IT employees expertise to fulfil the organization's needs, the desired IT strategic results would not be realized. As a result, IT personnel must be sophisticated enough to communicate with upper management while also mastering the technology needed for IS production and deployment (Poon and Wagner 2001). IT employees would be encouraged to bring in better and more appropriate technology change plans to promote company goals and strategies as they keep up with technological developments.

6. Limited Number of IT Employees

When comparing the thematic analysis of the two case studies in Company A and Company B, we discovered that having a small number of IT employees causes misalignment, as seen in Company A, where only 12 employees work in the IT operation division and the remainder work in the product development section. This number is not ideal, so the board of directors wants to increase the number of IT employees to 50 people. With the limited number of IT employees, there are several functions that one person must concurrently hold. This condition is different from Company B, where the number of IT employees is adjusted to the level of company needs. Because the information technology division at Company B makes many in-house applications, the developer and the IT service desk team's composition is balanced. With the number of IT employees reaching 180 people in company B, one employee can focus on their field. It is also strengthened by the company's technical career path with certification according to its type of expertise and position.

This study's misalignment factor is supported by past research that found that the limited number of IT employees influences business and IT's alignment process (Wang & Rusu, 2018). Wang & Rusu (2018) conducted a study on three SMEs in China and found that due to limited IT employees, request for IT application improvement from business managers was ignored because IT personnel were too busy to respond to the business manager's requests. Consequently, according to research from Chesley (2014), multitasking on the job doing by an employee will impact the employee to be stressed in their workplace. Interruptions are well-known to be harmful to work, and other investigations have indicated a link between interruptions and multitasking with decreased employee health (Jett and George 2003; Mark et al. 2008). Therefore, it is necessary to plot the number of IT employees according to the company's needs and the required expertise of these IT employees.

Enterprise Architecture as Misalignment Source

1. *There is a gap between the employees' core competencies and the technological developments that must be mastered*

In Company A, the VP of IT said a gap between IT technology changing so fast with employee's core competence. It is exacerbated by businesses that do not see the core competencies that must be owned. The VP of IT also said that aligning difficulties occurred when the Company's Long-Term Plan was not final and was not formulated in a detailed and structured manner.

If we want to examine the competencies that we already have, perhaps only at least two core competencies that we have, but for big data, IoT, Artificial Intelligence, we still do not have yet. Even though the business wants us to go in that direction, well, this is difficult in realigning because even in the company's long-term plans, the strategy is not final yet and no direction towards what we should going to do." (Interviewee 1)

The misalignment factor discovered in this study is reinforced by previous studies that find that IT staff's inability to keep up with innovations would preclude IT from converting business requirements into technological solutions (Krotov 2015; Kurti et al. 2013). As a result, the existence of a gap between IT employees' core competencies and the technology they must master makes IT employees feel frustrated and unable to provide support and advice related to IT technology to support business strategies in achieving competitive advantage. It adds to a tense relationship between business and IT executives, making it more challenging to grasp business and technological demands and requirements (Alaceva and Rusu 2015).

2. *The Strategy is not Illustrated in Strategy Map*

The strategy map is a Balanced Scorecard method to represent the strategy in cause-effect linkages. The strategic outcomes and performance drivers are core elements of the strategy map. For KPIs development, the strategy map should be the foundation. Without a strategy map, the employee will not follow the KPI's or participate in them. There is a risk that too many KPIs will evolve and cause uncertainty in such circumstances if KPIs are generated without a clear understanding of each other (Othman 2009). IT Executive in Company B admitted that this was a problem because due to the absence of a strategy map, productivity measurement could not be measure and only based on the feeling that the IT division had an impact and contribution.

"We have many certifications and training, but when we talk about the effect of certification and training on our productivity seems that we do not have yet. We feel the intrinsic presence of the activities that we did, but when asked to prove it by showing the relationship, then we do not have it." (Interviewee 3)

The misalignment factor observed in this study is reinforced by previous studies, which has shown that the lack of capacity to quantify IT contributions to the company leads to misalignment (Majstorovic 2016; Wang and Rusu 2018). Nfuka & Rusu (2013) also argue that merely making business and IT plans is inadequate. Business-IT alignment needs to provide and coordinate business-IT strategies to cascade them down in an enterprise. To fill this gap, IT leadership is needed to align enterprise technology architecture with business strategies.

3. Not Implement Appropriate Enterprise Architecture

The failure to adopt the latest enterprise architecture to support the business has allegedly played an essential role in supporting its business continuity in the future. Companies that catch up with the latest technology and implement them correctly can make significant changes in transforming a company's business. It is as emphasized IT Executive in Company B.

"The business has shifted from cooper to voice and now to the internet era. When I saw that the existing IT infrastructure and the applications that we have are no longer match, we have to modernize our IT core system." (Interviewee 3)

This study's misalignment factor is consistent with past research that found that business strategy that was not supported sufficiently by their IT systems will result in misalignment (Hussin et al. 2002). Many researchers and practitioners have stressed the importance of aligning business and IT strategies. It has often been acknowledged that a company's failure to capitalize on information technology (IT) may significantly impact its sustainability and viability (Besson and Rowe 2012; Ilmudeen et al. 2019).

IT Project Implementation as a Source of Misalignment

1. IT Project Overpromises

An IT executive has noted that one of the mistakes is to overpromise IT programs launched. At the start of the project, IT people are expected to be optimistic and offer a positive IT capability overview.

"The execution level exactly as you discussed earlier is not as beautiful as planned. In this sense, the timeline regarding the master plan time sometimes does not go smoothly. IT is unique, and it means that not everything we imagine has been done well. There are many dynamics, that is why there is CSS in Company B. Even though we have a 5-year work plan, we have to roll the term every year, we review it, resetting alignment again." (Interviewee 3)

This study's misalignment factor is consistent with past research, which found that overpromising when the beginning of IT project will cause the misalignment (Alaceva and Rusu 2015; Bloch et al. 2012; Lagerström et al. 2011; Pinto 2013). Lagerström et al. (2011) found out that in many situations, there seems to be a perception that IT Projects are struggling to provide the promised benefits to the company because they cannot be implemented efficiently and cheaply enough. According to their results, project managers are frequently expected to prepare for the project and provide the customer with an estimation of how long the project will take and how much it will cost. It means they must be skilled at calculating the project's duration and expense. Overpromising is a common occurrence of project managers who, to appease the customer, pledge more than they can achieve.

2. Low Demonstration of IT Value

In company A, the low perceived value of IT can cause misalignment between business and IT. The condition is that the business still does not see the value of IT. According to the interviewee in Company A, IT more frequently tends to solve the company's internal problem rather than bring attention to successful projects. In contrast, when looking at the Company A organizational structure where the IT department was put under the business directorate, which aimed to be a core of its business primarily to support Company A vision and mission portfolio.

"It is just sometimes like the project division is more prioritized rather than the IT department as a product development team. Even though we are in core or product development, we did not get too much attention." (Interviewee 2)

Past mistakes or successes in IT execution, on the other hand, will minimize or improve the potential to show IT value (El-Mekawy et al. 2015). It is just like what happened in Company B when the IT division succeeds to bring the sales increase in 2016 by developing a mobile application to request fibre optic instalment. As they already prove their work, IT's value in Company B increases and supports top management to develop and maintain its core infrastructure. It is also in line with Myers (1994) research, which suggests that the value of IT will achieve when an information system is perceived to

be successful by stakeholders. Our studies share the same results as previous results from El-Mekawy et al. (2015) that highlighted the business department perceived low IT value because they still do not see IT's value but instead sees it as a cost. El-Mekawy et al. (2015) also noted that a one-sided partnership is one of the main reasons the misalignment occurs in the group because IT is not seen as a strategic partner by the business department.

3. Low IT Budget

VP of IT in Company A emphasizes that misalignment occurs because the company is in survival mode condition. It causes the company to prioritize short-term business sustainability with the risk that there will be a further gap in the future between developing technology and the core competencies of employees.

"When we talk about survival mode, there is only a small amount to be invested in the research budget. Survival mode made our financial should be cut for developments." (Interviewee 1)

The misalignment factor found in this study is aligned with past research that found that lack of budget impacts business and IT alignment (Banaeianjahromi and Smolander 2017; El-Mekawy et al. 2015; Khan 2017). El-Mekawy et al. (2015) pointed out on their research the example of a company that still uses the ERP system developed in the late 90's due to the inflexibility of IT architecture related to cost. According to Khan (2017), the disruption of business-IT alignment is based on human and financial resources. A lack of any of the resources could lead to a misalignment of the two entities. To communicate with top management and keep up with the new technology, a high-quality IT staff is required (Poon and Wagner 2001). When available resources fail to achieve the desired outcomes, the resources must be reallocated, and a business-IT alignment must be created. It is necessary to keep human and financial support for the IT division since technology plays a central role in developing and capitalising on new business models. Thus, failure to keep up with the latest technology will cause the company to lose its competitive advantage towards business competition.

Discussion

The analysis has revealed 12 misalignment factors split into three major themes that could be identified into three major themes: human factors, enterprise architecture factors, and IT project implementation factors. The findings of this study fill significant gaps existing in business-IT alignment literature. From the alignment perspective, this study offers a more detailed view of the factors that inhibit alignment, which in turn affect business-IT alignment. The study reveals that misalignment factors cannot be only seen using one perspective of misalignment, but it needs to understand the whole understanding factors that can cause misalignment. The sub-factors identified in this study essentially confirm and significantly extend the earlier findings of several previous researchers. Simultaneously, we identified misalignment factors in this study (e.g., lack of transfer knowledge between senior and junior, the limited number of IT employees, the strategy is not illustrated in strategy map, there is a gap between the employee's core competencies and the technological developments that must be mastered) not much researched yet in the existing business-IT alignment literature.

By looking at the misalignment factors found in this study, we conclude that if these misalignment factors happen in a company, a perception will arise from the business department that IT is only wasting its investment. IT is not seen as a strategic partner that can help business departments achieve company goals but often perceived as a cost center. If they continue without any awareness of it, practices like this can cause the IT department's value to become less visible to the company. Instead of being an enabler or driver for a company to transform its business strategy, IT will only be seen as a department that only needs to focus on technical support without knowing how the business works. It will harm the entire organization because misalignment will hinder a company from achieving its competitive advantage by not maximizing the IT potential to transform the business.

Conclusion

This research has two implications, namely academically and practically. In academic implications, this study has described 12 misalignment factors that can occur in implementing the balanced scorecard with empirical evidence from two state-owned telecommunications companies through in-depth case study methodologies. Therefore, this result expands the knowledge in business-IT alignment literature by providing the factors that must be identified to align business and IT better. Besides, this research is also helpful for great practical use because it will raise awareness for the business and IT management to check whether the factors presented in this study exist in each environment. Therefore, all factors must be carefully considered if the company wants to fully utilize the IT department's alignment to achieve its business goals.

This study has several limitations. First, there is a limited number of individuals interviewed. The data collection was collected during the first quarter of the Corona pandemic when many companies close their office. To overcome this situation, the researcher collects the interviewee using the insider in each of company. Therefore, the participants' determination in this study was using the purposive sampling technique, which is selecting participants according to the objectives and criteria previously determined by the researcher. It can be ascertained that the data obtained will be in accordance with the phenomenon under study. One of the interviewee's requirements is that they should have a job in managing and planning the alignment between business and IT.

Second, we only examine big companies. Meanwhile, because medium and small companies are not dynamic, misalignment can be different. Consequently, prospective studies should focus on examining the causes of misalignment in less complex structures. Furthermore, all of the interviewees were from senior managerial positions within their companies. Getting the views of other parties, such as alignment experts and staff, may explain specific problems. Third, the study's interpretation, findings, and applicability should be interpreted in the research context. Therefore, it may pose doubts in terms of generalizability in the statistical sense. Nevertheless, the findings' generalizability is discussed theoretically by linking the findings to previous research. Also, more research is needed to understand further how to minimize the impact of misalignment factors in the workplace. It is also better to quantitatively analyse the importance or weight of each misalignment factors in the company.

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User Perception Analysis of Online Learning Platform "Zenius" During the Coronavirus Pandemic Using Text Mining Techniques

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Abstract

Access to online learning platforms is expected to support online learning activities during the Coronavirus (COVID-19) pandemic. In their online learning activities, students experience several issues related to Internet access, learning content, and learning evaluation. Online learning platforms are indispensable to provide good learning resources that are easily accessible to students. This study aims to explore data from user reviews of the Zenius platform on Google Play Store to determine the priorities for service improvement by the provider. Topic modeling and sentiment analysis are applied to extract useful information based on user sentiment regarding the topics discussed in application reviews. The results of the topic analysis show that topic trends in user reviews focus on live classes, tryouts, the subject matter, user accounts, tutorial videos, and free learning access. Meanwhile, the Net Reputation Score (NRS) is an assessment method to evaluate a product or service based on user opinions published on social media. The results of a NRS reveal that the service aspects that should be prioritized to improve the online learning platform are related to tryouts and user accounts. Conversely, access to free learning received the highest score. Users benefit from free access to all learning content during their learning from home activities.

Keywords: COVID-19, online learning platform, text mining, topic modeling, sentiment analysis

Introduction

The spread of the coronavirus disease (COVID-19) has impacted social and economic activities in Indonesia, including the education sector. In 115 days from the beginning of March 2020 to the end of June 2020, 50 thousand cases were recorded, and the next 50 thousand new cases were registered in just 32 days (Annur 2020). COVID-19 is an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, which can cause disorders of the respiratory system, acute pneumonia, and even death (WHO 2020). The Minister of Education and Culture responded immediately to the situation by issuing Surat Edaran Nomor 4 Tahun 2020. For the sake of continuing

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education amid the COVID-19 pandemic, one of the points emphasized by the policy was the implementation of learning from home. By August 3, 2020, around 100 thousand schools were closed, approximately 68 million students were performing learning from home activities, and about 4 million teachers were performing online teaching activities (Kemendikbud 2020a).

Preparation in limited time poses a challenge for educational units to provide an application platform for distance learning. As an alternative aiming to support distance learning activities, the Ministry of Education and Culture initiated a collaboration with online learning platform providers by giving free access to students across Indonesia (Kemendikbud 2020b). This collaboration resulted in a significant increase in the use of online learning platforms (Burhan 2020). Access to online learning platforms is expected to support students with self-learning and distance learning and minimize the gap in learning outcomes in a context of limited social interaction.

Nevertheless, unusual changes in the teaching and learning process have caused a culture shock in a society that is accustomed to face-to-face learning (Azzahra 2020). Students prefer face-to-face learning, especially for subjects that require hands-on learning (Mawarni et al. 2020). Other issues experienced by students are unstable Internet access, limited Internet quotas, and difficulties in understanding the subject matter (Mawarni et al. 2020). Student awareness of the possibility to evaluate learning strategies and learning outcomes is still low during online learning activities (Sa'dyah and Basuki 2020). These issues are also experienced by students in three Sub-Saharan African countries (Ghana, Kenya, and South Africa), where there is a very low level of satisfaction with Internet connection, the cost of Internet packages, and the reliability of online education (Pete and Soko 2020). Indian students' perception of conventional learning and online learning shows that the lack of Internet connectivity and limited access to online learning platforms hinder the transition of students to online learning environments in developing countries (Kamble et al. 2021). Besides, the use of technology has been shown to help in the design and delivery of the subject matter during the COVID-19 pandemic in Palestine, whose experience can serve as a roadmap for online learning to support post-pandemic education in developing countries (Shraim and Crompton 2020). Online learning strategies making use of technology can help reduce the transactional distance between teachers and students and offer opportunities to increase cognitive presence, social presence, and teaching presence (Holbeck and Hartman 2018). Online learning platforms are indispensable to provide good learning resources that are easily accessible to students. Therefore, online learning platform providers need to constantly innovate and optimize their services. The effectiveness of online learning platforms in providing alternative learning resources during this pandemic should be assessed by measuring user perceptions as an indicator of success and feedback for providers.

As the use of the Internet increases, user perceptions can be conveyed through various online media, and content published by users can become a source of information for fellow users (Hu and Chen 2016). Collecting user data is a way to obtain more information about different changes or behaviors among users. Moreover, data can be used to give insight into problems in current implementations. The insight gained by interpreting user data can help providers determine platform service improvements necessary to address the users' specific concerns. Application reviews on Google Play Store can be a source of textual data to see how users of an online learning platform respond to the services that have been provided. Review data contain implicit information about the opinions and experiences of users (Masrury et al. 2019). However, there are no rules for writing reviews on Google Play Store; the text can be written freely. This results in a variety of writing formats. Large amounts of review data and unstructured data require the use of a technique to be efficiently processed into useful information. The information contained in review data can be extracted using the text mining technique (Feldman and Sanger 2006). Topic modeling is one of the text mining approaches that can find groups of words that represent a topic in a given document (Blei et al. 2003). Topic modeling can be applied to cluster user reviews into several topics, revealing hidden themes related to the platform. Additionally, we conducted sentiment analysis to determine user satisfaction with a few platform themes based on the result of the topic modeling. Sentiment analysis quantifies the perception of users by classifying the sentiments expressed in reviews. It can identify emotions expressed textually in user reviews as positive or negative (Liu 2010). Results from both methods provide insights into user perceptions of the quality of the platform's services for the provision of learning resources.

Previous work on topic modeling and sentiment analysis has been carried out by Aziz et al. (2018) to reveal information regarding the level of user satisfaction with Surabaya government services based on tweet data. Other research extracted useful information from a collection of tweet data to examine public opinion on Uber (Alamsyah et al. 2019). However, previous works conducted topic modeling only to identify topics of conversation in each label or category. Topic modeling can be further applied to cluster textual data into more dynamic labels or categories. Moreover, previous studies have not used a product or service assessment method based on user sentiment on social media. Thus, this study aims to analyze useful extracted information based on user perceptions of online platform services for learning from home activities. This information is extracted using topic modeling and sentiment analysis through user reviews. The results of the study are expected to be useful for online learning platform providers, helping them determine the priorities for service improvement.

Literature Review

Text Mining

Text mining is the process of exploring the existing patterns in textual data sources to draw information and knowledge from large amounts of data (Feldman and Sanger 2006). The purpose of text mining is to assist in analyzing the connectedness of documents based on words that represent their contents to obtain useful information (Berry and Kogan 2010). The data that is used as input in the text mining process is unstructured, whereas data mining uses structured data or databases as the input (Han et al. 2012). Nonetheless, text mining applies data mining concepts and techniques because it requires giving the text a more structured form before carrying out further analysis.

Topic Modeling

Topic modeling is a form of unsupervised learning that allows for the efficient processing of a large amount of textual data. It aims to find out the structure of hidden topics in a collection of documents. In each document implied the topics, distribution of topics, and determination of topics per word (Blei et al. 2003). Latent Dirichlet allocation (LDA) is one of the most popular methods of topic modeling. The LDA model generates several keywords that are weighted on each topic. Thus, the LDA model can determine the dominant topic in each document by calculating the proportional value of the keywords contained in the text. Data can be clustered based on the similarity of the dominant topic.

Sentiment Analysis

Sentiment analysis consists in the computational study of opinions, appraisals, and emotions through entities, events, and attributes (Liu 2010). Sentiment analysis is carried out to classify the emotional tendency of an opinion into a positive or negative category. This study uses a lexicon-based approach with the SentiStrengthID algorithm. The algorithm generates positive and negative values to detect the strength of sentiments in an opinion (Wahid and Azhari 2016). If positive and negative values are equal, the sentiment is considered neutral. The table layout of a confusion matrix is used for the evaluation process. Confusion matrixes can help to measure the performance of the SentiStrengthID algorithm. F1-score is a performance measure that can be computed from the confusion matrix. It uses both a precision score and a recall score to understand the performance of the classifier from imbalanced data based on the formula shown in Equation 1 (Kulkarni et al. 2020):

$$\text{F1} - \text{score} = \frac{(2 * true\ positive)}{(2 * true\ positive) + false\ positive + false\ negative} \qquad \text{Equation (1)}$$

Net Reputation Score

User sentiment in textual data can be explored further to find information on user assessment. The Net Reputation Score (NRS) is an assessment method to evaluate a product or service based on user opinions on social media. This method generates a score for a product or service based on the

percentage of positive and negative comments posted by users, according to the Equation 2 (Meteor 2017):

$$\text{NRS} = \frac{(number\ of\ positive\ comments - number\ of\ negative\ comments)}{(number\ of\ positive\ comments + number\ of\ negative\ comments)} * 100\% \quad \text{Equation (2)}$$

The scores obtained range from 100% to -100%. This score can be used to determine the quality of a product or service and infer priorities for improvement.

Methodology

Prior research has discussed the use of topic modeling and sentiment analysis to extract useful information from textual data sources. However, these studies were conducted using different workflows. Aziz et al. (2018) conducted sentiment analysis and topic modeling on textual data obtained from Twitter to identify satisfaction with government service. Data was processed into information by grouping tweets into positive and negative classes. An LDA approach was used to identify topics that tend to have a strong influence on negative or positive opinions. Alamsyah et al. (2018), for their part, extracted useful information from tweets about a ride-hailing service provider. They mapped public opinions by analyzing text sentiments in a time-series format and developing a topic model to understand topics related to each sentiment and identify the topics being discussed. Alamsyah et al. (2019) also conducted content analysis to understand public opinion about an online-based sharing economy business model that disrupted innovation in the tourism industry. Content analysis was performed using tweet data. The results provide insights by identifying the words most frequently used in social conversations. Topic modeling with the LDA method is able to present the most popular topics to give a comprehensive understanding of how people react to the phenomenon.

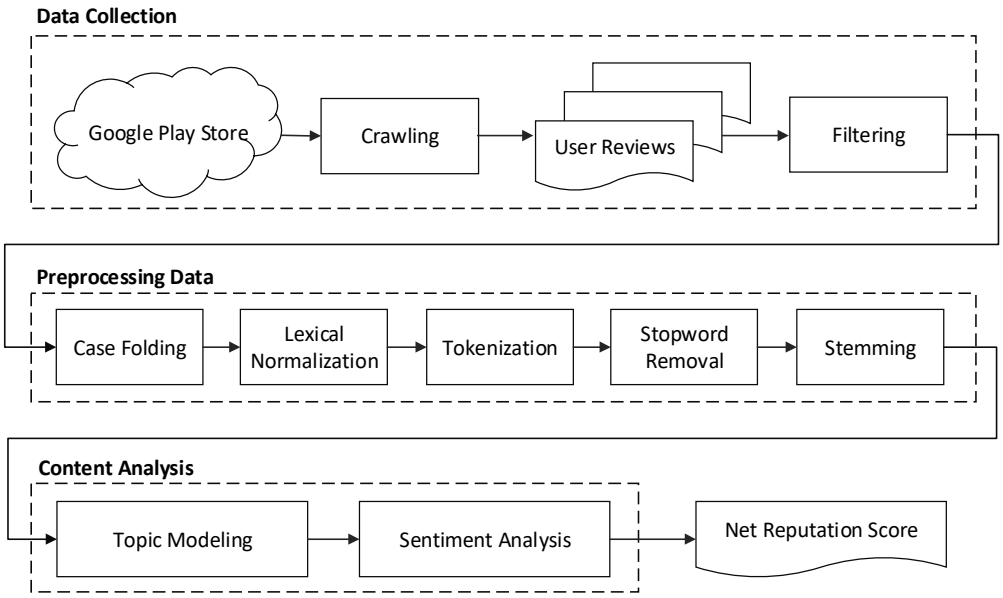

Figure 1. Proposed Research Model

The research of Masrury et al. (2019) classified review data on Google Play Store to collect information about the level of user satisfaction with an online travel agent. A trained model predicted the sentiment of reviews from Google Play Store, sorted into a positive or negative class. Additionally, a trained model was built by classifying reviews based on several aspects through manual annotations. Hariyani et al. (2019) conducted a lexicon-based sentiment analysis to find out students' assessments of the quality of educational services. They explained that the SentiStrengthID algorithm can be used to identify sentiment based on the polarity of a text. Text mining in this study is carried out using the model shown in Figure 1.

User review data were used as input in this text mining process. Text mining requires giving the text a more structured form before carrying out content analysis. We adopted LDA as a method for topic modeling. In addition, lexicon-based sentiment analysis was performed using the SentiStrengthID

algorithm of Wahid and Azhari (2016), and the data was analyzed thanks to Jupyter Notebook. The final result is expected to define satisfaction scores for service aspects of the online learning platform and shed light on the users' perceptions. This study consists of three stages: data collection, data preprocessing, and content analysis.

Data Collection

Data was collected using a crawling technique on Google Play Store. The data consist of reviews by users of the Zenius application, one of the most popular online learning platforms in Indonesia according to the DSResearch report (DailySocial.id 2020). All of the platform's service lines have also increased significantly since students have had to carry out learning from home activities (Burhan 2020). The services of this platform are intended for grade 1 to grade 12 (K-12) students, who have become the primary users. Review data are in Bahasa because the service provider operates only in Indonesia. This study focuses on reviews of the services by users, including relevant opinions and experiences. Review data were filtered to remove duplicate and irrelevant data.

Data Preprocessing

Some processes were applied to structure the still-unstructured review data. In this study, data preprocessing was carried out, which included case folding, lexical normalization, tokenization, stop-word removal, and stemming.

1. Case folding is a process of converting all letters in the review text to lowercase. Non-alphabetic characters (not expressing "a-z"), such as periods (.) and commas (,), were omitted because they are delimiters. We did not use any external libraries but worked with the Regular Expression and String modules available in Python. The output at this stage is more consistent review texts.
2. Lexical normalization aims to convert slang words into canonical words. We identified and normalized nonstandard ("Bahasa Alay") word variants by utilizing a word dictionary from Salsabila et al. (2018). Thus, this stage reduced the number of words that should have one meaning but are considered different.
3. Tokenization consists in splitting a sentence into word pieces called tokens. The sentences in the review text are separated into words using the "word tokenize" function of the NLTK library.
4. Stop-word removal aims to remove words that provide low information in a review text. Negation words in the review text affect the results of the sentiment analysis and are therefore excluded from the stop-word removal process for tokens used in sentiment analysis. The Indonesian stop-list for stop-word removal in this study was sourced from Tala (2003).
5. Stemming is performed to remove inflections and reduce words to their root form. This stage is used to limit the number of occurrences of different words that share the same root meaning. The stemming process in Bahasa uses the Sastrawi library. Inflected words in a sentence affect the results of the sentiment analysis. Therefore, the change of words into their root forms was not carried out for the features used in the sentiment analysis process.

Content Analysis

Content analysis was conducted to analyze user perceptions of online learning platform services. It can be used as an alternative to survey research to understand the context of the data, gain knowledge, obtain new insights, and represent data to guide action. Two text mining techniques were used at this stage, namely topic modeling and sentiment analysis.

1. Topic modeling was carried out to identify the dominant topic in each review text. Thus, review data can be clustered based on the similarity of their dominant topic. A specific number of topics was determined before the topic modeling process. We built some LDA models with 2 to 18 topics, using the Mallet version of the Gensim library. Some topic models are built to determine the best model. This study used topics generated by the LDA model as service aspects of the online learning platform.

2. The level of user satisfaction with these service aspects was determined by conducting sentiment analysis. The SentiStrengthID algorithm detects user sentiment in each review text via a polarity value. Based on the results of the sentiment analysis, user satisfaction was defined in three levels (positive, negative, and neutral). The level of user satisfaction with the service aspects of the platform was visualized in a histogram.

The final result was then obtained by calculating user satisfaction scores using the NRS method to determine priorities for service improvement. The insights extracted from user perceptions are very useful for the provider to develop effective platform services to increase user satisfaction.

Results

Dataset

Review data were gathered on October 28, 2020, from a total of 12,147 user reviews data posted between March 1, 2020, and October 27, 2020. Data were used as a dataset and collected in a CSV file. The attributes of the dataset are the content attribute and thumbs-up attribute. Data were filtered by removing duplicate reviews and cleaning empty text reviews based on the content attribute. In addition, review data were filtered based on the number of likes of the review posts, using the thumbs-up attribute. The number of likes defines how many users found the review helpful. Therefore, this study uses it as an indicator that these reviews constitute relevant data. Data from 1,225 reviews proceeded to the preprocessing stage, which was carried out to prepare the data for analysis using text mining techniques as shown in Table 1.

Table 1. Data Preparation Process

Process	Result
Raw Data	*Bagus,,, Skrg masih gratis,,, Walaupun ada bbrp yg berbayar,,, Tp utk membantu siswa belajar dr rumah sangat bagus,,,Semoga kelak semua videonya gratis.*
Case Folding	*bagus skrg masih gratis walaupun ada bbrp yg berbayar tp utk membantu siswa belajar dr rumah sangat bagus semoga kelak semua videonya gratis*
Lexical Normalization	*bagus sekarang masih gratis walaupun ada beberapa yang berbayar tapi untuk membantu siswa belajar dari rumah sangat bagus semoga kelak semua videonya gratis*
Tokenization	*[“bagus,” “sekarang,” “masih,” “gratis,” “walaupun,” “ada,” “beberapa,” “yang”, “berbayar,” “tapi,” “untuk,” “membantu,” “siswa,” “belajar,” “dari,” “rumah,” “sangat,” “bagus,” “semoga,” “kelak,” “semua,” “videonya,” “gratis”]*
Stop-word Removal	*[“bagus,” “gratis,” “berbayar,” “membantu,” “siswa,” “belajar,” “rumah,” “bagus,” “kelak,” “videonya,” “gratis”]*
Stemming	*[“bagus,” “gratis,” “bayar,” “bantu,” “siswa,” “ajar,” “rumah,” “bagus,” “kelak,” “video,” “gratis”]*

Topic Trends in User Reviews

This section analyzes topic trends in the review data. Topic trends explain user interest in a discussion about online learning platform services. The optimal number of topics is six and is determined by summarizing the visualization of the LDA model. This number was chosen because the bubbles

representing topics in the visualization of the LDA model are large enough, do not overlap, and are scattered across all quadrants as shown in Figure 2.

Figure 2. LDA Model Visualization

The number of topics specified should not be too large because this would impact the appearance of keywords that are repeated across several topics, making it difficult to conclude the topic. We used keywords to understand the essence of a topic. In addition, we read some of the most representative reviews to help identify the topic. Representative reviews have text that mentions the most specific keywords. The conclusions regarding the topics revealed by the LDA model are described in Table 2.

All topics discussed in user reviews were reflected in the keywords in Table 2. The first topic contains keywords such as *ajar* (teach), *bagus* (good), *download* (download), *kelas* (class), *banget* (really), *keren* (cool), *vidio* (video), *tutor* (tutor), *senang* (happy), and *saran* (advice). Adjectives identify abstract levels of customer satisfaction, *bagus* (good); *keren* (cool); and *senang* (happy), concerning possible subjects such as *kelas* (class), *vidio* (video), and *tutor* (tutor). The second topic concerns the users' opinion on the tryout service. Several user perceptions of the tryout service are conveyed abstractly, as represented by *baik* (good), *sesuai* (appropriate), and *salah* (incorrect). The third topic focuses on subject matters on the platform. User perceptions of the learning materials and concepts seem to be positive, which is reflected by *mudah* (convenient), *jelas* (clear), and *lengkap* (comprehensive). The fourth topic deals with user accounts. Some users have difficulty accessing the online learning platform, both when logging in and registering for a new account. The fifth topic touches on the level of user satisfaction with tutorial videos on the platform. Users are concerned about Internet connectivity and Internet quotas for accessing videos. The sixth topic contains user opinions about free access to learning content. The access provided helps students continue their education during the pandemic.

Table 2. Topics from the LDA Model

Topic No.	Topic Name	Keywords	Representative Review
1	Live Class	*0.096*"ajar" + 0.093*"bagus" + 0.054*"download" + 0.045*"kelas" + 0.027*"banget" + 0.024*"keren" + 0.023*"vidio" + 0.023*"tutor" + 0.022*"senang" + 0.020*"saran"*	*Setelah di-update tampilan aplikasinya jd mulus bangeet. Dan zenius bimbel satu2nya yng bikin gua ngefans berat sama tutor2nya! Asik2 bgt serius, dan mereka cara ngajarnya tuh ga 'digeneralisasi,' jadi tiap tutor tu khas. Ada bang sabda yang dabest, bang hilman yg bkn cinta sejarah, bang wisnu—& banyak lg deh! Plus ngajarnya slalu mentingin 'konsep' yg udh disusun pake kata2 sendiri, jd brasa diajarin* kaka tingkat (materinya jg jd umum, bsbuat smp-sma bahkan kuliah). Ga ky apk sblh yg baku bgt:(**Translation:** After updating, the platform looks really smooth. Then, Zenius is the only tutoring platform that makes me a big fan of the tutors! It's really fun, their way of teaching isn't "generalized," so each tutor is unique. There is Bang Sabda, who is the best tutor, Bang Hilman who makes me love a history lesson, Bang Wisnu, and many more! In addition, the way they teach always emphasizes "concepts" that have been compiled using their own terms, so it feels like I was taught by peer tutors. Unlike other platforms where the learning method is very standard.
2	Tryout	*0.057*"baik" + 0.053*"update" + 0.053*"sesuai" + 0.052*"bahas" + 0.048*"buka" + 0.041*"masuk" + 0.028*"bintang" + 0.028*"latih" + 0.025*"salah" + 0.021*"versi"*	*Tolong update terbaru ini di EVALUASI ulang, Pertama, Riwayat TO kok jadi hilang, ini menyebabkan belajar nya jadi merasa terputus, harus nya menu riwayat belajar tetap dipertahankan. Kedua, tampilan soal dan jawabam sangat banyak ditemukan masalah. Ketikan ulang nya acak acakan. Lebih bagus soal dalam bentuk scan gambar dari sumber lain, ini sangat banyak saya temukan di Soal soal kimia dimana struktur senyawa yang ditampilkan acak acakan. Opsi jawaban juga seringkali error' tak bisa tampil* **Translation**: Please re-evaluate this latest update. First, the tryout history is missing, this causes the study to have no explanation continuation of learning, the study history menu should be maintained. Second, there are many problems with the question-answer display. It's better if the practice questions are displayed with scanned images. I have found many problems in the practice questions of the chemistry lesson, where a chemical compound structure is shown irregularly. The answer options are also often not displayed.
3	Subject Matter	0*.133*"materi" + 0.121*"bantu" + 0.098*"ajar" + 0.086*"paham" + 0.084*"mudah" + 0.042*"jelas" + 0.032*"lengkap" + 0.031*"pokok" +*	*Kalian harus instal aplikasi ini, beneran membantu banget dan jadi mudah buat pahamin pelajaran, terutama bagi yg susah buat pahamin konsep matematika nah ini cocok banget dan aplilasi ini gak perlu bayar beneran gratis 🤭, pokonya kalo gak instal rugi deh, btw thank you ♡ ya zenius sudah membantu aku dalam memahami pelajaran, belajar jadi mudah deh 😉👍*

Topic No.	Topic Name	Keywords	Representative Review
		0.019"konsep" + 0.016*"biaya"*	**Translation:** You have to install this platform, it really helps and makes it easy to understand the lesson, especially for those who find it difficult to understand the mathematical concept. This app doesn't need to pay (it's really free 🤑). By the way, thank you Zenius for helping me understand the lesson, learning made easy 😉👍
4	User Account	*0.074*"suka" + 0.041*"erti" + 0.040*"coba" + 0.031*"orang" + 0.026*"akses" + 0.023*"login" + 0.018*"akun" + 0.018*"daftar" + 0.017*"pakai" + 0.017*"jurus"*	Jujur, aplikasinya bagus, tapi saya sudah daftar kok ke logout sendiri dan gak bisa login lagi, sudah 3 kali saya ganti akun supaya masih bisa make, nomor hp nggak bisa untuk 2 kali daftar. Nomor hp saya, ibu, dan ayah sudah saya pakai untuk daftar ulang. Saya mau Makai tapi sudah nggak bisa daftar. Tolong saya buat login. **Translation:** Honestly, the platform is good, but I have signed up and can't log in. I have changed my accounts 3 times so I can still use the platform, but the phone number can't be registered twice. I have used my phone number, my mother's phone number, and also my father's phone number to re-register. I want to use it but I can't register anymore.
5	Tutorial Video	*0.143*"video" + 0.056*"bagus" + 0.042*"bayar" + 0.034*"fitur" + 0.028*"tambah" + 0.023*"tulis" + 0.022*"kuota" + 0.019*"cepat" + 0.019*"langgan" + 0.018*"tonton"*	*Materinya mudah dipahami. Penjelasannya juga singkat, padat, jelas, dan mudah dipahami. Utk developernya, tambahin fitur download video karena ditempat saya ini jaringannya suka lelet. Jadi, kadang saya gak bisa nonton di apk Zenius. Ditempat saya ini kalau tengah malam, jaringannya bagus. Tapi kalau pagi s/d malam, jaringannya kadang lelet. Jadi, kalau bisa tambahin fitur download.. Biar saya bisa nonton videonya pas offline..* **Translation:** The tutorial video is easy to understand. The explanation is also concise and clear. For the developer, please add the download feature because the network is slow in my current location. Thus, sometimes I can't watch videos on the Zenius platform. The Internet is good in the middle of the night. However, the Internet is slow in the morning until the night. Please add a download feature so I can still watch the video when I'm offline.
6	Free Learning Access	*0.184*"ajar" + 0.122*"gratis" + 0.037*"anak" + 0.028*"guru" + 0.027*"online" + 0.025*"sukses" + 0.021*"sekolah" + 0.019*"manfaat" + 0.017*"rumah" + 0.017*"pandemi"*	*Sangat bagusssssss, terimakasih kepada pihak zenius telah mendidik generasi muda Indonesia tetap maju meski dalam pandemi. Tidak memungut biaya adalah jasa yang luar biasa, apresiasi yang sangat besar untuk zenius dan juga gurunya. Semoga guru guru semua diberikan kesehatan, kelancaran rizqi, dan kemudahan dalam menjalani hidup, aamiin. Semangaat terus zenius, terus jadilah yang terhebat sampai tangga sebelah kalah hahahaha* **Translation:** The platform is very good. Thanks to Zenius for educating the young generation in Indonesia to keep learning even in

Topic No.	Topic Name	Keywords	Representative Review
			a pandemic situation. Not charging a fee is a great service, a huge appreciation for Zenius and the teachers. I hope that all teachers will be given health, smooth sustenance, and ease in living life. In addition, I hope Zenius can become a great platform.

The weight of each keyword reflects the importance of the keyword for the topic. We used these weights to calculate the proportion value of the keywords that contribute to a review text. Review texts carry a proportion value for each topic, and the highest proportion value becomes a reference to find the dominant topic in a review text. Then, user reviews were clustered based on the similarity of their dominant topics. These topics were used as service aspects of the online learning platform. The distribution of user reviews on each topic is shown in Figure 3.

Figure 3. Distribution of Reviews on Each Topic

Figure 3 shows that each topic is featured in a large number of reviews, which means that they are interesting for users to discuss in-app reviews. The output of this section is used to determine the level of user satisfaction with the platform's services by conducting sentiment analysis.

User Sentiments Regarding Service Aspects

The frequency distribution was arranged in the form of a histogram to gain insight into user sentiments about each service aspect. User sentiments were identified using a lexicon-based algorithm, SentiStrengthID. An evaluation was carried out using a confusion matrix to assess the performance of the SentiStrengthID algorithm.

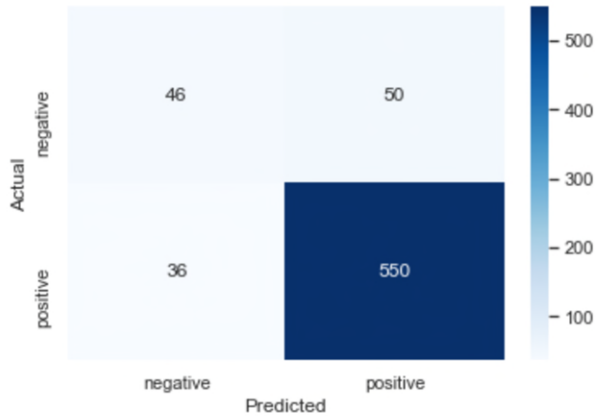

Figure 4. SentiStrengthID Evaluation Matrix

The rating value was used as a truth set, where a value of 1 indicates a negative review, and a value of 5 is interpreted as a positive review. There were 586 positive reviews and 96 negative reviews. An F1-score assessment served as a reference because the number of positive and negative reviews was non-symmetric. Based on Figure 4, the SentiStrengthID algorithm obtained an F1-Score of 92.75%. We conclude that the SentiStrengthID algorithm is reliable to classify the sentiment of user reviews.

A histogram was created to determine the patterns of user sentiments regarding each service aspect based on review data. Histograms can show user perceptions conveying positive, neutral, or negative opinions. This can give a broad overview of the level of user satisfaction with service aspects, described by the number of reviews expressing negative, neutral, and positive sentiments, as shown in Figure 5.

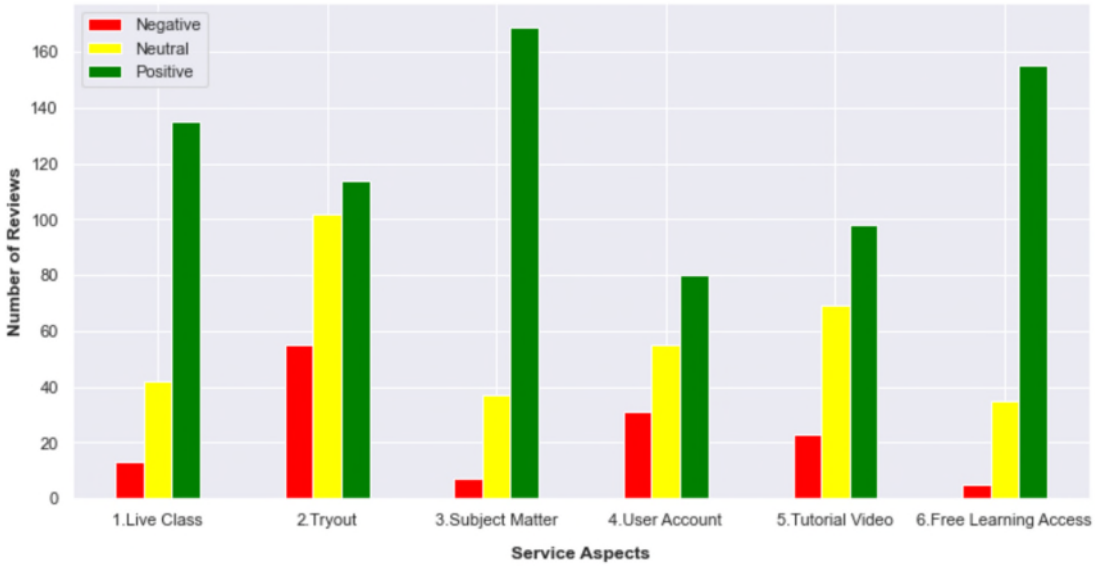

Figure 5. Histogram of User Sentiments

Figure 5 reveals that users were most satisfied with the subject matters and free learning access provided by the online learning platform, indicating that the service provider can meet its users' needs. Live class and tryout services also obtained a high number of positive reviews. However, the tryout service received negative user perceptions as indicated by the highest number of negative reviews. A high number of positive reviews does not necessarily indicate that the service aspect is perceived positively by users; a method is needed to calculate the user satisfaction score with certainty by using the number of positive reviews and the number of negative reviews. The output of this section was used to calculate the NRS in order to determine the user satisfaction score for each service aspect.

Assessment of Platform Services

A report on user perceptions of service quality on the online learning platform was generated. An assessment of online learning platform services was carried out using the NRS method, which calculates the difference in the percentage of reviews expressing positive and negative sentiments. NRS values are used to measure the user satisfaction score with the services provided by the online learning platform. The results of the NRS assessment are shown in Table 3.

Table 3. NRS Assessment Results

Topic No.	Service Aspect	Number of Reviews		NRS
		Positive	Negative	
2	Tryout	114	55	34.91%
4	User Account	80	31	44.14%
5	Tutorial Video	98	23	61.98%
1	Live Class	135	13	82.43%
3	Subject Matter	169	7	92.04%
6	Free Learning Access	155	5	93.75%

The user satisfaction scores for each service aspect are shown in Table 3. Service improvement can then be prioritized based on the lowest NRS scores. Two service aspects received an NRS below 50%, namely tryout and user account. Both service aspects are thus in critical need of immediate improvement by the service provider. Meanwhile, the highest NRS concerned free learning access (93.75%) and subject matter (92.04%), confirming that these aspects are satisfactory and relatively mature and showing that the focus of service improvement can be directed towards other aspects.

Discussion and Implications

This study aimed to explore review data on Google Play Store to extract information about user perceptions of online learning platform services. The satisfaction scores for each service aspect show that users are most satisfied with the free learning service provided by the platform. The user satisfaction score for this service is 93.75%. The reviews reveal that users are helped by free access to all learning content during learning from home activities. However, there are not many majors available for vocational high schools, and the existing subjects in Madrasah Aliyah are incomplete, preventing some users from using the platform. The subject matters on this platform are incomplete and some explanations are different from those taught by teachers in schools. Additionally, the arrangement of learning content is not sequential; as a result, users encounter difficulties when looking for subject matters. Nonetheless, subject matter as an aspect received a high user satisfaction score of 92.04%.

Meanwhile, the live class service allows the tutors to answer user questions in real-time. Users are satisfied with this service, as indicated by a user satisfaction score of 82.43%. Users complain that the explanations of the tutor are not to the point, that the tutor's language of interaction is too casual, that the tutor teaches too fast, and that the handwriting of the tutor on the blackboard is not visible on smartphones with small screens. Tutorial videos obtained a low satisfaction score of 61.98%. Many users complain that the video resolution is too high and recommend that the provider make learning content that can be accessed with minimum bandwidth and provide an app feature to adjust the video resolution.

Concerning the tryout service, users noted problems with the tryout history, which disappears after updating the application, as well as answer choices that are missing or do not follow the tryout questions, and answers to tryout questions that are considered empty even though they have been filled. This aspect obtained the lowest satisfaction score (34.91%), followed by user accounts (44.14%). Users have difficulty logging on to the platform even when using Facebook, Google, and Twitter accounts. Meanwhile, the registration process was reported to fail often despite multiple attempts. During the registration process, users received a message saying that their Internet connection was lost when the signal and Internet quotas were actually in good condition. This study

provides suggestions for improving platform performance that focus on the service quality of tryouts and user accounts.

Concerning practical implications, providers have a good chance to provide great online learning platform services by extracting useful information from large amounts of review data to be used as insights. Providers can periodically evaluate their online learning platform by exploring review data using text mining techniques. They can learn about user perceptions and specific issues by conducting content analysis based on the results of topic modeling and sentiment analysis and thus easily prioritize services that need to be improved. In particular, Zenius can optimize the service quality of tryouts by fixing technical issues that may affect the test scores obtained by the user and make the learning evaluation less precise. In addition, the platform provider can allow users to log in and register for a new account using a one-time password (OTP) sent to a phone number. It can also develop virtual assistance to facilitate access to its services for users.

This study also suggests that users have concerns about Internet connection and Internet quota availability when accessing tutorial videos. Excessively high and non-adjustable video quality hinders students in their online learning activities. This is similar to the results of a previous study, which concluded that the lack of Internet connectivity and access to online learning platforms hampers the transition of students to an online learning environment (Kamble et al. 2021). The conclusion regarding users' perceptions of borderless interactions with the tutors during live classes is in keeping with a previous study showing that online learning using technology can help reduce transaction distances between teachers and students (Holbeck and Hartman 2018). The user satisfaction score for the subject matter can indicate that online learning has a high potential to support post-pandemic education in developing countries, as stated by Shraim and Crompton (2020).

Conclusion

This study analyzed user perceptions of online learning platform services as a learning resource amid the COVID-19 pandemic, using text mining techniques. The dataset was gathered from Google Play Store reviews of one of the most popular online learning platforms in Indonesia. Review data reflect user perceptions that are conveyed objectively and voluntarily. This study conducted topic modeling and sentiment analysis to explore the dataset. Topic trends in user reviews concerned live classes, tryouts, subject matters, user accounts, tutorial videos, and free learning access. The service aspect that received the highest NRS is free learning access, with a user satisfaction score of 93.75%. After exploring user review data, it appears that users are helped by having free access to all learning content during learning from home activities. Conversely, the two service aspects that obtained the lowest NRS are tryouts and user accounts, with 34.91% and 44.14% user satisfaction, respectively. Users complained about missing tryout history preventing them from seeing discussions and learning from their mistakes when answering the questions. Additionally, users noted missing or inconsistent answer choices for the tryout questions and also reported that some answers to tryout questions are considered empty even though they have been filled. Meanwhile, complaints also concerned the difficult process of logging in and registering for accounts, which prevented users from accessing online learning platform services.

The results of the NRS assessment highlight priority aspects for improving platform services, namely tryouts and user accounts. The issues experienced by users are mostly technical in nature. Nevertheless, these issues may have an impact on the value of the lessons learned by the user and make the results of the evaluation of learning development less precise. Thus, this study brings useful insights to the provider based on feedback from the users. Suggestions for future study concern 1) the design and development of a system that can process review data periodically because data may change over time and 2) the validation of relevant user reviews thanks to a machine-learning model that may decrease data reduction in the filtering process.

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Access Control and File Distribution Management for Electronic Diploma and Transcript using Ethereum Smart Contract and InterPlanetary File System

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Abstract

This reserach build access control and file distribution management system for electronic diploma and transcript using ethereum smart contract and InterPlanetary File System (IPFS). The falsification of diplomas/transcripts is one of the problems in education. In Indonesia, falsification of diplomas/transcripts is a form of criminal act of falsifying letters. In addition, diplomas/transcripts that have not been digitalized make them easily damaged, lost, and difficult to manage. Therefore, this research developed digital diploma/transcript as digital twin from the hardcopy of diploma/tramscript. This research used IPFS to store data in a distributed system and Smart Contracts Blockchain to store and protect the digital diploma/transcript. The system also comes with access control to create and give approval for diplomas or transcripts to be published and saved into the system. Access control settings will be saved using the blockchain. This research using Quality of Service test method for measure throughput, packet loss, and delay. Beside that, tis research also analysis the usage of Central Processing Unit and Random Access Memory from the system. Based on the test that has been done, the fake diploma/transcript detection system can be run properly by using 1 node to 5 nodes. The best throughput value during the process of making and validating the diploma/transcript is to use 1 node. The value of packet loss in the process of making and validating the certificate/transcript has a very good category. The value of delay in the process of making and validating the diploma/transcript has a very good category.

Keywords: smart contract, IPFS, diploma, transcript, access control

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Introduction

Diploma is a license which given as a sign of completion of study. In addition to a diploma, after finishing studying students also receive a transcript containing the grades of learning for all of semester (Nord et al. 2011). Diplomas / transcripts that have been given to students have many problems. One of them is the falsification of diplomas/transcripts. Counterfeiting of diplomas/transcripts causes losses to educational institutions and businesses. Educational institutions have lost their legitimacy and reputation due to falsification of diplomas/transcripts. Companies that run businesses are harmed by accepting employees with fake diplomas (Ezell 2019).

There are a lot of counterfeiting of diplomas/transcripts in Indonesia. In 2018, There were 873 certificates produced by private universities in Tangerang. However, only 145 students graduated, so there were 728 fake diplomas issued (Tirto 2018). In addressing these problems, the Higher Education Service Institute or LL Dikti initiated the National Diploma Numbering or PIN policy in 2017. Another solution implemented by LL Dikti is the Online Certificate Verification System or SIVIL which is integrated with the online Higher Education Database or PD Dikti. SIVIL is an application that is used to verify the diploma number that has ever been issued and verify the validity and ratification of the national diploma number (Muliyani et al. 2021). Unfortunately, the system built still uses centralized storage so it is vulnerable to hack which can be changing, damaging, and losing the data (Gimenez-Aguilar et al. 2021). In addition, the use of diplomas and printed transcripts also has weaknesses such as damage and loss of documents (Finandhita and Afrianto 2018). The diploma and transcript should store and save in digital environment for anticipate damage and loss of documents (Al-Bahri et al. 2020).

Based on the problem above, there are some research questions that will address in this research. First, how to manage multi digital files from diploma and transcript from the university students. Second, how to manage access control from multi digital files from the diploma and transcript. Third, how to manage legalization rule for creating and issuing digital diploma and transcript in Indonesian university environment. After defining the research questions above, this research will discuss the analysis and implementation of a fake diploma and transcript detection system using IPFS and blockchain smart contracts. The research also uses access control to protect diploma/transcript digital from unauthorized and unauthenticated user.

The IPFS and blockchain is choose because many research used this technology for manage digital document (Chen et al. 2017). IPFS and blockchain technology also used to manage access control from distributed digitak files (Chen et al. 2017). IPFS is a distributed file system that uses Peer to Peer (P2P) system to replace HTTP (Hypertext Transfer Protocol) (Chen et al. 2017). IPFS enables a distributed file system to work by making all connected nodes share or use the same file system. IPFS will split the stored files into blocks and then distribute them to nodes that connected to IPFS (Sun et al. 2020). Moreover, this research also uses Blockchain and integrated Smart Contracts. Blockchain security is guaranteed by asymmetric cryptography and cannot be tampered with or faked (Christidis and Devetsikiotis 2016). Based on the advantages and decentralized infrastructure, Blockchain technology is used to issues related to trust, efficiency, privacy, and data sharing. A smart Contract is the embodiment of a contract or agreement in cyberspace (Wang et al. 2018). This contract is in the form of a code that can be created if all the conditions for making the contract have been fulfilled (Vacca et al. 2020). The advantage of this system is peer-to-peer transactions and databases can be managed safely and reliably (Masud and Kiringa 2011).

In the digital diploma and transcript system, access control is an important aspect that must be maintained. Recipients, makers, and those who legalize digital diplomas/transcripts must also be protected (Al-Bahri et al. 2020). Access control is used to keep files from being accessed and misused by unauthorized persons (Samarati and di Vimercati 2001). In this study an access control system will be created by utilizing blockchain. Access control systems in distributed systems provide its own challenges for its implementation (Wang et al. 2018). Blockchain is a suitable system to support the implementation of authentication and authorization in distributed systems (Qin et al. 2021).

In this research, the IPFS and blockchain technology will implement in digital diploma and transcript. The study case using rule and environment in Indonesian University. The management system also includes issuing and legalizing the digital diploma and transcript. This research will test the performance of Quality of Service (QoS) on the fake diploma/transcript detection system and analysis of the usage of the Central Processing Unit (CPU) and Random-Access Memory (RAM). QoS is a method for measuring the quality of the network that be used and for defining the characteristics of a service (Zeng et al. 2004). QoS analysis will produce the time needed in the process of sending data to the recipient (throughput), the length of time required in the delivery process (delay), and the number of packets lost in the transmission process (packet loss) (Wang and Crowcroft 1996).

Literature Review

Digital diplomas/transcripts have the advantage of being easier to manage and paperless. Digital diplomas/transcripts are still prone to be forged. This makes research in this area still open (Gresch et al. 2019). In research (Chaniago et al. 2021), explains that securing diplomas can take advantage of smart contracts that exist on the ethereum blockchain. Security is carried out by saving the hash of the diploma file and digital transcript into a smart contract. Based on research (Al'aziz et al. 2020), blockchain also helps the system to distribute data to make it more reliable and secure. Apart from storing the hashes into smart contracts, the files must also be stored in a distributed system. One technology that stores files in a distributed manner and can be connected to the blockchain is IPFS (Kumar et al. 2021). In research (Nizamuddin et al. 2019), IPFS and blockchain were created to store digital diploma files. The IPFS system is good for distributed file management.

To increase the security of the digital diploma/transcript system, an access control system will be used. Access control is the process by which a user is granted access and the right to view the system, or information available (Sandhu 1998). In research (Di Francesco Maesa et al. 2017), a blockchain-based access control system is able to maintain the authentication and authorization of a distributed system. Users must be authenticated and authorized when accessing a distributed system. This research uses Acl-PFS to handle access control list (Steichen et al. 2018). The diploma and digital transcript system that will be built must also be resistant to SQL Injection attacks. SQL injection attacks are very dangerous for web applications because they can damage data and make data stolen by unauthorized users (Fhadillah et al. 2020). Therefore, the system built in this study will implement rules of the Open Web Application Security Project (OWASP) in web application framework for prevent SQL injection attacks (Shar and Tan 2012). Based on research before, the research for combining blockchain and IPFS for digital file management, especially in digital diploma and transcript is still open. The access control system for managing, issuing, and legalizing the digital diploma and transcript using blockchain and IPFS is also still open to research and implement.

Therefore, this reserach build access control and file distribution management system for electronic diploma and transcript using ethereum smart contract and IPFS. The business process of this digital diploma/transcript system will use the existing standards in Indonesia namely Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 59 year 2018. There are three research contribution on this research. First, creating system for management digital diploma and transcript using blockchain and IPFS. Second, this research also maintains access control from digital diploma and transcript using blockchain and IPFS. Third, this system proposes a new feature that is approval for the issuance of new diplomas and transcripts using blockchain smart contracts based on existing standards in Indonesia.

Methods

This research starts with doing literature review from some existing system and research in field of digital diploma and transcript, blockchain and IPFS. That's done in introduction and literature review section. After that, this research describes the design from the prototype system in section file distribution management system and access control system. Lastly, the implementation and testing from the design is in result and discussion section.

File Distribution Management System

The system is designed using 5 nodes. The use of the number of nodes is intended to prove a distributed system and its relation to the QoS of the system. The node containing the web DApp will be installed IPFS and will create an IPFS cluster. This node will be installed by Geth to create Blockchain. The other nodes will be installed with IPFS and join the cluster that has been created. The system does not use Metamask so the storage process is done automatically. The system architecture can see on Figure 1.

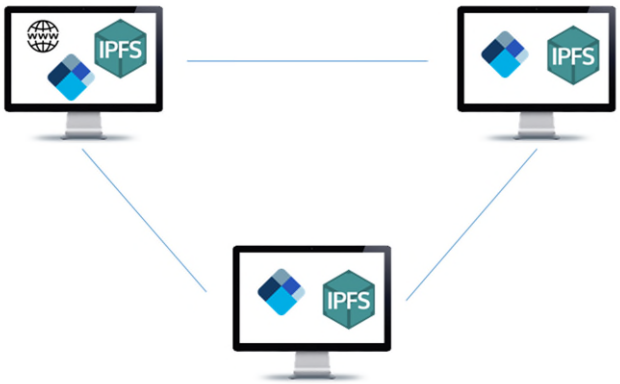

Figure 1. Architecture System

The flow of system can see on Figure 2. In the process of making a diploma/transcript, there are several steps: (1) the user fills the form on the web DApp and the web DApp will create a diploma/transcript file based on the data entered. (2) the diploma/transcript that has been made will be sent to the IPFS cluster and will be converted the file into blocks to be distributed to nodes in the cluster. (3) the hash of the file will be sent back to the web DApp. Furthermore (4) the web DApp will send the hash to the Blockchain cluster then the hash will be distributed to the nodes in the cluster. Finally (5) the web DApp will send the certificate / transcript file to the user for download.

In the diploma/transcript validation process, there are several steps: (1) the user uploads the diploma/transcript file to the web DApp then (2) the web DApp will send the file to the IPFS cluster to be converted into a hash. (3) the hash will be sent back to the web DApp. (4) the web DApp will send a hash to be validated by the Blockchain cluster. Then (5) the results of the validation will be sent back to the web DApp and (5) the results will be displayed to the user.

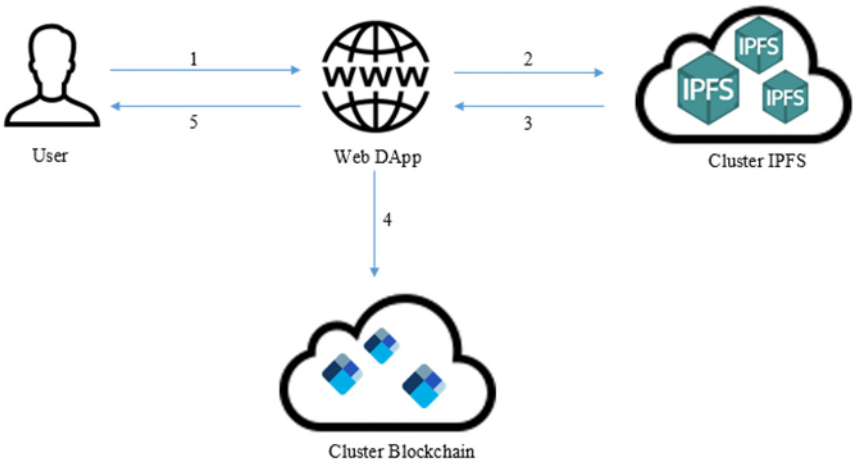

Figure 2. Flow System

Access Control System

The system has five roles, including creator, head of study program, dean, vice rector, and rector. Setting permissions will use the Blockchain as its database. The actor list can see on Table 1.

Table 1. User Role List

No.	Role	Description
1	Creator	Make diplomas and transcripts
2	Head of study program	Give approval for a diploma or transcript
3	Dean	Give approval for diploma or transcript after the head of the study program
4	Vice Rector	Give approval for diploma or transcript after dean
5	Rector	Give approval for diploma or transcript after vice rector

The process of access control for all user can see on Figure 3. Applications for digital diplomas and transcripts are called DApps. The system will always be connected to the blockchain to verify the authentication and authorization of all actors/users who will access the system.

Figure 3. Access Control System

After the user login through the application, it will be verified via the blockchain. Credentials and user access will be checked in the blockchain. After that the response will be sent by the blockchain through to the application. If the credentials are wrong then the user cannot access, but if it is true the user will be able to access.

Results & Discussions

This research implemented using web-based application. The programming language that used for building the system is NodeJS. The blockchain in this system used Ethereum blockchain model. The programming language for create smart contract model in Ethereum blockchain using solidity programming language. The specification for server that used for virtualization is Server Dell R440 Xeon Bronze 3204 8GB 1.2TB-SAS Poweredge. The code from backend system of this research is in this link: https://github.com/danilmuis/ta_BE_blockchain. The code from frontend system of this research is in this link: https://github.com/danilmuis/FE_TA_DAPP_IPFS_BLOCKHAIN_IJAZAH.git.

Application for detecting fake diploma/transcript

The application developed by the researcher is an application for making and checking fake diplomas/transcripts using IPFS and Smart Contract Blockchain. The dashboard of the application can be seen in Figure 4.

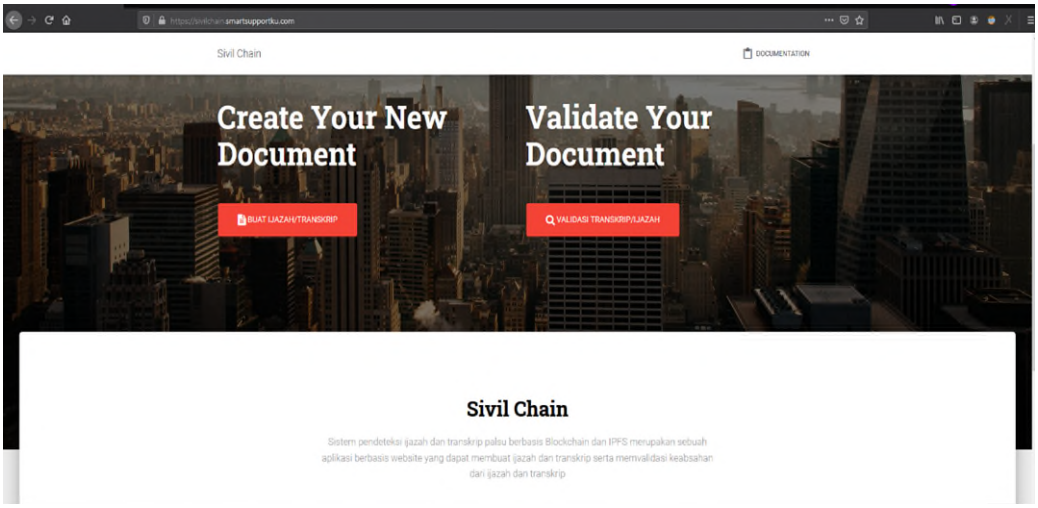

Figure 4. Dashboard of the application

The application consists of some features which make a diploma/transcript and validation a diploma/transcript. In making a diploma/transcript, the user is required to fill in the data on the form as shown in Figure 5.

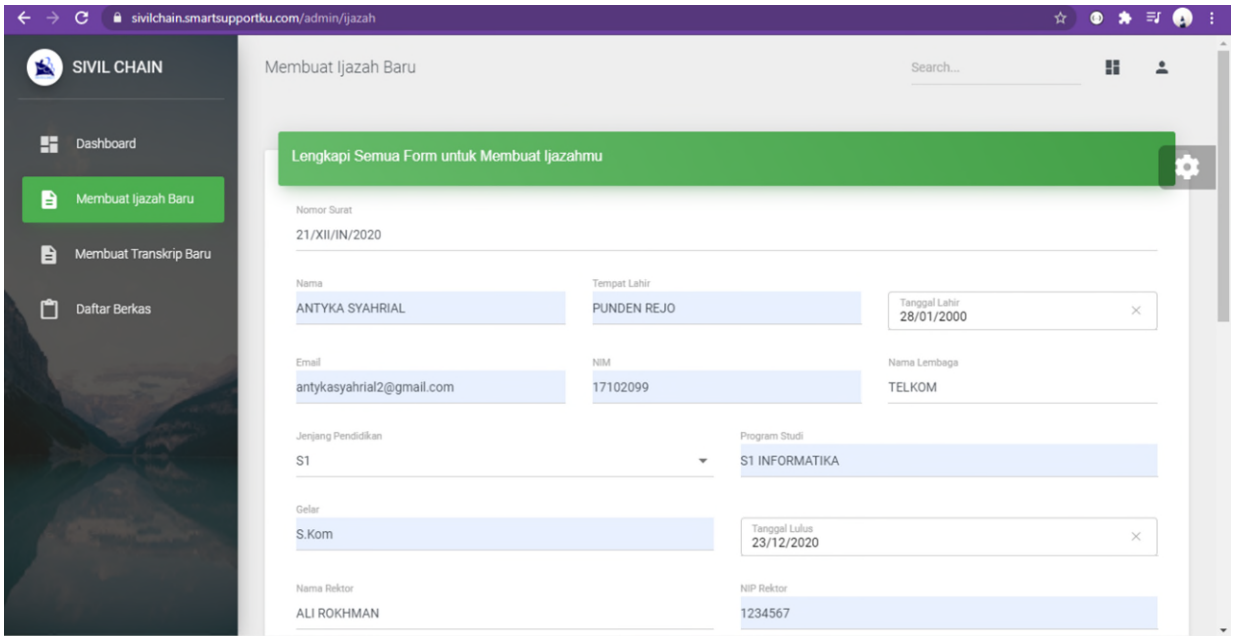

Figure 5. Form for making diploma/transcript

The diploma/transcript that has been created will be stored in IPFS and the hash will be stored on the Blockchain. Users can download the diploma/transcript file through the “File List” menu as shown in Figure 6.

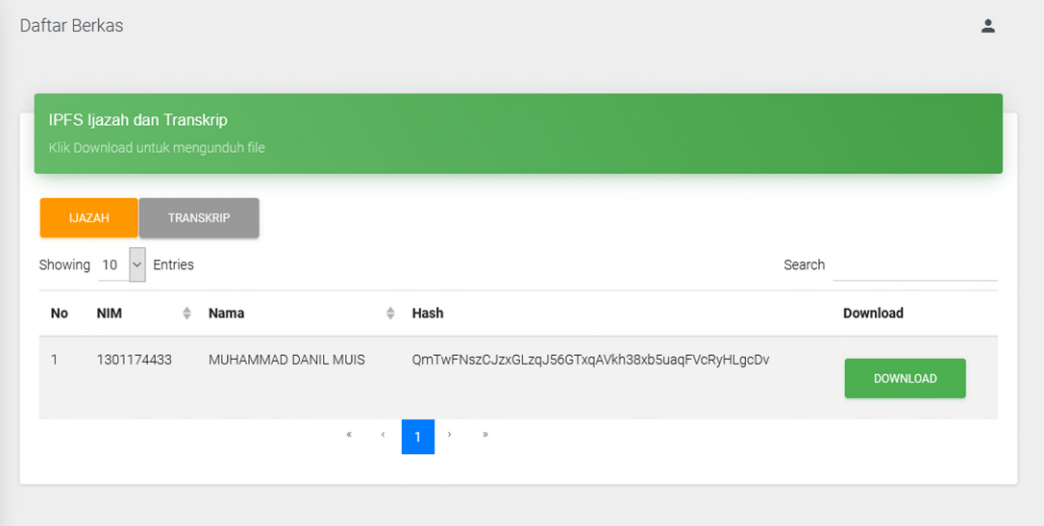

Figure 6. File list menu

The next menu is validating diplomas/transcripts. In this menu, the user can enter the diploma/transcript to check for authenticity. The menu for checking fake diplomas/transcripts can be seen in Figure 7. If the diploma/transcript file is declared genuine, the system will display the hash of the diploma/transcript file as shown in Figure 8.

Figure 7. Validation diploma/transcript menu

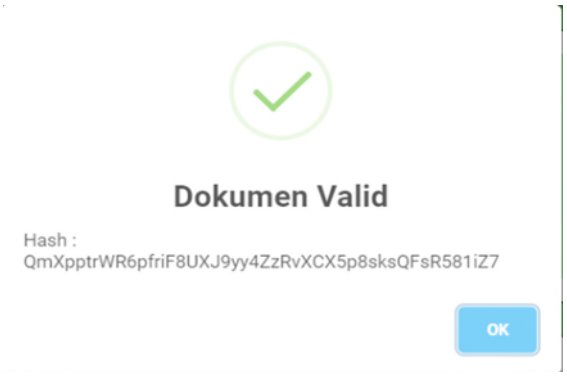

Figure 8. Notification of original diploma/transcript

Access control on the system

The application was developed by researchers using Smart Contract Blockchain as a database to store data along with the role of each account. The creator page can be seen in Figure 5, this role has access to create diplomas and transcripts stored on IPFS and the hashes will be stored on the Blockchain.

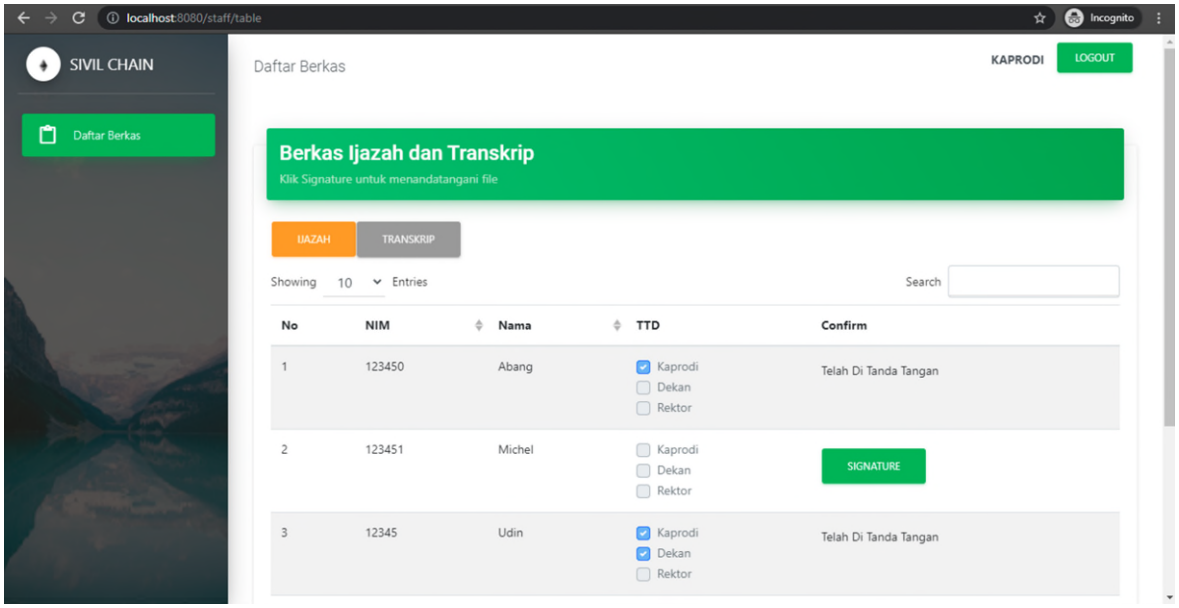

Figure 9. Pages of Study Program Chairmen, Deans, Vice Rectors, and Rectors

The other four roles have pages as shown in Figure 9. The page contains a list of diplomas and transcripts that need to be approved by each role. Approval is given sequentially from the head of the study program, the dean, the vice rector, and finally by the rector.

QoS Analysis with Parameter Throughput

Throughput is the actual bandwidth which obtained when carrying out the data transmission process. Based on the test, the throughput obtained during the process of making diplomas/transcripts is shown in Figure 10.

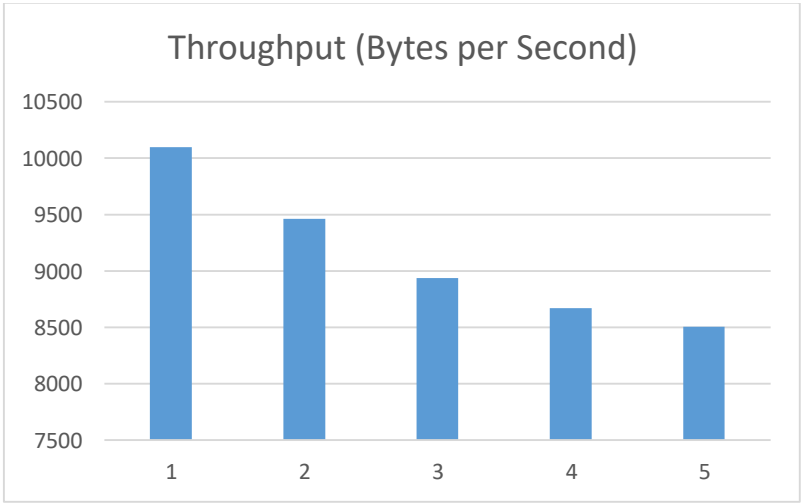

Figure 10. Throughput of making diploma/transcript

Based on Figure 10, the throughput on a system that uses 1 node is 10,098.5 Bps. Throughput on a system that uses 2 nodes is 9,462.3 Bps. Throughput on a system that uses 3 nodes 8,937.1. Throughput on a system that uses 4 nodes is 8670.6 Bps and Throughput on a system that uses 5 nodes is 8,507 Bps. QoS testing is also carried out using throughput parameters in the diploma/transcript validation process. The results of QoS at the time of diploma validation can be seen in Figure 11.

Based on Figure 11, the QoS in the diploma/transcript validation test using 1 node is 1,063,100 Bps. The throughput of QoS testing using 2 nodes is 882,700 Bps. The throughput of QoS testing using 3 nodes is 878,500 Bps. Throughput using 4 nodes is 871,100 Bps and throughput using 5 nodes is 989,700 Bps.

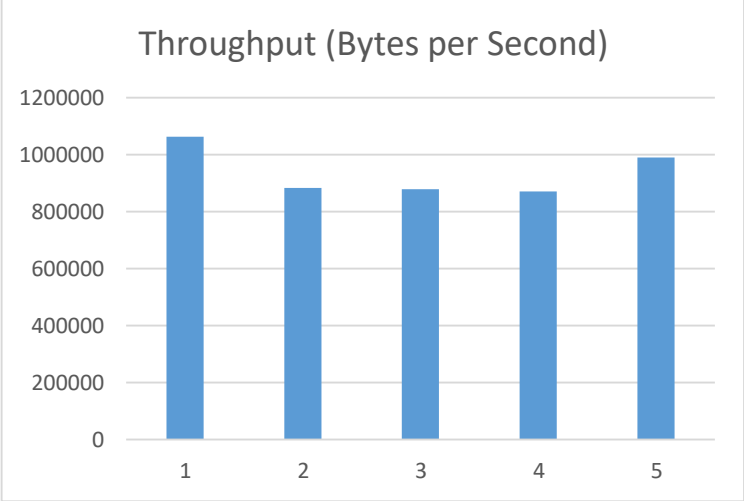

Figure 11. Throughput of validating diploma/transcript

QoS Analysis with Parameter Delay

Delay is the time takes to send data from the transmitter to the receiver. According to Telecommunications and Internet Protocol Harmonization Over Network (TIPHON), delay can be categorized as in Table 2.

Table 2. Category Delay

Categories	Delay
Very Good	<150 ms
Good	150 ms - 299 ms
Medium	300 ms - 450 ms
Bad	> 450 ms

Based on the tests that have been done, there is a delay in the process of making the diploma/transcript in Figure 12.

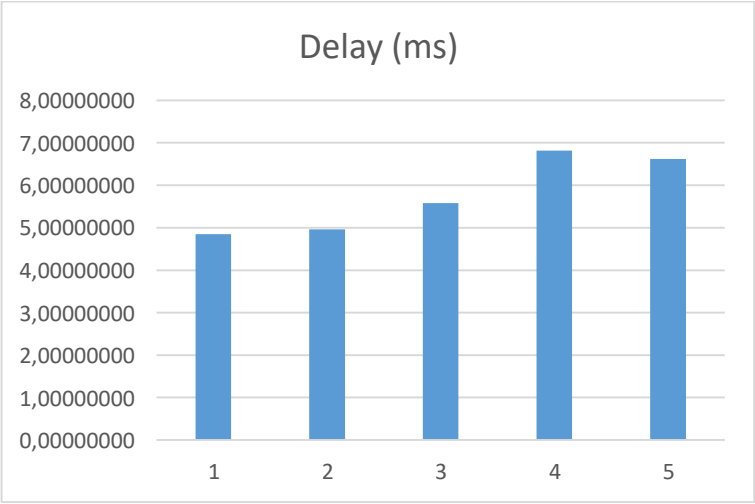

Figure 12. Delay of making diploma/transcript

Based on Figure 12, the delay in testing 1 node is 4.84 ms. Delay on testing 2 nodes 4.96 ms. Delay on testing 3 nodes 5.57 ms. The delay on the 4-node test is 6.81 ms and the delay on the 5 node test is 6.61 ms. The delay value for each number of nodes is classified as very good. The delay in the diploma/transcript validation process can be seen in Figure 13.

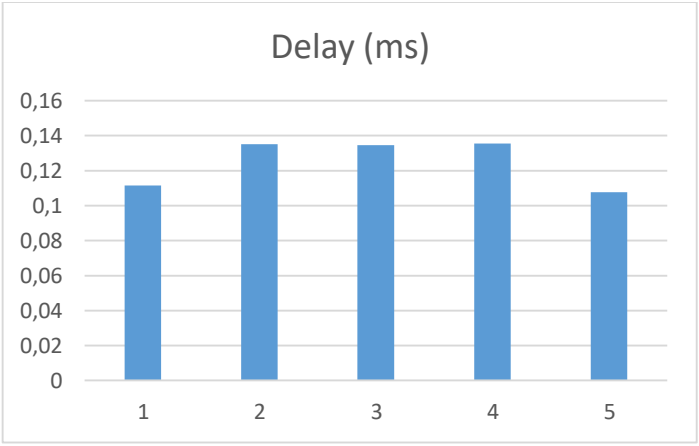

Figure 13. Packet loss of validating diploma/transcript

Based on Figure 13, the delay in testing 1 node is 0.111 ms. Delay on testing 2 nodes 0.135 ms. Delay on testing 3 nodes 0.134 ms. The delay in the 4 node test is 0.135 ms and the delay in the 5 node test is 0.107 ms. The delay value for each number of nodes is in the very good category.

CPU Usage Analysis

CPU usage analysis aims to determine the allocation of CPU to carry out the process of making diplomas/transcripts and validation processes of diplomas/transcripts. The results of the analysis of CPU usage in the process of making diplomas/transcripts can be seen in Figure 14.

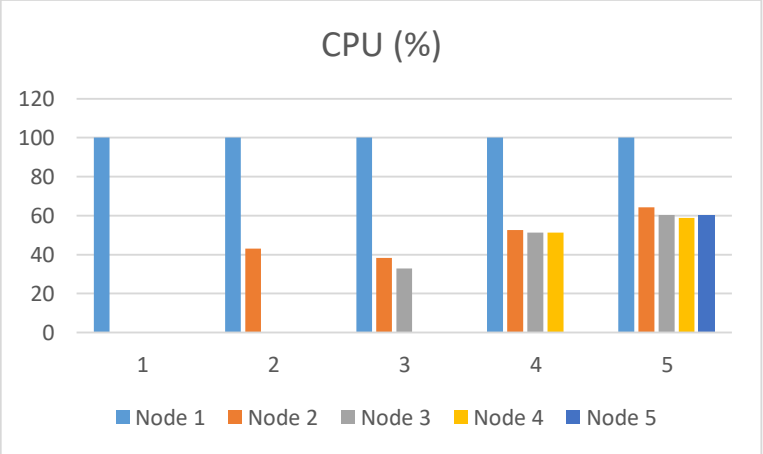

Figure 14. CPU usage of making diploma/transcript

Figure 14 shows a graph of CPU usage of making diplomas/transcripts in percent (%).On testing with 1 node, CPU usage reached 100%. The test uses 2 nodes, the CPU on the first node reaches 100% and the CPU on the second node reaches 43.07%. The test uses 3 nodes, CPU usage on the first node reaches 100%, the second node reaches 38.21% and the third node reaches 32.92%. In testing with 4 nodes, CPU usage at the first node reached 100%, the second node reached 52.54%, the third node reached 51.2% and the fourth node reached 51.2%. The test uses 5 nodes, CPU usage at the first node reaches 100%, the second node is 64.15%, the third node is 60.26%, the fourth node is 58.84% and the fifth node is 60.41%.

Figure 15 shows a graph of the CPU usage of the diploma/transcript validation process in percent (%). In testing with 1 node, CPU usage reaches 100%. The test uses 2 nodes, the CPU on the first node reaches 100% and the CPU on the second node reaches 19.76%. The test uses 3 nodes, CPU usage on the first node reaches 100%, the second node reaches 14.37% and the third node reaches 12.39%. In testing with 4 nodes, CPU usage at the first node reached 100%, the second node reached 12.98%, the third node reached 11.93% and the fourth node reached 11.61%. Testing using 5 nodes, CPU usage on

the first node reaches 100%, the second node is 15.42%, the third node is 16.06%, the fourth node is 13.86% and the fifth node is 13.28%.

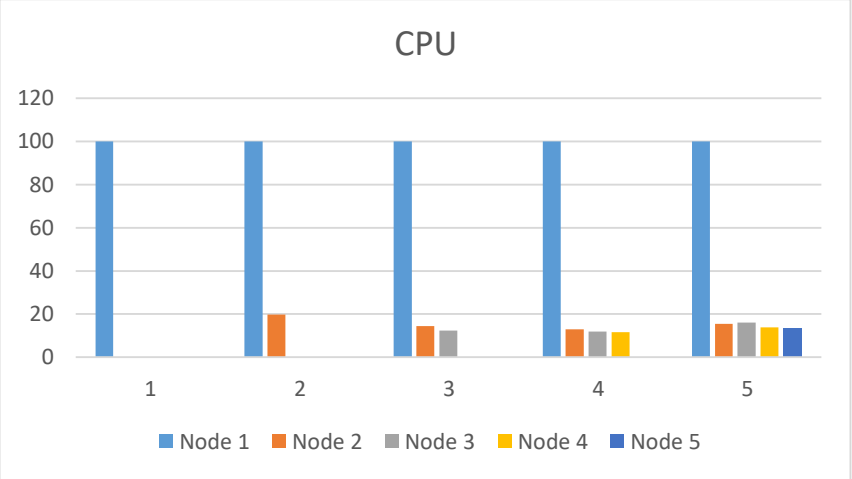

Figure 15. CPU usage of validating diploma/transcript

Memory Usage Analysis

The analysis of memory usage aims to determine the allocation of memory to carry out the process of making diplomas/transcripts and validation processes of diplomas/transcripts. The results of the analysis of memory used in the process of making diplomas/transcripts can be seen in Figure 16.

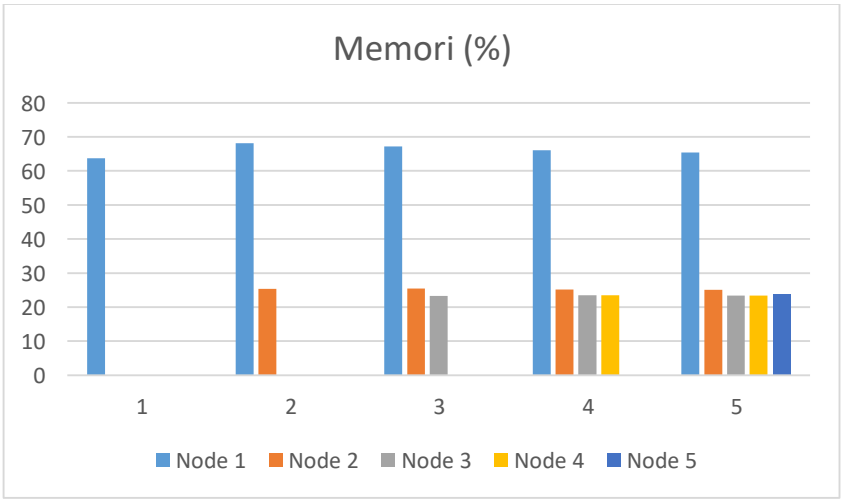

Figure 16. The memory usage of making the diploma/transcript

Figure 16 shows a graph of the memory usage of making the diploma/transcript in percent (%). In testing with 1 node, memory usage reached 63.7%. The test uses 2 nodes, the memory in the first node reaches 68.09% and the memory at the second node reaches 25.32%. The test uses 3 nodes, memory usage at the first node reaches 67.16%, the second node reaches 25.41% and the third node reaches 23.3%. In testing with 4 nodes, memory usage at the first node reached 66.07%, the second node reached 25.2%, the third node reached 23.44% and the fourth node reached 23.44%. Testing using 5 nodes, memory usage at the first node reached 65.4%, the second node 25.07%, the third node 23.42, the fourth node 23.4%, and the fifth node 23.67%. Memory usage analysis is also carried out during the diploma/transcript validation process as shown in Figure 17.

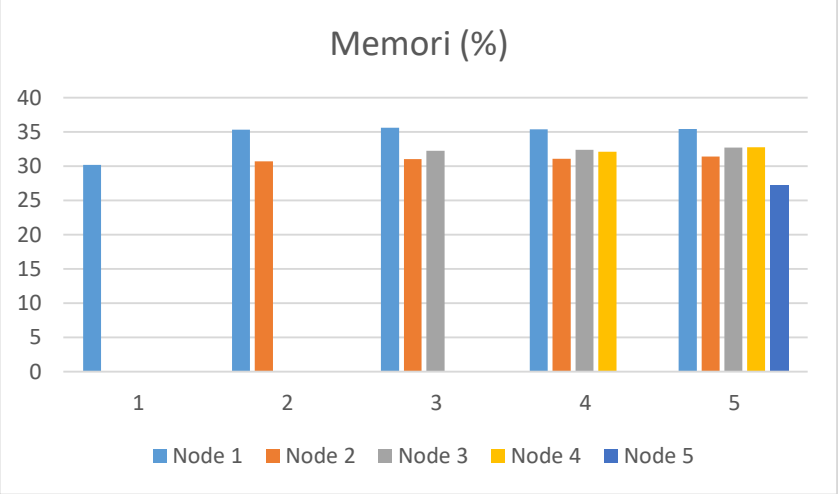

Figure 17. The memory usage of validating the diploma/transcript

Figure 17 shows a graph of the memory usage of the diploma/transcript validation process in percent (%). In testing with 1 node, memory usage reached 30.2%. The test uses 2 nodes, the memory at the first node reaches 35.34% and the memory at the second node reaches 30.7%. The test uses 3 nodes, memory usage at the first node reaches 35.61%, the second node reaches 31.02% and the third node reaches 32.26%. In testing with 4 nodes, memory usage for the first node reached 35.39%, the second node reached 31.08%, the third node reached 32.4% and the fourth node reached 32.13%. Testing using 5 nodes, memory usage at the first node reached 35.42%, the second node 31.41%, the third node 32.72%, the fourth node 32.75%, and the fifth node 27.27%.

Conclusion

Access controls are used to restrict some activities that can only be performed by certain positions such as creating or approving diplomas and transcripts. The diploma and transcript detection system are a system that use to create diplomas/transcripts and test the authenticity using Blockchain smart contracts and IPFS. IPFS is used to store diploma/transcript files in a distributed system. Using this distributed method can prevent SQL injection attacks from occurring on centralized storage. In this study, QoS analysis was also carried out of making diplomas/transcripts and the validation process for diplomas/transcripts. The QoS parameters used in this test are throughput, packet loss, and delay. Based on the experiments that have been done, the best throughput during the process of making diplomas/transcripts uses 1 node, which is 10,098.5 Bps. The best throughput of diploma/transcript validation uses 1 node, which is 1,063,100 Bps. Packet loss in the process of making diplomas/transcripts and validation of diplomas/transcripts is in the very good category. The delay in the process of making diplomas/transcripts and validation of diplomas/transcripts has a very good category. Based on the analysis of memory and CPU usage, this system can run either using 1 node up to 5 nodes. The limitation of this study is conducted using virtual devices and the number of nodes is still limited. Therefore, for further research development, physical devices can be used, and the number of nodes can be increased so the CPU and memory usage can be analyzed more accurately.

Acknowledgements (optional)

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Virtual Tour Actual Usage: The Influence of Perceived Benefits and Sacrifices

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Abstract

Virtual tours are developed as alternatives to traditional tourism in Indonesia. This quantitative study analyzed factors that influence actual virtual tour usage. We modified the value-based adoption model to measure consumers' desire to adopt virtual tour services. A survey was conducted with 1,125 respondents who were aware of virtual tour services. The data were processed using covariance-based structural equation modeling. The results indicate that perceived benefits and sacrifices influenced behavioral intention to use these services. However, accessibility did not affect this intention. Behavioral intention to use significantly affected actual virtual tour usage. This research can help virtual tour providers and regulators increase service utilization and implementation.

Keywords: tourism, virtual tour, virtual reality, actual usage, Indonesia

Introduction

The tourism industry is crucial to the economic growth of a country like Indonesia, and it can provide benefits such as increased employment, foreign exchange, income, and tax revenues (Skanavis and Maria 2011). Because the tourism sector can support world economic growth, many countries have started to create policies and innovations to further develop their tourism industries (Skanavis and Maria 2011). Furthermore, Sabri (2020) demonstrated that while both pleasure and happiness are sources of health, happiness can be obtained through travel activities.

More technologies are being created to provide convenience and solutions for individuals and businesspeople in the tourism sector, and virtual tour services are one breakthrough success. Virtual tours present a series of videos or still images that may be supported by multimedia elements such as sound effects, music, narration, and text. Several countries have used virtual tour applications for more than a decade to attract tourists. More specifically, they have maintained websites that contain 360° panoramic photos or videos of tourist destinations (Vishwakarma et al. 2020). As a promotional medium, virtual tours

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are said to provide richer experiences and information than traditional brochures, catalogs, and websites (Vishwakarma et al. 2020).

In Indonesia, the development of virtual tour services is booming, especially during the COVID-19 pandemic (Kemenparekraf 2021). A state policy prevents people from traveling both domestically and internationally, with the aim of reducing transmissions of the COVID-19 virus. Notably, the pandemic has strongly impacted the tourism sector in Indonesia. Data from the Data Center and Infomation System revealed an 88.08% decrease in the number of foreign tourist arrivals (Kemenparekraf 2021). There were 1,377,067 visits in December 2019, and this drastically decreased to 164,088 visits in December 2020 (Kemenparekraf 2021).

Traveloka, the leading online travel company in Indonesia, collaborated with the Ministry of Tourism and Creative Economy/Tourism and the Creative Economy Agency (Kemenparekraf) to launch the Online Xperience service, which is a virtual tour innovation (Antara 2020). Moreover, Kemenparekraf also collaborates with other travel platforms to introduce free virtual tours to Indonesians (Antara 2020). While virtual tours provide solutions to Indonesians who want to travel during the pandemic, they also allow businesspeople to keep their tourism businesses active (Mutiah 2020). However, virtual tours in Indonesia are still developing and being actively presented to Indonesians by those in the tourism sector (Mutiah 2020).

Until now, there was a lack of concrete data regarding virtual tour service usage in Indonesia. Vishwakarma et al. (2020) investigated the adoption of virtual reality (VR) devices for tourism by measuring the benefits and sacrifices incurred by Indian tourists when exploring tourist destinations virtually. In addition, Disztinger et al. (2017) analyzed user acceptance of VR devices to plan tourism. The use of VR devices has also increased in many countries in the gaming, health, and human resources sectors. However, the use of VR devices in Indonesia is limited due to factors such as their cost, which is still quite high. Because of the limited use of VR devices for virtual tours in Indonesia, this study differs from previous studies that focused on virtual tours supported by VR devices (e.g., Disztinger et al. 2017; Vishwakarma et al. 2020). Instead, this study covers virtual tour services on websites containing 360° panoramic photos, and it prioritizes the 360° virtual tour and live video virtual tour services available on online travel applications in Indonesia, such as those hosted by Traveloka and Airbnb.

Moreover, Disztinger et al. (2017) tested the use of VR devices on respondents with just one virtual tour application, Google Street View. However, this application is part of Google Maps and thus focuses more on navigational objectives than virtual tours. In contrast, this study analyzes multiple applications developed for virtual tour purposes. Finally, this study enriches the results of Caber et al. (2020), as the researchers did not account for the different perceptions and behaviors of first-time and repeat tourists. This study measures these differences in the context of tourists as users of virtual tour services.

This study applies the value-based adoption model (VAM) to measure consumers' desire to adopt virtual tour services based on their determined values (i.e., perceived values), which account for the benefits and sacrifices that they perceive. Lau et al. (2019) stated that the VAM can effectively measure technology adoption because it considers the perceived value of an individual. The VAM also pays more attention to perceived benefits and sacrifices than other technology adoption models, including the technology acceptance model, which only assesses what users obtain (Lau et al. 2019). This study contributes to the literature by analyzing the factors that influence a user's intention to adopt virtual tour services in Indonesia. Notably, this study can be used as a reference for service providers to evaluate their development of virtual tour services.

Literature Review

Virtual Tour

According to Ankomah and Larson (2018), virtual tours are information communication and technology-based tools that enable users to immerse themselves in and interact with virtual content from tourist destinations. These environments may be created with visual graphics, sound, and other multimedia elements (Ankomah and Larson 2018). Likewise, Umafagur et al. (2016) defined virtual tours as

simulations of tourist attractions that are usually based on video or still images, with support from multimedia elements like sound effects, music, narration, and text.

A 360° virtual tour is presented with photos or videos that users can rotate 360° (Wulur et al. 2015). Various software programs can be used as a medium for VR photography techniques, immersive photography, or 360° photos to display borderless and seamless images of tourist destinations that users can rotate 360° (Wulur et al. 2015). Vishwakarma et al. (2020) defined VR as a simulated environment that is created in such a way that users feel as if they are really present in it (Vishwakarma et al. 2020).

A live video virtual tour utilizes streaming technology, which allows for video, audio, and other multimedia elements to be enjoyed in real time on different types of networks (Diwi et al. 2015). Streaming technology reduces file sizes by dividing the data into small packets to be sent over the Internet to end-user devices (e.g., mobile phones and laptops). Live video virtual tours generally take advantage of video conferencing applications to connect virtual tourists with tour guides.

Value-based Adoption Model

The VAM was first introduced by Kim et al. (2007), and it can effectively measure individual behavior related to technology adoption in the fields of online shopping, tourism, and hospitality (Vishwakarma 2020). The VAM measures perceived value from the perspective of a consumer by considering the benefits and sacrifices that they feel when using a technology (Vishwakarma 2020). Benefits refer to the "get" factor, which describes the specific benefits that consumers get from using a technology (Kim et al. 2007). In contrast, sacrifices are related to the "give" factor, which covers the sacrifices made by consumers to use a certain technology (Kim et al. 2007). Based on their perspectives on what they may gain and spend by using certain technologies, consumers make an overall assessment of a technology to determine their adoption intention (Kim et al. 2007).

Research Hypothesis

Perceived enjoyment is an intrinsic motivation factor, and the enjoyment that users feel comes from a sense of joy and joy from interaction with the system (Vishwakarma et al. 2020). Kim et al. (2007) proved that perceived enjoyment benefits consumers in the context of mobile Internet adoption. Furthermore, Hsu and Lin (2016) demonstrated that perceived enjoyment significantly affects technology acceptance. In the tourism field, it is assumed that virtually exploring a tourist destination will give users pleasure because these services provide them with unique and new experiences (Vishwakarma et al. 2020). Several breakthroughs in virtual tours have been made in Indonesia, especially during this pandemic. These tours aimed to provide pleasure for COVID-19 patients and healthy communities alike.

Evidently, perceived enjoyment is a factor that supports virtual tour acceptance, as it is important for a fun-oriented system to provide pleasure to its users (Van der Heijden 2004). The acceptance of the technology itself is referred to as behavioral intention to use, and this intention reflects the tendency of individuals to continue using a given technology (Davis 1989). Therefore, we propose the following hypothesis:

H1: Perceived enjoyment (PENJ) has a significant influence on behavioral intention to use (BIU).

Accessibility refers to how affordable and easy a technology is to obtain (Disztinger et al. 2017). When discussing accessibility on the web, Ballantyne et al. (2018) outlined four accessibility criteria, namely that the content should be perceivable, operable, understandable, and robust. Kulkarni (2018) emphasized that website accessibility is crucial for individuals to access information and participate in the fields of education, economics, and politics, which benefits all groups of people. In addition, accessibility is an important characteristic of online products that seek to provide broad access for all users, regardless of their physical, intellectual, or cognitive deficiencies (Leite 2021).

In the context of tourism, virtual tours in Indonesia have been intensively developed to support sustainable tourism by applying the principles of attraction, amenity, ancillary, and accessibility. Cheong (1995)

reported that access to virtual tour services has a positive effect on travel-planning tourists, given that they receive richer information and real experiences by virtually visiting the tourist attractions that they intend to visit later on. In addition, Karahanna and Limayem (2000) classified accessibility into two types: physical accessibility and information accessibility. Significantly, user acceptance of a technology can be negatively affected by limited access to information and the physical use of this technology. Thus, we propose the following hypothesis:

H2: Accessibility (ACC) has a significant influence on BIU.

Epistemic value refers to the benefits felt by users when they use a product (Sheth et al. 1991). Further, epistemic value is part of the theory of consumption, and it explains the influences that determine consumer decisions to choose and buy a product (Sheth et al. 2019). Phau et al. (2014) stated that visitors receive epistemic value if they have new or different experiences during their visit. Focusing on virtual tour services, Vishwakarma et al. (2020) asserted that virtual tour service providers should target tourists who are fond of looking for new things (i.e., novelty) and interested in exploring new tourist attractions. Tourists with these characteristics are assumed to have an adventurous spirit and will tolerate the risks they face when using virtual tour services (Vishwakarma et al. 2020). With these characteristics, tourists can easily obtain epistemic value from their experiences with virtual tour services (Caber et al. 2020). Virtual tours are a new challenge for Indonesian tourism because of their hybrid concept, which combines virtual ideas and technology to attract tourists. Overall, virtual tour services can provide new experiences to tourists. Therefore, we present the following hypothesis:

H3: Epistemic value (EV) has a significant influence on BIU.

Technicality is an aspect of technology concerned with good performance while providing services (Kim et al. 2007). Moreover, it represents perceived ease of use, which refers to the extent to which an individual believes that the use of a system or technology does not require a lot of physical and mental effort (Kim et al. 2007). When conducting an ease-of-use assessment, users tend to ignore the external environment and instead focus on its interactions with the system (Kim et al. 2007). Kim et al. (2007) investigated how the ease-of-use component affects the adoption of mobile Internet technology. In doing so, they acknowledged that mobile Internet could only be run on limited devices in many cases, such as for owners of mobile phones with small screens that required high physical and mental effort to be interacted with. In the context of tourism, Schiopu et al. (2021) investigated VR reception of virtual tours during the current pandemic. Because they proved that perceived ease of use can strongly support the acceptance of VR technology, they recommended that VR tour service providers should improve VR performance in terms of its ease of use. Similarly, several virtual tour applications in Indonesia have made it easy for tourists to participate in virtual tourism activities. One technique utilizes video conferencing applications, such as Zoom, as a medium of interaction (Abu 2020).

Given that users assess the physical and mental effort spent using a given technology as an incurred cost, they view technicality as a non-monetary sacrifice (Kim et al. 2007). In addition, Kim et al. (2007) also emphasized that high technical complexity can have a significant negative relationship with technology acceptance. Consequently, we propose the following hypothesis:

H4: Technicality (TECH) has a significant influence on BIU.

As part of the theory of consumption, functional value considers the aspects that determine consumer decisions to choose and buy a product (Sheth et al. 1991). Functional value is assumed to be the main factor influencing a consumer's choice to buy a product, and it is based on economic utility theory, which explains individual preferences when making a choice (Sheth et al. 1991). This assumption is made because functional value involves aspects of product functionality, such as price and product quality, and is thus classified as a cost or monetary sacrifice that consumers must pay (Sheth et al. 1991).

In the context of tourism, functional value highlights the importance of the quality of the attractions and activities that tourists can interact with at affordable prices (Caber et al. 2020). The introduction of virtual tours in Indonesia has been actively carried out with the support of the Ministry of Tourism and Kemenparekraf, and its sponsored virtual tour program presents various tourist destinations free of charge. Significantly, Vishwakarma et al. (2020) included price as one sacrifice that users consider when accepting virtual tour services that use VR devices.

This aspect is illustrated in the perceived cost variable, which presumably has a negative impact on technology adoption (Vishwakarma et al. 2020). The higher the costs that consumers incur to use a technology, the lower their willingness to adopt it (Vishwakarma et al. 2020). While Vishwakarma et al. (2020) did not analyze the quality of the virtual tour service in their research model, they suggested that future research in this field should consider quality. Thus, we formed the following hypothesis:

H5: Functional value (FV) has a significant influence on BIU.

Interest is a psychological condition in which an individual tends to re-engage with something from time to time (Hidi and Renninger 2006). In addition, interest has a relationship with curiosity and engagement. An individual's interest in and engagement with something can arise if they are curious about it (Arnone et al. 2011). Interest can also retrigger curiosity, and if this interest is maintained, it will create a maintained situational interest (Arnone et al. 2011). Consequently, an individual's interest in a technology arises because of their initial curiosity about it, and it has also been proven that interest has a positive relationship with behavioral intention to use (Disztinger et al. 2017). Moreover, several previous studies have demonstrated that an individual's interest in following technological developments significantly influences their behavioral intention to adopt a technology (Schiopu et al. 2021). For example, Sanchez-Cabrero et al. (2019) reported that an individual's interest in technology can support their desire to use VR technology as a learning tool for educational purposes.

In the context of tourism, many Indonesians are becoming interested in using virtual tour services specifically during the pandemic. Roughly 900 virtual tourists explored domestic tourist destinations from July to September 2020 (Kemenparekraf 2021). Disztinger et al. (2017) claimed that an individual's interest positively influences their desire to adopt VR tour technology for the benefit of travel planning. Beck et al. (2019) also proved that an individual's interest in VR technology can specifically influence their behavioral intentions to adopt virtual tour activities that are supported by VR devices. Likewise, Beck et al. (2019) emphasized that it is important for tourism managers and marketers to investigate whether their target market is interested in VR technology. Therefore, we created the following hypothesis:

H6: Interest (INT) has a significant effect on BIU.

Actual usage is defined as the actual behavior or conditions of using a system, and it is significantly influenced by behavioral intention to use (Davis 1989). Amelia and Ronald (2017) proposed that behavioral intention to use can determine the actual usage of a technology. Furthermore, Paluri and Mehra (2015) found the same relationship between behavioral intention to use and actual usage in the acceptance of a technology. In the context of technology acceptance, most tourism research still does not focus on technology actual usage. Following these references, we present the following hypothesis:

H7: BIU has a significant influence on virtual tour actual usage (AU).

Methodology

Data Collection and Analysis

This quantitative study used online questionnaires to collect its data. After we designed the questionnaire, we carried out a readability test to test its feasibility and determine how well a prospective respondent would understand its questions. We conducted the readability test by distributing questionnaires to seven respondents with different demographic backgrounds. Most feedback noted that our vocabulary was not standardized, which made the questionnaire uncomfortable to read. In response, we revised the questionnaire and then distributed a link to it on various social media platforms, including Instagram, LINE, Twitter, and WhatsApp.

The data were collected online to reach more respondents, especially those with a broad demographic background. Regarding our respondent sampling technique, we used purposive sampling, which determines the sample by categorizing the respondents in accordance with the context of the study. We targeted Indonesian respondents who were aware or had knowledge of virtual tour services, especially those who had used these services.

Model

We designed our research model by modifying the VAM and considering the insights of Vishwakarma et al. (2020), Disztinger et al. (2017), and Caber et al. (2020). We selected the variables that were most appropriate for our context and hypotheses. As shown in Figure 1, our research model had eight variables, consisting of seven exogenous variables and one endogenous variable.

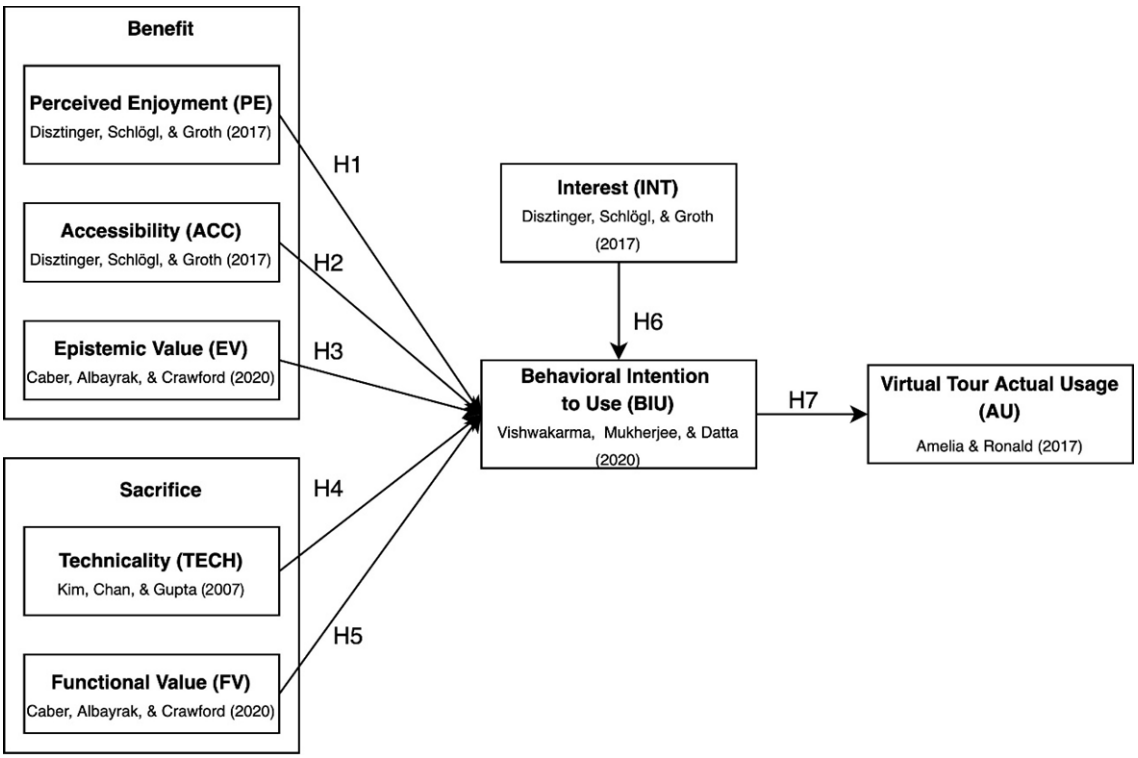

Figure 1. The Proposed Model

Analysis

We used covariance-based structural equation modeling to process and analyze the data, and our tools were SPSS, Amos 24, and Microsoft Excel. Our data analysis had six main steps: specifying the research model, identifying the research model, estimating the research model, testing the feasibility of the research model, modifying the research model, and hypothesis testing.

Instruments

Our questionnaire was divided into four parts. The first part contained validation questions to determine whether each respondent had used a virtual tour service before. If not, then the respondent could access examples of virtual tour services. The second part contained questions related to the demographics of the respondents, and it collected information such as their email address or cellphone number, gender, age, domicile, latest or current education level, current job, and monthly income. The third section contained questions related to the research instruments and characteristics of using virtual tour services. To address the research instrument, this section used 33 questions with a five-point Likert scale, ranging from strongly disagreed (1) to strongly agreed (5) (see Appendix A). The final section included questions related to the respondents' demographics and experiences while using virtual tour services.

Result

Respondent Demographics

The survey was distributed from February 19 to March 19, 2021. We obtained a total of 1,922 responses. Of the total respondents, only 1,125 respondents completely filled out the survey. Hence, other 797 respondents did not provide complete data; thus, we eliminate those data. Table 1 displays the demographics of the respondents.

Table 1. The Respondents' Demographics

Demographics		Percentage (%)	Number of Respondents
Have used a virtual tour	Yes	64.09	721
	No	35.91	404
Gender	Male	55.82	628
	Female	44.18	497
Age	16–25 years old	90.93	1,023
	26–35 years old	6.93	78
	36–45 years old	0.53	6
	> 45 years old	1.60	18
Domicile	Greater Jakarta	57.87	651
	Outside Greater Jakarta in Java Island	27.11	305
	Sumatera Island	5.33	60
	Bali/NTT/NTB Island	2.49	28
	Kalimantan Island	2.84	32
	Sulawesi Island	1.96	22
	Maluku/Papua Island	0.09	1
	Other	2.31	26
Type of virtual tour used	360° virtual tour	64.62	727
	Online experiences on travelling apps	38.22	430
	Virtual tour mobile apps	11.47	129
	VR tour	16.62	187
	Others	4.18	47

Measurement Model Assessment

We assessed the measurement model based on its convergent validity, discriminant validity, and internal consistency reliability (Hair et al. 2014). We carried out a convergent validity test by examining the loading factor value of each indicator. Each loading factor value needed to be ≥ 0.708 (Hair et al. 2014). After the modification process, all indicators had loading factors > 0.7.

We conducted a reliability test by examining the Cronbach's alpha (CA) of each factor. Each CA required a value ≥ 0.7 and next, we examined the construct reliability (CR) value, with a recommended CR value ≥ 0.7 (Hair et al. 2014). For the last step of the reliability test, we examined the average variance extracted (AVE). AVE is the average convergent indicator of the extracted variance for all items in construction (Hair et al. 2014). Our variables met the criteria: all CA values were > 0.7, CR values were > 0.7, and AVE values were > 0.5 (Table 2).

Table 1. Cronbach's Alpha (CA), Construct Reliability (CR), and Average Variance Extracted (AVE) Values

Variable	CA	CR	AVE
PE	0.893	0.898620373	0.6909915
ACC	0.849	0.849139198	0.58492325
EV	0.83	0.950115044	0.865131333
TECH	0.828	0.805636274	0.580485333
FV	0.894	0.89568604	0.6328888
BIU	0.924	0.920520393	0.763507
INT	0.839	0.901448414	0.753083667
AU	0.799	0.933996394	0.828149667

We used a discriminant validity test to ensure that each construct was considered to be unique compared to the other constructs in the model (Hair et al. 2014). To complete the discriminant validity test, we compared the cross-loading values of each indicator. Each indicator needed to have a higher loading value for the measured variable than for the other variables. As shown in Table 3, the model passed the discriminant validity test and could therefore undergo the structural model test.

Table 3. Discriminant Validity Test Results

	INT	FV	TECH	EV	ACC	PE	BIU	AU
INT	1							
FV	0.437	1						
TECH	0.512	0.773	1					
EV	0.367	0.57	0.593	1				
ACC	0.359	0.656	0.735	0.469	1			
PE	0.383	0.629	0.6	0.522	0.48	1		
BIU	0.394	0.649	0.546	0.519	0.47	0.666	1	
AU	0.152	0.25	0.21	0.2	0.181	0.256	0.385	1
AU4	0.113	0.187	0.157	0.149	0.135	0.191	0.342	0.768
AU3	0.151	0.248	0.209	0.199	0.18	0.255	0.383	0.996
AU1	0.152	0.25	0.318	0.2	0.181	0.256	0.373	0.997
INT3	0.861	0.376	0.44	0.316	0.309	0.33	0.339	0.131
INT2	0.888	0.388	0.455	0.326	0.319	0.341	0.35	0.135

	INT	FV	TECH	EV	ACC	PE	BIU	AU
INT1	0.854	0.373	0.437	0.314	0.306	0.327	0.337	0.13
BIU1	0.362	0.596	0.501	0.477	0.432	0.611	0.918	0.353
BIU2	0.371	0.611	0.514	0.489	0.443	0.627	0.941	0.362
BIU3	0.347	0.57	0.479	0.456	0.413	0.585	0.879	0.338
BIU4	0.367	0.604	0.508	0.484	0.438	0.62	0.722	0.278
FV1	0.326	0.747	0.577	0.426	0.49	0.544	0.514	0.198
FV2	0.316	0.722	0.558	0.412	0.474	0.454	0.469	0.18
FV3	0.356	0.816	0.63	0.465	0.535	0.513	0.529	0.204
FV4	0.336	0.77	0.595	0.439	0.505	0.484	0.499	0.192
FV5	0.342	0.783	0.605	0.446	0.513	0.492	0.508	0.195
TECH1	0.391	0.59	0.764	0.453	0.561	0.458	0.417	0.16
TECH2	0.394	0.596	0.771	0.457	0.566	0.463	0.421	0.162
TECH3	0.377	0.569	0.736	0.437	0.541	0.442	0.402	0.154
EV2	0.365	0.567	0.59	0.994	0.466	0.519	0.516	0.198
EV3	0.297	0.462	0.48	0.81	0.38	0.423	0.42	0.162
EV4	0.365	0.567	0.59	0.994	0.467	0.519	0.516	0.199
ACC4	0.288	0.527	0.591	0.377	0.804	0.386	0.378	0.145
ACC3	0.285	0.52	0.583	0.372	0.793	0.381	0.373	0.143
ACC2	0.265	0.484	0.543	0.347	0.739	0.294	0.323	0.124
ACC1	0.234	0.427	0.479	0.306	0.651	0.313	0.306	0.118
PE4	0.288	0.566	0.451	0.393	0.361	0.752	0.533	0.205
PE3	0.353	0.578	0.552	0.481	0.442	0.92	0.613	0.236
PE2	0.347	0.569	0.544	0.473	0.435	0.906	0.603	0.232
PE1	0.388	0.636	0.608	0.529	0.486	0.704	0.553	0.213

Structural Model Test

After we properly measured the latent variables with a measurement model test, we needed to investigate the relationship between the latent variables with a structural model test (Schumacker and Lomax 2010). The structural model test evaluated several values against the goodness-of-fit (GoF) criterion, which determined how suitable the model was for the obtained data (Schumacker and Lomax 2010). We compared CMIN/df, RMSEA, NFI, CFI, GFI, TLI, and RMR with the GoF criterion. Table 4 contains the final GoF value, which we determined after modifying the model.

Table 4. Final GoF Results

Index	*Cut-off Value*	Result	Value
CMIN/df	< 2.0	1.999	*good fit*
RMSEA	<= 0.08	0.031	*good fit*

Index	*Cut-off Value*	Result	Value
NFI	>= 0.9	0.97	*good fit*
CFI	>= 0.9	0.985	*good fit*
GFI	>= 0.9	0.959	*good fit*
TLI	>= 0.9	0.981	*good fit*
RMR	<= 0.05	0.046	*good fit*

Hypothesis Testing

We carried out hypothesis testing using a two-way test (two-tailed) with a significance level of 5%. Table 5 displays the results. We accepted a hypothesis if it had a p value < 0.05 (Hair et al. 2014). From our total of seven hypotheses, we rejected only one hypothesis (H2).

Table 2. Hypotheses Testing

Hypothesis				*Estimate*	P	Result
H1	BIU	<---	PE	0.39	0.002	Accepted
H2	BIU	<---	ACC	0.02	0.653	Rejected
H3	BIU	<---	EV	0.123	0.002	Accepted
H4	BIU	<---	TECH	-0.142	0.026	Accepted
H5	BIU	<---	FV	0.403	0.003	Accepted
H6	BIU	<---	INT	0.066	0.025	Accepted
H7	AU	<---	BIU	0.345	0.002	Accepted

Discussion

We find that the respondents had a higher desire to use virtual tour services if they felt joy or excitement while visiting virtual tourist attractions (H1). Our results reinforce those of Disztinger et al. (2017). They noted that when perceived enjoyment is treated as a hedonic system, it can have its strongest supportive effect on virtual tour acceptance. This hedonic system must be developed to provide self-fulfilling value to its users, and it is also important for the hedonic system to be oriented toward providing pleasure as well. Moreover, our results also support those of Vishwakarma et al. (2020) which were conducted in India. They reported that the virtual exploration of a tourist destination gives users pleasure because doing so provided them with uniqueness and new experiences. Further, Vishwakarma et al. also showed that perceived enjoyment is an important value that can influence individuals' desire to use virtual tour services.

Notably, we observed that accessibility did not significantly affect behavioral intention to use (H2). This is in accordance with Disztinger et al. (2017), as they also found that accessibility did not affect the behavioral intention to use virtual tour services for travel-planning purposes. To better understand this rejected hypothesis, we interviewed five respondents. All respondents said that in their own environments, many people did not know about the existence of virtual tour services. They thought that this was due to a lack of promotion or socialization from virtual tour developers that targeted Indonesians. In addition, some respondents theorized that people may have lacked information on how to access virtual tours because they were not interested in these services. For example, Respondent 3 stated, *"There are not many services available, and I don't know where to access them. Maybe because I am not interested myself."* Likewise, Respondent 5 claimed, "*Not interested in virtual tours, so there is no intention to find out.*" Moreover, the

respondents explained that because live video virtual tour services were sold on traveling applications, their high prices also reduced accessibility. Respondent 3 asserted, *"If I have to pay, I don't think I am willing."*

However, the interview results suggest that if individuals can access compatible devices and the Internet, then virtual tour services have the benefit of being accessible anytime and anywhere. In the words of Respondent 2, *"This virtual tour service is not limited by space and time, [as] no there are opening or closing hours."* Regardless, there were other important barriers to their use. Information related to the existence of virtual tour services may have struggled to reach various age groups. Respondent 4 stated, "*Millennials and below may not be too affected because they are technology literate enough to adapt easily. However, the older generation is not necessarily [the same]."* These services were not necessarily accessible to Indonesians in remote areas with poor Internet access and few compatible devices. Respondent 5 reported, "*Many people in remote areas also do not have good enough devices and adequate Internet to access this virtual tour."*

Based on our analysis, we conclude that a lack of awareness, Internet access, and infrastructure impedes local knowledge about virtual tour services and how to access them. We also propose that the limited spread of virtual tour services throughout Indonesian society has resulted in a low desire to use these services. Notably, 59.02% of the questionnaire respondents were hopeful about the future of virtual tour services, as they supported the increased promotion of these services to Indonesians. Interestingly, our results demonstrate that while the virtual tour services now offered in Indonesia are increasingly convenient, most respondents still encountered obstacles to their use. For instance, 63.82% of respondents had an unstable Internet connection, and 48.98% faced problems when using the features of the virtual tour service.

We also discovered that epistemic value significantly influenced behavioral intention to use (H3). In other words, the respondents had a desire to use virtual tour services if they could gain new experiences that would satisfy their curiosity and raise their enthusiasm for traveling. Hence, this study bolsters Caber et al. (2020), as they found that epistemic value is a significant value aspect. Crucially, epistemic value can affect users' desire to use virtual tour services (Vishwakarma et al. 2020). Further, our results support the theory of consumption, within which epistemic value helps to determine consumers' decisions to choose and buy a product (Sheth et al. 2019). Our results also strengthen those of Phau et al. (2014). They concluded that tourists gain epistemic value if they have new or different experiences because of their visit.

Also, we observed that technicality significantly impacted behavioral intention to use (H4). This suggests that the effort that a user spends to access virtual tour services can affect their desire to use them. We found that the facilities of Indonesian virtual tours performed well while offering their services to virtual tourists. Our results are in line with those of Schiopu et al. (2021). They reported that low system complexity plays a big role in supporting user acceptance of VR tour technology. Moreover, our study echoes Vishwakarma et al. (2020) and contradict Disztinger et al. (2017).

Furthermore, we noted that functional value significantly influenced behavioral intention to use (H5). More specifically, the respondents' desire to use virtual tour services was influenced by their quality and price. Thus, our results contradict those of Vishwakarma et al. (2020). They concluded that perceived cost, viewed as part of the functional value, is not a value aspect capable of determining an individual's desire to use a virtual tour. However, their study was conducted in India, where the price of VR devices is quite affordable and therefore accessible. Moreover, because Vishwakarma et al. (2020) did not examine service quality, our study enriches their results. This study also supports Caber et al. (2020). In the context of offline tourism, they determined that functional value is important for measuring the quality of attractions and activities that tourists seek out at commensurate prices.

We conclude that virtual tour services in Indonesia are sufficient to provide functional value because some of these services are free. 61.78% of our respondents reported that feature quality was quite satisfactory. On the other hand, our respondents still hoped for further development of virtual tour services, including 62.84% who wanted additional interactivity and 56.89% who desired more diverse tourist destinations.

Next, this study reported that interest significantly influenced behavioral intention to use (H6). In other words, the desire to use virtual tour services may arise if individuals are already interested in the technology. Our results support those of Disztinger et al. (2017). They proposed that an individual's interest in new technology, which can be fostered by following trends or technological developments, can significantly

influence their desire to adopt virtual tours for travel-planning purposes. Notably, Disztinger et al. (2017) studied individuals who were already aware of virtual technology and even had personal VR glass devices, regardless of the fact that this technology was relatively new and considered to be "futuristic." These participants were also aware of the use of VR in virtual tours.

Moreover, our results on the subject of interest bolster those of Beck et al. (2019). They noticed that an individual's interest in VR technology can specifically influence their desire to adopt a VR tour, either for the sake of travel planning or personal satisfaction. Likewise, Beck et al. (2019) also demonstrated that, compared to other variables, general interest is the strongest predictor of or has the greatest influence on behavioral intention to use.

Virtual tour services continue to be actively developed and used in Indonesia. Recently, they have served as an alternative to normal tourism for Indonesians during the pandemic, and they are also expected to provide new experiences for virtual tourists (Kemenparekraf 2021). Consequently, this study demonstrates the ability of virtual tour services to provide new experiences to Indonesians and their alternative use during the pandemic. According to our data, 64.09% of respondents had previously used virtual tour services, including 360º virtual tours and live video virtual tours. Of the various types of virtual tour services, 360º virtual tours were the most popular among respondents. Significantly, our results support the theory of planned behavior proposed by Ajzen (1991). The theory states that behavioral intention can trigger consumer behaviors, including actual usage, in the future. These behaviors can apply to virtual tour services (Amelia and Ronald 2017).

Implication

The results validate our proposed VAM, which shows how users may adopt virtual tour services if they obtain certain values while virtually exploring a tourist destination. These values are divided into benefits and sacrifices, both of which affect the emergence of behavioral intention to use virtual tour services. This emergence is accompanied by a sense of interest from within the individual. Crucially, behavioral intention has a significant effect on actual virtual tour usage. Our results agree with those of Vishwakarma et al. (2020) which were conducted in India and Disztinger et al. (2017) which were conducted in Austria. In addition, our results support Caber et al. (2020) by proving that both functional and epistemic values are important benchmarks to determine an individual's perception of a tourism activity.

Our results may help developers maximize virtual tour implementation by outlining how they can provide value for virtual tourists. We recommend that developers intensify their socialization and promotion activities to increase the awareness of virtual tour services among Indonesians. They can do so with support from other parties in the tourism sector, especially regulators. These socialization and promotion activities may take advantage of digital platforms, such as social media, to reach the wider community.

Additionally, we recommend that virtual tour service developers improve the features available in their services. Based on our data, these services should be more interactive. For example, some respondents suggested the addition of a chat service that would allow them to communicate with other virtual visitors. Other requested a virtual tour guide with Artificial Intelligent technology to increase visitor interaction with the system.

We acknowledge that support from regulators in the tourism sector is necessary to help developers increase awareness of and public access to virtual tour services. While the government has already taken several measures, such as the Ministry of Tourism and Creative Economy offering a free virtual tour service, its efforts can be expanded further by offering more diverse tourist destinations. In addition, many Indonesians still face obstacles when trying to access and use virtual tour services. Hence, we propose that regulators should improve Internet quality in Indonesia. This will allow Indonesians to take full advantage of the services available on the Internet, not limited to virtual tours, and thus allow them to properly meet their needs.

Conclusion

In this pandemic situation, virtual tours could provide solution for the tourism industry in Indonesia. However, few studies analyze the virtual tours actual usage. This study determined that perceived enjoyment, epistemic value, functional value, technicality, and interest significantly affected behavioral intention to use virtual tour services. In contrast, accessibility had no significant effect on behavioral intention. Following our results, developers in Indonesia should increase public access to and awareness of virtual tour services, with support from regulators in the tourism sector. Because this study only covered 360º virtual tours and live video virtual tours, further research should test other types of virtual tour services, such as mobile application virtual tours and virtual tour services. In addition, future studies should focus on VR glass devices as VR technology continues to develop in Indonesia.

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Appendix A

Code	Statement
PE1	I feel happy exploring virtual tour services
PE2	I feel happy traveling virtually
PE3	I enjoy traveling virtually
PE4	I don't feel bored during a virtual tour
ACC1	Virtual tour services can be enjoyed by society
ACC2	Virtual tour services can be accessed by society
ACC3	Virtual tour services can be accessed anytime and anywhere
ACC4	Access to virtual tour services can be easily obtained
EV1	Virtual tours provide an experience as if I were actually visiting a tourist destination
EV2	Virtual tours answer my curiosity about a tourist destination
EV3	Virtual tours lift my spirits
EV4	Virtual tours make me feel adventurous
TECH1	I find it easy to access virtual tour services
TECH2	I find it easy to get information about a tourist destination from a virtual tour service
TECH3	I don't have to spend a lot of effort to join a virtual tour
TECH4	I can easily use the virtual tour
FV1	Virtual tours have a good value for the price
FV2	Virtual tours offer reasonable prices
FV3	Virtual tours have good quality standards
FV4	Virtual tours have consistent quality standards
FV5	Virtual tours are well organized
INT1	I like to find information on the latest technology
INT2	I'm trying to find out about the latest technology trends
INT3	I keep looking for information related to technological developments
INT4	I am interested in virtual tour technology in the world of tourism
BIU1	I plan to use virtual tour services in the future
BIU2	I intend to use virtual tour services in the future
BIU3	I predict that I will use virtual tour services in the future
BIU4	I will recommend virtual tour services to my relatives
AU1	I've used a virtual tour service
AU2	I tend to use virtual tour services if necessary
AU3	I spend a lot of time using virtual tour services
AU4	I often use virtual tour services

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