Assisting Students Learning Experiences Using an Augmented Reality Model Framework

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***Abstract*—In learning through experience there are so many techniques that can be used in order to learn and master skills. Strategies used for learning may be in the form of presentation, multimedia, simulation or hands-on. Others might prefer combination of strategies both being able to hear and/or see the actual or real object of machines, tools or equipment. There are advanced visual technologies available in the internet to choose from but most are not designed to the learning process in a school. Augmented reality is an emerging advance technology that shows a lot of use and opportunity as a tool for learning and enhancing experience. AR can simulate real objects into models that be used for education. This study aims to experiment on an AR engine created using the AR model framework to enhance the learning experiences of students in the different learning strategies used in this study. The experiment is focused to find the significant differences of not having and having an AR model into the learning/teaching strategy. To analyze the data frequency, statistical mode is used to find the most frequent response to interpret the nominal and ordinal categories of the variables. The results of using the AR model framework significantly improved the learning experiences of the participants.**

***Index Terms*—Augmented reality, education al technology, AR in education**

I. Introduction

The European Union (EU) investigation on the status of maritime standards in the Philippines and other countries had initiated monitoring of the implementation of standards for the maritime industry [1]. The results of the findings are several deficiencies based on the produced skill and competency of graduates accepted and working in maritime vessels worldwide [2]. For the welfare and improvement of maritime education to be competitive with international standards in the Philippines, the maritime industry authority (MARINA) together with the commission on higher education (CHED), and maritime higher education institutions (MHEIs) in the Philippines has made a goal to improve the maritime education systems to be at par with international standards [3], even managers and ship owners are not spared to comply with the requirements [4]. The goal is to set and implement program standards, and consolidation of academic and shipboard training requirements under the standards of training, certification, and watchkeeping for seafarers (STCW) convention [5], are the requirements in the maritime education and training centers around the world.

In the report, there are more Filipino seafarer working international and European maritime safety agency (EMSA) is concerned with the status of Filipino seafarers [4]. Marine Filipinos had been long recognized as more appreciated seafarers for many years, therefore the Philippines has to resolve deficiencies to comply with the STCW and EMSA audit to enhance maritime education, training and certification system of seafarers [6]. Not only in the Philippines had been experiencing the situation it includes Asia, India, Poland, Germany and Brazil [7].

To survive the ordeals, every government had to comply and be ready for the next audit or monitoring and compliance set forth under STCW 78 convention [3]. There are already existing and current initiatives from the maritime industry in Asia. The use of advance and smart technologies had increased to improve teaching, learning and training of seafarers [8].

Similarly, there was a decrease of Japanese crew to become a third grade pilot in 2015, a ship handling simulator was innovated to have an augmented reality visual scenes that improved maneuvering motivation, knowledge and skill of trainees [9]. Innovations under industrial maintenance and manufacturing, AR and visual wearable devices were used to train and educate maintenance technicians in Finland [10]. Easy Marine company has introduced easy augmented reality (eAR) as a new era for ship navigation. The AR technology scans and evaluates information in real-time allowing fast and convenient decision making for different applications on deck [11]. And in France, a mobile AR system was developed for marine navigation assistance that improves load issues like electronic devices in navigation and bridge view, intended for vessels and recreational boats

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[12]. But these examples are more focused training at sea, only few AR models are created for learning in maritime institutions [13].

The maritime industry around the globe is in the verge of improving learning and teaching strategies to enhance future seafarers' education level, training and skill [14], through advance technologies [15]. This AR technology had shown a great potential to aide safe marine navigation but portable devices has limitations preventing practical marine usage [16]. AR enhances human perception inside and outside in working or living space or the environment to do tasks virtually. User needs to have tracking technologies from both hardware and software [17]. Today AR can use mobile devices as tools for development and a tool for viewing, an AR object on a flat surface can be used as the platform to virtually place the model [18].

In this study, the researcher will evaluate the learning strategies used by the participants together with the AR model. This will be used to determine changes and enhancement of learning experience. The objectives of the study are to adopt the AR model framework designed in the first study, and determine significant differences of the learning experiences of participants with the adopted AR model framework.

II. Methodology

Augmented reality is becoming more and more popular in many fields of studies and development. The most challenging part is the development of a new AR model to be deployed for the learning process. In this study the use of Photogrammetry workflow is used to create models using Meshroom to transform the images into a 3D model, Blender for image editing and the augmentation process. The final 3D model can be uploaded in the internet or it can be copied directly as a file, see Fig. 1. In this study a simple engine model is developed in the experiment. The final engine model is loaded into an Android-based smartphone and the AR model viewer from Google play apps will view the model on a desired marker.

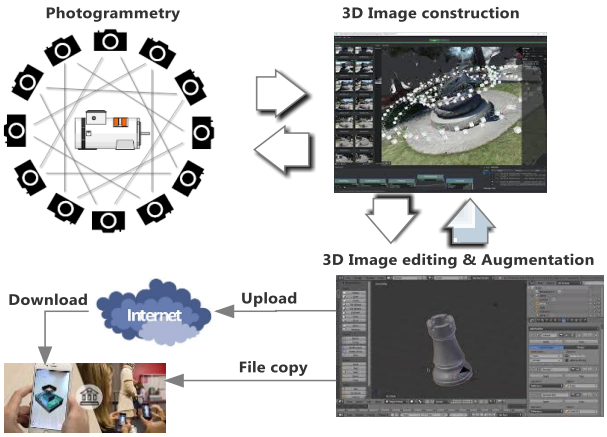

Figure 1. AR model development flow.

Using the augmented reality model framework in Fig. 2, this allows the experiment to evaluate a learning strategy focused on a car engine using simulator and hands-on. When the variables platform content, learner satisfaction, and knowledge satisfaction is significantly low, it will mean that the topic will need learning enhancement. This enables the development of an AR model to be used as another teaching or learning strategy to supplement and enhance the learning experience of the students.

The development of the AR engine model was made in collaboration with the teachers involved and in relation to courses that discusses machine engines. A prototype was shown to the teaching staffs, engine department head and to the dean of maritime education. As a result, the researchers were able to come up an AR engine model after several times of painstakingly modifying the model until all goals were met accordingly. Two teaching personnel were involved during the experiment to initiate the learning sessions with the AR engine model in the lesson.

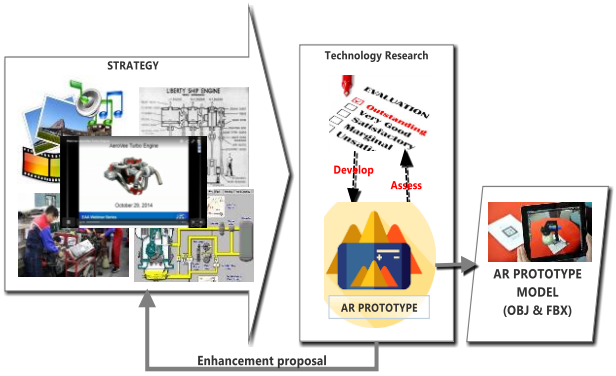

Figure 2. Augmented reality model framework.

A descriptive type of research method was utilized in the study. Descriptive survey method is appropriate for data derived from simple observational situations, whether these are actually physically observed or observed through the use of a questionnaire.

The respondents of the study is comprised of 22 Marine Engineering students enrolled during the 2nd Semester Academic Year 2018-2019 at Northern Philippine College for Maritime, Science and Technology, San Fernando City, La Union, Philippines. They were identified through systematic random sampling technique.

The instrument was adopted from Barbera [19] used in evaluating an online course in Open University of Catalunya, Barcelona, Spain. The researchers revised the instrument to focus more on the student's factors affecting learning experiences used in the first phase of the study focusing on common learning strategies and obtained the reliability scale of 0.87.

The researcher invited selected Marine Engineering students where the questionnaires were personally administered and informed regarding the purpose of the study and only those willing respondents are to participate in the study then answer a survey questionnaire. In the learning strategies, the AR engine model was used and blended with a slide presentation that defines parts of the engine. Under multimedia with the AR engine model the video supports audio/visual definition of the parts of the engine. In simulation and hands-on, the AR engine model was used as a supplementary or familiarization on the part of an engine

while waiting for their turn in using the simulator laboratory or the machine shop.

TABLE I. LEARNING STRATEGY VARIABLES

Variable	Description
Learning platform (LP)	The technology or material supporting the educational experience
Learning content (LC)	The content to be learned
Learner satisfaction (LS)	Student's satisfaction with the learning experience
Knowledge satisfaction (KS)	Student's perception of his/her learning in the educational experience

All items in the questionnaire were scored with the 5-point Likert scale, measuring the extent to which learners strongly disagreed to strongly agree on the statements. SPSS was used to analyze the data in the descriptive frequency distribution table was used to create (the mode), on which the most frequent responses has clear interpretation when applied to the most nominal and ordinal on the categorical variables of the instrument, see Table I.

III. RESULTS AND DISCUSSION

The study requires experimental session on the different learning strategies: Presentation, multimedia, simulator and hands-on with the AR model introduced and evaluated to determine the effectiveness of the enhanced learning strategy. Then each session will be evaluated through a questionnaire. In all of the learning strategies examined in this study when AR model supplements these learning strategies, there is a significant impact and increase on the learning experiences of the participants, see Appendix for the complete data.

TABLE II. PERCENTILE DIFFERENCE SUMMARY

Variables	Presentation	Multimedia	Simulator	Hands-on
LP1 - All important content was easy to locate and identify.	4.5	13.6	27.4	18.2
LP2 - Provides clear means of obtaining technical help.	27.3	4.6	9.2	36.4
LP3 - Strategy is appropriate for the topic.	31.8	9.1	28.2	31.8
LP4 - Strategy has sufficient time for discussions.	9.1	9.1	9.1	4.5
LP5 - Strategy does not need further support.	36.4	(18.2)	36.4	45.4
LC1 - Content was presented at an appropriate level for me.	9.1	(13.6)	9.1	18.3
LC2 - Content was relevant to the objectives of the course.	36.4	13.5	0.1	31.8
LC3 - Content was stimulating to me as a learner.	31.8	13.6	13.7	-
LC4 - Content was appropriate on the strategy.	31.8	13.7	-	36.4
LS1 - I was motivated to do well in this course.	22.6	4.5	27.2	41.0
LS2 - This course was a useful learning experience.	22.7	13.6	27.3	36.3
LS3 - The course was relevant to my needs.	9.1	4.6	31.8	22.9
LS4 - I learned from the activities assigned in the course.	31.9	22.7	4.6	12.6
LS5 - Recommend that other people use the strategy.	36.4	31.9	18.1	9.1
KS1 - Did well on class participation, discussion or quizzes.	36.4	4.5	13.7	19.1
KS2 - Can explain the material covered in this course to others.	22.8	18.2	18.2	27.3
KS3 - Difference between prior knowledge & knowledge gained.	22.7	22.8	27.2	27.3
KS4 - Conscious about strengths and weaknesses in learning.	27.3	(9.0)	18.1	22.8
KS5 - Correct decision & solve problem with knowledge gained.	13.7	9.1	31.8	27.3

There are some advantages and disadvantages observed during the experiment that was not anticipated. Slide presentation and multimedia has more exposure time than simulation and hands-on, these two strategies were too easy to finish by others, but most of the participants had accepted the AR model as part of the learning process. The percentile difference was computed by adding the values of neutral, agree and highly agree of strategies, see Table II. Example in LP1, there is significant increase of 4.5% for presentation, 13.6% for multimedia, 27.4% for simulator, and 18.2% in hands-on. The allotted time for discussions on any of the learning strategies has a low percentile impact 9.1% on presentation, multimedia and simulator, while 4.5% on hands-on, are still good and manageable.

In LP3, all of the strategies had a great significant impact on the learning strategies mixed with the AR model, presentation increased 31.8%, multimedia 9.1%, simulator 28.2, and hands-on 31.8%. Then in LP5, referring to void additional support on presentation 36.4%, simulator 26.4% and hands-on 45.5% indicating learning strategy satisfaction but not multimedia at (18.2%) that needs further support.

For the learning contents, a significant increase on presentation and hands-on, while multimedia with the AR model states that most of the participants has a difficulty when watching a video while controlling the AR model, and simulator a slight significance due to similarity of functionality. LC1 of hands-on had a significant computed score of 18.3%, stating that the participants are satisfied with the lesson content with AR model on their side. In LC2, presentation scored high 36.4% referring to the relevance of objectives of the topic. In LC3 the most significant in stimulating learning content with the AR model is presentation 31.8%, multimedia 13.6%, and simulator 13.7%, while hands-on at 0% stating that either with or without the AR model, participants can achieve learning satisfaction. And in LC4, the most significant and appropriate strategy to convey a learning content is hands-on at 36.4%, followed by presentation 31.8% and multimedia 13.7%, while simulator at 0% stating that either with or without the AR model participant's satisfaction on the relevance of learning content is achieved.

For learner satisfaction, all participants are satisfied with the learning strategies with AR model used during the sessions. The computed average score on presentation 24.54%, multimedia 15.46%, simulator 21.8%, and hands-on 24.38%. In LS1, for learner satisfaction on topic motivation, hands-on achieved the most significant score 41%, followed by simulator 27.2%, presentation 22.6% and multimedia 4.5%. In LS2, refers to the usefulness of the learning experience, the most significant learning strategy is hands-on 36.4%. In LS3, the most relevant to represent a topic is simulator at 31.8% followed by hands-on at 22.9%. In LS4, pertains to learning on activities the most significant learning strategy is presentation at 31.9%, followed by multimedia at 22.7%, then hands-on at 12.6%, and simulator only at 4.6%. And in LS5, best learning satisfaction is from presentation at 36.4%, followed by multimedia at 22.7%, simulator at 18.1%, and hands-on at only 9.1%.

On knowledge satisfaction, participants are satisfied with the knowledge gained during the session. The computed average score on presentation is 24.58%, multimedia 9.12%, simulator 21.80% and hands-on 24.76%. In KS1, referring to what strategy is best during class participation, discussion and quizzes, the most significant learning strategy on this is presentation 36.4%, followed by hands-on, 19.1%, simulator at 13.7% and, multimedia 4.5%. In KS2, the most significant on being able to explain the topic to their peers is hands-on 27.3%,

followed by presentation 22.8%, then multimedia 18.2% and simulator also 18.2%. In KS3, referring to prior knowledge and knowledge gained from the strategies that has significant effect are hands-on 27.3% and simulator 27.2%, followed by multimedia 22.8% and presentation 22.7%. In KS4, referring to strengths and weaknesses in learning, the most significant strategy is presentation 27.3% and hands-on 22.8%, followed by simulator 18.1%, a possible conflict of interest on multimedia (9%), there is a need to explore in this area. In KS5, about decisions and problem solving based on knowledge gained, hands-on 27.3% shows the most significant strategy followed by simulator at 31.8%, then presentation 13.7% and not much in multimedia 9.1%.

Under simulator, all variables had significant results and a marginal result in LC4 at 0%, the simulator and AR model is helpful while waiting for a turn to use the simulator or into the AR model. Also under hands-on, a marginal value seen in LC3 at 0%, the learning content using hands-on and AR model are stimulating while waiting to take turns in using an actual machine or device. These marginal values needs to be further investigated to know exactly what the students wants.

The overall computed average percentile of presentation is 23.8%, multimedia 6.3%, simulator 20.6% and hands-on 21.4%. Therefore the most significant changes that are mostly assisting students learning experience is though presentation, hands-on and simulator.

IV. Conclusions and Recommendations

This study conducted a descriptive frequency distribution using mode to get the significant differences of the variables in the instrument. The analysis had determined the impact of AR on the factors affecting learning experiences of the participants. The study showed a significant increase in the learning experience of students when learning strategy is supported by an AR model viewed in their smart devices. There are some drawback seen during the experiment in the acceptance of using the AR model with their smart devices, a drill and practice method must be used to introduce the operation and functionality of the model viewer application.

The study highly recommends the use of AR model anytime during vacant times and or out of the school to increase learning experience and further motivation. The AR model framework can be used to design and evaluate a concept AR model before being implemented in classrooms on any field of education and learning. In the maritime education, AR technology will significantly improve learning and teaching strategies of would be seafarers, this contributes to enhance learning experiences of students and further motivates familiarization of tools and equipment not present in school laboratories and mockups. This body of knowledge will open up future opportunities of making AR models to be used in classrooms of any science.

This also recommends that further study similar to this must be initiated to find out more potential opportunities and improvements in using the AR model framework and AR modeling technology to other learning and teaching strategies.

Appendix

LP1 - All important content was easy to locate and identify.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	4.5	13.6		27.3	22.7	36.4	18.2	31.8
Agree	27.3	27.3	36.4	36.4	22.7	27.3	27.3	27.3
Neutral	27.3	22.7	36.4	22.7	13.6	22.7	22.7	27.3
Disagree	13.6	27.3	27.3	13.6	22.7	13.6	22.7	13.6
Highly Disagree	27.3	9.1			18.2		9.1	
Total	100.0	100.0	100.1	100.0	100.0	100.0	100.0	100.0

LP2 - Provides clear means of obtaining technical help.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	22.7	40.9		27.3	13.6	27.3	4.5	40.9
Agree	27.3	36.4	59.1	36.4	40.9	36.4	36.4	36.4
Neutral	40.0	22.7	31.8	18.2	13.6	22.7	22.7	22.7
Disagree	9.1		9.1	18.2	31.8	13.6	36.4	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LP3 - Strategy is appropriate for the topic.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	18.2	22.7	13.6	27.3	13.6	45.5	4.5	22.7
Agree	27.3	40.9	45.5	59.1	40.0	36.3	27.3	40.9
Neutral	22.7	36.4	31.8	13.6	18.2	18.2	36.4	36.4
Disagree	27.3		9.1		27.3		31.8	
Highly Disagree	4.5							
Total	68.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LP4 - Strategy has sufficient time for discussions.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	9.1		18.2		9.1	18.2	9.1	
Agree	22.7	13.6	18.2	36.4	54.5	31.8	9.1	13.6
Neutral	18.2	45.5	31.8	40.9	9.1	31.8	36.4	45.5
Disagree	40.0	40.9	27.3	22.7	22.7	18.2	31.8	40.9
Highly Disagree	9.1		4.5		4.5		13.6	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LP5 - Strategy does not need further support.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	9.1	22.7	13.6		4.5	31.8	27.3	22.7
Agree	31.8	40.9	31.8	13.6	36.4	31.8	9.1	40.9
Neutral	22.7	36.4	18.2	31.8	22.7	36.4	18.2	36.4
Disagree	31.8		31.8	22.7	27.3		27.3	
Highly Disagree	4.5		4.5	31.8	9.1		18.2	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LC1 - Content was presented at an appropriate level for me.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	18.2	31.8	9.1		36.4	68.2	4.5	31.8
Agree	54.5	36.4	50.0	13.6	13.6		54.5	36.4
Neutral	18.2	31.8	31.8	36.4	40.9	31.8	22.7	31.8
Disagree	9.1		9.1	27.3	9.1		13.6	
Highly Disagree				22.7			4.5	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LC2 - Content was relevant to the objectives of the course.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	4.5	22.7	27.3	31.8	40.9	45.5	4.5	22.7
Agree	36.4	45.5	18.2	54.5	31.8	36.4	36.4	45.5
Neutral	22.7	31.8	40.9	13.6	27.3	18.2	27.3	31.8
Disagree	31.8		13.6				31.8	
Highly Disagree	4.5							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LC3 - Content was stimulating to me as a learner.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	4.5	40.9	27.3	31.8	22.7	54.5	13.6	40.9
Agree	36.4	45.5	31.8	22.7	54.5	40.9	45.5	45.5
Neutral	27.3	13.6	27.3	45.5	9.1	4.6	40.9	13.6
Disagree	31.8		13.6		13.6			
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LC4 - Content was appropriate on the strategy.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	9.1	22.7	4.5	22.7	40.9	36.4	4.5	22.7
Agree	40.9	40.9	59.1	45.5	22.7	50.0	22.7	40.9
Neutral	18.2	36.4	22.7	31.8	36.4	13.6	36.4	36.4
Disagree	27.3		13.6				27.3	
Highly Disagree	4.5						9.1	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LS1 - I was motivated to do well in this course.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	9.2	27.3	18.2	13.6	9.1	72.7	13.6	27.3
Agree	36.4	54.5	45.5	40.9	36.4	27.3	31.8	54.5
Neutral	31.8	18.2	31.8	45.5	27.3		13.6	18.2
Disagree	9.1		4.5		27.3		40.9	
Highly Disagree	13.6							
Total	100.0	100.0	100.0	100.0	100.1	100.0	100.0	100.0

LS2 - This course was a useful learning experience.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	9.1	27.3	9.1	22.7	13.6	77.3	9.1	27.3
Agree	36.4	50.0	45.5	40.9	27.3	22.7	36.4	50.0
Neutral	31.8	22.7	31.8	36.4	31.8		18.2	22.7
Disagree	13.6		13.6		27.3		36.4	
Highly Disagree	9.1							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LS3 - The course was relevant to my needs.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	9.1	36.4	13.6	18.2	13.6	54.5	22.7	36.4
Agree	50.0	45.5	59.1	27.3	27.3	40.9	31.8	45.5
Neutral	31.8	18.1	22.7	54.5	27.3	4.6	22.7	18.2
Disagree	9.1		4.5		31.8		22.7	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

LS4 - I learned from the activities assigned in the course.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	13.6	40.9	18.2	18.2	9.1	68.2	27.3	40.9
Agree	31.8	45.5	31.8	27.3	63.6	31.8	22.7	45.5
Neutral	22.7	13.6	27.3	54.5	22.7		37.4	13.6
Disagree	31.8		22.7		4.5		13.6	
Total	100.0	100.0	100.0	100.0	99.9	100.0	100.0	100.0

LS5 - Recommend that other people use the strategy.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree		40.9	4.5	18.2	18.2	45.5	22.7	40.9
Agree	31.8	50.0	31.8	27.3	45.5	54.5	50.0	50.0
Neutral	31.8	9.1	31.8	54.5	18.2		18.2	9.1
Disagree	31.8		31.8		18.2		4.5	
Highly Disagree	4.5						4.5	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

KS1 - Did well on class participation, discussion or quizzes.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	4.5	40.9	18.2		4.5	45.5	13.6	40.9
Agree	36.4	45.5	36.4	40.9	54.5	50.0	27.3	45.5
Neutral	22.7	13.6	31.8	50.0	27.3	4.5	40.0	13.6
Disagree	27.3		13.6	9.1	13.6		18.2	
Highly Disagree	9.1							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

KS2 - Can explain the material covered in this course to others.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	4.5	27.3	9.1	18.2	9.1	36.4	18.2	27.3
Agree	40.9	50.0	50.0	22.7	54.5	63.6	40.9	50.0
Neutral	31.8	22.7	22.7	59.1	18.2		13.6	22.7
Disagree	22.7		18.2		18.2		27.3	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

KS3 - Difference between prior knowledge & knowledge gained.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	13.6	27.3	22.7	36.4	9.1	50.0	4.5	27.3
Agree	45.5	54.5	31.8	40.9	27.3	50.0	31.8	54.5
Neutral	18.2	18.2	22.7	22.7	36.4		36.4	18.2
Disagree	18.2		22.7		22.7		22.7	
Highly Disagree	4.5				4.5		4.5	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

KS4 - Conscious about strengths and weaknesses in learning.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	13.6	4.5	4.5		18.2	31.8	4.5	4.5
Agree	31.8	45.5	54.5	22.7	45.5	22.7	40.9	45.5
Neutral	27.3	50.0	22.7	50.0	18.2	45.5	31.8	50.0
Disagree	27.3		18.2	27.3	13.6		22.7	
Highly Disagree					4.5			
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

KS5 - Correct decision & solve problem with knowledge gained.

	Presentation	Pres./AR	Multimedia	Media/AR	Simulator	Sim/AR	Hands-on	HO/AR
Highly Agree	13.6	45.5	13.6		18.2	77.3	13.6	45.5
Agree	50.0	54.5	27.3	27.3	27.3	22.7	36.4	54.5
Neutral	22.7		27.3	50.0	22.7		22.7	
Disagree	13.6		27.3	22.7	31.8		22.7	
Highly Disagree			4.5				4.5	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

Rommel Balcita has conducted the experiment and research, analyzed the data and wrote the paper. Thelma Palaoag is the research adviser, organized the research content and made important revisions; All authors had approved the final version.

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