

Interactive Classroom Discussions/Activities Using Augmented Reality for Chemistry

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ABSTRACT

In the past 100 years, transportation, houses, phones, and basically anything has evolved. Despite the new technology around us, our classrooms remain the same. By having a new method of learning, students would get engaged in learning more. ARC aims to bring a new, fun, interactive, and efficient way of learning to students and teachers alike. The application is made with Augmented Reality, a computer-generated reality that is interactive. The application was evaluated by six teachers and 5 IT experts. As they are experts in the field of education and technology respectively. The application was evaluated based on its Functional Suitability, Performance Efficiency, Usability, Maintainability, and Satisfaction. The study used ADDIE Developmental Design to help develop the application. The overall score of the evaluation is 3.57, this implies that the application passed the standards of the evaluators regarding the functional suitability, performance efficiency, usability, maintainability, and satisfaction.

INTRODUCTION

The development of new technologies for studying is vital for educators and students alike. In educational institutions, the development of teaching-learning materials is regarded as one of the major aspects that would promote student learning and help in the achievement of academic goals and objectives (Kapur, R. 2019). Every effort and a conscious determination in the learning process is nothing but to improve the quality of learning (Kristanto, A., Mustaji, M., & Mariono, A., 2017).

Educational technology, broadly speaking, has passed through five stages (Deka, S. 2011). To further innovate present learning materials, the researcher will make an application named ARC: Your Augmented Reality Classroom. The application is designed to help educators and students alike. There are already multiple cases of augmented reality being used in classrooms. AR increases students' comprehension rates, improves engagement through interactivity, and eliminates the risks associated with some practical classes (Keet. J. 2021). There are multiple AR apps that are used for classrooms, some of these are Lifeliqe, AR Flash Cards, and Elements 4d by DAQRI, where in both are used for learning. There are AR apps

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that are used for recreational activities, with these being Quiver – a 3D coloring app, Aurasma and Blippar – applications for creating Augmented Reality experiences.

AR apps are interactive by design; little wonder they bring about increased student participation. Plus, because the apps help students grasp concepts better and faster, it is a lot easier to get students to participate in learning activities both in the classroom and at home (Keet, J. 2021). Having a different approach for teaching will pique a student's interest and therefore give a better learning experience.

The researcher would use Unity to create an augmented reality app for android devices. Augmented Reality is a kind of computer-generated reality that intent to duplicate the world's atmosphere in a computer system. Along with Unity, the researcher would make use of Vuforia, a comprehensive and scalable AR platform. An augmented reality technology creates a combined view for the user. This composite view consists of real scene viewed and a computergenerated scene with additional information about the object or a place (Bharti, P. 2014).

The key difference between AR and VR is availability. Virtual Reality requires separate gadgets for a person to use it. Augmented Reality uses your own gadgets. A prime example of the use of Augmented Reality is the game called Pokémon GO. The way Augmented Reality is available for almost everyone makes it a very viable tool for learning. Augmented reality (AR) adds digital elements to a live view often by using the camera on a smartphone. Virtual reality (VR) implies a complete immersion experience that shuts out the physical world (Gupton, N. 2017).

Augmented Reality is a state-of-the-art technology that can make learning interactive and fun. It is accessible for most as most of us already have phones that can install AR software. Today has ever-expanding applications such as science, education, engineering, interactive, multimedia, medicine. Visualization through visual images is an effective way to deliver the idea in an easy simple way and more established in the brain. Augmented Reality technology has many possible applications in a wide range of fields, including entertainment, education, medicine, engineering, and manufacturing.

STATEMENT OF THE PROBLEM

One of the subjects that is hard to learn would be chemistry. The basis of chemistry is learning the Periodic Table of Elements. The researcher would create an augmented reality application that will focus on teaching the concepts of Chemistry, specifically the subject of the Periodic Table of Elements.





Figure 1: Periodic Table of Elements

The objective of the study is to give learners and educators another learning material for their classes. The application will focus on teaching concepts related to the Periodic table of elements.

Would the application be effective in terms of:

- I. Functional Suitability
- II. Performance Efficiency
- III. Usability
- IV. Maintainability
- V. Satisfaction

The results of the study will be helpful for the following:

Students: The application produced would help students in their daily activities.

Teachers: The application produced would help teachers explain concepts to their students and make learning interactive.

Schools: Similar with the students and teachers, schools would greatly benefit from the application as this would be a new learning material or resource.

Future Researchers: The data gathered from this study can be used by future researchers to create more advanced, more efficient, and more accurate applications.



The study will focus on the development of the application. The study will also focus on making the application accurate and efficient. The application can be used by future researchers as a base for their applications.

The application is only a prototype and will focus on one topic on a given subject. The researcher will only focus on one topic on a given subject.

The application will focus on teaching concepts related to the Periodic table of elements.

RESEARCH PARADIGM



Figure 2: IPO Model



The IPO model is a functional graph which shows the inputs, processing, and outputs

that are done. Figure 2 Process-Output of the Application. The basic systems theory. In declared that in 10 years schools because of century later, books are schools. Augmented improve classroom

Chemistry is a for this is that students in the subject. There are of things that are usually such as Molecules or Reality will be a way to for students and



displays the Input-Augmented Reality framework is based on 1913, Thomas Edison books will be obsolete in moving pictures. А still used in most Reality is a way to education.

hard subject. One reason aren't usually interested also no real-life models discussed in Chemistry, Atoms. Augmented create interactive models educators to use.

Framework

Conceptual

5



Figure 3. Flowchart of the Application

The conceptual model chosen is a flowchart designed to show the process in which the application will function.



Figure 4. Visual Abstract

The visual abstract introduces the context, points, and desired outcome of the research. The researcher plans to develop an application named ARC: Your Augmented Reality Classroom.



MATERIALS AND METHODS

Research Design

The researcher conducted a developmental type of research. This type of research aims to develop an application. This application aims to improve the quality of life of students and educators regarding Chemistry. The application used Unity to create the augmented reality application. The researcher utilized the ADDIE Instructional Design. This design will help determine the step-by-step process in making the application. With the use of the design, further enhancements on the device can be done after multiple evaluations.





Analysis

The topics covered were assessed based on reviewed related literature. The researcher assessed the necessary facts, topics, and articles for the development of the application. The topics covered in the application are all facts regarding the Periodic Table of Elements. Users of the application will get videos and pictures regarding the topic.

Design and Development

- 1. Materials:
 - a. Android Device
 - An android device is necessary for the application to run. The application is still a prototype and will run on multiple devices given enough time.
 - b. Laptop/Personal Computer
 - A personal computer is necessary to develop the said device.
 - c. Unity and Vuforia
 - The application will be made using Unity and will use Vuforia for the augmented reality part.
- 2. Design of the application
 - a. Resolution
 - i. 360 x 640 Density-Independent Pixels is the resolution size for most android devices. This would be the resolution size of the application.
 - b. Application Start
 - i. The application would start showing the logo and brand of the application.



Figure 6: Application Start



- 3. Interface of the application
 - a. The application simply uses the camera of the device for scanning targets.



Figure 7: Interface of the Application

Implementation and Evaluation

Upon accomplishing the task of developing the application, the researcher then let teachers and IT experts evaluate the said application. The researcher will explain the purpose and workings of the application.

The application was evaluated in terms of its functional suitability, performance efficiency, usability, maintainability, and satisfaction. The evaluation sheet used a 4-point Likert Scale questions for the data to be interpreted and analyzed easily. The researcher utilized a 4-point Likert Scale instead of a 5-Point to have specific responses from the evaluators. The questions are based on ISO 25010 or Software Product Quality, this will focus on what qualities a device, or a software product should have.

The demonstration of the app was done via a recorded video. The researcher demonstrated how the application will be used. The participants of the demonstration will also be the evaluators, these participants will be a mix of teachers, as they are the ones who will be using the application, and IT experts, as they are knowledgeable about this field.

The scores given by the participants of the survey are rounded off and interpreted by the researcher. This would show the strengths and weaknesses of the application.



Functional Suitability				
The application				
can scan targets				
accurately.				
The application				
will render				
outputs				
accurately.				
		Usabilty		
The application				
has a friendly				
interface.				
The application				
can easily be				
used by students				
and educators.	D	putoumanaa Effician	au	
The application		i jormance Ejjicien		
can render				
multiple outputs				
accurately				
The application				
covers essential				
topics related to				
chemistry.				
		Maintainability		
The application				
can be improved				
and modified.				
The application				
can be evaluated				
further to				
determine				
whether specific				
criteria are met.				
		Satisfaction		
The application				
is a reliable and				
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is canable of				
achieving its				
specific goals				
specific guais.				



RESULTS AND DISCUSSION

The study is about Interactive Classroom Discussions/Activities Using Augmented Reality for Chemistry. The researcher used a 4-point Likert Scale, using a 4-point Likert Scale forces the evaluators to form an opinion regarding the application. A score of one means strongly disagree, two being disagree, three being agree, and four being strongly agree (Cornell, J. 2022). Upon conducting an evaluation for the said application, the following data were collected:

Table 1

Evaluation of the application regarding its function	ional suitability	
Functional Suitability	Mean	SD
The application can scan targets accurately	3.36	0.50
The application will render outputs accurately	3.36	0.50
Overall	3.36	

Table 1 shows the mean and standard deviation of the evaluation of both the teachers and IT experts regarding the functional suitability of the application. Functional suitability represents the degree as to how a product, system, or service functions when used under specific circumstances. The overall rating of the application's functional suitability is 3.36, this implies that the application is more than capable of providing said functions under specified circumstances.

Table 2 Evaluation of the application regarding its usability	lity	
Usability	Mean	SD
The application has a friendly interface	3.55	0.69
The application can easily be used by students	3.45	0.69
and educators		



Overall

3.5

Table 2 shows the mean of the evaluation of both teachers and IT experts regarding the application's usability. Usability refers to the degree in which a product or a system can be used by certain users to achieve specific goals with efficiency and satisfaction. The overall rating of the application's usability is 3.5, meaning that the usability of the application is above average.

Table 3

<i>Evaluation of the application regarding its perfo</i>	rmance efficiency	,
Performance Efficiency	Mean	SD
The application can render multiple outputs accurately	3.64	0.50
The application covers essential topics related to chemistry	3.64	0.50
Overall	3.64	

Table 3 shows the mean of the evaluation of both teachers and IT experts regarding the application's performance efficiency. Performance efficiency refers to the performance of the product or service relative to the number of resources used. The application received an average rating of 3.64, which means that the application is performing well given the amount of resources used.

Table 4Evaluation of the application regarding its maintainabilityMaintainabilityMeanSDThe application can be improved and modified3.640.50The application can be evaluated further to
determine whether specific criteria are met3.640.50Overall3.64



Table 4 shows the mean of the evaluations of both teachers and IT experts regarding the application's maintainability. Maintainability refers to the degree of effectiveness and efficiency with which a product or a system can be modified to improve, correct, or adapt it according to the changes in environment. The application received an average rating of 3.64, which means that the application can definitely be improved, corrected, and can easily adapt to changed in the environment.

Fable	5
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Evaluation on the user's satisfaction within using	g the application	
Satisfaction	Mean	SD
The application is a reliable and fun learning material	3.73	0.47
The application is capable of achieving its specific goals	3.73	0.47
Overall	3.73	

Table 5 shows the evaluation of both teachers and IT experts regarding their satisfaction within using the application. The average rating is 3.73, this implies that the application met the standards of the evaluators and were therefore satisfied with using it.

The overall rating of the application is 3.57/4, this means that the application was well received by the evaluators. This also implies that the application was good with regards to its Functional Suitability, Performance Efficiency, Usability, Maintainability, and Satisfaction.

CONCLUSION

After conducting the study, it is shown that ARC can do its job properly, accurately, and efficiently. ARC is a fun and reliable learning material. Based on the findings, it can be concluded that ARC can be used by almost anyone and can be used in classrooms as another form of learning material.

RECOMMENDATION

For future researchers, it is recommended that researchers should optimize the code used and that they create better targets that are also pleasing to the eye. It is also recommended that they should create more targets and add subjects aside from chemistry.



The use of markerless AR is also advised as using markerless AR would reduce the use of targets.

ACKNOWLEDGEMENT

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APPENDICES:

Appendix A: Documentation

File Edit Assets GameObject Component Window	w нер			
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Appendix B: Raw Data

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	Strongly Disagree	Disagree	Agree	Strongly Agree
	(1)	(2)	(3)	(4)
		Functional Suitability	/	
The application				
can scan targets			7	4
accurately.				
The application				
will render			7	Α
outputs			· · ·	7
accurately.				
		Usabilty		
The application				
has a friendly		1	3	7
interface.				
The application				
can easily be used				
by students and		1	4	6
educators.				
	F	Performance Efficienc	y	
The application				
can render				-
multiple outputs			4	/
accurately.				
The application				
covers essential				_
topics related to			4	7
chemistry.				
		Maintainability		
The application				
can be improved			4	7
and modified.				
The application				
can be evaluated				
further to				_
determine			4	7
whether specific				
criteria are met.				
		Satisfaction		
The application is				
a reliable and fun			3	8
learning material.				
The application is				
capable of			2	
achieving its			3	8
specific goals.				



Appendix C: Sample Survey

Interactive Classroom Discussions/Activities Using Augmented Reality for Chemistry

INFORMED CONSENT

Greetings! I am Kean Louis R. Rosales, a Grade 12 student at Caloocan City Science High School. I am working on a research project titled "Interactive Classroom Discussions/Activities Using Augmented Reality for Chemistry" as part of our subject Research/Capstone Project & Inquiries, Investigations, and Immersion. I am inviting you to participate in this research.

PURPOSE OF THE RESEARCH
The objective of the study is to give learners and educators another learning material for
their classes. The application will focus on teaching concepts related to the Periodic table
of elements.

CONFIDENTIALITY The information you provide will be used solely for the purposes of this study and will be kept private. The researcher will be the only one who will have access to your responses.

CONTACT INFORMATION If you have any concerns or questions, you may contact the researcher: Globe: 09777712926/09176298175 Email: keanlouis30@qmail.com

Thank you for taking the time try and test Augmented Reality for Chemistry (ARC). I want to express my gratitude in advance for helping in my research study and evaluating Augmented Reality for Chemistry (ARC).

Full Name (Last Name, Given Name) *

Your answer

Email *

Your answer

Type of Respondent (Field of Work) *

Your answer

Specialization *

Your answer

Request for consent

The researcher fully recognize their responsibilities under the Republic Act No. 10173, also known as the Data Privacy Act of 2012, with respect to the data collected and processed from the respondents. Hence, all information obtained and used from this study will adhere to its Implementing Rules and Regulations, relevant policies and issuance of the National Privacy Commission. Rest assured, information will be discarded upon completion of the research study.

Do you agree to participate in this study? *

O Yes ○ No

