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Augmented Reality in Innovating Pedagogy: Ethical Issues on Persuasive Technologies

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Abstract: Augmented Reality (AR) is a technology that recognizes visual and auditory information to enhance the end users' experience in a potentially powerful way. It is unquestionably here to stay. However, not all are avid supporters of AR, there are others who oppose it. This may be because of AR's positive influences that caused people to believe and support it while there are also negative ones that drove others to scrutinize and even condemn it, especially when it comes to ethical concerns, which include persuasiveness and behavioral and physiological effects to students. This study was conducted to investigate persuasive technologies' ability to change the attitudes and behavior of end users, especially in hedonic-motivation system acceptance, investigate if experience affects their behavior, and conduct ethical reflections based on utilitarian and deontological approaches. It was found out that perceived usefulness, curiosity, joy, and control are associated with perceived ease of use; however, all of these have no significant correlation with behavioral intention to use. It is one's experience that greatly affects the latter. The positive and negative experiences encountered by the respondents were identified and served as the bases in assessing the utilitarian and deontological context of the use of AR apps in innovating pedagogy. Recommendations were then presented so as to improve the conduct of the study.

Keywords: Augmented Reality, Innovating Pedagogy, Ethical Issues, Persuasive Technologies, Mobile Technologies

1. Introduction

Augmented Reality (AR) is a technology that recognizes visual and auditory information to enhance the end users' experience through smartphones in a potentially powerful way (Pase, 2009). It combines digital information with the real environment. AR is unquestionably here to stay (Rutledge, 2012), however, not all are avid supporters of AR, and there are others who oppose it. Many academic institutions today are already incorporating AR technology in innovating teaching and learning pedagogy (Huang, Li, and Fong, 2016) because it is observed that AR technology can: 1) increase the student motivation in the learning process, 2) useful tools for teachers to improve their teaching effectiveness, and 3) integrate the real-world with learning environment, among others. However, there are technical risks and disadvantages brought by AR application, such as: 1) negative effects on young children's social, visual, and motor development, 2) pushing student-teacher laziness, losing its effectiveness when perceived as games, and 3) creating technology addiction (Yilmaz and Batdi, 2016).

Persuasiveness of AR applications is another ethical concern (Pase, 2009). As defined, it is called a persuasive technology if it is already having a direct impact on the lives of individuals that are involved in this technology such as the developers, designers and most especially the end users, even bystanders (Rutledge, 2012), which enables the development of harmful and uncontrollable habits caused by the use of these technologies, like its ability to intrude into people's lives and manipulate them. This is a threat to end users; however, this is the main objective of the developers in creating these technologies, that is, to persuade the target audience.

With all these apprehensions, this study was conducted to investigate persuasive technologies' ability to change the attitudes and behavior of end users, especially in hedonic-motivation system acceptance and investigate if experience affects their behavior in the classroom. To support the results of this investigation, ethical reflections were conducted based on

two (2) approaches, such as: 1) the utilitarian approach, which assesses an action based on the consequences of its use, and 2) the deontological approach, which evaluates the ethical duty of the actor, and pursues the construction of rules and maxims by which all actors should abide. (Gram-Hansen, 2014).

2. Review of Related Literature

2.1 Augmented Reality (AR) as Persuasive Technology

Persuasive technology is a sub-discipline within the broader field of human-computer interaction which is designed to persuade users that leads them to do a particular course of action (Mintz and Aagaard, 2012). Fogg (2003) coined this term as an interactive computing system that is designed to effectively change individuals' attitudes or behaviors. One persuasive technology that profoundly impact peoples' lives is AR because of its high-level interactivity, which outstrips the conventional ways of doing and viewing things (Tseng-Lung and Liu, 2014).

2.2 AR in Education

AR can potentially provide powerful, contextual, and established learning experiences. It can be applied across different disciplines in education, such as ecosystems, chemistry, biology, geography, history, electromagnetics, and others, where students can acquire a whole new level of understanding based on interactions with virtual objects (Zhu, Arash, Masiello, and Zary, 2014).

3. Theoretical Framework

The arrival of computers urged psychologists to try to understand the complexities of human cognition by comparing it with an artificial system such as a computer (McLeod, 2015). As illustrated in Figure 1, McLeod's theory of cognitive psychology already included the computer analogies information processing approach in the areas of artificial intelligence and computer simulation.

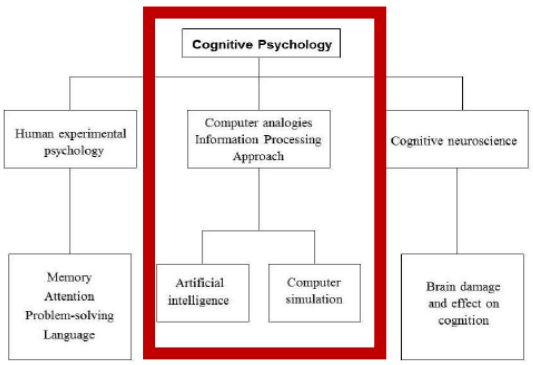

Figure 1. Cognitive Psychology Model by McLeod (2015).

This is believed to be a favorable area of research in this digital age knowing that children today, as early as 2-5 years old, are surrounded by computers and information technologies as the primary sources of information prior to years of formal education (Shamir, 2013). Thus, one practical challenge to researchers and members of the academic institutions is to explore ways to incorporate tools that can efficiently make metacognitive thinking habitual within the school in this digital age (Shamir, 2013). One way is to maximize the use of AR technology in the classroom and innovate pedagogy since it provides a powerful, contextual, and situated learning experience and it supplements the real world with virtual objects such that it appears to coexist in the same space as the real world (Zhu et al., 2014).

The existence of these technologies enables the adoption of HMS since it covers both extrinsic and intrinsic motivation as the precedents of the intention to use and actual use of a system (Gerow at al., 2013). With regard to utilitarian IT, extrinsic motivators are prioritized over intrinsic motivators, while in the hedonic IT, intrinsic motivators have more impact that extrinsic motivators.

The shift from extrinsic to intrinsic motivators when target technology varies from utilitarian to hedonic explains why "perceived usefulness" is less important predictor, as emphasized in the Technology Acceptance Model (TAM), than enjoyment in a hedonic system-use setting (Wu and Lu, 2013). However, to have a better conceptual understanding of HMS use, Lowry, Gaskin, Twyman, Hammer, and Roberts (2013) designed a new model to explain further the intentions to use HMS, which is called Hedonic-Motivation System Adoption Model (HMSAM), as shown in Figure 2, which was found to improve existing models to predict HMS use through intrinsic motivations and to explain the relationships between these motivations and traditional technology acceptance factors.

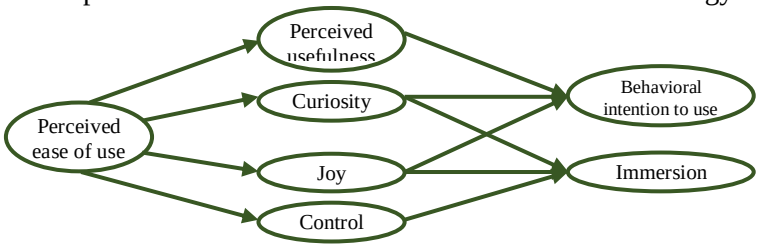

Figure 2. Hedonic-Motivation System Adoption Model (HMSAM) Framework (Lowry et al., 2013)

Despite positive results from HMSAM, this study wanted to investigate ethical concerns of AR technology as a persuasive technology and its ability to change the attitudes and behavior of end users, especially in Hedonic-motivation system acceptance, in the Philippine setting, and whether experience can affect behavioral intention to use, as shown in Figure 3.

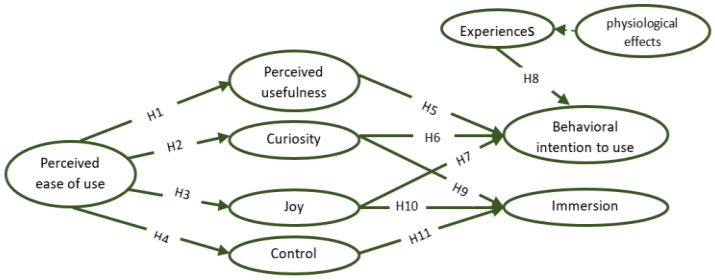

Figure 3. Research Model

4. Methods of Data Collection and Analysis

Thirty-seven Grade 7 students from the University of the Philippines Cebu High School Department, where the researcher is connected with, were identified as the respondents of the study since they are the youngest group among high school students.

Two (2) short AR-related video clips, a 3-min. video on Pokemon Go and 2-min. video on Anatomy 4D AR, were shown to the students prior to answering the survey questions, which was intended for them to have an idea on AR. Then, a short demonstration was done on the AR app (Anatomy 4D) prior to the actual interactions of the students with the AR app. Anatomy 4D AR app by DAQRI was used in the study since it is one of the most-easily downloaded and free apps found. All of them were instructed to answer Part I (demographics) and Part II (behavioral intention to use) of an adopted 7-scale survey instrument by Lowry, et al. (2013). They were then asked if they have heard about AR and have used AR apps before the conduct of the study. Those who answered "yes" to the question were instructed to proceed answering Part III (experience and physiological effects) of the questionnaire, while those who answered "no" were told to stop answering. All the data were carefully analyzed through different statistical treatments. Results and findings, conclusions and recommendations were then formulated and presented.

5. Results and Findings

5.1 Analysis of the Ethical Issue

Table 1 presents the correlations between variables as identified in the framework. Based on test statistics, PEOU is significantly correlated with PU, CUR, JOY, and CTL. This implies that a

student's interaction and reaction to AR apps depends on how easy and joyful (Lowry et al., 2009) it is to navigate and manipulate, regardless whether it has positive or negative effects on them.

Table 1

Results of Behavioral Intention to Use based on HMSAM

	Sample Mean (M)	Standard Deviation (STDEV)	Test Statistics (α=0.05)	P-Value
PEOU →PU	0.863	0.104	8.181*	0.000
PEOU →CUR	0.624	0.147	4.263*	0.000
PEOU →JOY	0.749	0.104	7.204*	0.000
PEOU →CTL	1.023	0.147	6.701*	0.000
PU →BIU	0.478	8.572	0.165	0.434
CUR →BIU	0.011	2.446	0.090	0.464
JOY →BIU	0.299	7.119	0.065	0.474
CUR →IMM	-0.200	11.256	0.027	0.489
JOY →IMM	-0.358	9.804	0.012	0.495
CTL →IMM	1.483	18.616	0.033	0.487
EXP →BIU	3.771	1.958	8.262*	0.007

*Significant

BIU is not associated with PU, CUR, and JOY. It is the experience (EXP) that they have with the AR app that has significant correlation with BIU. This implies that, no matter how useful that AR app to them, it will not affect their behavior toward intention to use if they do not experience it themselves. In the same way that their behavior is not affected by how curious they are with the AR app and what that AR app can give joy to them. Thus, experience plays an important role in increasing the BIU. On the other hand, CUR, JOY and CTL are not significantly correlated with IMM. This opposes the statements which state that an interest or a heightened arousal of sensory and cognitive inquisitiveness is increased by curiosity (Agarwal and Karahanna, 2000), that finding that joy plays a greater role in bringing about immersion (Challco et al., 2016) and that control is a key reason why people feel competent, able, and capable of making decisions (Lowry et al., 2013).

With regard to the students' experience in using AR apps, a few of the results support the list presented by Pase (2009) and Yilmaz and Batdi (2016), particularly on gaining advanced knowledge, as well as the negative side of it, which are addiction, laziness, and accidents. However, some responses from the students are new addition to the list from the above-mentioned researchers.

Table 2

Positive and Negative Physiological Effects of AR Apps

Body Part	Positive Effect		Negative Effect	
• Eyes	• It is interesting	• Sparkles on your eyes because it is amazing and inspiring.	• You will have poor eyesight. • If you use it for a longer period, it can damage your eyes because of the brightness and radiation.	• It hurts when you use too much. • Your eyes are strained and get tired.
• Hands/ Fingers	• Your speed in typing becomes fast. • It will exercise your fingers.	• It is moderately good. • Reflexes will be enhanced. • Nothing will happen to your hands.	• Numbness of the fingers.	
• Other Parts	• It is an exercise to the feet because of walking (e.g. PokemonGo) • It can drive other parts of the body to move faster.	• It has an effect to the brain, that is, to think and be vigilant to the surroundings.	• You will have sickness. • Your leg and feet hurt.	

Table 2 shows a list of positive and negatives effects of using AR apps to one's body based on their "experiences", as specified in the table. This confirms Rutledge's (2012) statement that these technologies already have a direct impact on individuals which leads to harmful effects and habits.

5.2 Ethical Assessment and Approaches

Normative ethics is one of the subsets of philosophy which involves moral standards that regulates right and wrong conduct and addresses concerns on how one should act (Hoover & Pepper, 2015). This is believed to be the best ground of ethical assessment of the issue presented, especially the utilitarian and deontological approaches, which are two of the normative ethics identified in philosophy.

5.2.1 Utilitarianism

In utilitarianism, utilitarians believe on the idea that the intention of morality is making one's life better through increasing the quantity of good things, such as pleasure and happiness, and decreasing the bad things like pain and unhappiness (Internet Encyclopedia of Philosophy, 2018). As it is observed, an increase in hedonic experience also increases behavioral intention to use. These apps make them feel happy and relieved from stress in school and these are perceived to be tools to explore new, uncommon feeling of being part of the app, and to gain knowledge and rejuvenate one's mind. These are the reasons why academic institutions today are adopting blended learning where new technologies are integrated into instructions to transform traditional way of teaching and learning into more interactive and enjoyable multimedia pedagogy, thus, allow teachers to attract the attention of students (Huang, Chen, and Chou, 2016).

5.2.2 Deontology

There are a number of factors that affect the behavioral intention to use AR apps that everyone should be aware of. Thus, a set of guiding rules are recommended so as not to harm anyone, especially the students: 1) in the planning stage of introducing a new pedagogy, it is important for educators to identify the objective of doing so. It is equally important to note that AR technologies are just tools to assist in delivering the lessons in an interactive way rather than as a primary method (Miller and Dousay, 2015); 2) educators should make sure that each one of them are acquainted with the AR apps and comfortable in using it. There should be a social and cognitive coaching to students in using the AR apps; 3) students are encouraged to participate in the AR-related activity in order for them to acquire better understanding of the concepts they are studying, not doing it alone; and 4) Seek advises from clinical, physiological and psychological experts on how to avoid negative effects from happening to students in using AR apps. Like for instance, the preferred brightness of the screen so as not to strain the eyes, when and where to use it or not use it, and more.

6. Conclusion

Therefore, perceived ease of use is a predictor of how useful AR apps are to Grade 7 students of UP Cebu. It also triggers one's curiosity, joy, and control over the use of persuasive technologies like AR apps. However, all of these factors are not predictors of one's behavioral intention to use (BIU) and immersion. It is the experience that greatly affects the BIU, which may mean that ethical concerns such as risks and negative effects decrease BIU while the benefits and positive effects increase BIU. These ethical concerns were addressed through assessment of actions based on the consequences of its use (utilitarianism) and by presenting general guidelines that the educators and the students should abide (deontological).

7. Limitations and Future Research

There were difficulties in the dissemination of parent's permits, which hinder the selection of the pre-elementary pupils, thus, Grade 7 were selected as the respondents, being a group with almost similar characteristics with the ideal group. It is, thus, recommended to consider longitudinal research to pre-elementary pupils to validate the results. Inclusion of educators as respondents should also be considered to gather data based on their perspective. Moreover, it is recommended to conduct further researches on the possible mediating factors that can affect the relationship between

EXP and BIU. Lastly, further research should be conducted to come up with detailed guidelines to address specific needs of individuals with regard to the use of AR technologies which are persuasive in nature, particularly on how to address physiological effects from experts of the field.

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