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Developing augmented reality-based learning media and users' intention to use it for teaching accounting ethics

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Abstract
Ethics education is increasingly needed in business schools due to the escalation of fraud in business practices. However, faculties face challenges in gaining the millennials and Z generation's interest and attention, who are generally digital savvy, when teaching accounting ethics. One of the learning media that is suitable for millennial and Z generation students is that based on augmented reality technology, a technology that combines the real world and the virtual world in either 2-dimensional or 3-dimensional forms to reflect the real environment. This work aims to develop an augmented reality mobile application for teaching accounting ethics for university students using revenue recognition case. In this project, the development of the application uses the SCRUM method. Additionally, the System Usability Scale (SUS) is used to measure perceived usability. We conduct pre- and post-tests on the SUS. The pre-test is performed when the application is first released, and the post-test is conducted after the application has been improved based on the feedback from our respondents. The score of the pre-test is 80.00 (good to use) and the post-test score is 90.27 (excellent to use). Further, this study tests users' intention to use the application. Using Technology Acceptance Model, the results show that potential users intent to use the application and the intention is affected by the perceived ease of use via the perceived usefulness of the application and the attitude towards the application.

Keywords Accounting ethics · Augmented reality · Business ethics · Learning media · Mobile application · Technology Acceptance Model (TAM)

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1 Introduction

The increase in corporate fraud cases has made ethics education to be high on the agenda in curriculum development in many business schools (Van Liedekerke & Demuijnck, 2011). Development of technology-enhanced learning media is gaining momentum to serve the millennial and Z generation students who are digital savvy. Since this generation is familiar with all forms of technology, educators need to adapt their teaching methods to stay connected with students (Wankel, 2009). Teaching millennials and Z generation is more effective when it is student-centered (Howe & Strauss, 2000), innovative, interactive, and experiential.

Augmented reality (AR) is an interactive computer program that combines real and virtual objects (Javornik, 2016) and thus, will have a great impact on students (Garzón & Acevedo, 2019). According to Carmigniani and Furht (2011), AR is defined as a real-time direct or indirect view of a real-world environment that has been enhanced and added with information generated by virtual computers. AR technology has now been developed to help people in various fields, such as education, tourism, industry, and others. In education, several AR-based applications have been developed as a learning medium to assist in teaching and delivering information. However, there is still limited work in developing AR-based learning media for accounting ethics education. In this study, AR technology was developed as a learning media for teaching accounting ethics courses. The application of AR technology is aimed at improving students' ability to make ethical decisions in the area of accounting. This work develops a mobile-based AR technology (hereafter is m-AR) using revenue recognition case in a well-known Indonesian state-owned enterprise (hereafter is SOE).

The SOE is an airline company and one of the leading players in the aviation industry in Indonesia. This company is one of the airlines known for its excellent service quality in terms of high customer satisfaction and loyalty compared to other airlines. Despite the popularity of the SOE, the company suffers reputational damage following many cases of ethics violations, including earnings management, particularly in the agresiveness of revenue recognition. This practice againsts conservatism principle in accounting. As a result, the financial statement, particularly the income statement, is oversated and does not reflect the real condition of the SOE financial condition. This practice can be considered as unethical. Therefore, this work aims to develop a learning media based on AR technology for learning accounting ethics using the case of SOE's aggressive revenue recognition.

In this study, the application was developed using the Scrum method and then tested using System Usability Scale (SUS). The test reveals the application is perceived excellent to use. Further, this study tests whether potential users, namely faculty members of Indonesian universities, intent to use it and whether the intention is affected by perceived ease of use and perceived usefulness of the application. The results show that potential users have intention to use the application and the intention is affected by the perceived ease of use via the perceived usefulness of the application and the attitude towards the application.

2 Literature review

2.1 Augmented Reality (AR)

Due to mobile devices development, AR technology has been used in various fields such as medicine, tourism, industry, and education (Mekni & Lemieux, 2014). There are several components in the creation of augmented reality. The components are: (1) the detection/tracking component, which is to detect the available AR marker, (2) the storage or registration component, which is required to save to the database, (3) the visualization component, which is a component to display animations that have been for display, and (4) database component to store animation/markers (Carmigniani & Furht, 2011).

AR technology has been developed in the field of education. For instance, Firdaus et al. (2018) developed AR technology as a learning medium to introduce medical equipment to pharmacy vocational high school students without having to own medical equipment physically. The results of the initial evaluation stage indicate that students used the application as a learning medium. Another study by Maijarern et al. (2018) is related to the use of AR technology as a medium for learning introductory science, specifically in understanding the plant life cycle, in junior high schools. However, in its development, the image display and plant simulation that have been applied are not in the form of 3D animation, so the image displayed failed to reflect reality. Another work related to the development of AR technology in education is that of Hidayat et al. (2019). They developed it to aid medical students in recognizing human anatomy. The application applies 3D puzzles as a tool for evaluating students' knowledge after using the application. The development of AR technology in education was also carried out by Hamzah and Kurniadi (2019) who applied it for learning network hardware. In its development, AR technology is used by vocational school children for learning WAN technology networks. This application development only applies 3D objects without animation, so the output produced is only 3D objects that are not moving.

A meta-analysis conducted by Garzón and Acevedo (2019) revealed the benefits of AR technology in STEM learning to improve students' understanding and learning outcomes. They further suggest that AR learning technology could be applied as a learning method for flipped classroom. Based on the research that has been done, the development of AR in education has been widely carried out. However, to the best of our knowledge, none has been developed in the area of accounting ethics. Thus, the current study contributes to the literature on the use of AR technology in the area of accounting ethics.

2.2 Accounting ethics, earnings management, ethics education, and AR

Webster's Collegiate Dictionary defines ethics as: 1) a set of moral principles or values; 2) a theory or system of moral values; 3) the discipline dealing with what is good and bad and with moral duty and obligation; and 4) the priciples of conduct governing an individual or group. According to Velasquez (2014) business ethics is a specialized study of moral right and wrong that concentrates on moral standards as they apply to business institutions, organizations, and behavior. Accounting ethics means ethics applied and/or related to accounting practices and accountants. According to Merchant and Rockness (1994), earnings management is " … the most important ethical issues facing the accounting profession, yet little research has explored the topic" (page 79).

Earnings management is the use of personal interests in financial reporting that misleads users of financial statements to influence contract results that depend on reported accounting figures (Healy & Wahlen, 1999). There are at least 3 ways to manipulate earnings. First, accrual manipulation, namely manipulation carried out by choosing accounting policies subjectively to increase or decrease earnings (Scott, 2009). For example, to reduce earnings, managers choose the accelerated depreciation method compared to the straight-line method. Second, real activities manipulation, which is defined as earnings manipulation through deviations from the company's normal operating activities, so that it creates an impression on stakeholders that certain financial reporting targets have been achieved through the company's normal operating activities (Roychowdhury, 2006). For example, by reducing expenses discretionary costs such as research and development costs, and sales, general and administrative expenses. Third, classification shifting, that is the method of manipulation by shifting items in the income statement.

Accounting ethics education, particularly related to earnings management, is worth to discuss in the class because the ethics that accountants and auditors have during the education process will be reflected in the quality of the financial reports (Al-Frijat & Albawwat, 2019). Earnings management is unethical behavior, regardless of the materiality. Loomis (1999) states that earnings management obscures the facts investors should know, and leaves them in the dark in making judgments about the company. The collapse of large companies such as Enron and Worldcom, because of the practice of earnings management, raised concerns about the importance of ethics education for accounting students (Young & Annisette, 2009).

Ethics education in accounting is a therapy to overcome the ethical crisis of the accounting profession (Jackling et al., 2007). Differences in individual ethical standards are determined by ethics education (Bampton & Cowton, 2013). Several previous studies have found the importance of ethics education in accounting education (Torno-Carbó et al., 2016). Ethics education in accounting aims to increase students' ethical perceptions, especially in responding to ethical dilemmas, improve ethical decision-making skills and increase students' understanding of the code of ethics. Unfortunately, some studies have found no difference in the level of moral development of accountants after and before getting ethics education (for example, Bernardi et al., 2011). This implies that ethics education is not effective in inserting ethical values in students. Criticism on ethics education is that it fails in instilling ethical values due to the complexity of ethical problems, the unpreparedness of business faculties to teach (Swanson & Fisher, 2008), and too theoretical. This lead to the fact that students are difficult to understand the relationship between ethical theory and its application in the real world (Raman et al., 2019).

Learning techniques to instill ethical values in students can use passive or active learning methods (O'Leary & Stewart, 2013). Passive learning only requires students to listen and record, it does not necessarily involve them in higher-order thinking (Benjamin, 1991; Dabbour, 1997). Meanwhile, active learning is a learning that involves students' thinking which transforms students from listening to higher order thinking (both inside and outside the classroom) (Massey et al., 2005). Active learning is also able to improve students' ethical perceptions Coyne et al. (2005). A study conducted by Jagger et al. (2016), shows that active learning in ethics courses using case-based visual simulations can improve ethical decision-making skills. Additionally, O'Leary and Mohamad (2008) find that active learning improves ethical decision-making abilities.

In line with the advancement of technology, active learning can utilize computer technology such as interactive games, computer-based simulations and Augmented Reality (AR) (O'Leary & Stewart, 2013). AR is more effective compared to video, images, animation, and video resolution (Garzón & Acevedo, 2019). Augmented reality is a means to enhance the experience of interacting with the real world (Garzón & Acevedo, 2019). AR can facilitate sensing virtual objects in the real world, thereby increasing imagination and helping to understand abstract concepts and phenomena (Wu et al., 2013). The model of theory of interactive media effects states that media characteristics will cause immersive experiences which will have an impact on affective, cognitive and behavioral responses (Sundar et al., 2015). In ethics learning, Sari et al. (2021) found that AR technology makes students easier to imagine and to understand the consequences of their actions on the interests of stakeholders so as to increase moral imagination. Moral imagination is the ability to identify moral conflicts in ethical dilemma situations, and determine which stakeholders will be impacted in those situations as well as develop alternative solutions from a moral perspective (Whitaker & Godwin, 2013). The higher the moral imagination, the higher the moral sensitivity which will ultimately shape ethical behavior (Moberg & Seabright, 2000).

Earnings management is an abstract concept and occurs in business practice. By using AR technology, students will find it easy to understand the earnings management concept and increase immersive experience, which in turn will have an impact on behavioral response through an increase in moral imagination or the ability to imagine the impact of profit manipulation on stakeholders (Sari et al., 2021). The development of this augmented reality application is an effort to improve students' ethical decision-making abilities to respond to ethical dilemmas.

2.3 System Usability Scale (SUS)

The System Usability Scale (SUS) is a method of measuring the usability of a computer-based system based on the user's subjective point of view (Brooke, 2013). The SUS provides a total score of 0–100 and does not involve complicated calculations (Bangor et al., 2008). The SUS questionnaire consists of 10 questions with positive and negative statements using a Likert scale of 1–5. Each question on the SUS has a contribution value of 0–4. Each positive statement, namely the odd number statements (1, 3, 5, 7, and 9) has a contribution value of a respondent's score minus 1. For example, if a respondent responds 5 for an odd statement, the contribution value is 4 (5–1). As for the negative statements with an even number (2, 4, 6, 8, and 10), the contribution value of each statement is 5 minus the respondent score. For example, if a respondent responds 2 for an even statement, the contribution value is 3 (5–2). After that, each question's total contribution value is multiplied by 2.5 to get the total SUS score. The final SUS score is obtained by calculating the average SUS score of each respondent divided by the number of respondents. Based on the study of Bangor et al. (2008), the average value of SUS below 20.30 is the Worst, the average value above 20.30 to 35.70 is Awful, the average value above 35.70 to 50.90 is Poor, the average value above 50.90 to 71.40 is OK, the average value above 71.40 to 85.50 is Good, the average value above 85.50 to 90.90 is Excellent, and the average value above 90.90 is the Best.

2.4 Technology Acceptance Model (TAM)

TAM assumes that an individual's perception of the usefulness and ease of use of a system can determine his/her attitude and behavioral intentions towards using the system (Davis, 1989). According to this model, the use of a technological product depends on the intention to use (IU), which is affected by attitude towards the technology and this attitude is formed by perceived ease of use (PEU) and the perceived usefulness (PU) of the technology (Agrebi & Jallais, 2015) as depicted in Fig. 1. In the context of this study, we argue that the intention to use the m-AR is affected by the attitude towards the m-AR and that the attitudes is affected by perceived ease of use (PEU) and the perceived usefulness (PU) of the m-AR for the following reasons.

2.4.1 Perceived ease of use and perceived usefulness

Perceived ease of use (PEU) represents an assessment of the degree to which interaction with a system or a specific information technology is free of mental effort, while perceived usefulness (PU) is the degree to which a person believes that the use of a particular system enhances his or her work (Davis, 1989). PEU

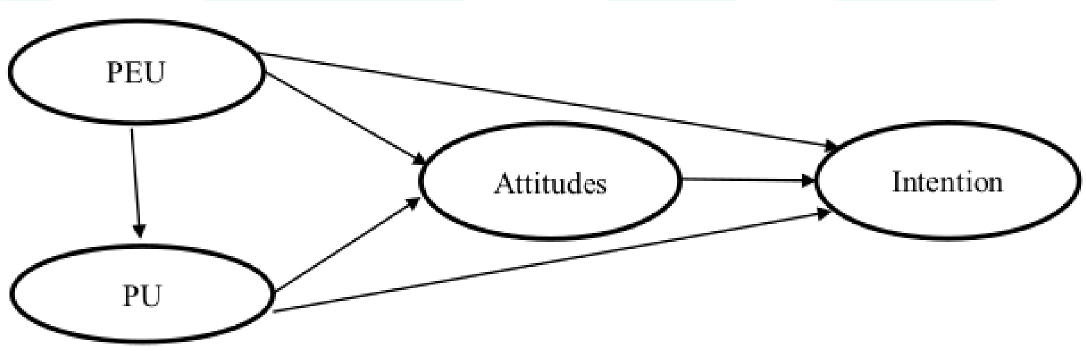


Fig. 1 The model

reflects a customer's assessment or perception of a given system in terms of its easiness to operate and learn (Gefen & Straub, 2000).

Individuals are more willing to use and learn new system features and end up using it if the system is easy to use (Hamid et al., 2016). The empirical tests that have been done by prior researchers (Alharbi & Drew, 2014; Ayeh et al., 2013; Calisir et al., 2009; Kim et al., 2010; Kuo & Yen, 2009; Liu et al., 2010; Luarn & Lin, 2005) showed a positive significant effect of perceived ease of use on perceived usefulness. Therefore, in the context of the m-AR we hypothesize:

Ha1: Perceived ease of use positively affects perceived usefulness of m-AR.

2.4.2 Perceived ease of use, attitude, and behavioral intention

Alharbi and Drew (2014) found that perceived ease of use positively affects attitudes toward using learning management systems as well as intention to use it. Ayeh et al. (2013) found that perceived ease of using consumer-generated media positively influences attitude towards its use for travel planning. Fagan et al. (2008) explored the intention to use computers and found that perceived ease of use has a significant positive relationship with behavioral intention to use computers in the workplace. Kim et al. (2010) found that perceived ease of use has a positive effect on the intention to use m-payment. Liu et al., (2010) found that perceived ease of use positively affects the intention to use an online learning community. Luarn and Lin (2005) found that perceived ease of use has a positive effect on the behavioral intention to use mobile banking. Therefore, we hypothesize:

Ha2: Perceived ease of use has a positive influence on the attitude towards m-AR.
Ha3: Perceived ease of use has a positive effect on the intention to use m-AR.

2.4.3 Perceived usefulness, attitude, and behavioral intention

As previously mentioned, perceived usefulness is defined as the perception of individuals with regard to the improvement of the tasks performed when using a certain system. In this study, perceived usefulness describes users' expectations that using m-AR will enhance faculty members' effectiveness in teaching ethics. The common belief is defined as individuals will use an application if they find the application useful to achieve a certain outcome, and the basis of the relationship is the idea that people develop their intention towards behavior which they perceive to be beneficial, excessive, and above any possible positive or negative feelings they have towards the behavior per se (Ayeh et al., 2013).

Empirically, Ayeh et al. (2013) found that perceived usefulness of consumer-generated media positively influences attitude towards its use as well as the behavioral intention to use it for travel planning. Alharbi and Drew (2014) found that perceived usefulness positively affects attitudes toward using learning management systems and the intention to use it. Calisir et al. (2009) found that perceived usefulness has a positive effect on the attitude toward the use of enterprise resource planning systems and the behavioral intention to use it. Kuo and Yen (2009) found that perceived usefulness had a significantly positive influence on attitude toward use 3G mobile value-added services. Liu et al. (2010) found that perceived usefulness positively affects the intention to use an online learning community. Agrebi and Jallais (2015) identified factors affecting the intention to use mobile phones for purchasing and found that the “perceived usefulness” of m-purchasing has a positive impact on the intention to use it. Kim et al. (2010) found that perceived usefulness has a positive effect on the intention to use m-payment. Luarn and Lin (2005) found that perceived usefulness has a positive effect on the behavioral intention to use mobile banking. Therefore, we hypothesize:

Ha4: Perceived usefulness has a positive influence on the attitude towards the use of m-AR.
Ha5: Perceived usefulness positively affects behavioral intention to use m-AR.

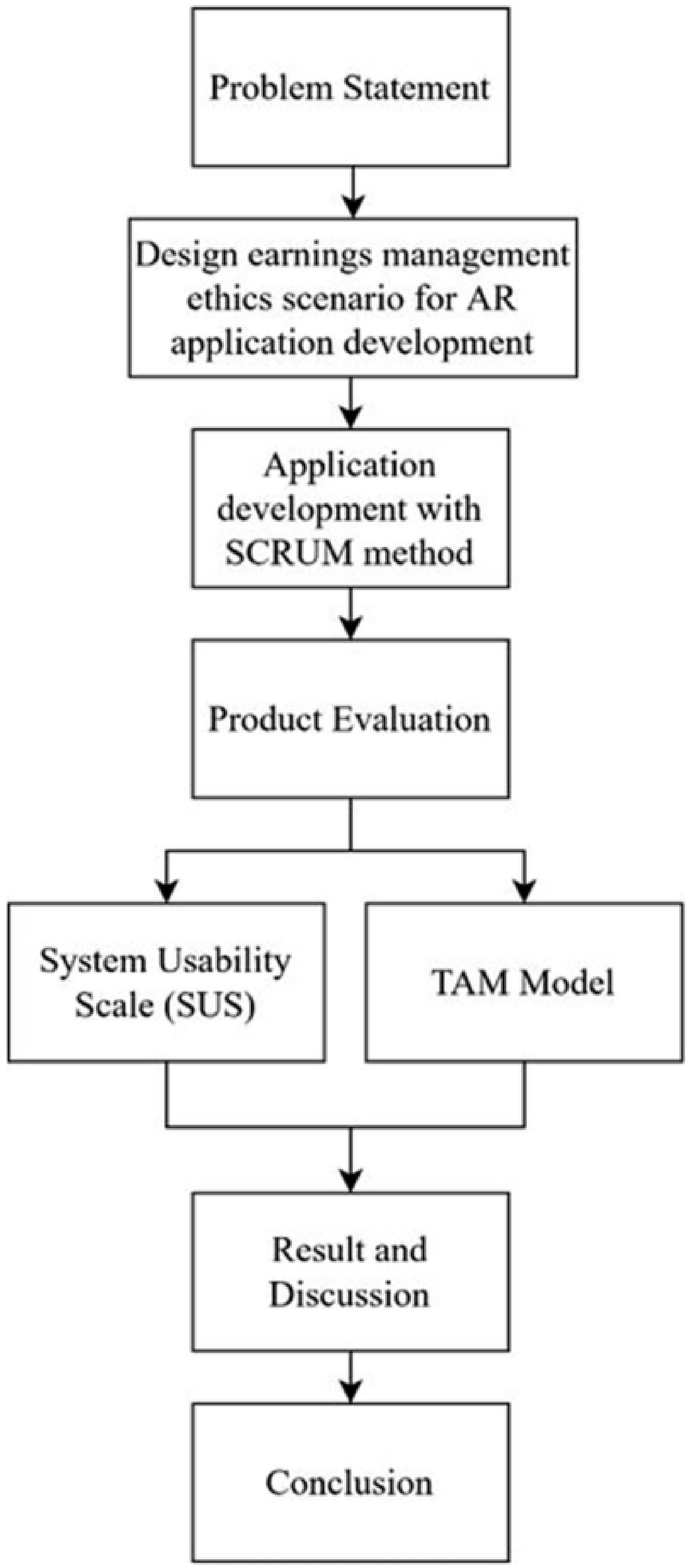
3 Methods

This section explains the research flow and methods used to develop and to evaluate the AR application. It covers the development methodology, AR development, Use Case diagram, and the black box test. Additionally, this part explains the data collection method and the instrument used to test our research model. Figure 2 shows the research flow diagram. This research starts from a problem which is faculty members face challenges in gaining the millennials and Z generation’s interest and attention, who are generally digital savvy when teaching accounting ethics. From the problem, we design the scenario for AR application development. It includes the user activities (i.e. deciding for a given case). Thus, the application is developed using an agile method, namely SCRUM. SCRUM method consists of four stages (product backlog, sprint planning, sprint backlog, and sprint). After that, the application is evaluated using the SUS and TAM methods.

3.1 Development methodology

The application is developed using the Agile Software Development, a software development methodology that is based on a repetitive process where the agreed-upon rules and solutions are carried out with collaboration between each team in an organized and structured manner. Agile development itself is a model of software development in the short term (Pressman, 2010). It requires rapid adaptation in dealing with any changes. The most important value of agile development is that it allows a team to make decisions quickly, with good quality and predictions, and has good potential in handling any changes. Agile software development methods have several types, namely Adaptive Software Development (ASD), Agile Modeling (AM), Crystal, Dynamic System Development Method (DSDM), Extreme Programming (XP), Feature Driven Development (FDD), Relational Unified Process, and Scrum Methodology.

Fig. 2 Research flow diagram



This study uses the Scrum framework developed by Schwaber (2004) as depicted in Fig. 3. It is suitable for development projects that deal with new innovative technologies with unpredictable challenges and outcomes such as AR technology, where conventional predictive and planned project management approaches are not suitable. This method is used to develop this augmented reality application according to the needs and make the application be controlled. The terms and definitions used in this method are as follows.

Backlog is a list of priority requirements and features of the project that provides business value to customers. Items can be added to the backlog at any time, and at this stage the product manager assesses the backlog and updates the priority list as needed (Pressman, 2010). Product backlog is a priority list of the main features that customers want. Sprint consists of work units that are qualified to meet the requirements specified in the backlog and must be invincible by a predetermined time box, usually 30 days (Pressman, 2010). Sprint backlog contains items from product backlog which are planned to be implemented in one sprint (Popli & Chauhan, 2011). Sprint planning is where the product owner and team get together to collaborate about what will be done for the next sprint (Schwaber & Sutherland, 2010). Pregame is defined as planning phase in scrum framework. This phase consists of conceptualization and analysis (Popli & Chauhan, 2011). Game is defined as development sprints phase. This phase is the phase of developing the functionality of the new release with regard to time, requirements, quality, cost, and competition. At this stage, there are several iterative or cyclic development sprints that are used to develop the system (Popli & Chauhan, 2011). Finally, postgame phase is the closure phase. This phase is the phase for releasing the system, which includes final documentation, pre-release staged testing and then release (Popli & Chauhan, 2011).

Determining the Product Backlog is very important. The Product Backlog lists all features, functions, requirements, enhancements, and fixes that will be applied to products in future releases. Product Backlog items have attribute description, order, estimate, and business value. Product Backlog items often contain product testing descriptions, which will be proof of completeness when the Product Backlog of the item is "Done". After determining the Product Backlog, we created a Sprint Backlog on the selected product backlog. Sprint Backlog works as a task list in one sprint. It contains items from Product Backlog which are planned to be implemented in a one sprint (Popli & Chauhan, 2011). There are three main stages in the Scrum framework, namely pregame, game, and postgame (Popli & Chauhan, 2011).

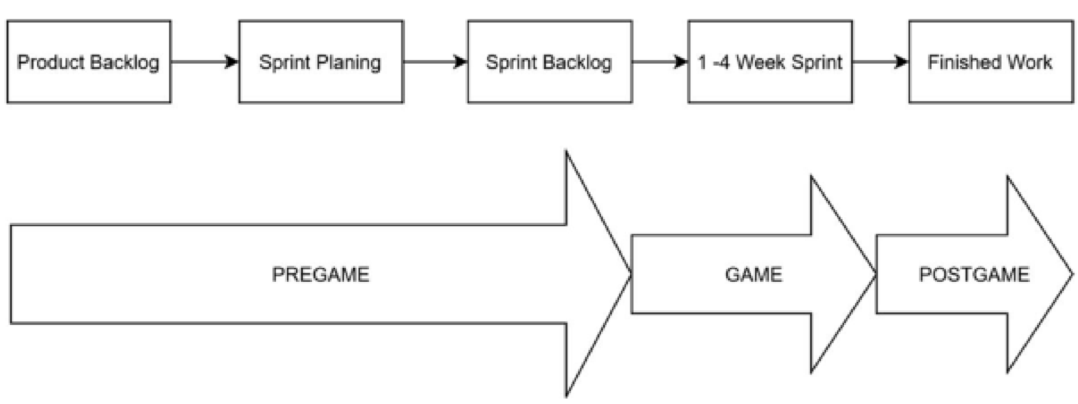


Fig. 3 Scrum framework

3.1.1 Pregame

The pregame stage consists of two sub stages, namely, planning and architecture. Planning involves making plans based on the existing backlog, which includes schedule and cost planning. If the developed application is new, then these sub-stages include conceptual design and analysis. However, if the application developed is related to an old application, it only needs limited analysis. Architecture in this sub-stage is to design how the backlog will be implemented. This sub-step includes the architectural modifications system and design at the user level.

3.1.2 Game

At this stage, the Product Backlog is developed into several sprints by considering factors such as time, need, quality, and cost. These variables determine the extent required for the sprint to complete the entire backlog and the placement of the backlog of items on the sprint. Sprint represents a project development iteration, where the period is one week or more. Every Sprint defines what will be developed and what features can be delivered at the end of the sprint.

3.1.3 Postgame

This stage involves preparation for product release, including final documentation, testing the pre-release phases, and the final product release.

Table 1 shows the Product Backlog and Sprint Backlog of the application developed.

Table 1 Product backlog and sprint backlog

Product Backlog	Sprint Backlog	Time (in Days)	Priority
Application Concept	Application Design	5	1
	Design Storyboard & Interface	5	1
Asset & Animation	Animation making	7	1
	Asset Scene Story Design	2	2
	Character Design & Modeling	10	1
	Item Design & Modeling	5	2
	UI Design	5	1
	Marker Design	2	4
Game Features	AR Scanner	2	1
	Question Features	2	4
Sound	Sound Effect Making	3	3
	Sound Implementation	1	3
Evaluation	Additions & changes to the application	5	5
	Bug-fixing	3	5
	Finishing	1	6

At the end of the sprint, we come up with a usable application. After the achievement of the sprint goal, the stakeholders update the Product Backlog for the next sprint based on the design.

3.2 Augmented reality development

The method used to develop AR in this project is based on a marker. It is needed to bring up the desired 3D object. Augmented reality markers can use a specific logo or image. The computer uses the marker to make the 3D objects appear. They are then stuck to the marker. The 3D object will also move to the marker position when the marker is moved. The flowchart of the application is depicted in Fig. 4.

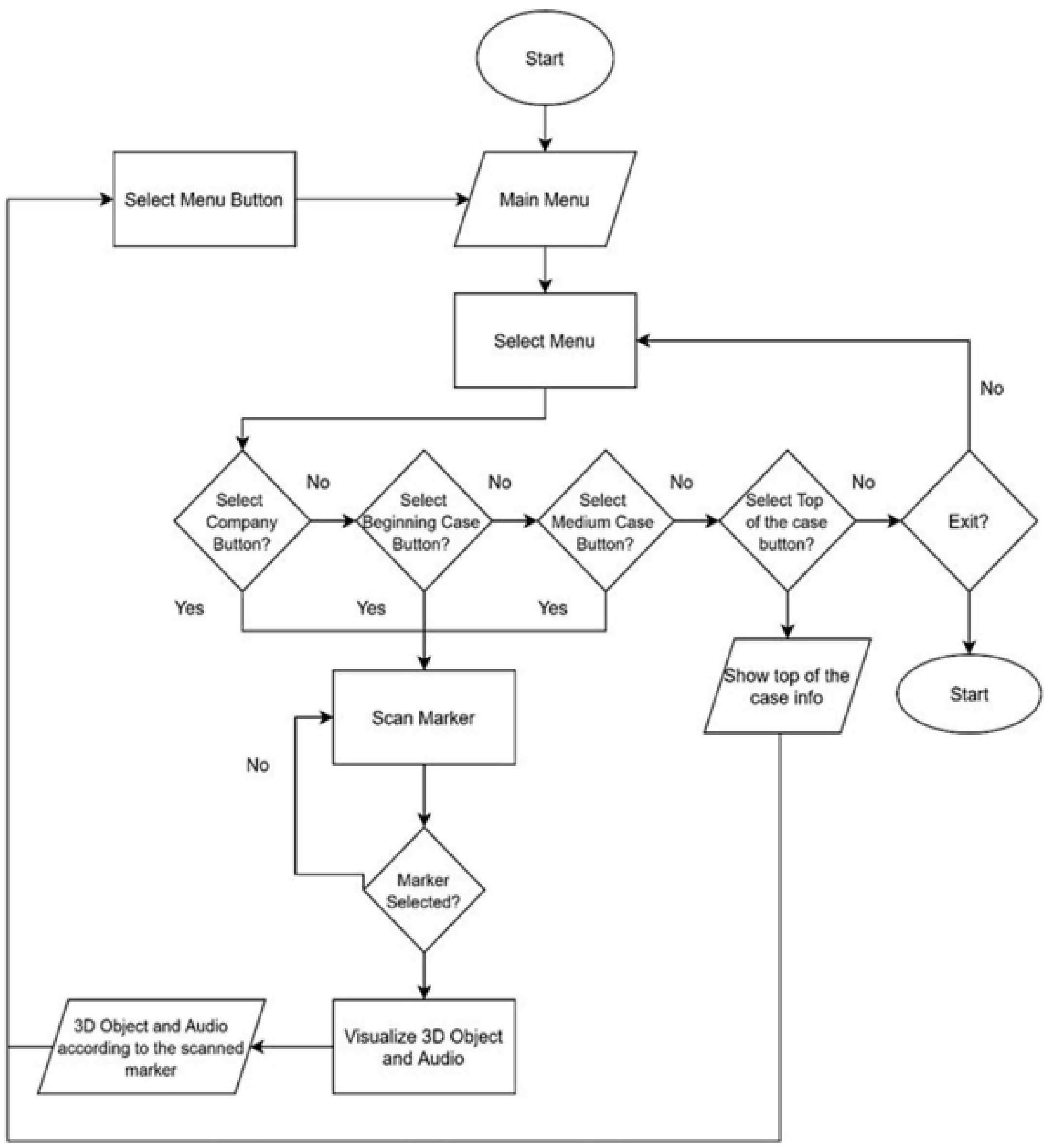


Fig. 4 Application flowchart

3.3 Use case diagram

The design of application functionality is modeled using case diagrams. A use case presents an interaction between actors and applications. Use Case Diagram is shown in Fig. 5 as follows.

As shown in Fig. 5, the application has one actor, namely User. The use case shows that users get every button except the "top of the case" button containing an AR scanner that can display a 3D animated dialogue and play a sound if it scans a specific marker.

3.4 System Specification and requirement

At the application development stage, we need a system capable of running the software used for application development. The specifications of the system in this study are given in Table 2.

In this application, there are several multimedia objects such as audio, animation, images, text, and 3d objects. To process all these objects, a fairly reliable system is needed. A system that has an AMD A12-9720P RADEON R7 processor with a memory capacity of 8192 RAM is sufficient to process all these objects and run the software used for making applications.

In addition, a compatible mobile phone is required for testing and debugging purposes. The specifications of the mobile phone used for testing and debugging the application in this study are presented in Table 3.

Additionally, various software are used for application development. They are:

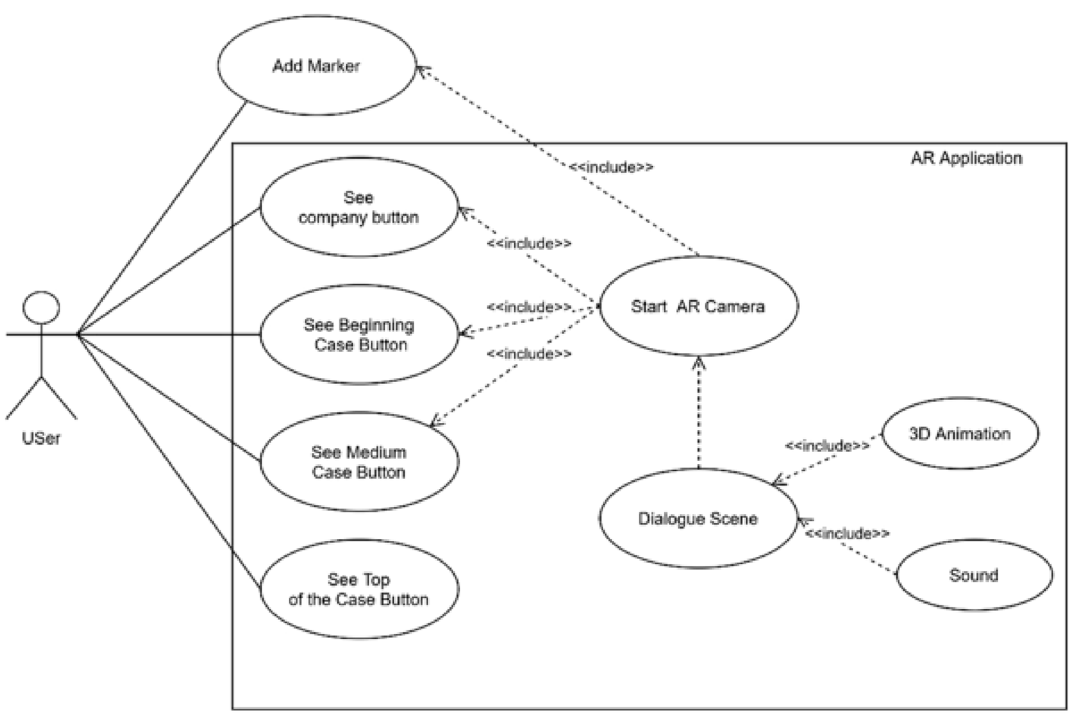


Fig. 5 Use case diagram

Table 2 System specifications

Windows edition	Windows 10 Home Single Language
Processor	AMD A12-9720P RADEON R7, 12 COMPUTE CORES 4C + 8G (4 CPUs), ~ 2.7 GHz
Installed Memory	8192 MB RAM
System type	64-bit Operating System

a. Unity 2019.4.5f1

Unity is an engine used for video game development for PCs, consoles, mobile devices, virtual reality and augmented reality, and websites in 2D and 3D. Unity machines are used because they are cross-platform possible. In this research, the unity machine used in Unity 2019.5.5f1. The script language used in application development is C#; some of the assets used in this study have been taken from Unity's asset warehouse while others have been designed.

b. EasyAR

EasyAR is an AR software development kit (SDK) for developing applications based on augmented reality technology. Easy AR detects markers using computer vision technology. The markers used can be in the form of planar images or simple 3D objects in real-time. This feature allows users to place and position virtual objects and 3D models regarding the target image to observe the results via a mobile device with a camera. Virtual objects displayed on mobile devices appear to be real to the original.

In order to use this application, users must have a smartphone that meets the requirements as described in Table 4.

3.5 Black Box Test

Black Box Test is a test to observe the program execution results through test data and check the software's functionality. The test evaluates the interface and the functionality without checking the code structure and design of the software. The Black box testing method is an easy-to-use technique because it only requires a lower and upper limit of the expected data. The approximate amount of test data can be calculated by the number of data entry fields to be tested, the entry rules that must be met

Table 3 Mobile phone specifications

No	Mobile Phone	Processor	RAM (GB)	Rear Camera (MP)	OS
1	Lenovo K4 Note	Octa-core 1.3 GHz	3	13	Android 5.1.1 (Lollipop)
2	Sony Xperia XZs	Quad-core (2×2.15 GHz Kryo & 2×1.6 GHz Kryo)	4	19	Android 7.1 (Nougat)

Table 4 Minimum requirements of the smartphone used to run the application

Operation System	Android 5.0 'Lolipop' (API level 21) or Higher
Memory	2 GB RAM or Higher
Storage	148 MB (after Installation)
Network	No internet connection required

and the upper and lower case limits are fulfilled. With this method, it can be seen if the functionality can still accept unexpected data input and whether it causes the stored data to be less valid (Mustaqbal et al., 2015).

After the m-AR was completed, we test whether to potential users are willing to use it. We invite potential users, namely faculty members to join the online seminar on "Teaching Ethics using Augmented Reality". The topics discussed in the seminar were: 1) Understanding Augmented Reality, 2) Learning style of Z and Millennial generations, and 3) m-AR: what and how to use it. After the seminar, we distributed a set of questionnaires which consist of perceived ease of use, perceived usefulness, attitudes toward m-AR, and intention to use m-AR to fill in by the participants. The questionnaires (see Appendix) are adapted from Kuo and Yen (2009). The data was analyzed using Warp PLS 3 to test the Structural Equation Model in Fig. 1.

4 Results

4.1 Features of the application

The results of the application development is a menu page with several scenes in different places.

Figure 6 illustrates the beginning menu page that describes the office situation (in one of the rooms), and there is a 3D object that will later act as the User. On the Start page, there is a menu button in the middle of the page. When pressed, the application will open an introduction page.

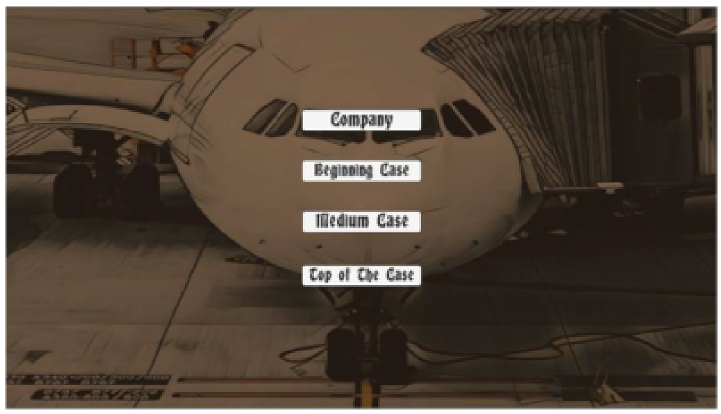
The main menu shown in Fig. 7 shows four buttons and each button will open a different page. The "Company" button will open a page containing the AR scene and information related to the company. The "Beginning Case" button will open a page containing an AR Scene about the case's initial events, the User's decision page, and the consequence of the User's decision. Next is the "Medium Case" button which will open a page containing conversations between the User and the Commissioner of the SOE. The last button is the "Top of the Case" button which includes the Indonesian Stock Exchange question page for the User and a reflection page.

Figure 8 depicts the scene related to information about the company described by the company in the form of a 3D object. It describes the history of the company, its businesses, etc.

Figure 9 is the scene that appears when the User presses the "Beginning Case" button and scans the second marker. The scene is related to the discussion between

Fig. 6 Beginning menu

Fig. 7 Main menu



the User and the SOE's CEO about SOE's financial statements. At the end of the scene, the user is asked to decide on the decision page.

On the decision page as shown in Fig. 10, the User is asked to select whether s(he) agrees or disagrees. If the User selects 'agree', it will proceed to the "Medium Case". If the User selects 'disagree', the application will open the consequence of the decision that has been taken.

Figure 11 is the page when the User selects not to accept the CEO's request. This page contains an explanation of the consequences based on the decisions made by the User.

Fig. 8 Company exposure

Fig. 9 Scene of the CEO

Fig. 10 Decision page

Figure 12 is the scene that appears when pressing the "Medium Case" button and scanning markers 2 and 3. This scene contains a dialog between the User and the Commissioner. They discuss the financial condition of the SOE.

Figure 13 illustrates the page containing questions from the Indonesian Stock Exchange Authority to the User. The User is required to answer all the questions and once they are completed, the application will display the Impact decision page and subsequently, the reflection page.

The 'Decision impact' page as illustrated in Fig. 14, contains the impact of the decisions that the User has made using the application on the company as well as various stakeholders viz. shareholders, company employees, the government, and the people of Indonesia.

Fig. 11 Disagree page

Fig. 12 Scene of commissioners of the SOE and the user

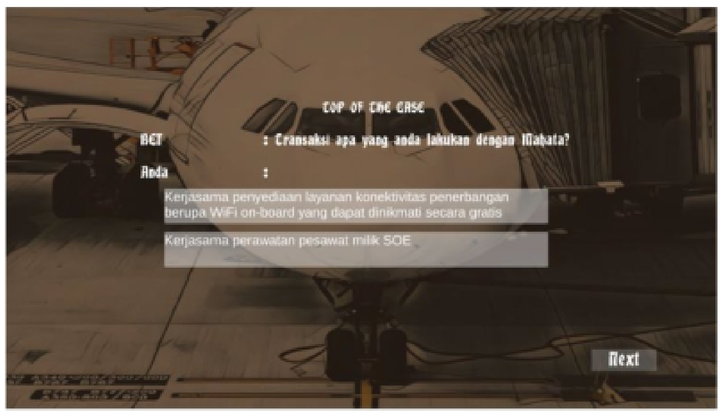


Fig. 13 Indonesian stock exchange page

The last one is the ‘Reflection’ page as shown in Fig. 15. This page contains an explanation of what actually happened in the case of SOE including the name of the parties involved and what they did.

4.2 Black box testing results

The black box stage is to observe the program execution results by testing the data and checking the functionality of the software. In the testing process, the researchers collected data from 9 respondents who have vast teaching

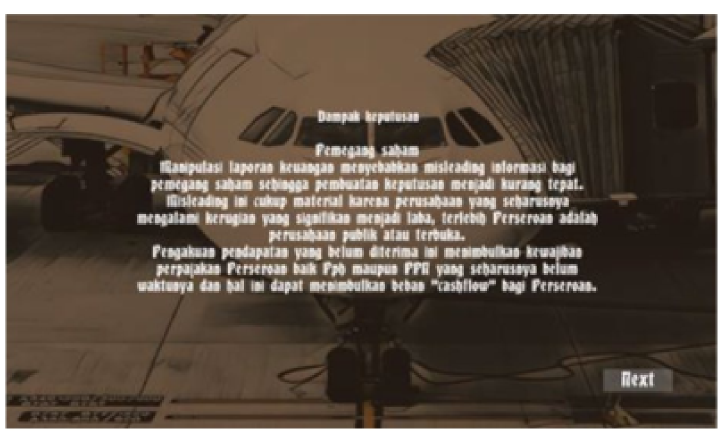


Fig. 14 Decision impact page

Fig. 15 Reflection page

experience to participate in application testing so that the data obtained were more accurate.

The tested aspects of the application were as follows:

1. Page View

   Testing on this aspect aims to find out whether each page has been displayed correctly without any interruption.
2. Sound on the application

   The aim of testing this aspect is to find out whether the voice of the conversation, button sound and background music from the application can be heard clearly without any other noises.
3. Menu button

   The test conducted on the buttons in the application is aimed to check if the buttons are operating properly and executing the command given without any problems.
4. Augmented reality camera

   Testing on this aspect seeks to check whether the AR camera is running well, scan markers without any issues, and display the AR animation on the scanned marker.
5. Augmented reality marker

   In this aspect, testing is carried out to determine whether the marker can be scanned by the AR camera and correctly display the image according to the selected menu.
6. Question feature

   Testing on this aspect aims to check whether the questions feature is functioning properly.

   Table 5 presents the results based on the tests conducted on nine respondents on those six aspects.

Table 5 Black box testing

System Feature	Expected Result	Actual Result
Page View	page can be displayed properly without interruption	Pass
Sound	voice of the conversation, button sound, and background music from the application can be heard properly and there is no accumulation of other sounds	Pass
Button	button is running properly and able to execute the command given without any problems	Pass, With some improvements
Augmented reality camera	AR camera is running well and can scan markers without any problems and is able to display AR animation on the scanned marker	Pass, With some improvements
Augmented reality marker	the marker can be scanned by an AR camera and the marker displays the image according to the selected menu	Pass, With some improvements
Question feature	The question feature is functioning properly	Pass

4.3 System usability evaluation

Before the application is released, the application is evaluated involving potential users. In this study, the application developed was evaluated twice. The evaluation method used to assess the usability of the application is using the System Usability Scale. System Usability Scale (SUS) is a questionnaire to measure perceived usability developed by Brooke (2013). It was developed with the idea of allowing respondents to express their agreement or disagreement with the application. The scale provides both positive and negative items to account for biases from the lack of attention while completing it (Brooke, 1996). The final score is on a scale of 0 – 100. This simple scale was shown to be reliable across numerous sample sizes compared to other usability scales such as the Questionnaire for User Interface Satisfaction (QUIS) and Computer System Usability Questionnaire (CSUQ) (Tullis & Stetson, 2004). The questionnaire contains ten questions which are given to the same nine respondents, both for pre- and post-tests. After collecting the data from the respondents, the data was then analysed. The overall average SUS score is determined by adding up each respondent's score and dividing it by the number of respondents. The following is the formula for calculating the average SUS score (1):

$$\bar{x} = \frac{\sum x}{n} \quad (1)$$

where:

$\bar{x}$ Average score
Σ SUS score total
n Number of respondents

The grade and adjective rating of the average SUS score is presented in Table 6 below (Bangor et al., 2008)

The questionnaire's answers are based on a 5-point Likert scale with 1 indicating strongly disagree, 2 means disagree, 3 means somewhat agree, 4 means agree, and 5 means strongly agree. The questionnaires is given to 9 respondents for pre-test and pos-test phase. Before filling out the questionnaires, the respondents were asked to use the application first. The results of the questionnaire filled out by the respondents can be seen in Table 7.

Table 7 shows the results of pre-test and post-test SUS scores. The pre-test score is the SUS value when the application is first released, while the post-test score is the SUS value after the application is improved. The results of the questionnaire show that during the pre-test, the application gets a SUS score of 80.00, which means that the

Table 6 SUS calculations

SUS Score	Grade	Adjective Rating
>80.3	A	Excellent
68%—80.3	B	Good
68	C	Okay
51—68	D	Poor
<51	F	Awful

Table 7 Validation: pre-test and post-test SUS score

No	Questions	Average SUS Score (Pre-test)	Average SUS Score (Post-test)
1	I will use this application again	75.00	87.50
2	This app is complicated to use	67.50	77.50
3	This application is easy to use	82.50	85.00
4	I need technical assistance to use this application	77.50	80.00
5	The functions in this application are well integrated	62.50	85.00
6	There are lot of inconsistencies in the application features	60.00	75.00
7	In my opinion, this application will be quickly learned by many people	77.50	87.50
8	This application is difficult to use	70.00	87.50
9	I feel confident when using this application	75.00	80.00
10	I have to learn many things in order to use this application	72.50	72.50
	Average SUS Score	80.00	90.27

application is good to use. However, after the application improved, the post-test score of SUS is 90.27, which means that the application is excellent to use.

4.4 Hypotheses testing

This study has five hypothesizes which is summarized in Fig. 1. The hypotheses are: perceived ease of use positively affects perceived usefulness of m-AR (H1), perceived ease of use has a positive influence on the attitude towards m-AR (H2), perceived ease of use has a positive effect on the intention to use m-AR (H3), perceived usefulness has a positive influence on the attitude towards use of m-AR (H4), and perceived usefulness positively affects behavioral intention to use m-AR (H5).

To test the hypotheses, we employ structural equation modelling (SEM) and test it using WarpPLS 3.0. SEM is often named the second generation of regression (Hair et al., 2013) as it can analyze various regression simultaneously. PLS covers both measurement and structural models. The measurement model assesses the reliability and validity of the measures (indicators) of specific constructs, whilst the structural model examines the relationship between constructs.

4.4.1 Measurement model analysis

This study's measurement analysis reveals that all measures are significant and above 0.60 loading level, indicating that the measures share more variance with their respective construct than with the error variance (See Table 8).

Table 8 indicates that all the measures meet the convergent validity as all the measures loaded above 0.60 on its expected construct and the discriminant validity because the cross loading of all the measures on other constructs is all below 0.60.

Table 8 Combined loading and cross-loading

	PEU	PU	Attitudes	Intention	SE	P value
PEU_1	**0.951**	-0.129	0.079	-0.073	0.120	<0.001
PEU_2	**0.951**	0.129	-0.079	0.073	0.103	<0.001
PU_1	0.035	**0.915**	-0.208	0.141	0.118	<0.001
PU_2	-0.020	**0.932**	-0.176	0.057	0.102	<0.001
PU_3	-0.015	**0.898**	0.394	-0.203	0.095	<0.001
Att_1	-0.004	0.116	**0.926**	-0.156	0.073	<0.001
Att_2	-0.002	-0.051	**0.922**	-0.009	0.069	<0.001
Att_3	0.007	-0.068	**0.896**	0.171	0.118	<0.001
Int_1	0.002	0.268	-0.255	**0.911**	0.157	<0.001
Int_2	0.032	0.197	-0.056	**0.903**	0.150	<0.001
Int_3	-0.051	-0.695	0.466	**0.606**	0.188	<0.001

Bold is to show the highest loading factor value in each column

4.4.2 Structural model analysis

The structural model is used to test the hypothesized relationship. The results of the structural model is presented in Fig. 16. The figure shows that PEU positively and significantly affects PU. Therefore hypothesis 1 is supported. PEU however does not affect attitudes and intention. Therefore hypotheses 2 and 3. The figure shows that PU positively and significantly affects attitudes but does not affect intention with PU. Therefore, it supports hypothesis 4 but does not support hypothesis 5. Finally the figures shows that attitudes positively and significantly affects intention. Based on the results, it can be said that the effect of PEU on intention to use is indirect via PU and attitudes.

Our results are partly consistent with previous studies on behavioral intention to use other technologies, such as learning management systems (Alharbi & Drew, 2014), consumer-generated media for travel planning (Ayeh et al., 2013), computers in the workplace (Fagan et al. (2008), m-payment (Kim et al., 2010), online learning community (Liu et al., 2010), mobile banking (Luarn and Lin (2005), enterprise resource planning systems (Calisir et al. (2009), 3G mobile value-added services (Liu et al., 2010), and mobile phone for purchase (Agrebi & Jallais, 2015).

5 Conclusion and suggestion for future research

This project's main objective is to develop Augmented Reality-based accounting ethics learning media to respond to millennials' learning preferences and Z generation who have started entering college. Additionally, this study examines whether potential users, namely faculty members of Indonesian universities, intent to use the application and whether the intention is affected by perceived ease of use and perceived usefulness of the application. Augmented reality applications are needed to improve the learning process as they can be used as interactive case learning so that users do not get bored and can enhance their

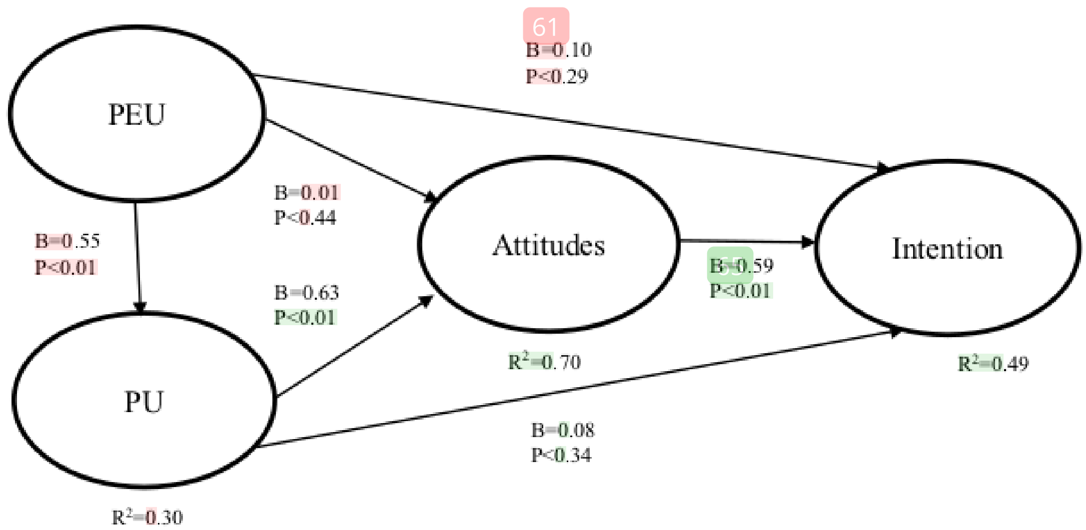


Fig. 16 The results of the structural model

understanding more effectively. In this project, the development of the media uses the SCRUM method. In the SCRUM framework, there are 4 stages: Product Backlog, Sprint planning, Sprint Backlog, and Sprint Review. The System Usability Scale (SUS) is used to measure perceived usability. The result of the final SUS score is 90.27, which means the application is excellent to use. The study also finds that the users have a high intention to use the application and the intention is affected by the perceived ease of use via the perceived usefulness of the application and the attitude towards the application. Future work may improve the quality of the AR application developed in this study and/or develop other AR-based applications using other cases. Additionally, a future study may develop more interactive learning media, such as the one based on virtual or immersive reality using the same case in this study or other cases. Finally, further research can test whether the interactive features of AR-based ethics learning media affect students' cognitive style and attitudes.

Appendix. The questionnaires

PEU

1. Learning to use m-AR is very simple.
2. It is extremely easy to be familiarized with the use of m-AR.

PU

1. Using m-AR can increase the efficiency of teaching business ethics.
2. Using m-AR can help me accomplish tasks in teaching business ethics.
3. Using m-AR can provide me useful media in teaching business ethics.

Attitudes

1. I think using m-AR to help me teaching business ethics is a good idea.
2. I think using m-AR is a good idea
3. Generally speaking, I like the idea of m-AR.

Intention

1. I plan to use m-AR in the future.
2. If possible, I will try to use m-AR.
3. I will try to use m-AR of necessary in teaching business ethics.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27

PAGE 28