

# Technology Tool in Teaching Biology: A Mixed Reality Mobile Application

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**Abstract**— Teaching biology subject is difficult most especially when the topic needed to have an actual experimentation. Human Anatomy is one of the fields of biological science. In a traditional teaching and learning process, teachers used traditional way of presenting visual materials to their students. The researcher developed a Mixed Reality application that transformed the traditional presentation of visual materials of the teachers into a 3D model of the human anatomy. There was a total of forty-five (45) respondents. The researcher utilized descriptive qualitative type of research where it was used to describe a situation, subject, behavior or phenomenon. Rapid Prototyping Development Methodology (RPDM) was utilized in the development of the application to quickly build and improve the application through user's feedback. Results showed that the respondents strongly agreed on the effectiveness of the application based on functionality with a total weighted mean of 4.58, usability with 4.58, efficiency with 4.55, and portability with 4.41. The respondents also strongly agreed on the user's acceptance of the developed application as manifested by the computed total weighted mean of 4.53. Based on the ranking on the user's acceptability to the developed application, criterion 1 or "Strongly Agree". It is recommended that the application was functional, usable, efficient, portable, and accepted by the user to use as a technology tool in teaching biology subject using mixed reality application in mobile devices.

**Keywords**— Human Anatomy, Mixed Reality, 3D

## I. INTRODUCTION

Teaching with the use technology in our present situation is very important as we are facing the challenges brought by the pandemic. In the academe, teachers are now transforming the traditional teaching and learning process into a technology driven instruction. Dr. Ruben Puentedura developed a model that will support and enables teachers to design, develop and infuse digital learning experiences that utilizes technology which is called SAMR (Substitution, Augmentation, Modification and Redefinition). Lessons that are supported by technology will lead to more innovative forms of teaching and learning [1]. This is because the use of technology involves real-world problems, current informational resources, simulations of concepts, and communication with professionals in the field. Meanwhile, android mobile devices are emerging technologies where smartphones and tablets can be used as tools in learning. Simulations through merging real world and virtual world known as mixed reality are a new technology trend. MR brings together real world and digital

elements. In mixed reality, you interact with and manipulate both physical and virtual items and environments, using next-generation sensing and imaging technologies [2]. Mixed reality in education especially in science education can aid in the learning process of the user. The required knowledge acquisition is much more experiential, self-directed, and hands-on than in many other disciplines, with 3D models that can give realistic experience in learning.

The researcher developed a mixed reality mobile application that will enable the teachers to easily deliver their topics in biology subject. Specifically, the mixed reality application will introduce to the students a different learning environment where textbooks and other printed materials were already replaced by 3D objects implemented and visualized in a mobile device. The mixed reality application will let the students visualize 3D graphical pictures of the parts of the human anatomy. Moreover, the application is combined with text and voice narration of descriptions and illnesses which provides students visual and auditory learning. Because it is a mobile application, the students can also use it to learn anywhere and anytime. In the conceptualization of the research study, the research used IPO (Input, Process and Output) model.

FIGURE 1  
PARADIGM OF THE STUDY

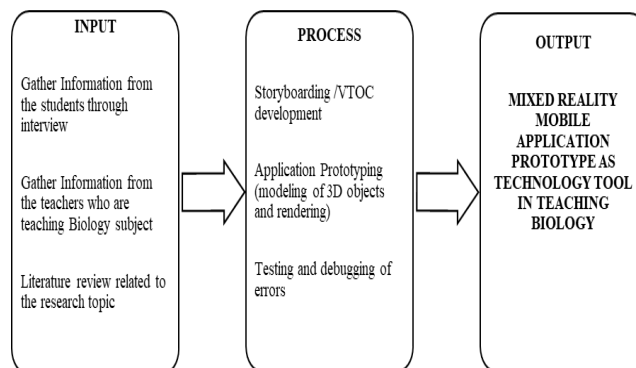


Figure 1 shows the paradigm of the study which the research used in conceptualizing the developed application. The researcher started to gather information from the students who have biology subject through informal interview. Series of question related to their experience in learning human anatomy was the focused on

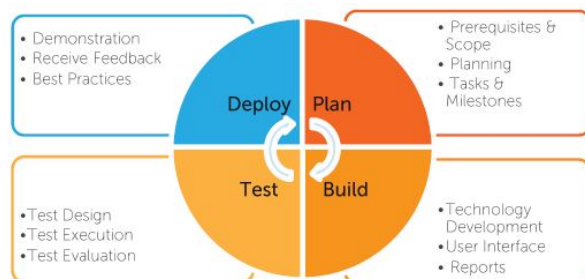
the questions. After gathering information from the students, the researcher seeks guidance from the teachers who were teaching biology subject. Through series of research about the topics related to the research interest, the researcher conceptualized the initial development of the application. Storyboarding and Visual Table of Contents (VTOC) were used by the researcher to formally start making the prototype of the application as it serves as guide or blueprint of the mixed reality application.

The scope of the developed application is a mixed reality mobile application of human anatomy in teaching biology. The developed application mixed the virtual world and the physical world by giving the students an experience of the blended environment using mobile devices. The application will let the students view the human internal organs with descriptions and 3 corresponding illnesses. Descriptions of the human internal parts and illnesses for each organ was presented through text and voice narration that enable the students to learn through visual and auditory.

## II. MATERIALS AND METHODS

Descriptive research is a research used to “describe” a situation, subject, behavior, or phenomenon. It is used to answer questions of who, what, when, where, and how associated with a particular research question or problem. It is a type of research that applies surveys, questionnaires, design and data analysis that will be used to a given topic. The researcher decided to use this type of research method to help gather the necessary information needed in the development of the system. Also, the researcher aimed to measure the effectiveness of the software to its users. In the development of the mixed reality application the researcher utilized Rapid Prototyping Development Methodology (RPDM) as guide for the development of the application. It is best suited for this kind of software development activity since it provides a prototype of the application to be tested by the users to identify errors to be corrected before the finalization of the application.

FIGURE 2  
RAPID PROTOTYPING DEVELOPMENT METHODOLOGY



The rapid prototyping method involves three steps in the development of the application. It is the development methodology used by the researcher in building the mixed reality mobile application. The following are the steps.

**Prototyping** - In this phase, the researcher developed an initial prototype of the application which is based on the design specification set out in the requirements documents gathered during the planning phase.

**Feedback** – After the development of the prototype application, the researcher allows the end-user to test the application to identify possible errors to be corrected. It helped the researcher to modify some features of the application in terms of usability and efficiency of its required use.

**Improvement** – The researcher collected all the feedback of the end-users and start modifying identified errors of the prototype application. The improvement continues until no error was detected in iteration process.

The researcher used purposive sampling was used for selecting the participants of this study. Purposive sampling is a sampling technique where the researcher relies on his/her own judgment when choosing elements of the population to participate in the research or study. The participants were three (3) faculty members from Senior High School Department, thirty-seven (37) Senior High School Students who tested the developed application in the beta testing and five (5) IT Experts who performed the Alpha test. A total of forty-five (45) participants were involved to test the developed mobile application.

Research instruments were used by the research in gathering data from the respondents. Interview was conducted by the research to the respondents to gather initial information about the research topic. It includes the information's of the different parts of the human anatomy and how it was incorporated in the lesson in biology subject. In the assessment of the efficiency and acceptability of the developed application, the researcher used evaluation questionnaire. A questionnaire is a research instrument consisting of a series of questions for the purpose of gathering information from respondents. The researcher designed an evaluation questionnaire based on ISO 9126-1 Software Quality Standard for Software Development Projects as a data collection instrument. After collecting all the data from the respondents, statistical treatment was conducted for analysis and interpretation. The quantitative data was tabulated and interpreted using a 5-point Likert Scale based on Rensis Likert Model to determine the attitudes and opinions of the respondents.

III. RESULTS AND DISCUSSION

After the development of the application, the evaluation questionnaire was distributed to the target respondents. It is composed of forty (45) respondents; five (5) IT Experts for the alpha testing, three (3) faculty members from Senior High School Teachers and thirty-seven (37) Senior High School students for the beta testing underwent the activity to ensure the efficiency and effectiveness of the application. The evaluation questionnaire was based on ISO 9126-1 Software Quality Standard for the evaluation of the developed application.

TABLE 1  
DATA INTERPRETATION OF RESPONDENTS ON  
FUNCTIONALITY, USABILITY, EFFICIENCY  
AND PORTABILITY OF THE SYSTEM

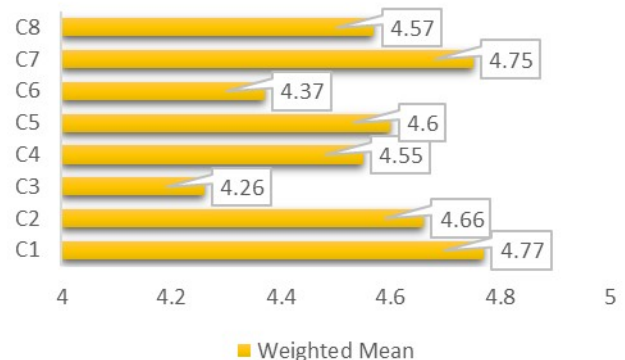
| Criteria  | SA | A  | U | D | SD | Weighted Mean |
|---|----|----|---|---|----|---------------|
| <b>A. Functionality</b>   |    |    |   |   |    |               |
| 1. Content of the application is up-to-date                             | 32 | 13 | 0 | 0 | 0  | 4.71          |
| 2. Application meets its expected output                                | 22 | 23 | 0 | 0 | 0  | 4.48          |
| 3. The application supports educational needs in teaching human anatomy | 30 | 10 | 5 | 0 | 0  | 4.55          |
| <b>Mean</b>   |    |    |   |   |    | <b>4.58</b>   |
| <b>B. Usability</b>   |    |    |   |   |    |               |
| 1. User Interface if friendly   | 31 | 14 | 0 | 0 | 0  | 4.68          |
| 2. Graphics are descriptive and educational (3D model)                  | 28 | 17 | 0 | 0 | 0  | 4.62          |
| 3. All buttons are working properly                                     | 23 | 19 | 3 | 0 | 0  | 4.44          |
| <b>Mean</b>   |    |    |   |   |    | <b>4.58</b>   |
| <b>C. Efficiency</b>  |    |    |   |   |    |               |
| 1. Easy to navigate   | 30 | 12 | 3 | 0 | 0  | 4.60          |
| 2. The application can be used even without internet connection         | 28 | 15 | 2 | 0 | 0  | 4.57          |
| 3. The mobile application respond/load immediately                      | 29 | 10 | 5 | 1 | 0  | 4.48          |
| <b>Mean</b>   |    |    |   |   |    | <b>4.55</b>   |
| <b>D. Portability</b>   |    |    |   |   |    |               |

|   |    |    |    |   |   |             |
|---|----|----|----|---|---|-------------|
| 1. The application supports other android device for installation | 27 | 15 | 3  | 0 | 0 | 4.53        |
| 2. Easy to install in an android device                           | 23 | 17 | 5  | 0 | 0 | 4.40        |
| 3. Application works properly in its plug-ins (Virtual box)       | 25 | 10 | 10 | 0 | 0 | 4.33        |
| <b>Mean</b>   |    |    |    |   |   | <b>4.41</b> |
| <b>Total Weighted Mean</b>  |    |    |    |   |   | <b>4.53</b> |

5.00-4.20 (Strongly Agree), 4.19-3.40 (Agree), 3.39-3.00 (Undecided), 2.59-1.80 (Disagree), 1.79-1.00 (Strongly Disagree)

Table 1 shows the response of the respondents with regard to functionality, usability, efficiency and portability of the developed mobile application. It is noticeable that the functionality of the application gathered a mean of 4.58 or “Strongly Agree”. The usability of the application was 4.58 or “Strongly Agree” and the student-respondents commented that “the application provides a new and innovative way of understanding human anatomy and it is very useful in understanding human body organs”. The efficiency of the application gathered also a positive response from the respondents, 4.55 or “Strongly Agree” were students find it easy to navigate throughout the application. Lastly, the usability of the application was also “Strongly Agree” or 4.41. This shows that the respondents experience was satisfied in using the developed application in learning biology subject.

FIGURE 3  
DATA INTERPRETATION OF RESPONDENTS ON  
USER’S ACCEPTANCE AND RANKING



Note: 5.00-4.20 (Strongly Agree), 4.19-3.40 (Agree), 3.39-3.00 (Undecided), 2.59-1.80 (Disagree), 1.79-1.00 (Strongly Disagree)

Where:

- C1 The user interface is easy to use.
- C2 The user interface allows easy navigation.
- C3 The user interface contains all the necessary functions/information at first glance.
- C4 Contents are understandable.
- C5 Contents are good basis especially the 3D representation of the

internal organs.

- C6 The graphics does not cause confusion.
- C7 The software application provides another technology-driven environment.
- C8 The software application is able to provide its specified functions.

Figure 3 shows the response of the respondents and ranking based on the acceptability level of the developed application on each criterion. The criteria on the user interface ranked no. 1 with a mean of 4.77 or “Strongly Agree” since the users find the application easy to use. On the other hand, criterion for interface contains all the necessary functions/information at first glance ranked no. 8 with a mean of 4.26 or “Strongly Agree”. It is noticeable that all the remaining criterion were rated “Strongly Agree”. The user-respondents experience in using the system in terms of content, graphical interface for the 3D objects, navigation and its function were all positive. The user-respondents were satisfied on the performance of the developed application as it provides another learning environment for the learners.

#### IV. CONCLUSIONS

The researcher developed a mixed reality mobile application as a technology tool in teaching biology subject. The researchers found the developed application to be useful in teaching students specifically biology classes where the application provides a new learning opportunity for the students to learn and experience an innovative tool in learning. Given the various methods used in researching and analyzing, the greater part of the information and data convince that MR technology is applicable to support the learning in science education and the 3D representation of the human internal body organs were acceptable to its target users. With the use of mobile device, it has brought the potential of this technology to provide a different learning avenue for the students to learn. Giving its users a more realistic, interactive and creative way of learning in teaching human anatomy. The results of the client testing of the proposed system satisfied the objectives of the study. Majority of the respondents strongly agreed in the effectiveness in terms of the functionality, usability, efficiency, portability and user's acceptance of the proposed application. With all the supporting resources and analysis, the researcher concluded that application was functional, usable, efficient, and portable and accepted by the user to use in support to learning of the students in human internal body organs.

#### V. RECOMMENDATIONS

Based on the findings of the study, the researcher recommends the use of the developed mobile application as a technology tool in teaching human anatomy. The researcher would like to recommend the use of the developed application to the teachers and students of

Senior High School specifically those who have biology subjects. Based on the comments and suggestions of the respondents, it is recommended that the mixed reality mobile application on human anatomy should have more detailed parts in each organ. They also suggest its availability in IOS, so that the IOS users can use it, and also as a Microsoft Windows or Apple's MAC application, to be accessible not only on smartphones but also on computers.

#### References

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