Impact of Virtual Reality in Maritime Education and Training: The Case of the Maritime Academy of Asia and the Pacific

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Abstract

The use of virtual reality (VR) in education is one of the revolutionizing strides in developing computer-assisted instruction. Through an elaborate literature review, the study tracked the development of VR in education and its progress in maritime education and training (MET) here and abroad. The research employed a case study analysis in assessing the impact of VR-based education juxtaposed with the traditional method of teaching. The two groups of students from Maritime Academy of Asia and the Pacific (MAAP) underwent two sets of tests which were the Diagnostic Test and the Assessment Test. Each set of tests was composed of 25 questions. The T-test was used as the analysis framework to determine whether there was significant difference between the two sample means. The two separate treatments (VR-based Teaching and Traditional Teaching) which were used in the experiment were two independent samples, were normally distributed, and had the same variance. The p value was less than 0.05; therefore, the null hypothesis that there was no significant difference between the two means of the VR-based Teaching and Traditional Teaching was rejected. The mean score of the VR-based Teaching was 20.84% while the mean score of Traditional Teaching was 10.44%. The primary advantage of VR-based teaching which emerged in the study was the ability of VR to engage the learners while infusing fun and excitement and to immerse them in experience that generally makes retention easier. Furthermore, majority of the students reported that given the option, they would utilize and recommend VR in their education and training. Overall, students reported positive experiences in using VR, specifically citing the realism that the VR head gears were able to replicate in the virtual environment. They study also found that simulation technology in education and training can deliver the desired competency among seafarers and safety in shipping vessels

Keywords: *Quality assurance, open and distance e-learning, learning visit/externship, knowledge sharing and co-creation*

Introduction

Many innovations that have revolutionized the way in education and training are being utilized in the maritime industry. The fast-paced progress of computational power has drastically changed trainings and assessments from the basic use of personal computers to the utilization of advanced simulations. To better fit these technological improvements, major revisions were made in the Standards of Training, Certification, and Watchkeeping (STCW) Convention and Code. A couple of notable major revisions were the addition of the following provisions: New requirements relating to training in modern technology such as Electronic Chart Display and Information System (ECDIS) and Introduction of modern training methodology including distance learning and web-based learning (IMO, 2010).

Such revisions on the STCW Convention and Code prompted many stakeholders in the industry to innovate and adopt new methods of training that will allow the seafarers to have an edge in the highly competitive industry. Acknowledging this need to adapt forced maritime education and training (MET) institutions to become more flexible and innovative in seeking ways to educate students; hence, the need to make education more accessible and learner-centric so that skills enhancement and knowledge development are neither restricted by physical spaces. With the advent of Virtual Reality (VR) technologies and distance learning, immersive learning experiences and better knowledge retention were achieved.

Despite the international recognition of the growing need for these innovative solutions, VR is only now being established as an emerging market in the Philippines. This may be attributed to the reality that the stakeholders may have little to no knowledge about the impact VR has on the performance of students and learners. There is limited literature that documents the progress of VR being incorporated in the country's education system; hence, the lack of traction in launching it in a much larger scale. Another explanation would be that there is a lack of VR content providers in the country that caters specifically to the needs of maritime institutions. With this in mind, the researchers recognized the need to study the impact of VR in education by providing empirical data on its actual use to create better understanding of its worth in maritime education.

Rationale of the Study

The Philippines' maritime educational system employs outcome-based education (OBE). It is an educational theory that requires components of an education system to be grounded on goals that must be achieved. The OBE theory requires that all efforts (i.e., classes, instructions, assessments, etc.) must all yield the desired results. The theory does not state specific methods and is only concerned with meeting the objectives of education. Outcome-based learning allows clarity of and focus on goals thus prohibiting unnecessary deviations from the topic. Flexibility is also put at a premium as the need to prioritize the needs of the students is emphasized; hence, OBE is coined as 'student-centered learning'.

OBE grounds the methods of teaching in the Maritime Academy of Asia and the Pacific (MAAP) and every other maritime educational institution in the country. However, despite the intentions of OBE, the question on whether the country's MET is delivering quality seafarers has been presented.

Over the years, the country's MET has been marred with issues of deficiencies in declining employment of Filipino seafarers. The Nordic Chamber of Commerce of the Philippines reported a decline by 25% (Guerrero and Cahiles-Magkilat, 2018). One of the factors cited for the decline was the educational gaps in Philippine's MET as audited by European Maritime Safety Agency (EMSA). EMSA identified gaps in the country's compliance to STCW Convention and Code which outlines the minimum requirements for officers, masters, and watch personnel in vessels. The country is given until October of the year 2018 to come up with proof that the issues are being address by the government. If still found to be non-compliant, 80,000 Filipino seafarers are threatened to be displaced and become unemployable by European Union (EU) member states. There arises the need to integrate modern technology, as mandated by the 2010 Manila Amendments of STCW Convention and Code, in the country's education to significantly impact the quality of seafarers produced locally to make them more competent and globally competitive.

Objectives of the Study

Primarily, the study, through a comprehensive literature review, aimed to track the development of VR in general and its progress in MET in the global and local scene. Piecing together the development through its varied applications in various fields, the researchers aimed to establish the advantages of VR in education.

Secondly, the research employed a case study analysis in assessing the impact of VR-based education juxtaposed with the traditional method of teaching. The researchers aimed to accomplish this by measuring the academic performance of two sets of students (VR –based Teaching Group and Traditional Teaching Group) through their test scores before and after going through the designed teaching session. The study focused on comparing the impact of both VR-based Teaching and Traditional Teaching on the students' test scores and their memory retention.

More specifically, the study aimed to assess the impact of VR when used in maritime education using a case study done among students from MAAP. The study determined if there is a significant difference between the performance of students who undergo VR-based teaching and traditional method of teaching.

Review of Related Literature

Virtual Reality's Definition and Applications

VR's defining characteristic is the navigational and immersive experience it provides its user/s (Rheingold, 1991). According to Rheingold (1991), immersion in VR technology pertains to VR's ability to replicate an environment from the real world while navigation is the ability of any user to manipulate the objects present in that environment. Precisely because of these definitive features, VR discovered its place in the educational setting.

Several fields of study have employed VR technology in education. Some of these fields are more often exposed to high risk scenarios; hence, the high value placed in reducing human error in execution. In the study of medicine, Scalese, Obeso, and Issenberg (2008), noted that simulations are used by medical practitioners through computer representations of physical body parts. Through virtual simulations, medical professionals can practice and master the procedures that they need to perform on their patients with the aim of reducing errors in operations. The medical field has since expanded the application of VR and has recorded advantages in terms of eliminating the need for live patients, reducing costs, and upholding various ethical considerations. Further applications involved testing competencies and medical knowledge of medical students. One research adopted this technology in designing and implementing a medical outreach workshop. Findings showed that through VR technology, students' aspirations to pursue medical degrees were heightened as they were able to immerse and have a feel of how medical professionals work (Tang, Maroothynaden, and Kneebone , 2013). With this, VR's practical applications in the medical field had widespread implications and inspired adaptations in other fields.

Virtual Reality Society (2015) gave other applications of VR in education and training in the military context which included flight simulations, medic training, battlefield simulations, and vehicle simulations. VR trainings are conducted with head-mounted gears that allow interaction among the trainees. With these, the military can simulate combat scenarios. The main advantages identified from VR application in the military are better cost efficiency and eliminated or reduced exposure to actual danger such as deaths and injuries and property damage.

Virtual Reality's Application in Maritime Education and Training

Tan (1999) studied the feasibility of using VR in MET highlighting the advantages of VR as a form of simulation. An example which the author cited was the Canadian Navy with its Maritime Surface/ Subsurface Virtual Reality System (MARS/VRS). The system was developed to enhance training performance through its 3D imaging, voice recognition, speech synthesis, and artificial intelligence features. Eades as cited by Tan (1997), emphasized the advantages of VR namely: portability, affordability, high flexibility, and ease of use. In the same study, Eades (1997) attested that the effectiveness of using head-mounted VR gears in training were subject to 'proof of concept' when they tested for the results with trainees registering 25-30% increase in their scores after having undergone the VR-based education.

Results and Discussion

Preparation

The preparation phase consisted of Course Development, Selection of Participants, and Pre-Testing. Course Development ensured that the content and design of the subject were delivered within the time allotted. Time allotment for both methods, VR-based Teaching and Traditional Teaching, was controlled. Pre-testing was done to test the procedures before running the experiment. Questionnaires were screened to ensure that the time allotment sufficed.

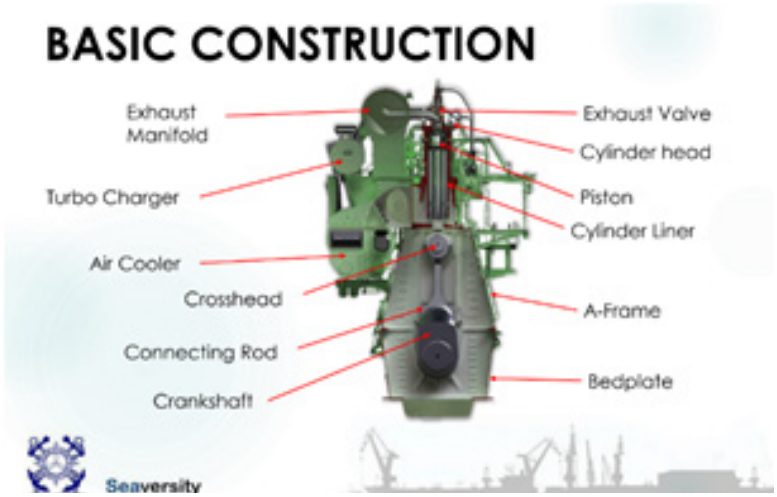


Figure 1: Sample content of ME Engine discussion

Course Objectives

Course Objectives were based on the module provided by MAAP which served as basis for materials such as PowerPoint presentation and VR content developed by the researchers. The VR content was run and powered by Unity. The questionnaires for both the two sets of tests administered were checked and validated by maritime instructors.

Figure 2: Course Content discussed in both VR-based and Traditional Teaching

The course objectives outlined for the teaching session conducted were as follows:

a. identified and locate principal components of ME Diesel Engine;
b. distinguished the advantages of ME engine from MC engine;
c. understood the basic construction of ME type engine; and
d. explained the difference between ME diesel engine and MC diesel engine in terms of parts and features.

These objectives were reflected on the questionnaires developed for both the Diagnostic and Assessment Test.

Table 1: Research procedures for study on effectiveness of VR-based and traditional teaching among BS MT students in MAAP

Preparation	Testing Proper					Analysis
Course Development Selection of Participants Briefing Informed Consent Profile	Traditional Teaching	Diagnostic Test	Traditional Teaching	Assessment Test	VR Use Attitude Survey	Results
	VR-Based Teaching	Diagnostic Test	VR Instruction and Training	Assessment Test	Attitude Survey	

The study employed two methods in assessing the impact of incorporating VR technology in maritime education. The quantitative part measured the performance of the students using their test scores while the qualitative part utilized the feedback on VR use based on the students' attitude and perception towards VR's application in education.

Statistical Analysis on Performance of Students

Two classes of first year Bachelor of Science Marine Transportation (BS MT) students from MAAP were screened and selected for the study. The two classes were ensured to have similar characteristics in terms of level of initial knowledge about a ship's ME Engines. Class A was composed of 19 students while class B was composed of 18 students. For the purpose of the study, Class A was assigned to undergo the VR-based type of teaching while Class B, the control group, was assigned to undergo the Traditional type of teaching.

The two groups underwent two sets of tests which are the Diagnostic Test and the Assessment Test. Each set of test was composed of 25 questions. Ten questions from the Diagnostic Test were retained in the Assessment Test. To assess the effect of the two different methods of teaching on the performance of the students, the percent increase in their scores were noted and tabulated below.

Table 2: Test scores of participants under VR-Based and Traditional Teaching

Treatment 1 VR-Based Teaching		**Treatment 2 Traditional Teaching**	
Student n=19	**Test Score % Increase**	**Student n=18**	**Test Score % Increase**
1	10	1	29
2	20	2	10
3	40	3	15
4	15	4	24
5	20	5	20
6	15	6	-5
7	15	7	5
8	20	8	20
9	20	9	5
10	10	10	25
11	19	11	10
12	29	12	-19
13	19	13	25
14	14	14	5
15	20	15	5
16	20	16	0
17	14	17	29
18	10	18	-15
19	66		

Statistical Analysis

The T-test was used as the analysis framework to determine whether there was significant difference between the two-sample means. The two separate treatments which were used in the experiment ware two independent samples, ware normally distributed, and had the same variance.

Null Hypothesis

The null hypothesis was there was no significant difference between the means of the two populations. Using a two-tailed test hypothesis and significant level of 0.05, t and p values were computed.

Ho: u1-u2 =0,
Where: u1 = the mean of the first population
u2=is the mean of the second population

Equation

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\left(\frac{(N_1 - 1)s_1^2 + (N_2 - 1)s_2^2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

Figure 3. T-Test statistic equation
(Source: Social Science Statistics)

Advantages of VR-based Education

The p value was less than 0.05; therefore, we rejected the null hypothesis that there was no significant difference between the two means of the VR-based Teaching and Traditional Teaching. The mean score of VR-based Teaching was 20.84% while the mean score of Traditional Teaching was 10.44%. The average test scores of the class with VR technology incorporated in learning was relatively higher than that of the Traditional learning.

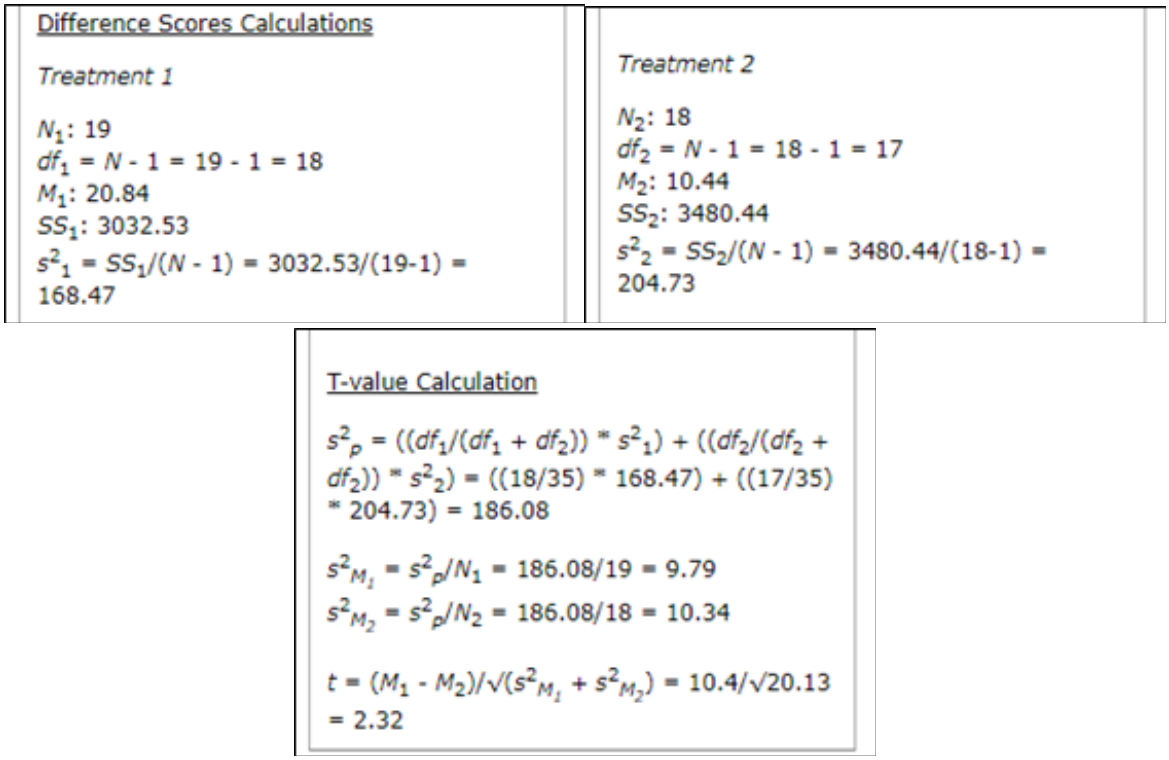
The higher average test score of the first group suggested that VR-based teaching helped improve the students' performance as evident in the 10.40% gap between the two groups' mean scores. This also suggested that the VR-based teaching method helped in improving students' retention of new information. The objectives of the course discussed in both types of treatment which were reflected in the test questionnaires included familiarizing with the ME Diesel Engine, distinguishing advantages of ME engine from MC Engine, and differentiating the parts of ME and MC engine. To gain mastery of the parts of the ship, the students must be able to visualize the parts as they appear in the actual engine which VR successfully replicated and demonstrated complete with dimensions, functions, and dynamics based on real-life scenarios.

Table 3: VR-Based Teaching Group
(Source: https://www.socscistatistics.com/tests/studentttest/Default2.aspx)

Treatment 1 (*X*)	*Diff* (*X* - *M*)	*Sq. Diff* (*X* - *M*)^2
10	-10.84	117.55
20	-0.84	0.71
40	19.16	367.02
15	-5.84	34.13
20	-0.84	0.71
15	-5.84	34.13
15	-5.84	34.13
20	-0.84	0.71
20	-0.84	0.71
10	-10.84	117.55
19	-1.84	3.39
29	8.16	66.55
19	-1.84	3.39
14	-6.84	46.81
20	-0.84	0.71
20	-0.84	0.71
14	-6.84	46.81
10	-10.84	117.55
66	45.16	2039.24
	M: 20.84	SS: 3032.53

Table 4: Traditional Teaching Group
(Source: https://www.socscistatistics.com/tests/studentttest/Default2.aspx)

Treatment 2 (*X*)	*Diff* (*X* - *M*)	*Sq. Diff* (*X* - *M*)^2
29	18.56	344.31
10	-0.44	0.20
15	4.56	20.75
24	13.56	183.75
20	9.56	91.31
-5	-15.44	238.53
5	-5.44	29.64
20	9.56	91.31
5	-5.44	29.64
25	14.56	211.86
10	-0.44	0.20
-19	-29.44	866.98
25	14.56	211.86
5	-5.44	29.64
5	-5.44	29.64
0	-10.44	109.09
29	18.56	344.31
-15	-25.44	647.42
	M: 10.44	SS: 3480.44



The t-value is 2.31735. Th p-value is 0.026456. The result is significant at $p<0.05$.

A general higher improvement in the scores showed proof that the students benefited from the use of VR compared to the other group who did not experience VR before the assessment test. The deviation in the mean scores implied that VR-based education was more effective in achieving the outcomes desired for the teaching demonstrations.

Concerns about Virtual Reality and Future Use

All the participants were provided the opportunity to experience VR using the ME Engine Familiarization module. To ensure the validity of the test, the control group was allowed to try the VR headset only after their Assessment Test. A total of 37 students composed of 35 (94.6%) males and 2 (5.4%) females took the survey placed before and after undergoing their designated ME Engine Teaching session.

Majority of test subjects had little exposure and knowledge about VR technologies and only about half of them used VR at least once. When asked about their source of VR content, 54.1% indicated YouTube and 18.9% indicated Google Expeditions. These sources were the ones most accessible to the users.

Figure 4: Familiarity with VR technology

The participants were also asked about their initial concerns about VR and possibility of future use. When asked about whether they expected to use VR in their education in the near future, 91.9% indicated that they had expectations of using said technology for their learning while 8.1% were unsure.

The researchers also included questions on their perceived benefits of VR in education and possible concerns on its use. The top benefits identified are Lessons are made easier to grasp (56.8%); Lessons can be accessed anytime (37.8%); Students can determine own pace (29.7%); and Students are excited about the lessons (29.7%).

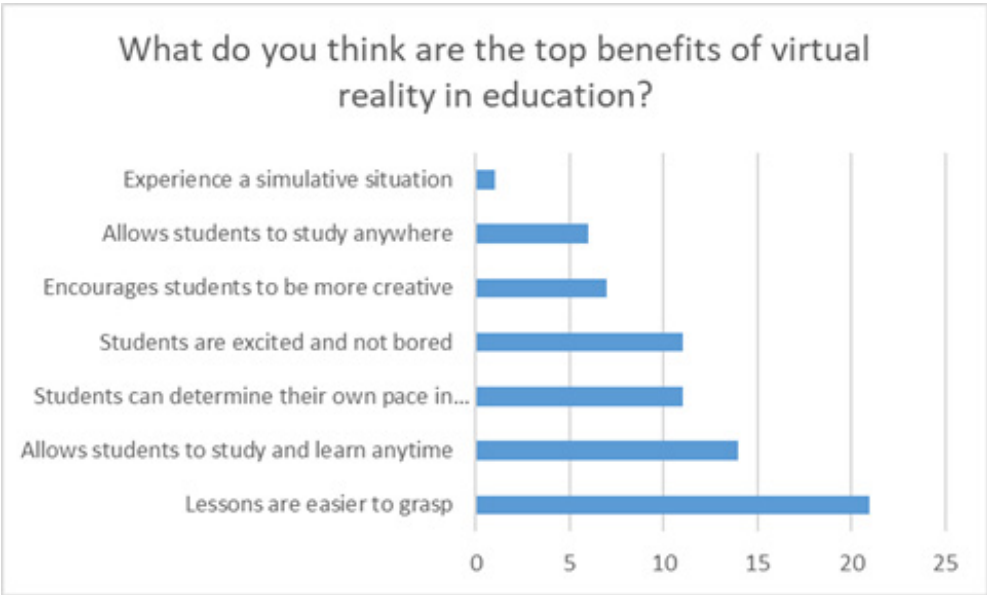


Figure 5: Top benefits of VR in education

The advantages of VR included the interactive and immersive environment where students can simulate real-life environments (e.g., see the parts of engines, assemble the parts of engine, 360-degree virtual tour of to-scale ship, etc.). Some students indicated that it is usually very difficult to visualize the parts of the ship as some of their lessons provided only theoretical discussions and visualizations, limiting their comprehension on the subject matter. Another top benefit indicated was the accessibility of the lessons. With the presence of VR-enabled tools, students easily familiarized themselves with the environment whether they are inside or outside their classrooms. One advantage also cited was the self-determined pace of lessons as the students easily navigated through the material without affecting the progress of other students. Finally, students indicated that VR infused excitement through gamification of the lessons which caught and engaged their attention.

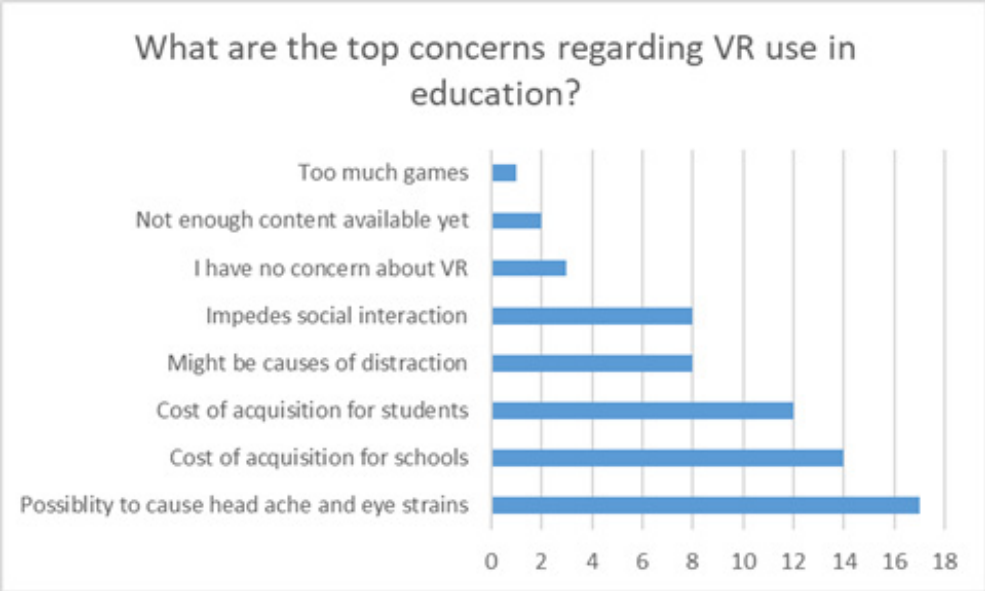


Figure 6: Top concerns for VR use in education

Possibility of eye strains and headaches, cost of acquisition for schools, and cost of acquisition for students were identified as the top three concerns of the survey participants. VR head gears are part of the equipment which have to be acquired by schools from any VR supplier.

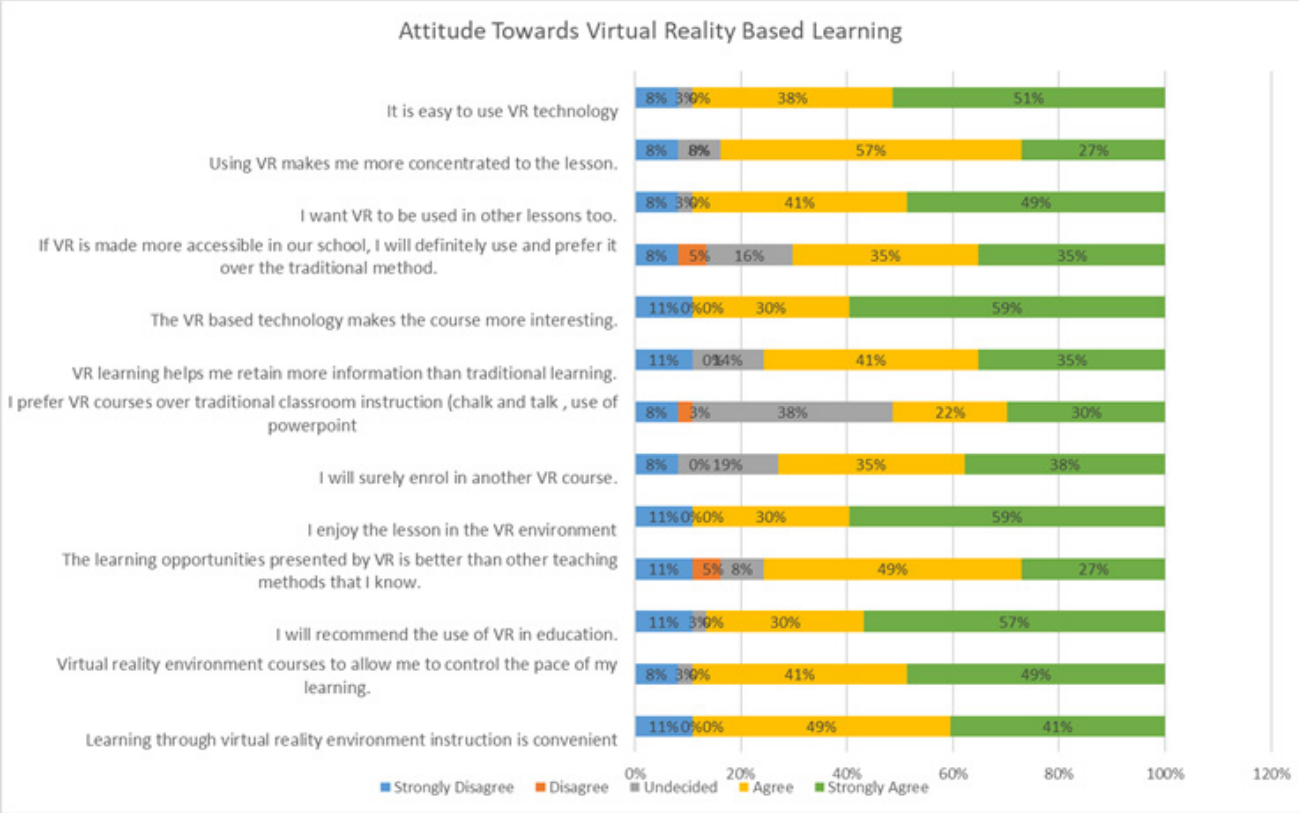


Figure 7: Results of survey on attitude towards VR use in education

The survey on Attitudes Towards VR-based Learning was conducted after the participants were able to try out the VR content using the VR head gear. The survey questionnaires included topics on usability of VR, receptiveness to lessons due to VR, willingness to recommend VR use to peers, and willingness to use VR in the future.

Virtual Reality Usability

Participants indicated strong agreement on the ease of use (Agree:38%, Strongly Agree:51%) and convenience of VR (Agree:49%, Strongly Agree 41%). Using the VR controllers, the students did multiple tasks in the virtual environment. The VR environment was also voice-activated, allowed for elaborate movements, and allowed users to navigate the place and manipulate objects within the environment. The simulations were replications of real-life scenarios in ships and may be used for maritime trainings and assessment.

Knowledge Retention, Concentration, and Willingness to Use

VR-based Teaching made the lessons more interesting compared to other methods of teaching (Agree: 30%, Strongly Agree:59%) and it increased attention and concentration of students on the subject matter being tackled (Agree: 57%, Strongly Agree: 20%). Moreover, students expressed their desire to use VR in other subjects as well (Agree: 41%, Strongly Agree: 59%). Participants strongly agreed that given the option, they preferred the use of VR in education over other methods and expressed that VR can supplement the traditional style of teaching (Agree:35%, Strongly Agree: 35%). Most have expressed that both methods can be combined to supplement one another in terms of enhancing knowledge retention of students. Almost 90% of the participants expressed

intention to use VR again in their education and strongly recommended its use to their peers.

Qualitative Feedback on VR Experience

At the end of the Attitude Towards VR Survey, two open-ended questions were posted. The first open ended question asked the participants 'How was your VR experience?". All the students gave positive feedback expressing excitement towards and high interest in the use of VR. Majority thought of the experience as immersive in a sense that they were able to navigate through the parts of the engine and the ship as if it were happening in real life. Some found the experience memorable as it reinforced theoretical knowledge they had about the engine.

"My VR experience interesting because I never thought that I will learn through virtual reality. It is a very good example of a new technology nowadays because you can visualize on what you will want to see if you don't have it in real life, you can see what you want through virtual reality. For example, I can see the Main engine and how it big even though we are not in a ship. Because of Virtual Reality we can see the engine and the parts of it. We can see also in 360 degrees and we can transfer to one place to another."

"It was a good experience although it's not my first time. Suddenly I realize it can really be a big help when it comes to education. For example, in a ship board familiarization you can familiarize a vessel and its parts even though you are not in a real vessel."

"It was a great experience, indeed. It helps to boost my interest in this field of work and excites me more for the future ahead. Virtual Reality creates environment that would satisfy the need to learn through experience."

"It was immersive. I really felt that I was in front of an engine of a ship. in terms of education, I think it made me more engaged to the topic and it really catches my full attention. It made the subject more interesting compared to the boring slides in a presentation. I think it really helped that the engine presented was the actual size because usually when presenting a PowerPoint, the size of the engine is limited to the size of the screen"

"The VR experience was really nice and thoughtful, because we are able to see the real size of a ship engine that really open my eyes that we are dealing with a very big machine in the ship. This experience would be memorable because we are able to be in a ship even though we are inside the academy."

The second open ended question prompted the survey participants to think of possible applications of VR. Recurring answers included education, training, distance learning, ship engine familiarization, safety scenarios, trainings, games, rehabilitation, and medical application to name a few.

"If the school lacks facilities, they can just use VR in order to simulate the work environment needed for a specific practicum."

"It can be used in teaching students. It is a more effective medium of teaching since it offers an actual or real-life image of a particular topic."

"Education, Simulator, Games, Medical (Rehabilitation, Medical Operation Simulations)"

"From entertainment to academics, I think VR has a lot of possible applications. With the help of VR, teaching will be convenient compared to the traditional one (using chalk and board). With the help of VR, learning will literally be exciting and fun."

"VR can really help Maritime schools simulate a real ship even inside the schools, VR can be used to show the real size of a machinery to a student, show how big a ship is etc. I think this is applicable for those maritime schools who wants to teach students how a ship really looks like even if they don't leave the school."

"Ship familiarization, Bridge Desktop Simulators and Engine Desktop Simulators"

"It can be used in many different ways: familiarization of the ship, studying the ColRegs, specifically the lights and shapes, buoys, and more. There are lots of possible applications in this."

The most recurring or salient theme was the desire to use VR in education and the interest in its possible applications in MET. During the demonstration of the engine with the use of VR, students exhibited awe in the visuals that they saw using the VR head gears. Participants were enthused in using VR and some students who were actually drawn to the ship's edges were shocked as the actual depth is reflected in the virtual environment. The immersiveness in the virtual environment made their experience memorable and the knowledge of the engines' parts that they gained were retained more effectively.

Conclusions

The purpose of the study was to determine the impact of VR-based education on the academic performance of students from MAAP and to learn how receptive they are of the technology. Results showed that there was a significant difference in the effectiveness of the two teaching methods (VR-based and Traditional Teaching) with the VR group averaging twice the mean score of the Traditional group. Using T-test statistical analysis, the t-value and the p-values were computed resulting to the rejection of the null hypothesis; hence, a significant difference between the mean scores of the two groups was noted. Majority of the students reported that given the option, they would utilize VR in their education and recommended its use in education. Overall, the students reported positive experiences in using VR, specifically citing the realism that the VR head gears were able to replicate in the virtual environment. Simulation technology in education and training can deliver the desired competency among seafarers and safety in shipping vessels.

The primary advantage of VR that emerged in the study was its ability to engage and immerse the learners in a fun and exciting learning experience that generally makes knowledge retention more effective. The effectiveness of VR in this case study was not generalizable as only few samples were taken for both studies. This study can be improved by increasing sample sizes and taking sample maritime educational institutions. This study was found to be effective in determining the effectiveness of VR-based teaching through assessing the knowledge level of students. The study also found evidence that there is still lack of awareness about the use of VR in MET and noted concerns of students on the accessibility of VR devices and content. This study found that overall VR-based instruction is quite effective in enhancing learning outcomes.

Further studies can be designed to test more variables and may incorporate various VR tools (e.g., gamification, desktop-based, etc.). It is also recommended to test the achievement levels of students using knowledge-based, abilities-based and skills-based measures as this study was only limited to knowledge-based measures.

VR application in MET provides great promise for Filipino seafarers and the entire maritime industry. The impact of VR-based learning and teaching may prove useful in developing excellent and highly competent maritime professionals.

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Appendix

Truly Informed Consent

Good day! We are a group of researchers under Seaversity, a technology enabler company working with Virtual Reality as a tool used in education and training in the maritime industry. We are conducting a study on the use of Virtual Reality-based teaching in maritime education.

In this regard, we would like to invite you to partake in a short survey and experiment which aims to assess the impact of VR in Education.

The survey aims to learn the attitude and perception of students with regards to the use of virtual reality technology in education. The survey also aims to gather the thoughts and insights of students from the VR experience that the experiment provided.

Participants' Certification

I have read and fully understand the informed consent document clause. I believe and understand the purpose of research study and what instructions I will be asked to do.

I hereby give my informal and free consent to be a participant in the research study.

I also understand that in taking part in the study, I will be required to provide my name, age, year level and school information. I also understand that I have the right to withdraw from the experiment should I wish to. I also understand that I can have my information modified and erased form the researchers' database should I wish to.

_____

Signature Over Printed Name/ Date

VIRTUAL REALITY IN EDUCATION SURVEY

1. Name: _____
2. Age: _____
3. Year Level and Course: _____
4. School: _____
5. School Address:_____
6. Which of the following describes your institution?
   - Primary
   - Secondary
   - Tertiary (College/University)
   - Training Center
   - Other (Please Specify) _____
7. What is your role or function in the organization/institution?
   - Faculty
   - Administration
   - Student
   - Other (Please Specify)_____
8. How familiar are you with Virtual Reality (VR)?
   - I am not aware of VR
   - I am slightly aware about VR
   - I have used it once or twice before.
   - We plan to use VR.
   - We are already using VR.
9. Have you tried VR in school or in training centers?
   - Yes, I have tried VR in a school setting.
   - No, I haven't tried in a school setting.
10. In what subject area/s have you used VR? _____
11. Please describe your experience._____
12. What do you think about VR being used in education?
    _____

13. Which VR brand have you used?
    - Google
    - Samsung
    - Oculus
    - Hololens
    - Meta
    - Magic Leap
    - Not sure/don't recall the brand
    - Other (Please Specify)

    _____

CONCERNS ABOUT VR AND FUTURE USE

14. How often do you use VR in your school?
    - My school/training center has never used VR
    - I am not aware if my school/training center uses VR
    - My school/training center uses VR regularly (at least once a month)
    - My school/ training center sometimes uses VR (less than a month)

15. Do you expect or plan to use VR in the future
    - Yes, I plan or expect to use VR in the future
    - No, I don't have plan or expect to use VR in the future
    - I am not certain

16. What do you think are the top benefits of virtual reality in education? (Please choose top 2.)
    - Allows students to study and learn anytime, anywhere
    - Provides an immersive experience for students
    - Lessons are made easier to grasp
    - Encourages students to be creative
    - Students are less distracted with VR
    - Students can determine their own pace in learning through VR
    - Students are excited and not bored
    - Other (please specify) _____

17. What do you think are the top concerns regarding VR if used in education?
    - Possibility to cause headaches, eye strains, and other health concerns
    - Expensive for students to afford
    - Expensive for school to acquire
    - Too hard to operate during class
    - Too much games
    - Not enough content available yet
    - Might be cause of distraction

- ☐ Impedes social interaction and collective learning
- ☐ I have no concern about VR
- ☐ Other (Please specify)_____
- ☐

18. What source of VR content have you seen in the past?
    - ☐ Google Expeditions
    - ☐ Samsung Milk
    - ☐ Open Educational Resources (OER)
    - ☐ YouTube
    - ☐ Netflix
    - ☐ Oculus Video
    - ☐ Nearpod
    - ☐ None
    - ☐ Other (please specify)

A Survey on the Attitude Towards Virtual Reality Based Learning

Please encircle the statement that corresponds to the statement which you agree upon. Put a check on the likert scale.

	Strongly Disagree 1	Disagree 2	Undecided 3	Agree 4	Strongly Agree 5
1.Learning through virtual reality environment instruction is convenient	☐	☐	☐	☐	☐
2.Virtual reality environment courses to allow me to control the pace of my learning.	☐	☐	☐	☐	☐
3. I will recommend the use of VR in education.	☐	☐	☐	☐	☐
4.The learning opportunities presented by VR is better than other teaching methods that I know	☐	☐	☐	☐	☐
5. I enjoy the lesson in the VR environment	☐	☐	☐	☐	☐

6. I will surely enroll in another VR course.	☐	☐	☐	☐	☐
7. I prefer VR courses over traditional classroom instruction (chalk and talk, use of powerpoint presentation, etc.)	☐	☐	☐	☐	☐
8.VR learning helps me retain more information than traditional learning.	☐	☐	☐	☐	☐
9.The VR based technology makes the course more interesting.	☐	☐	☐	☐	☐
10. If VR is made more accessible in our school, I will definitely use and prefer it over the traditional method.	☐	☐	☐	☐	☐
11. I want VR to be used in other lessons too.	☐	☐	☐	☐	☐
12. Using VR makes me more concentrated to the lesson.	☐	☐	☐	☐	☐
13. It is easy to use VR technology.	☐	☐	☐	☐	☐