The International Journal of Management Education 18 (2020) 100428

Contents lists available at ScienceDirect

The International Journal of Management Education

journal homepage: www.elsevier.com/locate/ijme

Teaching Resource

A new way of teaching business ethics: The evaluation of virtual reality-based learning media☆

Mahfud Sholihin [a], Ratna Candra Sari [b,*], Nurhening Yuniarti [c], Sariyatul Ilyana [a]

[a] Faculty of Economics and Business of Universitas Gadjah Mada, Indonesia, Bulaksumur, Yogyakarta, Indonesia
[b] Faculty of Economics of Universitas Negeri Yogyakarta, Karangmalang, Yogyakarta, Indonesia
[c] Faculty of Engineering of Universitas Negeri Yogyakarta, Karangmalang, Yogyakarta, Indonesia

ARTICLE INFO

Keywords:
Learning media
Virtual reality
Business ethics
Ethical efficacy
Self-efficacy

ABSTRACT

Business schools have challenges in internalizing ethical values in business because of the gap between ethical theories and their application in the real world. Learning activities using real situations involve high costs, lack infrastructure, and are too risky. Therefore, the virtual environment will help students understand the actual context. This study aims to evaluate learning media based on virtual reality (VR) for teaching business ethics. VR-based learning media is implemented for accounting students who take business ethics course at the Faculty of Economics, Yogyakarta State University, Indonesia. The results show that virtual-reality based media make the learning process motivating, interesting, and increases perceived learning effectiveness. Furthermore, VR-based learning media can increase the level of ethical efficiency of individuals by increasing their self-efficacy. This research contributes to the learning of business ethics by developing VR-based learning media to improve students' abilities in dealing with ethical dilemmas.

1. Introduction

Education currently faces the challenge of adapting to very rapidly changing environments due to technological developments. Currently, the millennials and Z generations have entered the world of higher education. Indeed, they are native digitals who grew up in the digital age instead of acquiring digital knowledge as adults (Palfrey & Gasser, 2011). Technological developments affect the evolution of learning styles from verbal, visual to virtual (Proserpio & Gioia, 2007), therefore educators need to adopt new teaching methods to connect with students (Wankel, 2009). Unfortunately, most educators are reluctant to change and they teach using the same pedagogical methods as they did 20 years ago (Montiel, Delgado, Natalia, Mandojana, & Antolin, 2020). Matulich, Papp, and Haytko (2008) and Montiel et al. (2020) show that for millennial and Z generation, learning is more effective when using interactive learning, demonstration, and social networking than using traditional lectures. The educational community has concerns about the implications of the shift in progressive learning styles, so increasing learning through technology adoption must remain the goal of

☆ We would like to thank Deputy for Research and Development, Ministry of Research and Technology. Research grant number 2988/UN1.DITLIT/DIT-LIT/PT/2020.

* Corresponding author. Universitas Negeri Yogyakarta, Jl. Colombo No. 1, Caturtunggal, Depok, Sleman, Daerah Istimewa Yogyakarta, Indonesia.

E-mail addresses: mahfud@ugm.ac.id (M. Sholihin), ratna_candrasari@uny.ac.id (R.C. Sari), nurhening@uny.ac.id (N. Yuniarti), sariyatul.ilyana@mail.ugm.ac.id (S. Ilyana).

https://doi.org/10.1016/j.ijme.2020.100428
Received 22 April 2020; Received in revised form 26 July 2020; Accepted 30 September 2020
Available online 20 October 2020

educators.

The efforts of business schools to instill ethical values in students are replete with challenges. Wang and Calvano (2015) find empirical evidence that students who experienced ethics education did not have better moral judgment when faced with ethical dilemmas than students who did not experience ethics education. Some obstacles in ethics education include the gap between ethics theories and their application in the real world (Raman, Swapnil, & Thapliyal, 2019). These are due to some learning activities being difficult to implement in real environments because of high costs, lack of infrastructure or simply being too risky. New technology platforms such as mobile apps and virtual simulation offer the possibility of imitating real-world complex processes and systems (Loon, Evans, & Kerridge, 2015; Ralhan, 2016; Salas, Wildman, & Piccolo, 2009), which are difficult to replicate using traditional educational material such as lectures or case studies. Virtual technology gives students a deep learning experience because there are three basic features of virtual technology: immersion, imagination, and interaction (Ralhan, 2016).

This study is particularly relevant to respond to recent situation caused by the COVID-19 pandemic. This is because virtual technology is able to introduce practical knowledge to the class without leaving it. Additionally, shifting from a physical classroom learning environment to a virtual learning environment can provide real-time visualization and interaction in a virtual world that is very similar to the real world (Chuah, Chen, & Teh, 2010), and students can get practical knowledge without leaving home. Therefore, virtual technology can be one of the learning media to keep study at home during the pandemic crisis.

Virtual Reality (VR), as one type of virtual technologies, can help students understand abstract topics and increase student motivation (Makransky & Lilleholt, 2018) as well as having a positive impact on the learning outcomes of students' behavior skills training (Çakiroglu & Gökoglu, 2019). A growing number of recent studies examine the potential use of virtual reality technology at the university level: VR improves perceived learnings effectiveness (Zhang et al., 2017), enhances students' learning outcome and interest in environmental education (Su, 2018), immersion in VR impacts perceived learning outcomes in learning biology (Makransky, Bonde, et al., 2016), persuasive technology in the form of video games and virtual reality changes attitudes and/or behaviors in the area of health care (Chow, Susilo, Phillips, Baek, & Vlahu-gjorgievska, 2017), and improves fire safety behavioral skills (Çakiroglu & Gökoglu, 2019). However, research on the effectiveness of VR-based learning in the field of business ethics is scarce. This research fills the gap to evaluate the use of virtual reality-based learning media as a new way of teaching business ethics.

The main aim of this study is to test the effectiveness of virtual reality-based learning on students' ethical efficacy and non-cognitive outcome. Ethical efficacy is worth studying because it affects persistence in setting ethical goals and in dealing with ethical dilemmas (Chou, Yang, & Chiu, 2016; Schwarzer & Jerusalem, 2010). Further, a person with high ethical efficacy has persistence in upholding ethical principles (Schwarzer & Jerusalem, 2010) and in performing ethical behavior and actions (Huang & Lin, 2019; Mitchell & Palmer, 2010; Nelson, Poms, Wolf, Nelson, & Wolf, 2012). For the non-cognitive outcome, we measure the user experience and perception of learning effectiveness using VR.

We conducted this study in Indonesia, a country with the 4th biggest population (265 millions) in the world (World Bank, 2019) and 33.75% of them are millennial generations (BPS, 2018) (Badan Pusat Statistik, 2018). However, Indonesia is in the 2nd quartile of the most corrupt countries. It is ranked 89th in 2018 and 85th in 2019 among 180 countries surveyed with the Corruption Perception Index (CPI) score of 38 and 40 out of 100 in 2018 and 2019, respectively. Corruption is widely agreed to be unethical behavior. The results of this study may contribute to reducing this unethical behavior in the future.

2. Literature review

2.1. Virtual reality

The digital native generation provides greater potential for the development of educational games based on technology. Educational games based on technology are also often referred to as educational games or serious games because the purpose is not only to entertain, but also to learn at all levels (Afari, Aldridge, Fraser, & Khine, 2013; Annetta, Cheng, & Holmes, 2010; Whitton, 2012). Proserpio and Gioia (2007) state that the development of internet and game technology encourages educators to explore some implications of a progressive shift from verbal to visual to virtual approaches to learning because effective learning occurs when student learning styles are aligned with classroom teaching styles. Virtual reality is a technology that is able to answer the challenges of shifting learning styles of the digital native generation.

Virtual Reality (VR) can be defined as n interactive computer simulation, which senses the user's state and operation and replaces or augments sensory feedback information to one or more senses in a way that the user gets a sense of being immersed in the simulation or virtual environment (Mihelj, Novak, & Beguš, 2014). Virtual reality also can be defined as a simulation technology that aims to immerse the user in a virtual environment so that they feel "there", feeling and behaving as if the user were in a virtual environment. VR immerses users in a way that presents the users' senses, mainly visual and auditory, and possibly haptic, with an illusion of reality (Sanchez-Vives & Slater, 2005).

The main advantage of learning with VR is that it emphasizes immersion, interaction, and imagination (Zhang et al., 2017). Immersion consists of two things: physical immersion and mental immersion (engagement). Physical immersion is feeling physically present in the non-physical world, whilst mental immersion refers to involvement as well as a sense of 'being' in the task environment. Interaction means that users can see the change on-screen activity through their input (i.e., movement) and instantly respond to the new activity. Imagination means that the VR environment triggers the human mind's capacity to understand and imagine the creative sense. According to the value control theory of achievement emotions (Pekrun, 2016), immersion increases positive values on task and object learning.

As an interactive technology, VR has three roles: (1) as a tool, VR is able to present interesting visual and audio information so that

it is easy to understand; (2) as a medium, VR makes it possible to explore the cause and effect relationships of events or actions, provide motivating experiences, and facilitate behavioral training; (3) as a social actor, VR can provide rewards to users through positive feedback which helps shape the attitudes or behavior of the target (Chow et al., 2017).

VR has at least three main characteristics: first, VR provides experience. VR makes it possible to re-create the real world as it is or to create a whole new world, providing experiences that can help people to understand concepts and learn to do certain tasks, where they can be repeated as often as needed and in a safe environment (Yusoff, Zulkifli, & Mohamed, 2011). Examples of the use of VR are for training for surgeons (Francis, Bernard, Nowak, Daniel, & Bernard, 2020), firefighters (Çakiroglu & Gökoglu, 2019), negotiation training (Ding, Brinkman, & Neerincx, 2020), and health care training (Chow et al., 2017). In a VR-based learning environment, the learning experience in skills training is obtained by providing a virtual environment that is similar to real-life situations (Huang, Rauch, & Liaw, 2010; Yusoff et al., 2011).

Second, in addition to providing experience, VR is also able to provide feedback for persuasive purposes. Chittaro and Zangrando (2010) tested personal awareness on fire safety issues and behavior changes, namely not to smoke in buildings. Immersive VR is an effective platform to change behavior so as not to smoke in buildings. Third, VR as a learning tool aims to improve, motivate, and stimulate the understanding of participants. VR allows students to actively become part of the learning and review process (Yusoff et al., 2011).

Previous studies have found that VR simulations have an effect on improving cognitive (Bonde et al., 2014; Lee & Wong, 2015) and non-cognitive performance (Makransky, Bonde, et al., 2016; Makransky, Thisgaard, & Gadegaard, 2016; Thisgaard & Makransky, 2017). Several studies have found that immersive virtual training procedures improve cognitive performance in the fields of engineering (Alhalabi, 2016), military (Webster, 2016) and robotic surgery (Bric, Lumbard, Frelich, & Gould, 2016). A study by Merchant, Goetz, Cifuentes, Keeney-Kennicutt, and Davis (2014) finds that students with VR-based and traditional-based learning experience have higher performance than students who experienced traditional learning only, Fig. 2-D, or without treatment.

Recent developments in motivation theory (Renninger & Hidi, 2016; Wentzel & Miele, 2016) show that understanding of how to utilize the appeal of e-learning tools is a major problem for learning and teaching. This is because situational interest in e-learning tools is the first step in improving learning performance (Renninger & Hidi, 2016). In addition, students' emotional reactions to instruction can have a large influence on academic achievements (Pekrun, 2016). Therefore, the approach used in this study is to investigate whether the use of immersion virtual technology impacts on non-cognitive and cognitive learning outcomes.

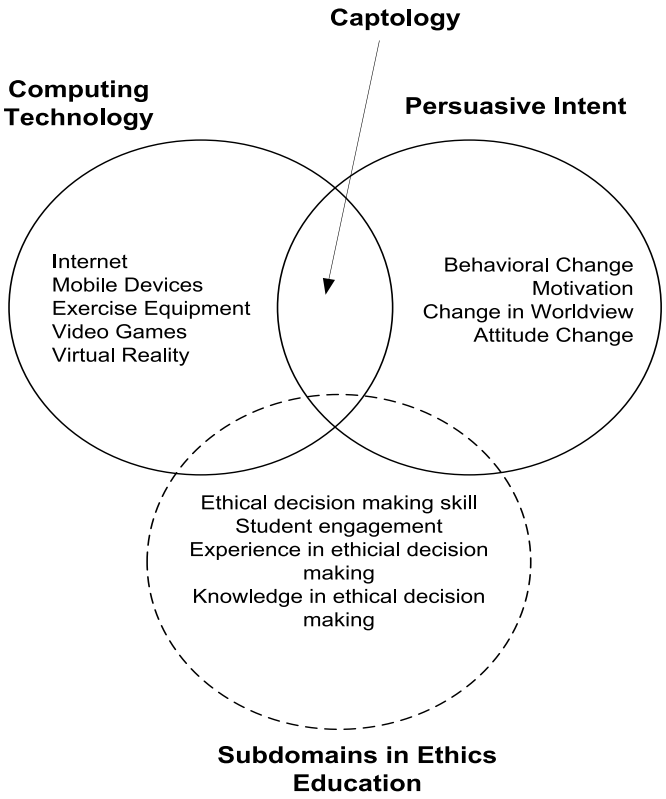

Fig. 1. Captology, the intersection between computing technology and persuasive intent.
Source: Modified from Chow et al. (2017).

2.2. Ethical efficacy

According to social cognitive theory (Bandura, 2001; Bandura & Locke, 2003), ethical efficacy reflects one's belief in their ability to maintain ethical motivation, set task focus, and manage themselves to deal with ethical issues (Hannah & Avolio, 2010; Mitchell & Palmer, 2010; Nelson et al., 2012; Youssef & Luthans, 2005). Mitchell, Palmer, and Schminke (2008) defined ethical efficacy as a person's belief in their ability to increase motivation, cognitive resources, and actions needed to behave ethically.

Ethical efficacy affects persistence in setting ethical goals, and determination in dealing with ethical dilemmas/obstacles (Chou et al., 2016; Schwarzer & Jerusalem, 2010). As a result, a person with high ethical efficacy has persistence in upholding ethical principles (Schwarzer & Jerusalem, 2010). Ultimately, ethical efficacy influences ethical behavior and actions (Huang & Lin, 2019; Mitchell & Palmer, 2010; Nelson et al., 2012). Gist and Mitchell (1992) examined the antecedents of ethical efficacy and found that experience, learning and feedback were determinants of self-efficacy, one component of ethical efficacy.

In the area of ethics education, ethical efficacy is used to measure the effectiveness of ethical learning. Fischbach (2015) tested the effectiveness of novel graphic-based business ethics training to improve ethical efficacy. Training effectiveness is measured by increasing self-efficacy with three sub-scales: (1) self-efficacy shows confidence in one's ability to control motivation, behavior, and social environment; (2) involvement reflects the assessment of the interests and usefulness of ethical education; (3) principle-based ethics (PBE) is an approach that focuses on the importance of ethical principles. The results show that the use of graphic novel media increases self-efficacy and principle-based ethics.

2.3. The influence of virtual reality on ethical efficacy

Technological developments encourage research in the field of captology. Captology is a field of research that explores the use of computing technology for persuasive purposes with their challenges and opportunities (Chow et al., 2017). Increased attention to Captology encourages the field of persuasive technology that has gained much interest and attention within the research community and practitioner (Fig. 1).

Persuasive technology (PT) is defined as interactive information technology, which is designed to intentionally change the attitudes and/or behavior of its users without fraud or coercion (Fogg, 2003). Persuasive technology has been used in several fields including the retail industry (Cronin, 1997), the military (Zyda, 2005), for training and education (Chittaro & Sioni, 2015; Orland et al., 2014), as well as for health care (Chatterjee & Price, 2009; Intille, 2004; Matthews, Win, Oinas-Kukkonen, & Freeman, 2016), and ethics education (Delacroix & Denvir, 2020; Ruggeroni, 2003).

One of interactive technologies is virtual reality (VR). Previous research found that VR enhances experience (Chow et al., 2017; Yusoff et al., 2011) and learning (Yusoff et al., 2011), and is able to provide feedback (Chittaro & Zangrando, 2010; Chow et al., 2017). These three components are important antecedents for increasing self-efficacy (Gist & Mitchell, 1992). Self-efficacy refers to belief in one's ability to mobilize motivation, cognitive resources, and actions needed to meet certain situational demands (Bandura & Wood, 1989). Ethical efficacy is self-efficacy related to situations of ethical issues. Several studies have examined the effect of using VR to improve self-efficacy.

VR training plays a role to improve mastery and learning experience, self-motivation, and allows users to actively participate in the learning process in a virtual environment, which ultimately increases people's self-efficacy. Ding et al. (2020) found that VR-based negotiation training improves self-efficacy. Wang and Hu (2017) found that applying virtual reality to adventure athletic education increased students' self-efficacy and team cohesiveness. Francis et al. (2020) tested the use of VR for surgery training for surgeons. The results showed that students who received VR-based surgical surgery training demonstrated a significant improvement in their self-efficacy compared to students that did not receive VR.

Several studies use VR for ethics learning. Jagger, Siala, and Sloan (2016) developed an immersive interactive game as a medium for learning business ethics. The study found that immersive interactive games are positively associated with transferring skills and knowledge in ethical decision making because it relates to real life. Ruggeroni (2003) states that the use of VR in ethical education is effective because VR is able to provide experience with creating a virtual world for students to practice making decisions in ethical dilemmas without deducing socially despicable effects. Students can learn, feel and observe potential consequences and take part in decision making to solve real problems. Delacroix and Denvir (2020) recommend considering the potential of VR technology when teaching ethics to future and current professionals. The use of virtual reality can offer students an unparalleled opportunity to reflect/receive feedback about the dissonance between behavior taken when confronted with ethical dilemmas, and the theoretical attitude they propose during class.

In summary, VR-based ethics learning provides useful experiences and effective learning for students in ethical decision making (Ruggeroni, 2003) and in providing feedback (Delacroix & Denvir, 2020). Those may affect ethical efficacy. Therefore, we hypothesize:

H1. There is a difference in ethical efficacy between groups who take ethics learning using VR versus those who do not use VR.

3. Research method

3.1. The study instruments

This study uses learning media developed by Research and Development Institute of the Yogyakarta State University and Center for

Accounting Education Faculty of Economics and Business, Universitas Gadjah Mada, Indonesia. The development of VR-based learning media using the Research and Development method consists of five steps: analysis, designing, development, implementation, and evaluation (Dick & Carey, 1996). In the process of developing the media, the researchers first conducted an analysis using data obtained from observations in the classroom and interviews with the faculty members. The results of the analysis became the basis for designing the learning media. The next stage was the development stage, in which the researchers arranged the storyboard, and developed the learning media based on it. After the product's development, the researchers implemented the learning media. The last stage in the media's development was evaluation.

In the evaluation stage we assessed non-cognitive and cognitive outcomes. The user experience and perception of learning effectiveness measure non-cognitive learning outcomes, while ethical efficacy is used to measure cognitive outcomes. Measurement of ethical-efficacy was adapted from Fischbach (2015), while user experience and perception of learning effectiveness measures were adapted from Dalgarno, Hedberg, and Harper (2002). User experience is measured by motivation and interest (Makransky & Lilleholt, 2018). Ethical efficacy measures the effectiveness of ethics training (Ferrell, 1996; Fischbach, 2015). Examples of user experience questions are: the ability to manipulate the objects (e.g: pick up, cut, change the size) within the virtual environment makes learning more motivating and interesting. An example of perceptions of the effectiveness of learning: I gained a good understanding of the basic concepts of the materials. All items were measured with a 7-point Likert scale, from 1 = strongly disagree to 7 = strongly agree.

3.2. The sampling approach

The learning media was implemented to accounting students who were taking business ethics course at the Faculty of Economics, Yogyakarta State University, Indonesia. When this study was conducted, there were two parallel business ethics classes. We offered the opportunity to participate as participants in this research to all the students in the classes. There were a total of 35 students registered to participate in this study; and then we assign them randomly to the treatment group (18 students) and to the control group (17 students).

3.3. The type of VR used

Ruggeroni (2003) categorizes VR into three types: 1) non-immersive (desktop): the images are delivered by a screen even if there are 3D images. It is the most common and inexpensive form of VR; 2) semi-immersive (projected): images and effects are projected on a wide big screen, immersion is increased but the level of interaction is affected; and 3) fully Immersive VR: this is the most expensive and the most famous VR. It requires special interfaces devices such as data glove and head couple visual displays unit. This study uses a semi-immersive VR type because students can interact with computers using their personal computers. Compared to the fully immersive VR method, semi-immersive VR has a medium level of interaction, medium to high sense of immersion, and less cost (Alqahtani, Daghestani, & Ibrahim, 2017). In addition, the semi-immersive VR system allows students to use their hands to scan, rotate, and zoom the 3D model (Tsandilas, 2003). Popescu (2008) argues that semi-immersive VR is the most appropriate for education.

3.4. The protocol of the experiment

The subjects were randomly assigned to the treatment and control groups. In the treatment group, participants were given VR-based ethics learning, whereas the control group participants were given ethics learning without VR. Each participant filled out a pre-and post-survey. In the pre-survey, the participants were asked to complete an ethical efficacy test.[1] After the pre-survey, the participants received a case related to ethical decision-making. Both groups received material from the same lecturer. The difference is that, besides being given the theory of ethics, participants in the treatment group were also using VR-based learning media. VR-based learning media contains behavior simulation scenarios with ethical dilemmas.

The scenario is based on ethical dilemmas situations that might be encountered by auditors; whether to choose to be a detector or to be ignorant of profit manipulation done by the auditee. Participants in this study acted as auditors. The auditor carries out audit work in accordance with the audit engagement letter. In carrying out the audit work there are several steps taken by the auditor: first, the auditor reviews the completion of the project. Fig. 2 shows the screenshots of the VR condition when the participant as the auditor is reviewing the completion of the project .

After reviewing the project, the auditor determines the level of project completion. In the second step, the auditor enters the accounting department to audit the financial statements, and to check whether the revenue recognition is in accordance with the level of the project completion (see Fig. 3).

The auditor found that there was a difference between the percentage of project completion and the revenue recognition reported. In accordance with accounting standards, companies must recognize revenue as much as the completed project. Participants experience ethical dilemmas. Whether to choose action A, detect earnings manipulation and ask the auditee to adjust the level of profit or action B, detect earnings manipulation but approve the client action. If the auditor chooses action A, the audit engagement is stopped and the auditor loses the client. If the auditor chooses action B, the auditor will continue the audit work and the client is still with him.

[1] We did not conduct a pre-test for non-cognitive measures (motivation and interest) because the participants have not used the VR learning media.

Fig. 2. Screenshot of the VR condition when the auditor reviews the completion of the project.

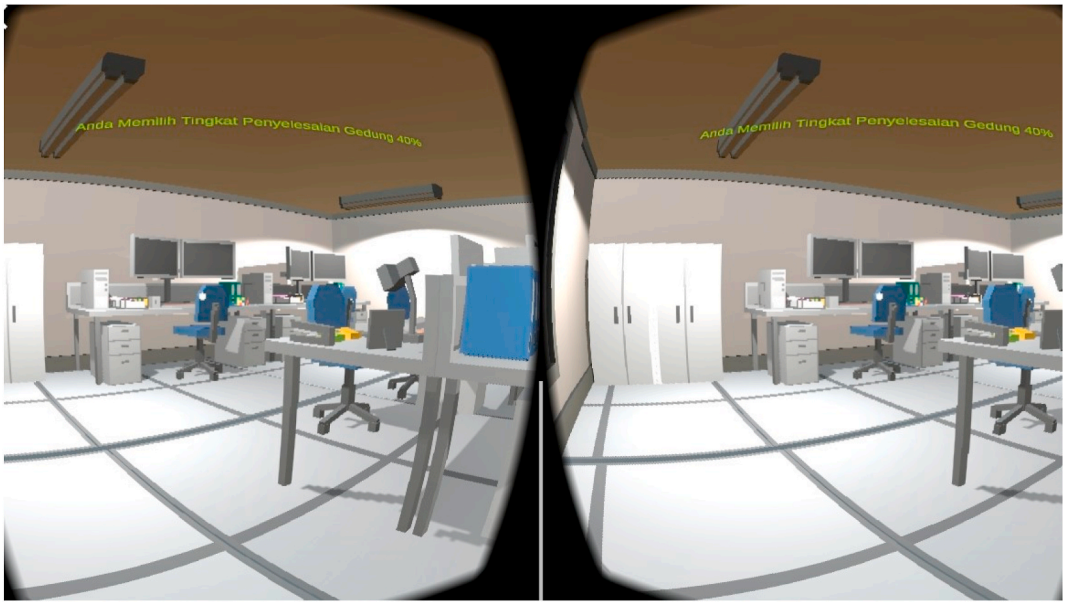

Fig. 3. Screenshot of the VR condition when the auditor enters the accounting department.

After making a choice, the auditor gets a visual picture of the impact of the actions chosen for the stakeholders.

After the ethics training, all participants in the treatment and control groups responded to the measurement of ethical efficacy. The final score of ethical efficacy is calculated by comparing the increase in scores (post-test minus pre-test) between the two groups. Additionally, the experimental group was also given a questionnaire about user experience and perception of learning effectiveness.

4. Results

The purpose of this research is to develop virtual reality-based learning media and to evaluate the effectiveness of its usage. The development process uses the ADDIE process (analysis, design, development, implementation, and evaluation phase). The design stage is presented in Fig. 4 which is a diagram that serves to explain the workflow.

This ethics learning media was developed on the ethical dilemma case experienced by an auditor, that is, the auditor is pressured by

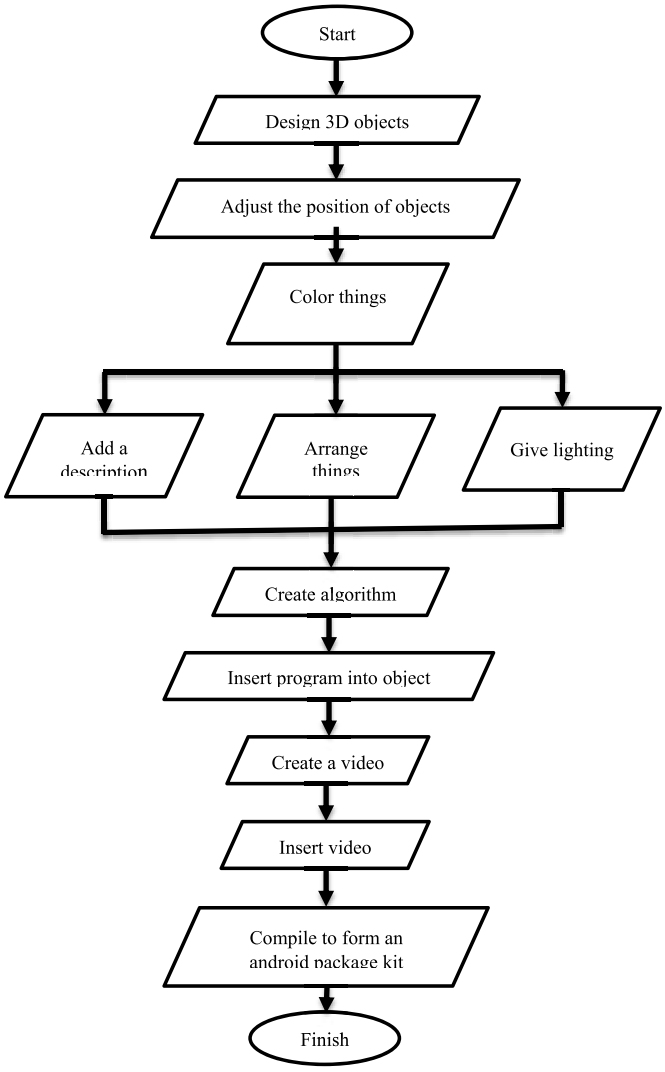

Fig. 4. Flowchart diagram.

a client to approve the practice of manipulating earnings: if the auditor rejected the client's wish the auditor loses the client. This case was reviewed by two professional auditors and two auditing faculty members. The display media is as follows:

1. The first display (Fig. 5) presents a general description of the client, a construction company that is building several large projects such as bridges, sports centers, and bridges.
2. The second display (Fig. 6) is an overview of the auditor's meeting with the board of directors of the client company. Participants, as the auditors, feel involving in meetings with the directors. The auditor feels pressure from the directors to approve the client's financial statements.
3. The third display shows the auditor signing the audit engagement and performing audit work. The auditor begins to review the percentage of project completion (see Fig. 7) and audit the company's financial statements.
4. The fourth display is the auditor experiencing an ethical dilemma on the choice to disclose actual conditions or to follow the directors' pressure to approve earnings manipulation practice (see Fig. 8).
5. The fifth display (not presented here) is participants get an overview of the consequences of ethical choices chosen.

Prior to the implementation, material and media expert validations were carried out, then revisions were made. Validation is carried out by two professional auditors and two auditing faculty members. The revision was related to audit procedures and the consequences received by the auditor if he approved the earnings manipulation. After the revision, the implementation was carried out on 35 accounting students who were taking a business ethics course. Table 1 shows the descriptive statistics of the participants.

Based on Table 1 we performed an analysis to examine whether age, work experience, and GPA of treatment group (group A, virtual

Fig. 5. Screenshot of the VR condition about Company overview.

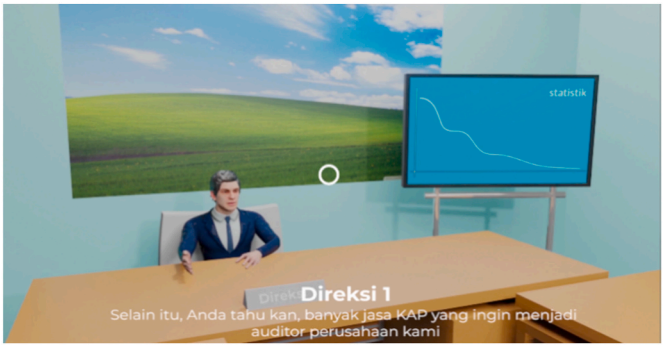

Fig. 6. Meeting room.

Fig. 7. Project completion.

reality) and control group (group B, no-virtual reality) are different. The results indicate there is no significant difference in age between the treatment and control groups (p-value = 0.45), there is no difference in work experience between the two groups (p-value = 0.19), and there is no difference in GPA (p-value = 0.68).

The final phase of this development process was evaluation. At this stage students were asked to assess their experience, perceptions

Fig. 8. Auditor meeting with the client.

Table 1
Descriptive statistics of participants' characteristics.

Training Format	Gender		Age		Work Experience		GPA	
	Male (%)	Female (%)	Mean	SD	Mean (year)	SD	Mean (out of 4)	SD
Virtual Reality (A)	11.11	88.89	20.50	0.86	3.06	0.65	3.67	0.49
No-Virtual Reality(B)	17.65	82.35	20.70	0.69	2.83	0.32	3.59	0.62

Table 2
Students' experience and perceptions of learning effectiveness using VR.

	Students' Assessments	
	Mean	Standard Deviation
User experience of VR	6.50	0.5
Learning Effectiveness VR	6.37	0.4

of learning effectiveness, and ethical efficacy. The results of the students' evaluation are presented in Table 2.

Table 2 shows, on average, students agree that using VR makes the learning process more motivating and interesting, and this is indicated by the high average value of user experience. Additionally, students agree that VR increases perceived learning effectiveness.

The next step is testing the effectiveness of the media to increase the ethical efficacy. This effectiveness test was carried out by testing differences in the increase of ethical efficacy between groups using VR relative to the control group.

All measured results showed improvement during the study period both in the group who experienced ethics learning using VR (treatment group) and those who did not (control group).

MANOVA[2] was used to compare the increase in ethical efficacy (and its dimensions) scores of pre and post-test. The results of our analysis are presented in Table 4.

ANOVA tests were first performed using the overall average score for variable ethical efficacy. This variable is used as a single measure. The result shows there is a significant difference in ethical efficacy between the treatment and control group ($F = 3.39$, $p = 0.07$). Therefore, H1 is supported. Furthermore, MANOVA [2]was used to test the improvement of ethical efficacy dimensions: self-efficacy, involvement, and principle-based ethics. Table 4 shows that there is a significant difference in the increase in self-efficacy between the treatment and control groups ($p < 0.05$). In the pretest (see Table 3) the average self-efficacy treatment group was 3.14 ($SD = 0.21$) and after getting VR-based ethics learning increased to 3.29 ($SD = 0.33$). Involvement and PBE were not significant.

5. Conclusion, limitations, discussion, and implications

5.1. Conclusion

Technological developments affect the evolution of learning styles from verbal to visual to virtual. It encourages educators to explore some of the implications of a progressive shift from visual to virtual approaches to learning, because effective learning occurs when student learning styles are aligned with classroom teaching styles. This research aims to evaluate the effectiveness of virtual reality-based learning media on business ethics learning.

[2] We used MANOVA instead of *t*-test as we test the three dimensions together (once), instead of one by one. We believe this approach gives us a greater statistical power.

Table 3
The Pre-Test and Post-Test results of the dimensions of ethical efficacy of the treatment group and the control group.

	Treatment				Control			
	Pre test		Post test		Pre-test		Post-test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Self-efficacy	3.14	0.21	3.29	0.33	3.28	0.21	3.35	0.24
Involvement	3.58	0.41	3.76	0.37	3.57	0.42	3.73	0.39
Principle-based ethics (PBE)	3.43	0.53	3.57	0.49	3.57	0.48	3.61	0.37
Number of Samples Observed	18		18		17		17	

Table 4
Result of MANOVA.

Effect	F-value	p-value
Overall Ethical Efficacy	3.39	0.07
Self-efficacy	5.95	0.02
Involvement	0.02	0.87
Principle-based ethics	0.21	0.65

On average, students agree that the experience of using VR makes the learning more motivating, interesting, and is able to increase learning effectiveness. Using multivariate analysis of variance (MANOVA), the result shows that applying virtual reality-based learning media increases the individual's level of ethical efficiency by improving their self-efficacy. This suggests that virtual reality-based as a learning tool would be useful to undergraduate students as a way to gain skills on dealing with ethical dilemmas.

5.2. Limitations

Despite the intention of this study to develop VR-based learning media, there are several limitations for this study. First, because of class size limitations, the sample size is small. Second, this learning only uses one scenario, that is, auditor's ethical dilemma. Future research should use several scenarios to see the effectiveness of learning. Third, the study did not compare the effectiveness of VR with other learning media. Future studies can compare the effectiveness of VR with other learning media such as augmented reality or 3D video.

5.3. Discussion

The results of this study indicate that using VR makes the learning process motivating, interesting, and increases perceived learning effectiveness. This supports previous research that VR increases non-cognitive performance (Makransky, Bonde, et al., 2016; Makransky, Thisgaard, & Gadegaard, 2016; Thisgaard & Makransky, 2017). Students' emotional reactions to VR media are the first step in improving learning performance (Renninger & Hidi, 2016). Supporting this argument, this research also found that applying virtual reality-based learning media increases the individual's level of ethical efficacy by improving their self-efficacy. This provides empirical evidence that VR enhances ethical efficacy in the field of ethics education, as in the field of training negotiations (Ding et al., 2020), in the field of surgical training (Francis et al., 2020), and in the field of athletic education (Wang & Hu, 2017).

We studied ethical efficacy as it is often used to measure the effectiveness of business ethics education (Fischbach, 2015). Someone with high ethical efficacy will be firm in holding ethical principles, which will ultimately affect ethical behavior. Indonesia is a country with a high level of corruption, so hopefully, VR-based ethical learning could be used as an option to reduce the level of corruption by increasing the ethical efficacy of students.

5.4. Implications

5.4.1. Theoretical implication

This research gives a subtle contribution based on the theory of persuasive technology in which VR is an interactive information technology, designed to intentionally change attitudes. The findings of this study support this view as VR-based ethical learning provides benefits in increasing ethical efficacy by increasing their self-efficacy.

5.4.2. Practical implications

This research also has implications for business ethics education in three important areas. First, the use of virtual technology-based media is likely to be more suitable to the learning styles of the new millennial generation; hence it can produce effective learning. This is evidenced by their perception that VR makes the learning process motivating and interesting, and increases learning effectiveness. Second, the finding of this study shows that VR-based learning media is an effective way to improve learning outcomes in the field of ethics education. This may encourage educational institutions to invest time and financial resources to design learning media that

improve the effectiveness of the learning environments. Third, the use of VR-based learning media is able to respond to recent crises caused by the COVID-19 pandemic. VR media can introduce practical knowledge to students without their leaving home. Shifting from a physical classroom learning environment to a virtual learning environment can provide real-time visualization and interaction in a virtual world that is very similar to the real world. Thus, virtual technology gives students a deep learning experience.

Credit authorship contribution statement

Mahfud Sholihin: Conceptualization, Supervision. **Ratna Candra Sari:** Investigation, Methodology, Writing original draft. **Nurhening Yuniarti:** Data Curation, Formal Analysis. **Sariyatul Ilyana:** Visualization, Resources, Review and Editing.

Declaration of competing interest

None.

Appendix. Questionnaire

Variables	Questions (In parentheses are the subdimensions)
Ethical Efficacy Scale	1. Making ethical decisions in an organization is well within the scope of my abilities (Self Efficacy). 2. I do not anticipate any problems making the correct ethical decision when working for an organization (Self Efficacy). 3. I feel confident that my ability to make ethical decisions equals or exceeds those of my peers (Self Efficacy). 4. My educational experience and accomplishments increase my confidence that I will be able to make the correct ethical decisions in an organization (Self Efficacy). 5. Ethics education is important (Self Efficacy). 6. Ethics education is of no concern to me (Self Efficacy). 7. Ethics education is irrelevant (Self Efficacy). 8. Ethics education means a lot to me (Self Efficacy). 9. Ethics education is useless (Involvement). 10. Ethics education is valuable (Involvement). 11. Ethics education is beneficial (Involvement). 12. Ethics education is not needed (Involvement). 13. Participating in principle-based ethics education could heighten my awareness of ethical issues and the complexity in reaching the correct decision (PBE). 14. I am motivated to learn more about principle-based ethics in the organization (PBE). 15. I believe it would be valuable for my organization to address principle-based business ethics education (PBE).
User experience	1. The realism of the 3D images motivates me to learn. 2. The smooth changes of images make learning more motivating and learning. 3. The realism of the 3D images helps to enhance my understanding. 4. The ability to change the view position of the 3D objects allows me to learn better. 5. The ability to change the view position of the 3D objects makes learning more motivating and interesting. 6. The ability to manipulate the objects (e.g: pick up, cut, change the size) within the virtual environment makes learning more motivating and interesting.
Perceived learning effectiveness	1. I am more interested to learn the topics. 2. I learnt a lot of factual information in the topic. 3. I gained a good understanding of the basic concepts of the materials. 4. I learnt to identify the main and important issues of the topics. 5. I am interested and stimulated to learn more. 6. I am able to summarize and conclude what I learn. 7. The learning activities was meaningful. 8. What I learnt, I can apply in real context.

References

Afari, E., Aldridge, J. M., Fraser, B. J., & Khine, M. S. (2013). Students' perceptions of the learning environment and attitudes in game-based mathematics classrooms. *Learning Environments Research, 16*(1), 131–150.

Alhalabi, W. S. (2016). Virtual reality systems enhance students ' achievements in engineering education. *Behaviour & Information Technology, 35*(11), 919–925. https://doi.org/10.1080/0144929X.2016.1212931.

Alqahtani, A. S., Daghestani, L. F., & Ibrahim, L. F. (2017). Environments and system types of virtual reality technology in stem: A survey. *International Journal of Advanced Computer Science and Applications, 8*(6).

Annetta, L. A., Cheng, M. T., & Holmes, S. (2010). Assessing twenty-first century skills through a teacher created video game for high school biology students. *Research in Science & Technological Education, 28*(2), 101–114.

Badan Pusat Statistik. (2018). Tingkat pengangguran terbuka berdasarkan tingkat pendidikan, 2015 - 2018. Jakarta. Retrieved from https://www.bps.go.id/dynamictable/2018/05/17 00:00:00/1321/tingkat-pengangguran-terbuka-berdasarkan-tingkat-pendidikan-2015—2018.html.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*(1), 1–26.

Bandura, A., & Locke, E. A. (2003). Negative self-efficacy and goal effects revisited negative self-efficacy and goal effects revisited. *Journal of Applied Psychology, 88*(1), 87–99.
Bandura, A., & Wood, R. (1989). Effect of perceived controllability and performance standards on self-regulation of complex decision making. *Journal of Personality and Social Psychology, 56*(5), 805.
Bank, W. (2019). *The World Bank in Indonesia*. Retrieved from https://www.worldbank.org/en/country/indonesia.
Bonde, M. T., Makransky, G., Wandall, J., Voldby, M., Larsen, M. V., Morsing, M., et al. (2014). Improving biotech education through gamified laboratory simulations. *Nature Biotechnology, 32*(7).
Bric, J. D., Lumbard, D. C., Frelich, M. J., & Gould, J. C. (2016). Current state of virtual reality simulation in robotic surgery training : A review current state of virtual reality simulation in robotic surgery training : A review. *Surgical Endoscopy* (January).
Çakiroglu, Ü., & Gökoglu, S. (2019). Computers & Education Development of fi re safety behavioral skills via virtual reality. *Computers in Education Journal, 133* (September 2018), 56–68.
Chatterjee, S., & Price, A. (2009). Healthy living with persuasive technologies: Framework, issues, and challenges. *Journal of the American Medical Informatics Association, 16*(2), 171–178.
Chittaro, L., & Sioni, R. (2015). Serious games for emergency preparedness: Evaluation of an interactive vs. a non-interactive simulation of a terror attack. *Computers in Human Behavior, 50*, 508–519.
Chittaro, L., & Zangrando, N. (2010). The persuasive power of virtual reality: Effects of simulated human distress on attitudes towards fire safety. *Lecture Notes in Computer Science*, 58–69, 6137 LNCS.
Chou, C., Yang, K.-P., & Chiu, Y.-J. (2016). Coupled open innovation and innovation performance Outcomes : Roles of absorptive capacity. *Corporate Management Review, 36*(1), 37–68.
Chow, Y., Susilo, W., Phillips, J. G., Baek, J., & Vlahu-gjorgievska, E. (2017). Video games and virtual reality as persuasive technologies for health Care : An overview. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 8*(3), 18–35.
Chuah, K. M., Chen, C. J., & Teh, C. S. (2010). Incorporating Kansei Engineering in instructional design : Designing virtual reality based learning environments from a novel perspective. *Themes in Science and Technology Education, 1*(1), 37–48.
Cronin, P. (1997). *Report on the application of virtual reality technology to education*. University of Edinburgh.
Dalgarno, B., Hedberg, J., & Harper, B. (2002). *The contribution of 3D environments to conceptual understanding* (pp. 149–158).
Delacroix, S., & Denvir, C. (2020). *Virtually teaching ethics. Papers.Ssrn.Com*. Modernizing Legal Education.
Dick, W., & Carey, L. (1996). *The systematic design of instruction* (ed.).
Ding, D., Brinkman, W. P., & Neerincx, M. A. (2020). Simulated thoughts in virtual reality for negotiation training enhance self-efficacy and knowledge. *International Journal of Human-Computer Studies, 139*(January), 102400.
Ferrell, L. K. (1996). *Gray matters ethics training: An evaluation*. Memphis, TN: University of Memphis.
Fischbach, S. (2015). Ethical efficacy as a measure of training Effectiveness : An application of the graphic novel case method versus traditional written case study. *Journal of Business Ethics, 128*(3), 603–615.
Fogg, B. J. (2003). *Persuasive technology. Using computers to change what we think and do*. San Francisco, CA: Morgan Kaufmann Publisher.
Francis, E. R., Bernard, S., Nowak, M. L., Daniel, S., & Bernard, J. A. (2020). Operating room virtual reality immersion improves self-efficacy amongst preclinical physician assistant students. *Journal of Surgical Education, 540*.
Gist, M. E., & Mitchell, T. R. (1992). Self-efficacy: A theoretical analysis of its determinants and malleability. *Academy of Management Review, 17*(2), 183–211.
Hannah, S. T., & Avolio, B. J. (2010). Moral potency: Building the capacity for character-based leadership. *Consulting Psychology Journal: Practice and Research, 62*(4), 291–310.
Huang, H., & Lin, C. (2019). Assessing ethical efficacy, workplace incivility, and turnover intention: A moderated-mediation model. *Review of Managerial Science, 13* (1), 33–56.
Huang, H. M., Rauch, U., & Liaw, S. S. (2010). Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. *Computers & Education, 55*(3), 1171–1182.
Intille, S. S. (2004). A new research challenge: Persuasive technology to motivate healthy aging. *IEEE Transactions on Information Technology in Biomedicine, 8*(3), 235–237.
Jagger, S., Siala, H., & Sloan, D. (2016). It's all in the game: A 3D learning model for business ethics. *Journal of Business Ethics, 137*(2), 383–403.
Lee, C. S., & Wong, K. Y. (2015). Development and validation of knowledge management performance measurement constructs for small and medium enterprises. *Journal of Knowledge Management, 19*(4), 711–734.
Loon, M., Evans, J., & Kerridge, C. (2015). Learning with A strategic management simulation game: A case study. *International Journal of Management in Education, 13* (3), 227–236.
Makransky, G., Bonde, M. T., Wulff, J. S. G., Wandall, J., Hood, M., Creed, P. A., et al. (2016). Simulation based virtual learning environment in medical genetics counseling : An example of bridging the gap between theory and practice in medical education. *BMC Medical Education, 16*(98), 1–9.
Makransky, G., & Lilleholt, L. (2018). A structural equation modeling investigation of the emotional value of immersive virtual reality in education. *Educational Technology Research & Development, 66*(5), 1141–1164.
Makransky, G., Thisgaard, M. W., & Gadegaard, H. (2016). Virtual simulations as preparation for lab Exercises : Assessing learning of key laboratory skills in microbiology and improvement of essential non-cognitive skills. *PLoS One*, 1–11.
Matthews, J., Win, K. T., Oinas-Kukkonen, H., & Freeman, M. (2016). Persuasive technology in mobile applications promoting physical activity: A systematic review. *Journal of Medical Systems, 40*(3), 1–13.
Matulich, E., Papp, R., & Haytko, D. L. (2008). Continuous improvement through teaching Innovations : A requirement for today's learners. *Marketing Education Review, 18*(1), 1–7.
Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education, 70*, 29–40.
Mihelj, M., Novak, D., & Beguš, S. (2014). *Virtual reality technology and applications*. New York London: Springer Dordrecht Heidelberg.
Mitchell, M. S., & Palmer, N. (2010). The managerial relevance of ethical efficacy. In M. Schminke (Ed.), *Managerial ethics: Managing the psychology of morality*. Routledge/Taylor & Francis Group.
Mitchell, M. S., Palmer, N., & Schminke, M. (2008). Understanding the influence of ethical efficacy. In *Annual meeting of the Academy of Management. Anaheim, CA*.
Montiel, I., Delgado, J., Natalia, C., Mandojana, O. De, & Antolin, R. (2020). New ways of Teaching : Using technology and mobile apps to educate on societal grand challenges. *Journal of Business Ethics, 161*, 243–251.
Nelson, J. K., Poms, L. W., Wolf, P. P., Nelson, J.K., & Wolf, P. P. (2012). Developing efficacy beliefs for ethics and diversity management. *Academy of Management, 11* (1), 49–68.
Orland, B., Ram, N., Lang, D., Houser, K., Kling, N., & Coccia, M. (2014). Saving energy in an office environment: A serious game intervention. *Energy and Buildings, 74*, 43–52. https://doi.org/10.1016/j.enbuild.2014.01.036
Palfrey, J. G., & Gasser, U. (2011). *Born digital: Understanding the first generation of digital natives*. New York: Basic Books.
Pekrun, R. (2016). *A social-cognitive , control-value theory of achievement emotions. Advances in psychology, 131*. Elsevier Masson SAS.
Popescu, E. (2008). *Dynamic adaptive hypermedia systems for e-learning*.
Proserpio, L., & Gioia, D. A. (2007). Teaching the virtual generation. *The Academy of Management Learning and Education, 6*(1), 69–80.
Ralhan. (2016). India can learn from Finland phenomenon based learning system. Retrieved from https://www.hindustantimes.com/education/india-can-learn-from-finland-s-phenomenon-based-learning-system/story-PMu4sT7KrUyYE6c7yI3RZO.html.
Raman, G. V., Swapnil, G., & Thapliyal, S. (2019). Integrative live case: A contemporary business ethics pedagogy. *Journal of Business Ethics, 155*(4), 1009–1032.
Renninger, K. A., & Hidi, S. (2016). Interest, attention, and curiosity. *The Power of Interest for Motivation and Engagement*, 32–51.

Ruggeroni, C. (2003). Ethical education with virtual Reality : Immersiveness and the knowledge transfer process. *Education*, 119–133.
Salas, E., Wildman, J. L., & Piccolo, R. F. (2009). Using simulation-based management education training to enhance management education. *Academy of Management, 8*(4), 559–573.
Sanchez-Vives, M. V., & Slater, M. (2005). From presence to consciousness through virtual reality. *Nature Reviews Neuroscience, 6*(4), 332–339.
Schwarzer, R., & Jerusalem, M. (2010). The general self-efficacy scale (GSE). *Anxiety, Stress & Coping, 12*, 329–345.
Su, C. (2018). Exploring sustainability environment educational design and learning effect evaluation through migration Theory : An example of environment educational serious games. *Sustainability, 10*(10), 33–63.
Thisgaard, M., & Makransky, G. (2017). Virtual learning simulations in high School : Effects on cognitive and non-cognitive outcomes and implications on the development of STEM academic and career choice. *Original Research, 8*(May), 1–13.
Tsandilas, T. (2003). *Adaptive hypermedia and hypertext navigation*. Canada: University of Toronto.
Wang, L. C., & Calvano, L. (2015). Is business ethics education Effective ? An analysis of gender , personal ethical perspectives , and moral judgment. *Journal of Business Ethics, 126*(4), 591–602.
Wang, Y., & Hu, T. (2017). Transformational leadership behavior and turnover intention in China physical education. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(9), 6357–6368.
Wankel, C. (2009). Management education using social media. *Organization Management Journal, 6*(4), 1–12.
Webster, R. (2016). Declarative knowledge acquisition in immersive virtual learning environments environments. *Interactive Learning Environments, 24*(6), 1319–1333.
Wentzel, & Miele. (2016). *Handbook of motivation at school*. Malwah.
Whitton, N. (2012). The place of game-based learning in an age of austerity. *Electronic Journal of e-Learning, 10*(2), 249–256.
Youssef, C., & Luthans, F. (2005). A positive organizational behavior approach to ethical performance. In R. A. Giacalone, C. L. Jurkiewicz, & C. Dunn (Eds.), *Positive psychology in business ethics and corporate responsibility*. Greenwich: Information Age.
Yusoff, M. F., Zulkifli, A. N., & Mohamed, N. F. F. (2011). Virtual Hajj (V-Hajj) - adaptation of persuasive design in Virtual Environment (VE) and multimedia integrated approach learning courseware methodology. In *2011 IEEE conference on open systems* (pp. 256–261). ICOS, 2011.
Zhang, X., Jiang, S., Ordóñez, P., Pablos, D., Lytras, M. D., & Sun, Y. (2017). How virtual reality affects perceived learning effectiveness : A task – technology fit perspective. *Behaviour & Information Technology, 36*(5), 548–556.
Zyda, M. (2005). From visual simulation to virtual reality to games. *Computer, 38*(9), 25–32.