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DESIGN, DEVELOPMENT, AND EVALUATION OF A MOBILE LEARNING APPLICATION FOR TOURISM EDUCATION

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Abstract

This study focuses on a mobile application designed, developed, and evaluated using design science research approach in developing VirTEd mobile learning application for tourism education in the context of higher education in Indonesia. VirTEd facilitates tourism education learning process through mobile devices. This application supports learning that can be accessed anywhere. In fact, this application provides interactive learning media with 360-degree video views. The first part of this paper describes the analysis, design, and implementation of activities in relation to the development of VirTEd. Later on, this paper discusses the characteristics and scope of VirTEd's adherence to the nature and ideas of design science research. To evaluate VirTEd in a real study, an experiment was conducted with 100 second year undergraduate students at a university in Indonesia. This study evaluates the feasibility, effectiveness, and ability of VirTEd in tourism education. Usability testing on the VirTEd application was done to assess the capabilities of the VirTEd application. One of the Usability measurement tools is USE Questionnaire highlighting three main parameters; usefulness, satisfaction and ease of use. The results of this study indicated that the VirTEd application can be considered user friendly in tourism learning based on the results of the Usability Testing. This research study offers suggestions on how to implement mobile learning that supports learning in tourism education curriculum.

Keywords: Design science research, Mobile learning, Tourism education, VirTEd.

1. Introduction

The development of cellular telephone technology, both in hardware and software, along with its features, has opened up great opportunities for teachers and students to use it as a learning tool. Students, nowadays, have broader and more open access. Various platforms can be accessed, such as mobile and web-based applications, which can be employed for learning. Wireless technology and mobile devices will continue to evolve over time. This technology has become the center of attention in every aspect of the society' life including economy, education, trade, and transportation.

The constant use of mobile devices such as smartphones and tablets for tourism education continues to attract interests from researchers and educators [1-13]. Such an interest is driven by the availability of mobile devices, affordable costs, technological infrastructure, and the students' interest [12, 14-16]. To date, students can carry and use their mobile devices anytime and anywhere to support their learning. Our preliminary survey revealed that tourism education students are eager to learn and have a learning experience through mobile devices. The number of mobile device ownership in Indonesia is increasing every year [15, 17].

A survey on mobile devices and laptops between teachers and students at universities in Indonesia indicates that 91% of teachers and 95% of students use mobile devices [18, 19]. The studies describe an opportunity to motivate students to take advantage of the tools they have in their learning process. Although learning via mobile devices is considered useful, students' perceptions and experiences will determine the success of this technological intervention.

This study applied DSR framework proposed by Johannesson and Perjons [20] to develop a new mobile learning application called VirTEd, in the context of Indonesian higher education. DSR has been widely applied studies investigating issues of information systems and educational technology [20-25] as it is considered appropriate for mobile learning [26, 27]. The research question this study is trying to answer is as follows.

How is the implementation of VirTed through usability test questionnaire to the students of Tourism Education, Universitas Pendidikan Indonesia?

To answer the research question, we conducted a Usability Testing test on the VirTEd application. Participants in this test were second year tourism education students enrolled in hotel operational management learning courses at the Indonesia University of Education, Bandung, Indonesia. VirTEd is used as a technological intervention to manage learning, support student experience and engagement in learning. There have been several studies on mobile learning in Indonesia, but most of them are merely theoretical studies and studies on feasibility [28-32].

We are not aware of any similar research on the full implementation and evaluation of mobile learning for tourism education in Indonesian. It is safe to say that this is the first study in Indonesia that examines the experiences of undergraduate tourism education students learning through mobile learning applications. Our results are the first to describe students' experiences and perceptions of assessment in using VirTEd in an actual learning situation.

2. Research Methods

2.1. Design science research framework

This study uses a DSR framework adapted from Johannesson and Perjons [20]. This framework is then used to develop the Virtual Tourism Education (VirTEd) application for learning media. The framework includes five stages including the explicating problem, outlining the artefact and defining requirements, designing and developing the artefact, modelling the artefact, and evaluating the artefact. It was then referred to as EODDE to refer to the framework. The EODDE framework stands for explicating the problem, describing the application and defining requirements, designing and developing the application, demonstrating the application, and finally, evaluating the application (see Fig. 1). All activities of the DSR processes can contribute to knowledge related to a particular field of study.

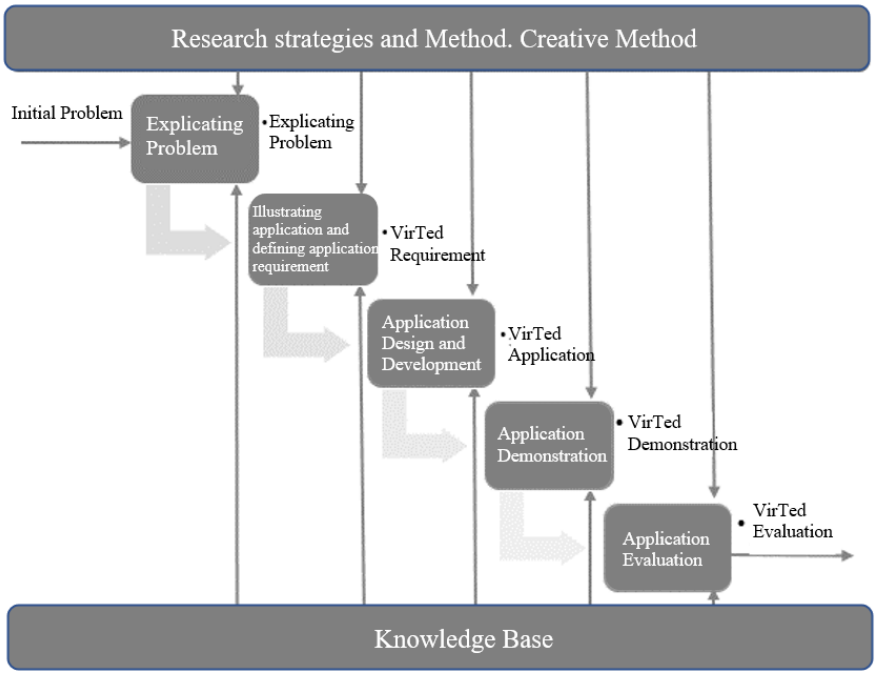


Fig. 1. Framework of DSR adapted from Johannesson and Perjons [20].

2.2. VirTEd development design

VirTEd is a mobile learning application that covers learning about tourism education, especially the hotel operational practices of housekeeping and making bed. VirTEd can be used for collaboration, blended learning, social networking, and learning assessments because this application is already connected to a mobile server subsystem to share data among all mobile devices connected to the server. VirTEd's physical structure consists of the VirTEd learning center administration, Users, databases and Servers. VirTEd learning center administration is at the heart of the entire systems. VirTEd application have eight menus / tabs / windows consisting of 3D Games (Room Design), 360 Photos (Room Tour), 360 camera-based learning videos (normal), 360 camera-based learning videos (New Normal)

Application Instructions, Modules / teaching materials, quizzes as a learning evaluation process, discussion forums / notifications (Credit) and Log Out.

2.3. VirTEd implementation system

The information of hardwares and softwares used to implement VirTed are shown in Tables 1 and 2.

Table 1. Hardware.

Devices	Specifications
Asus X550V Laptop	15,6 Inch, Windows 10, Intel (R) core (TM) i7-7799HQ CPU @ 2,80 GHz 2,81 GHz, 1TB Hard Drive, 8GB ofDDr SDRAM.
Personal Computer	Microsoft windows 10 (OS), 2.20 GHz Intel Duo Processor, 500GB hard drive, 4GB of RAM
Handphone Oppo A5	Android 9.0 pie, 6,5 inch (720x1600) Screen, 3GB Memory
Samsung Galaxy Tablet	Android 9.0 pie, 8 inch (1280x800) Screen, 3GB Memory
Insta 360 one r Camera	

Table 2. Software.

Software tools	Specification
Programming tools	• Android SDK is an operating system for Linux-based mobile devices that includes an operating system, middleware, and applications • Unified Modeling Language (UML) is a standard modeling language for the development of object-oriented software and systems. UML provides a visual modeling language that is useful for developers in creating blueprints of the program to be created • MySQL is a product of RDBMS (Relational Database Management System) which is very popular in Linux and it is also available for Windows
Graphics tools	• Blender is used for modeling, rendering and 3D animation. In addition, blender can be used in video editing, video effects, image retouching, and game development. • PTGui is an affordable commercial merging tool for creating large panoramic images of the scenery captured by a 360-degree camera. PTGui is a panoramic stitching software for Windows and Mac OSX. This software was developed as a graphical user interface for Panorama Tools • Adobe Illustrator is a leading vector graphics editor program, developed and marketed by Adobe Systems. Illustrator CC is the latest version of this program, the twentieth generation of Illustrator products. • Adobe Premiere Pro is a non-linear based video editing program from Adobe Systems. • Insta 360 software for 360-degree image processing from insta 360 oner camera
Sound Tools	• Audicity
Document and Present tools	• Mixrosoft Office 2013

The first working version of VirTEd is mobile application compatible in Android-based devices. As explained in the design stage, the whole system consists of the client (mobile devices compatible with Android operating system), VirTEd learning center administration, user, database, and server. To ensure its portability, efficiency and system maintenance, we built each subsystem using different software technologies. The subsystems were connected using dynamic link libraries. After developing the application, we ran it separately on the emulator and the actual device to confirm the functionality of the different units. Then, we installed the application on a real mobile device for debugging. Testing was carried out on Oppo A5 7.1 inches and Samsung Galaxy Tablet 8 inches. Implemented applications went through strict tuning and iteration, as defined by the DSR. The DSR framework for VirTEd is illustrated in Fig. 2. The VirTED application is available on the Google Play Store. This application can be downloaded for free.

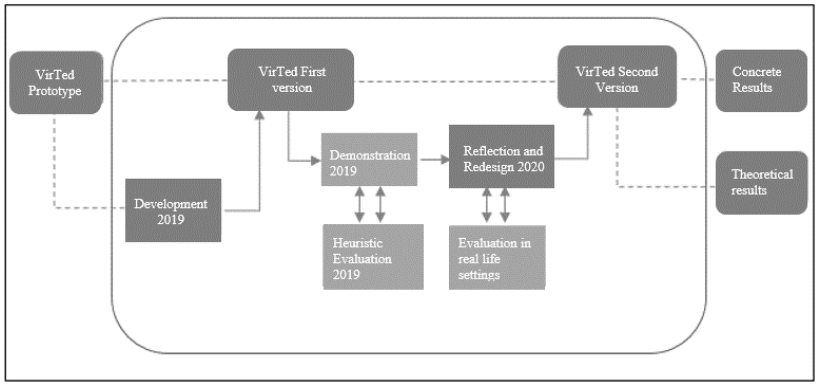


Fig. 2. Summary of the VirTEd DSR process.

2.4. VirTEd application demonstration

VirTEd's home screen contains eight tabs for carrying out learning activities. Both instructors and students were welcomed with the 3D Game tab (Room Design), Room Tour (360 Photo), 360 camera-based learning videos (containing learning material for normal situations), 360 camera-based learning videos (containing materials for learning New Normal conditions during Covid-19 pandemic) Application Instructions, Modules / teaching materials, quizzes as a learning evaluation process, discussion forums / notifications (Credit) and Log Out. Figure 3 illustrates the screenshot of the home screen.

Fig. 3. Home screen.

The 3D Game tab (Room Design) supports users with such functions as hotel room introduction game activities in 3-dimensional views and a virtual tour of hotel rooms and the information attributes therein. Besides that, 3D games present a room plan view which contains information about all available objects which are placed in a hotel room as shown in Fig. 4. Room Tour, this feature shows a 360-degree virtual tour of the room where the user can shift the mobile screen 360 degrees to see the viewing angle of the room as a whole and display all attributes needed. Figure 5 shows a screenshot of the Room Tour tab. The 360 camera-based learning video contains learning materials and learning practice videos with 360 camera formats for normal situations where the user can scroll the mobile screen to see the overall viewing angle of the room.

Fig. 4. Room plan tab view.

Fig. 5. Room tour tab view.

The 360 camera-based learning contains material for learning and learning practice with the 360 camera format in the New Normal situation during the Covid 19 pandemic where users can shift the mobile screen to see the overall viewing angle of the room. Figure 6 shows a screenshot of the normal tab and the new normal tab. Application Guide shows how to use the application. Instruction for using the application contains the descriptions of all icons in the VirTed application where users will get complete information of each icon in the VirTed application. Figure 7 shows a screenshot of the application manual tab. Module provides

information on teaching materials regarding to housekeeping and simulation center which can be accessed by its users. In this feature, there is a very complete description that will help in learning so that it can facilitate users to get the information needed. Figure 8 shows the module tab. Quiz is one of VirTed's features which contains quizzes in which users are challenged to be able to fill in questions related to information received after using the VirTed application.

The user will get a point of 10 in each question if he answered correctly and will get a point of 100 if he answered all questions accurately. Figure 9 shows the student quiz interface. The quiz interface contains multiple choice questions that can be used by students. The discussion forum / notification / Credit and Log Out are represented by Fig. 3. The originality of our solution lies in the fact that the VirTEd system is all-encompassing to support blended learning while providing opportunities for assessment, Multimedia, collaboration and social networking at the same time. Figure 10 represents an abstract model of the entire VirTEd system using a UML use case diagram. Actors (lecturers, students, and administrators) are shown to interact with system functions.

Fig. 6. 360 video.

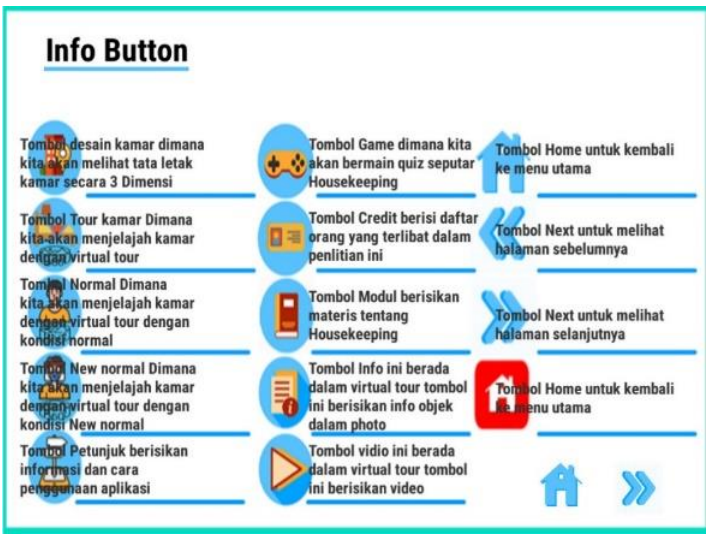


Fig. 7. Application manual.

Fig. 8. Modules.

Fig. 9. Student's quiz screen.

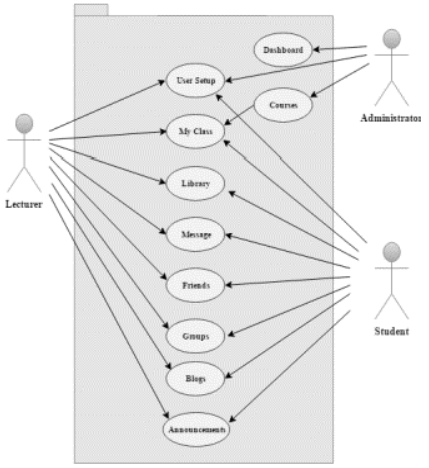


Fig. 10. UML use case diagram of VirTEd system.

2.5. VirTEd evaluation through usability testing

To evaluate the feasibility, effectiveness, and ability of VirTEd in Tourism education, we conducted a Usability Testing test on the VirTEd application to assess the capabilities of the VirTEd application. One of the usability measurement tools is the USE Questionnaire divided into three main parameters; Usefulness, Satisfaction and Ease of Use [33]. The following is the explanation 1. Usefulness is the extent to which the application allows the user to achieve its goals and is an assessment of the user's willingness to use it. 2. Satisfaction refers to how users feel when using a product or response to product design. 3. Ease of use measures the extent to which the user can operate the system. Testing was only done in one stage in testing the VirTEd application against students by testing the Application Task Usability. The Test result is presented in Table 3.

Table 3. Application of task usability testing.

No.	Tasks	Descriptions
1	Open VirTed Application	users try the application and pays attention to the application interface
2	Open Room Design	users try Open Room Design
3	Run Room Tour	users try interactive features of interactive map such as rotate and zoom
4	Search for a facility	users enter the facility name in the search button
5	Opening facilities via hotspots in room designs	users select hotspot facility on interactive map page
6	Running virtual tour (Room Tour) and 360 Videos in normal and new normal tab	users try a virtual tour and interacts like viewing the room and 360 Videos in the normal and new normal tabs
7	Running facility hotspots	users choose facility hotspots
8	Trying switching pages between virtual tours	users open the map and tries to move the virtual tour page
9	Open Manual	users open the info button in the main menu to see the manual for using the application
10	Open Module	users see the material in the module
11	Open Quiz	users see and try the quiz
12	Open credit	users see credit info about the application
13	Open Log Out	Users log out

2.6. Research context and participants

The research was carried out in the Tourism Study Program at Universitas Pendidikan Indonesia, Bandung, Indonesia. Participants in the VirTEd application trial were second year tourism education program students who participated in the hotel operational management course. The nine participants were taken based on the demographic results showing that 43% of the respondents sampled were female and the other 57% are male students. The dominant age group who responded was 16-20 years (72%), followed by 21-25 years (28%). There are 100 participants to test the VirTEd application.

2.7. Research instruments

After the task was completed, the questionnaire was given to users to find out their experience with the application being tested. It was done to identify what the users see and feel when performing the prearranged task. The questionnaire contains 16 questions for students representing the three aspects of USE questionnaire (Table 4), consisting of five question items related to Usefulness, four question items related to Satisfaction, and seven question items related to Ease of Use. Each parameter was broken down into a set of statement offered to users in the form of a Likert-scale questionnaire. Each item in the questionnaire aims to show the level of usability according to user acceptance which was scored on a scale of 5. The scoring scale is presented in Table 5.

Table 4. Application usability USE questionnaire.

No.	Questions	Aspects
1	Are the 360-degree photos and information easy to understand?	Usefulness
2	Is the Application Guide easy to understand?	
3	Is it easy to access the menu offered?	
4	Is the 3D map building easy to use?	
5	Are 360-degree photos easy to use?	
6	Does this application facilitate you to find out more about tourism education learning, especially housekeeping practices in hotel rooms?	Satisfaction
7	Can you easily get an overview of learning tourism education with this application, especially housekeeping practices in hotel rooms?	
8	Can the application facilitate you to get the information about learning tourism education, especially housekeeping practices in hotel rooms?	
9	Does this application allow you to locate the facilities you are looking for?	
10	Is the interface in the VirTEd application easy to recognize?	Ease of use
11	Is the application easy to use?	
12	Are the colours on the VirTEd app compatible?	
13	Is the application menu display easy to recognize?	
14	Is the information easy to read?	
15	Are symbols, icons and images easy to understand?	
16	Is the 3D building display easy to understand?	

Table 5. Scoring scale.

QI	VD	D	FE	E	VE
Score	100	200	300	400	500

QI (Questionnaire Item), VD (Very difficult), D (Difficult), FE (Fairly Easy), E (Easy), VE (Very Easy)

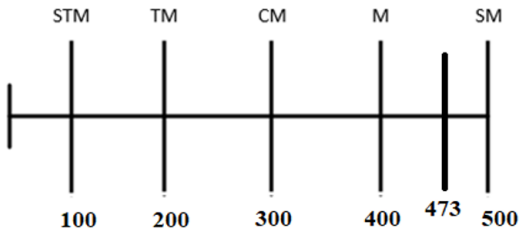
2.8. Data analysis

This study combined between quantitative and qualitative data analyses. The data collected were calculated using a Likert scale calculation scale.

3. Results

There are three main parameters the usability use questionnaire test covers, namely usefulness, satisfaction and ease of use by 100 students on the VirTED application is described and elaborated as follows.

This measurement of the usefulness parameter measures the extent to which the application allows the user to achieve his goals and is also an assessment of the user's willingness to use it. The average value of the usefulness parameter assessment by 100 respondents is 473 with a percentage of 94.6% which indicates that this application is very user friendly (Fig. 11). Based on the results of a questionnaire of five question items related to the Usefulness parameter in using the VirTEd application, the results show that this application facilitates its user to achieve their goal related to the feature information in the VirTEd application. The main concern of the respondents is the use and purpose the use 360-degree photos and containing information, material, practices related to tourism learning. According to the respondents, this feature provides very important and objectives information related to tourism learning. In addition, the guide feature in this application can also facilitate the use of the application. The respondent's assessment of the menu access offered is considered very easy to use in accessing every functions of the application.



STM / VD	: Very difficult	M / E	: Easy
TM / D	: Difficult	SM / VE	: Very Easy
CM / FE	: Fairly Easy		

Fig. 11. Average score of usefulness assessment result.

The measurement of Satisfaction parameter deals with how the user feels when using a product or what are the user's response to the product design as well as the response to the overall product design. The average value of the satisfaction parameter (Fig. 12) assessment by 100 respondents is 465.5 with a percentage of 93.1% which indicates that this application is user friendly [12]. Based on the results of the questionnaire four question items related to this Satisfaction parameter in the use of the VirTEd application, it was revealed that this application facilitates users to find out more about tourism education learning, especially housekeeping practices in hotel rooms through the 360-degree camera-based video display feature. In addition, users also get an overview and information about learning tourism education, especially the experience of housekeeping practices in hotel rooms. Moreover, this application also enables users to find the location of the facilities they are looking for.

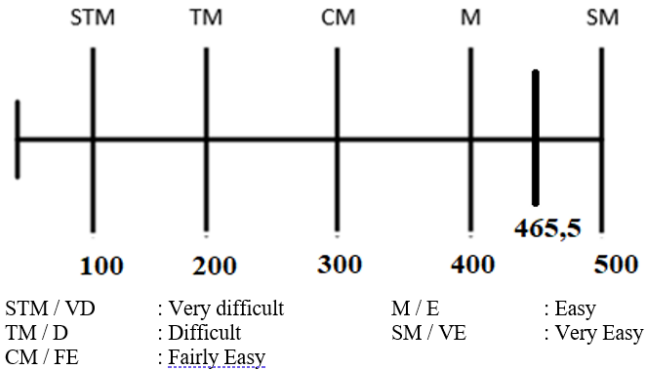


Fig. 12. Average score of satisfaction result.

The measurement of the ease of use parameter measures the extent to which the user can operate the system. The average value of the ease of use parameter assessment by 100 respondents is 449.29 with a percentage of 89.8% which shows that this application is easy to operate by the system by users. Based on the results of a questionnaire of seven question items related to the ease of use parameter in the use of the VirTEd application, it was found that the application and interface design of this application can be said to convenient for users to operate; the color display is considered appropriate, the application display is easily recognized, the information, symbols, icons and images are easy to read and understand. The 3D building views are easy to read and understand. The average score of ease of use assessment result is presented in Fig. 13.

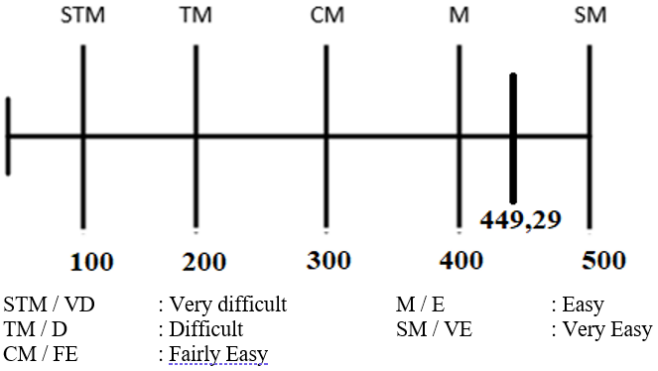


Fig. 13. Average score of ease of use assessment result.

4. Discussion

The purpose of this study is to evaluate VirTEd, a mobile learning application developed specifically for tourism education in Indonesia. Our attention is focused on developing VirTEd for student learning experiences using mobile learning applications. Students' experience in using the VirTEd application is needed to ensure that the system fits in tourism education. Therefore, our research investigates the potential offered as a mobile learning solution and confirms the user's perceptions of the application.

The results of this study indicate that the VirTEd application can be considered easy to use in tourism learning based on the results of the Usability Testing using the USE Questionnaire measurement tool which divides into three main parameters; Usefulness, Satisfaction and Ease of Use. Usability and satisfaction are also useful. Usability is an important factor in developing mobile learning applications. The results we get from testing the application by users on the Usefulness aspect show that the VirTEd application is considered very easy to use. The satisfaction and benefit aspects are considered very easy and very helpful solutions related to tourism learning and based on user aspects (Ease of use), the application is rated as easy to operate. This is in accordance with what was conveyed by several researchers regarding how to evaluate mobile learning application testing using Usability Testing [34, 35].

Evaluation of mobile application testing using Usability Testing functions is essential to see the utility of application functions, effectiveness, and efficiency for its users. The similarity of the evaluation results of the VirTEd application with the results of the assessment of other applications is in the aspect of ease. Conversely, what distinguishes it from other applications is the function and usefulness of the application content. The application has a different focus where the material displayed is about learning tourism education and its uses, which is different from previous application research, for example in Setten et al. [36], Kenteris et al. [37] da Silva and da Rocha [38], Gulbahar and Yildirim [39], most of which are more focused on the perspective of mobile learning in general, application adoption, feasibility studies of mobile learning implementation, challenges of mobile learning, the impact of m-learning, the effect of m-learning on learning performance. Based on the results of other studies, it is also stated that the application of mobile learning can improve student learning performance [40, 41].

Although many studies of this kind have been conducted, our findings support the expansion of novelty about mobile learning tools, particularly in the field of tourism education. In addition, the flexibility of using mobile devices allows students to learn anytime and anywhere [42-48]. The VirTEd application provides students with a learning experience through a mobile application and helps students to organize and carry out study routines even when the students want to study alone. However, further research is needed to ascertain the effect of mobile learning on student learning performance. Furthermore, the experiences and attitudes of students who use and rate VirTEd for tourism education are considered easy to use as a medium for mobile learning. As a result, we conclude that VirTEd has a positive rating and has great potential in tourism learning.

5. Conclusion

Based on our investigation, it can be concluded that the VirTEd application can be considered easy to use in tourism learning based on the results of the Usability Testing through the USE Questionnaire measurement device which highlights three main parameters; Usefulness, Satisfaction and Ease of Use. In addition, Usability, satisfaction and usefulness are important factors in developing mobile learning applications. The satisfaction and usefulness aspects are considered very easy and very helpful in providing solutions related to tourism learning. It can be inferred that tourism education utilizing mobile application is an effective alternative within the context of higher education.

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