The Development of an e-Driver: Creating Awareness of Ethics in Driving via Game-Based Learning

Muhammad Syafiq Saharudin[1], Ismassabah Ismail[2], Norzilah Musa[2], Zainab Othman[3] and Nurul Hidayah Mat Zain[3]

[2]*Centre of Foundation Studies, Universiti Teknologi MARA, Malaysia, {ismassabah@uitm.edu.my, norzi105@uitm.edu.m}*
[1,3]*Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Malaysia, {syafiqsaharudin@gmail.com, zainab_othman@uitm.edu.my, nurul417@uitm.edu.my}*

ABSTRACT

Ethics in driving should be followed in reducing the number of road accidents. According to the research, most of the road accidents in Malaysia are caused by not following driving ethics and unethical drivers. This study aims to develop a game-based learning application for driving ethics awareness (e-Driver) and implement the ADDIE model to provide a stable and effective development process. The evaluation phase adopted the Technology Acceptance Model (TAM) that involved 20 respondents and produced 82% of the acceptability. The findings suggest that the application is enjoyable and effective in delivering the instructions for creating awareness of driving ethics. The impact of morality in driving will create a safe and systematic traffic environment since most road users respect others' rights to road usage.

Keywords: ADDIE, EPIC framework, ethics, game-based learning, TAM

I   INTRODUCTION

Nowadays, most of the citizens in Malaysia utilize their vehicles as their main transportation. Despite that car ownership in the South-East Asian markets is ranked among the world's lowest, Malaysia was ranked the third-highest trend of owning a car among its member countries (Mueller, 2020).

On the other hand, Malaysia was placed among the top three countries with the deadliest roads in ASEAN and Asia. A report by the WHO Global Status Report on Road Safety in 2018 (WHO, 2018), Malaysia recorded a 23.6/100,000 road accident fatality rate equal to 7,152 cases (Abdullah, 2019). It was estimated that around 7,000 to 8,000 people in Malaysia died in road traffic annually (George, 2019). The extreme amount of Malaysian road fatality rate should be fixed as it is extremely close to the average rate among low-income nations.

The massive number of road accidents in Malaysia is due to all drivers in the country not following the road safety procedure, ethics, and morality in driving (Eusofe & Evdorides, 2017). Some of the immoral and unethical actions were switching lanes without giving indicator lights, using smart devices while driving, swerving recklessly in and out of traffic, and driving beyond the speed limit (Abas, 2020). Hence, the misbehavior victims and non-ethical experienced drivers are the new drivers, as they lack driving experience and skills on the road. As Director-General of the Road Safety Department (JKJR), Datuk Rosli Isa (Raaf, 2017), various parties such as parents, schools, and Road Transport Department need to increase the awareness of their role of driving ethics among new drivers.

Hence, this research is initiated to increase the awareness of driving ethics by using game-based learning. Game-based learning is considered a unique instructional approach and significantly impacts achieving the learning objective (Dimitra, Konstantinos, Christina, & Katerina, 2020). Furthermore, the educational game enables the learner to find the learning process easier, more interesting, and more effective.

II   LITERATURE REVIEW

A study showed that Malaysia has the biggest road death risk among the ASEAN countries (Harith & Mahmud, 2018). This scenario is due to a lack of awareness of driving ethics and morality. Individual awareness is very important towards a healthy living culture without harming others' safety (ASP Dr. Mohd Roslan, Harian Metro,2020). According to Dr. Haslinda (Bernama June 17, 2018), there must be a psychotic concept to produce a calm and soothing driver in forming a quality drive. Drivers who have a unified spiritual and physical system will indirectly display a better quality and prudent driving pattern on the road.

Based on the Oxford dictionary, ethics is meant by the moral principles that guide a person's activity, conduct, or behavior (Kramer, "Definition of Workplace Ethics," 2019). Ethics and morals are terms used in the plural and often regarded as synonyms, but there is some distinction in how they are used (Habibullah, 2018). Morality, however, is the principle concerning the distinction between good and bad behaviour. The Qur'ān also states that morality is one of the keys to success, *"and from among you there should be a party who invite good and enjoin what is*

right and forbid the wrong and these are those who shall be successful" (Qur'ān, 3:104).

Furthermore, studies have proved that lacking proper ethics in driving presents a problem on the roads. This scenario is because it has been identified as a predictor of traffic crashes and precursor to behaviours that increase the probability of traffic crashes (Idris, Hamid, & Teik Hua, 2019). One of the problems of driving ethics is the emotional distraction of driving. This phenomenon is important as prior studies have shown that emotional disturbance can lower task performance and safety awareness (Choudhary & Velaga, 2019). Besides, drowsy driving is one of the problems of not following driving ethics.

Moreover, studies found that "tiredness and sleepiness is a major cause of road traffic injuries" (Higgins et al., 2017). Not to mention that texting while driving is also a problem in driving ethics. Studies proved that students around the age of 17 to 18 are likely to text while driving, increasing the risk of road accidents and careless driving (Hill, Sullman, & Stephens, 2019; Li et al., 2018). Young drivers among the stated age are most likely to perform risky driving, especially when they are not under adult supervision. This scenario is a major concern as it may become one of their common habits if they do not acquire enough supervision.

This study was presented in game-based learning using Windows 10 to attract learners' interests and attention. Game-based learning immerses learners in observing, exploring, and making decisions in a virtual world, creating higher interactivity. High interactivity is a basic component for powerful learning and may result in students' strengthening, at last improving their adequacy and awareness (Vlachopoulos & Makri, 2017).

Tobar-Muñoz, Baldiris, and Fabregat (2017) demonstrated that well-designed educational video games might have incredible potential for enhancing students' learning accomplishments. It is because educational computer games could make the students interested and motivated to use the application (Huang, Chang, & Wu, 2017). A study has shown that "learning motivations of students have a significant impact on learning achievement using game-based learning" (Hartt et al., 2020). Zainab et al. (2020) indicated that game-based learning helped students visualize, memorize, and understand the theories of driving easily. This study shows that game-based learning is a better approach than using the traditional way of learning.

The EPIC (Ethics Practice and Implementation Categorization) framework was implemented in this study's development phase. The framework enables teachers to recognize the beneficial games to utilize for ethics practice in learning situations. Designers create a game for ethics education using the EPIC framework to meet specific objectives or procedures (Schrier & Schrier, 2015). Moreover, the EPIC framework analyzes the instructive needs on systems used to teach morals and does not rely upon students' past ability level.

The EPIC Framework's educational goals could be mixed, matched, and selected to suit the study development (Schrier & Schrier, 2015). It contains seven ethics education target outcomes: forming ethical awareness, practicing reflection, improving the character, and 12 strategies related to ethical learning. Therefore, this study used the EPIC framework to increase the effectiveness of ethical education application development. This game used the current multimedia technology and 3D visuals. The utilization of 3D vision in a virtual learning condition has a meaningful, beneficial outcome on the students' performance and appreciation of the environment (de Boer, Wesselink, & Vervoorn, 2016).

Implementing the driving ethics application via game-based learning created the awareness of users and Malaysian drivers about important driving ethics. It motivated them to engage with morality in daily driving. The impact of morality in driving will create a safe and systematic traffic environment since most road users respect other road usage rights. The game-based learning application also positively impacted students, as most of them are new to road driving. Training new drivers at an early stage will produce better road users with ethics in the future.

Lastly, this application is mainly intended to create a safe road environment in Malaysia as the accident rate will decrease. This scenario is due to the increment of drivers that apply ethics and tolerate other road users in their driving.

III   METHODOLOGY

The ADDIE model was selected as a methodology and used as the procedure to fulfill the study objectives. The model contains five important phases: Analysis, Design, Development, Implementation, and Evaluation Phase. The ADDIE model is suitable for the development of teaching or educational courses. It is a model that is commonly used by training developers and instruction designers. This model also helps the instructors or educational design to produce an effective educational design. Furthermore, the ADDIE Model components can be used as the development guidelines in any environment (Aldoobie, 2015).

The analysis phase was done by gathering all of the information related to the study scope, constraints, and literature review gathered from numerous sources. All of the information is usually referred from dependable

sources such as journals, online journals, books, articles, and more. This important information is crucial for better planning to produce a better study outcome. This phase ends when the developer agrees on the key issues and obtains possible problem solutions to continue.

Next, the design phase contains tasks such as designing a flowchart and storyboard of the game, which is necessary as a guide to see the flow of the planned product while programming and developing. The development phase uses several tools to create all detailed interfaces, technical design, script, and coding.

IV   DEVELOPMENT

The design phase of every game-based study needs integration from various platforms and software. The e-Driver game-based learning study requires a great amount of important design phase before integrating it into the game engine. Furthermore, early planning and rough design on the study's overall structure are necessary to determine which platform is the fittest to be utilized. Components and structure examples required to be designed from early development are the game environment, character objects, obstacles, scoring, and penalty system. Figure 1 shows the process of developing the study overall.
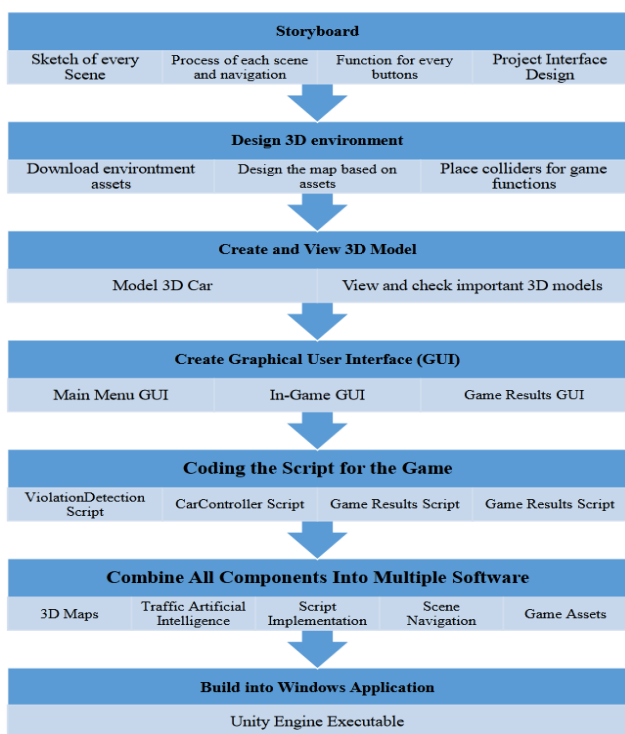

Figure 1. Overall Process of the Study Development.

V   IMPLEMENTATION

EPIC Framework criteria and required development goals are implemented in the study development to create awareness of ethics in driving. Every necessary goal implemented will be explained and shown.

A. Ethical Awareness

The application's user interface will alert and make the user aware of the specifically required ethics in driving specific areas. Figure 2 is an example where the game asks the user to slow down when they drive over the school area's speed limit. Developing ethical awareness identifies a person's perspectives on a given situation and imagines the effect and consequences (Meng et al., 2014).

Figure 2. Snapshot of Ethical Awareness Criteria.

B. Emotional Intelligence

The game trains the user to drive, especially when there are heavy traffic and inevitable obstacles. If the user drives in a hurry or makes unethical decisions despite the situation, they will acquire violation points, affecting the game points and penalty, as in Figure 3.

Figure 3. Snapshot of Emotional Intelligence Criteria.

C. Ethical Reasoning

The game involves the user in ethical decision-making on scoring ethical points and avoiding violation points (Figure 4). The user must give a signal light at right turns and obey the speed limit at times to obtain ethical points. This scenario enables the user to think thoroughly about their decisions in driving. Ethical reasoning is making and interpreting choices and evidence, along with its pros and cons effect (Schrier, 2011).

Figure 4. Snapshot of Ethical Reasoning Criteria.

D. Ethical Reflection

The game makes the user reflect on the ethical issues made in the game and help them overcome them by providing the related unfinished objectives as in Figure 5. The game also limits that the user can only get violation points with the maximum value of three to pass a level. This scenario enables the user to reflect on their decisions to avoid as many violations as possible.

Figure 5. Snapshot of Ethical Reflection Criteria.

VI   RESULT AND ANALYSIS

The evaluation process is done by collecting data and getting user feedback. Technology Acceptance Model (TAM) was implemented for the evaluation phase before this application was given to the targeted users. The participants have also received the study application for the testing before responding to the evaluation instrument. The purpose of the TAM is to know user acceptance of the technology.

A. Technology Acceptance Model

The study's evaluation is placed to determine whether the target users accept the game to create awareness of driving ethics. The evaluation is also conducted to check whether the study fulfills the output requirements and objectives. The minimum number of participants needed to answer the questionnaire is 20 people. This study is for a minor subgroup that is purposely for students at UiTM Shah Alam (ex-students from SMK Puncak Alam) for the case study. It is sufficient to use 20 respondents because ex-SMK Puncak Alam students who become the UiTM Shah Alam are a minor subgroup. In survey research, 100 samples should be identified for each major sub-group in the population and between 20 to 50 samples for each minor sub-group (Cohen et al., 2000). The evaluation contains five parts, but only three are used (perceived usefulness, perceived ease of use, and perceived satisfaction) in this study.

B. Participants

The proposed study's evaluation process involves the target audience, including University students around the age of 17 to 19, common to have a driving license and still adapting to driving on the road. The evaluation is conducted among UiTM Shah Alam students, and the evaluation was performed by distributing the Google Form link after they tested and understood the product. Since most of the targeted audience is officially a university student, using complex English is suitable in the questionnaire for a correct evaluation. The participants who are involved with the evaluation are briefed, and the demo is provided online. The participants must finish the game within the time frame given, which is about an hour. After finishing the game, the participants need to fill in the provided online questionnaire, the technology's user acceptance evaluation.

C. Instrument

The questionnaire is used in this evaluation of the study to evaluate the users' acceptance. This method is chosen because it is very effective and does not require much cost. The questionnaire is created based on the TAM containing five criteria: *Perceived Usefulness, Perceived Ease of Use, Behavioral Intention To Use, Actual Usage,* and *User Satisfaction.* However, there are constraints for not using all five criteria since the study is currently only a prototype. Therefore, *Behavioral Intention* and *Actual Usage* are removed from the evaluation questionnaire. Furthermore, the questionnaire consists of 11 items listed in three sections, as displayed in Table 1.

Every item in the questionnaire is ranged from 1 to 5 to value the level of agreeance of each item. Then, the value will be added and averaged to calculate the score related to the percentage. An overall conclusion is made with the mean value of each item and each dimension. Each dimension has been calculated for its mean total value to display the agreeability on the specific dimension. IBM SPSS software is used to process such data, including the mean and standard deviation values for each item in a table format. IBM SPSS is commonly used as a statistical software to produce calculations for research and business purposes.

Table 1. Evaluation Items.

Dimension	Items
Perceived Usefulness	The game makes you more aware of driving ethics
	The game makes you more aware of the importance of driving ethics
	The game makes you reflect on every decision you make while driving
	The game encourages you to become a more ethical driver.
Perceived Ease of Use	You are able to control the car and navigate easily
	It is easy for me to understand the game objectives
	The user interface (UI) is simple and easy to operate
	I think this application is easy to use
User Satisfaction	You had fun using e-Driver.
	You find the gameplay included in e-Driver to be interesting.
	In the future, if there were similar learning application or software were to be created, I would use it.
	Overall, you find e-Driver application interesting and satisfying

D. Findings

Based on Table 2, the overall mean is determined based on each dimension's mean value to calculate the overall mean percentage. The percentage of the proposed study's overall mean is 82% of the acceptability, which shows that the e-Driver application effectively creates awareness in driving ethics to users. The highest average mean from all the dimensions stated is from the *Perceived Level Satisfaction* dimension with 4.28. It shows that the users are satisfied and interested in the gameplay and instructional delivery method. Besides, the respondents are satisfied with the approach method and usability of the e-Driver application that helps them create awareness of driving ethics. This finding strengthens the study by Sailer, Hense, Mayr, & Mandl (2017) that stated the effects of specific game design elements on psychological need satisfaction.

Moreover, the second-highest dimension is the *Perceived Usefulness* with 4.13. This result indicates that users can understand the lessons through the game's challenges and understand the benefits of following the application's driving ethics. In conclusion, the results also show that the users are satisfied and interested in the study application's gameplay and instructional delivery method. Not to mention that the respondents generally find the application easy to use and navigate for the user interface and menu navigation.

Table 2. Total Mean for Each Dimension and Overall Average Value.

Dimension	Total mean
Perceived Usefulness	4.13
Perceived Ease of Use	3.91
Perceived Level of Satisfaction	4.28
Overall mean	4.10
Percentage of overall mean	**82%**

VII   CONCLUSION

Applying game-based learning and epic framework as the instructional approach is very effective for this study application. This study helps the user, especially new drivers, to enjoy and gain benefits from the ethical educational experience provided in the application. The evaluation determined that the game is suitable and beneficial to new drivers such as form 5 students and university students. Furthermore, e-driver is a game that creates awareness of driving ethics and is an enjoyable experience for the study's target users. Future improvements can be applied to this study to become a beneficial application that will contribute to road safety, especially in Malaysia. Ethical game-based learning application has many ways to be explored in this country, although the gaming industry has evolved. Creating such a clear focus on enjoyable ethical learning could increase road safety and moral traffic usage in Malaysia.

REFERENCES

Abas, M.A.(2020, November 21). We must inculcate ideal driving behaviour through policies, education. The News Straits Times. https://www.nst.com.my/opinion/columnists/2020/11/642999/we-must-inculcate-ideal-driving-behaviour-through-policies

Abdullah, O. (2019, Mei 14). WHO: Malaysia is Third in Road Deaths in ASEAN and Asia, Bikersrepublic. https://www.bikesrepublic.com/featured/who-malaysia-is-third-in-road-deaths-in-asean-and-asia/

Aldoobie, N. (2015). ADDIE Model. American International Journal of Contemporary Research, 5(6), 68-72.

Bergmark, R., Gliklich, E., Guo, R., & Gliklich, R. (2016). Texting while driving: the development and validation of the distracted driving survey and risk score among young adults. Injury Epidemiology, 3. https://doi.org/10.1186/s40621-016-0073-8

Chang, W., Wang, T., Lin, F. and Yang, H. (2009). Game-Based Learning with Ubiquitous Technologies. IEEE Internet Computing, 13(4), pp.26-33.

Choudhary, P., & Velaga, N. R. (2019). A comparative analysis of risk associated with eating, drinking and texting during driving at unsignalised intersections. Transportation Research Part F: Traffic Psychology and Behaviour, 63, 295–308. https://doi.org/10.1016/j.trf.2019.04.023

Cohen, L., Manion, L., & Morrison, K. (2000). Research methods in education [5 th edn] London: Routledge Falmer. Teaching in Higher Education, 41, 21.

De Boer, I. R., Wesselink, P. R., & Vervoorn, J. M. (2016). Student performance and appreciation using 3D vs. 2D vision in a virtual learning environment. European Journal of Dental Education, 20(3), 142–147. https://doi.org/10.1111/eje.12152

Dimitra, K., Konstantinos, K., Christina, Z., & Katerina, T. (2020). Types of Game-Based Learning in Education: A brief state of the art and the implementation in Greece. The European Educational Researcher, 3(2), 87–100. https://doi.org/10.31757/euer.324

Dr. Haslinda Abdullah, Deputy Dean (Research and Innovation) and Lecturer in Social Psychology, Faculty of Human Ecology, Universiti Putra Malaysia (UPM), Bernama Jun 17,2018

Eusofe, Z., & Evdorides, H.(2017). Assessment of road safety management at institutional level in Malaysia: A case study. IATSS Research, 41(4), 172-181. https://doi.org/10.1016/j.iatssr.2017.03.002.

George, T. (2019, September 3). Keeping death rate in check. News Straits Times. https://www.nst.com.my/opinion/letters/2019/09/518489/keeping-death-rate-check

Global status report on road safety 2018. (2018, June 17). WHO. https://www.who.int/publications/i/item/9789241565684

Habibullah, S. (2018, March 25). Retrieved March 03, 2019, from https://www.slideshare.net/SannumHabibullah/difference-between-ethics-morals-norms-feelings-or-emotions

Harith, S. H., & Mahmud, N. (2018). Human risk factors and road accident causation among motorcyclists in Malaysia: A review article. Proceedings of the International Conference on Industrial Engineering and Operations Management, 2018-March, 2202–2209.

Hartt, M., Hosseini, H., & Mostafapour, M. (2020). Game On: Exploring the Effectiveness of Game-based Learning. Planning Practice and Research, 35(5), 589–604. https://doi.org/10.1080/02697459.2020.1778859

Higgins, J. S., Michael, J., Austin, R., Åkerstedt, T., Van Dongen, H. P. A., Watson, N., … Rosekind, M. R. (2017). Asleep at the Wheel—The Road to Addressing Drowsy Driving. Sleep, 40(2). https://doi.org/10.1093/sleep/zsx001

Hill, T., Sullman, M. J. M., & Stephens, A. N. (2019). Mobile phone involvement, beliefs, and texting while driving in Ukraine. Accident Analysis and Prevention, 125(January), 124–131. https://doi.org/10.1016/j.aap.2019.01.035

Huang, Y. L., Chang, D. F., & Wu, B. (2017). Mobile game-based learning with a mobile app: Motivational effects and learning performance. Journal of Advanced Computational Intelligence and Intelligent Informatics, 21(6), 963–970. https://doi.org/10.20965/jaciii.2017.p0963

Idris, A., Hamid, H., & Teik Hua, L. (2019). Factors contributing to motorcycle accidents in Malaysia. IOP Conference Series: Earth and Environmental Science, 357(1). https://doi.org/10.1088/1755-1315/357/1/012039

Kramer, L. (2019, February 11). Retrieved March 03, 2019, from https://bizfluent.com/about-6677585-definition-workplace-ethics.html

Li, L., Shults, R. A., Andridge, R. R., Yellman, M. A., Xiang, H., & Zhu, M. (2018). Texting/Emailing While Driving Among High School Students in 35 States, United States, 2015. Journal of Adolescent Health, 63(6), 701–708. https://doi.org/10.1016/j.jadohealth.2018.06.010

Meng, C. L., Othman, J., D'Silva, J. L., & Omar, Z. (2014). Ethical decision making in academic dishonesty. International Education Studies, 7, 126–139.

Mueller, J.,(2020,Marc 13). Automotive Industry in Malaysia - Statistics & Facts. Statista https://www.statista.com/topics/5040/automotive-industry-in-malaysia

Osman, S., Liew, L., & Yei, S. (2019). Development Of Malaysian Driver Anger Scale Integrated With Psychological Effects And Road Accident Risk Factor, (October), 23–24.

Othman, Z., Zain, N. H. M., Ismail, I., Mohd, S. N. S. S., Affandi, N. A. M. N., & Yasin, A. M. (2020). An educational game on the theories of driver education curriculum: An evaluation. Int J Eval & Res Educ. ISSN, 2252(8822), 1089.

Oviedo-Trespalacios, O. (2018). Getting away with texting: Behavioural adaptation of drivers engaging in visual-manual tasks while driving. Transportation Research Part A: Policy and Practice, 116(September 2017), 112–121. https://doi.org/10.1016/j.tra.2018.05.006

Raaf, A.R.(2017, September 12). Modul baharu keselamatan jalan raya mulai. Berita Harian. https://www.bharian.com.my/berita/nasional/2017/09/324585/modul-baharu-keselamatan-jalan-raya-mulai-2019

Sagberg, F. (1999). Road accidents caused by drivers falling asleep. Accident Analysis and Prevention, 31(6), 639–649. https://doi.org/10.1016/S0001-4575(99)00023-8

Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. Computers in Human Behavior, 69, 371–380.

Schrier, K. (2011), Ethical thinking and video games: The practice of ethics in Fable III. Doctoral Dissertation.

Schrier, K. (2015). EPIC: A framework for using video games in ethics education. Journal of Moral Education, 44(4), 393–424.

Sitzmann, Traci. (2011). A meta-analytic examination of the instructional effectiveness of computer-based simulation games. Personnel Psychology. 64. 489 - 528. 10.1111/j.1744-6570.2011.01190.x.

Sung, H. Y., & Hwang, G. J. (2013). A collaborative game-based learning approach to improving students' learning performance in science courses. Computers and Education, 63, 43–51. https://doi.org/10.1016/j.compedu.2012.11.019

Tobar-Muñoz, H., Baldiris, S., & Fabregat, R. (2017). Augmented Reality Game-Based Learning: Enriching Students' Experience During Reading Comprehension Activities. Journal of Educational Computing Research, 55(7), 901–936. https://doi.org/10.1177/0735633116689789

Vlachopoulos, D., & Makri, A. (2017). The effect of games and simulations on higher education: a systematic literature review. International Journal of Educational Technology in Higher Education (Vol. 14). International Journal of Educational Technology in Higher Education. https://doi.org/10.1186/s41239-017-0062-1

Von Wangenheim, C. G., & Shull, F. (2009). Voice of evidence To Game or Not to Game? IEEE Software, 26(2), 92–94. https://doi.org/10.1109/MS.2009.54