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The Affordances of Augmented Reality Technology in the English for Specific Purposes Classroom: It's Impact on vocabulary learning and students motivation in a Saudi Higher Education Institution

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Abstract

The recent years have witnessed an unprecedented growth and innovation in information communication technology. One of the fields that has benefited immensely from these developments is education. Augmented reality (AR) technology is currently applied in English for Specific Purpose Classroom (ESP). AR technology comes with several advantages including more focused learning, improved motivation among learners, personalized learning and remote learning among others. However, questions have arisen on the efficacy of this approach. Using a Higher Education Institution in Saudi Arabia (private medicine school) as a case study, we target the students registered for this English for Specific Purposes (ESP) course who are all Saudi students. They are B1/B2 CEFR level. They are considered first year college students. We use Krejcie and Morgan sampling formula to get the required sample which is 144. Participants are then sampled using stratified sampling and purposive sampling methods. The study has both control and experiment groups. Mixed methods including questionnaires and interviews are used in data collection. The respective data is collected from 100 MCQs vocabulary questions. Descriptive statistics and content analysis are used in data analysis. The results indicate that although traditional vocabulary learning methods can improve students' performance, augmented reality technology still leads to better results. While most students in the control group scored less than 80 in the vocabulary questions, a majority of the students in the experiment group scored more than 90. On students' perception of the AR technology, students who strongly agreed were 124 while those who agreed were 18. This is an indication that AR technology impacts positively in learning motivation and vocabulary retention.

Keywords— Augmented Reality, AR technology, ESP, vocabulary learning, students' motivation

Introduction

Education and Technology

The 21st Century has witnessed an exponential growth in information communication technology. These developments have had a spill-over effect on virtually all fields including education. E-learning refers to the application of information technology in conveying education to learners. One such technologies is augmented reality (AR). According to Chang et al., the use of augmented reality in classrooms usually results into an engaging experience. This can be attributed to the examples and gaming elements inherent in this technology. This tends to support textbook materials. Consequently, the resulting interactivity enhances students' ability to remember the content they have learnt [1].

According to Chiang, Yang and Hwang, one of the learning areas that AR has been applied successfully is foreign language learning. The authors argue that vocabulary knowledge is an essential tool for second language learners

given that with limited vocabulary, learners' ability to communicate is impeded. AR incorporates virtual learning and as such, students are able to relate vocabulary learnt with images [2]. These findings are

augmented by that of Yaacob et al. who argues that previously, flashcards were popular in teaching vocabulary [3]. However, they were rendered redundant with the invention of 2D flashcards and currently 4D flashcards which are a reflection of AR technology. The author attributes these shifts to the fact that the flashcards were boring and less attractive. AR technology, on the other hand, has been found to be more appealing vocabulary learning method. Nevertheless, Mena-Vargas, Millán-Rojas, and Sánchez-Castillo raises concerns that although augmented reality has attracted a lot of attention and research, there is still a large deficit in trained teachers who can successfully apply augmented reality in teaching vocabulary [4]. Similar deficit has also been witnessed in the availability of technicians to develop AR technology [1] [3] [4].

From these previous researchers, it is evident that augmented reality technology is relatively new approach in vocabulary learning [4]. This paper is a case study of augmented reality technology in vocabulary learning among medical students in a medical school in Saudi Arabia. As such, we seek to empirically establish the differences in student learning motivation and vocabulary learning with and without the use of AR mobile technology, and health services students' perceptions about AR technology in English for Specific Purposes (ESP) class. The paper further researches on the differences between traditional teaching and AR language classes. Ultimately, we seek to establish the impact of using AR technology in the ESP classroom in terms of vocabulary learning and retention. The paper is sectioned into six main parts. Subsequently, the next section discusses affordance of augmented reality technology and the independent study variables. The third section discuss the methodology followed by a section on findings and analysis. Consequently, discussion and conclusion sections wrap up the paper.

Affordances of Augmented Reality Technology (AR)

Scrivner et al. defines augmented reality as real time indirect view of the real world buttressed by virtual computer generated information [5]. Affordances refers to the potential benefits that a learner can gain from using AR technology. According to Bonner and Reinders, the single most important benefit of AR for students' is its ability to reduce distractions [6]. This is achieved by blocking out visual and auditory distractions that might exist within the classroom. As a result, leaners are able to connect with the study materials deeply. To augment these findings, Yaacob et al. argues that this level of immersion helps learners to make connections between the vocabulary they have learnt and the real world [3].

Another feature of AR technology which gives it an edge over previous approaches is that it incorporates mobile technologies. According to Chang et al. this portability means that learners can use this technology within both formal and informal settings to the advantage of learners [1]. In second language learning, AR technology facilitates social interactivity which is a prerogative for collaborative learning [5] [6]. This is achieved when students hold discussions within the technology. In affirming these findings, Chiang et al. argues that in addition to collaborative learning, AR offers context sensitivity which enhances situation learning [2]. Learners are also more connected to their teachers and learning resources. This facilitates personalized learning as learners are able to focus on their individual preferences. This is further enhanced by the fact that learners are able to participate in coordinated construction of their learning experience by posting questions and comments pertaining to their learning location and experiences. This is further augmented by just-in-time learning where teachers are able to open the classroom and offer remote assistance to learners [3] [4] [6]. This study adopts affordances of AR technology as a framework within which other variables of this study will be anchored. The proposed variables for the study are presented in the subsequent sub sections.

Literature Review

The study adopts an intuitive approach given that it is reliable in joining intuition to intellectual precision. This will help enhance readers' understanding

Student Learning Motivation and AR Technology

In their study on how technology can be used in learning second language vocabulary, Horno-Chéliz and Sarasa-Cabezuelo identify lack of motivation among learners as an impediment to perseverance [7]. This usually translates into dismal learning outcomes contrary to both learners and teachers' expectations. Consequently, effective learning strategies coupled with suitable computer technology is essential in increasing learning motivation. According to Chiang, Yang and Hwang, the best approach involves

supplementing inquiry-based learning with computer technology in a scenario-based learning environment [8]. This is buttressed by Bonner and Reinders who in their findings argue that the use of AR technology in learning language needs to emphasize on interactions between the learning technology being used and the actual environment. This approach is likely to translate into increased learning motivation given that student-centered knowledge exploration activities are incorporated. As such, students are able to learn proactively. These sentiments are echoed in a study by Vargas et al. who emphasize the need for digital learning aids with real-life scenarios in enhancement of learning motivation [4].

Accordingly, with AR technology, learners are able to incorporate personal knowledge in the learning process. For instance, in the context of this study, students can chose a virtual learning tool from the actual medical environment with the help of a mobile learning aid and consequently improve their learning motivations. From previous researches that have investigated the role of AR technology in learners' motivation, results have indicated that compared to traditional learning approaches, the technology contributes immensely to improved academic achievement [3] [5] [7]. However, homogenous results have not been achieved considering that the success of AR technology is dependent on the levels of learners' sensory experience. As such, this study seeks to establish the differences in student learning motivation and vocabulary learning with and without the use of AR mobile technology in the study sample. As such, the following research question suffice;

RQ1: What are the differences in student learning motivation and vocabulary learning with and without the use of AR mobile technology?

Perceptions of ESP Classes using AR Technology

Scrivner et al. defines English for Specific Purposes (ESP) as a learner-centered approach to teaching English as an additional language. This is rationalized by the fact that communicative competence is essential in professional undertakings [5]. For instance, in our case, medical professionals' competence in English is a prerogative for learning new approaches n medicine and patient diagnosis in multicultural setups. ESP has distinctive features from English language courses given that they are designed to meet specific needs of learners, are focused on particular disciplines and seek to advance intercultural competency among learners [2] [7].

Asmali notes that language changes from one context to the other. As such, it is essential to employ activities and materials that takes learners' need and wants into consideration [8]. For this reason, ESP teachers have integrated technology in these classes. Asmali's observations are buttressed by those of Chiang et al. whose study focused on the impact of technology on ESP [2]. The study's findings indicate that the integration of technology in ESP curriculum avails myriad opportunities and advantages for professionals. Some of the benefits identified include enhanced interactive and communicative activities [8]. The other advantages of application of technology in ESP is the availability of feedback and self-evaluation on the feedback on a specific context. ESP learning among health science students is supported with AR technology. Kamphuis et al. argues that this paradigm shift can be attributed to the technology's ability to facilitate ubiquity and collaboration in situated learning [9]. As such, learners are able to immerse themselves in the learning process. The end result is meaningful learning that is an essential precondition for professional competence. In their research on health science students' perception on AR technology, Hung, Chen and Huang acknowledges that AR technology has immensely improved the learning performance among students [2]. As such, they are more motivated and perceive AR as an essential component of learning. These findings are in tandem with studies that recommend AR technology as a strategy for improving student concentration [3] [5] [6].

In this study we seek to establish the how health science students perceive the use of ESP classes learnt using augmented reality technology. Based on empirical results, the research question below will be addressed;

RQ2: How do health science students perceive the use of AR technology in English for Specific Purposes class?

Traditional teaching vs. Teaching by Augmented Reality (AR)

Since the introduction of augmented reality technology in the learning spheres, researchers have been attracted to establishing whether this approach has advantages over traditional technologies used in the same manner [4] [6] [10]. One of the areas that has experienced

immense contributions in this context in the use of AR technology in English for Specific Purposes (ESP) classes. According to Carmigniani et al., vocabulary is the most important aspect of a language that has to acquire. This is because communication aspects such as reading, listening, and speaking are usually influenced by ones' vocabulary competence [11]. As such, it is essential to identify a learning medium that will enhance vocabulary retention. Saidin, Halim and Yahaya argues that compared to traditional technologies such as 2D, augmented reality technology incorporates virtual learning enabling students to relate vocabulary with images [12]. Previously used traditional teaching have also been shunned for being boring and less attractive. According to Yilmaz et al. another advantage of AR over traditional technologies used in learning is its ability to block auditory distractions that are likely to arise in the classroom setup. This gives learners an opportunity for deeper learning which is essential in learning a second language [13]. In this context, such deep immersion helps learners to relate the vocabulary they have learnt with the real world [9] [12].

Further, AR technology has been adopted for its ability to incorporate mobile technologies. Unlike past technologies adopted in ESP classes, AR is portable. As such, students are empowered to use this technology in both formal and informal settings. According to Carmigniani et al, this is advantageous to medical students given that they are expected to be highly competent. As such, at their private time, regardless of their location, they are able to learn seamlessly [11]. Hsu's contributions to this subject also indicate that AR technology usually facilitates social interactive which is essential in collaborative learning [14]. In this approach, students hold discussions within the technology. This could not be achieved with traditional technologies used in learning. Another notable advantage of AR is that learners have unperturbed access to learning resources. This enhances personalized learning among them given their preferences, especially vocabulary aspects that they are yet to grasp. The fact that students can make comments and ask questions, which are answered remotely by teachers, on this platform also augments their learning experiences [9] [14] [15].

Subsequently, it is essential to empirically assess whether there is any significant difference between traditional teaching and augmented reality teaching in language classes. As such, the research question below will be addressed;

RQ3: Is there any significant difference found between teaching using traditional teaching methods versus teaching with Augmented Reality Technology (AR) in language classes?

Impact of Augmented Reality Technology on Vocabulary Learning and Retention

According to Sandberg, Maris, and Hoogendoorn, vocabulary learning and retention is an essential aspect of English for Specific Purposes (ESP) Classes [15]. The author further opines that although ESP is a critical requirement in professional development, learners find it difficult in the absence of a friendly learning strategy. This explains constant efforts in development of learning resources for use in vocabulary learning. In their work on the use of AR flashcards in learning vocabulary among children, Chen and Chan argue that flashcards have evolved over the years as common vocabulary instructions tools [16]. The authors classify these flashcards as traditional paper flashcards, virtual flashcards and AR flashcards [14] [15] [16].

These findings are buttressed by those of Ke and Hsu who argue that traditional paper flashcards had images and words associated with them. However, these were faced out with virtual flashcards which are comparatively more interactive and engaging in teaching vocabulary. These come in different formats and are run on mobile devices. In ESP classrooms, this approach was adopted given that it also incorporated pronunciations, videos and animation. As such, they enrich the learning experience translating into better vocabulary learning and retention [15] [16] [17].

AR flashcards are the most recent innovation in this front. According to Özcan, Özkan, and Sahin, this technology superimposes virtual objects with the real world [18]. Consequently, learners rely on mobile devices to learn from the virtual features. The learning content is presented in 3D perspective. The AR application also has games, simulations and models which help in ensuring ubiquity and collaboration in learning. According to Madini and Alshaikhi, this mix of real and multimedia contents, AR systems are able to offer learners immersion and immediacy. This improves the learners' ability to learn and retain vocabulary [19]. The authors further remark that this further supplements the textbooks used in teaching learners and can be a reliable approach in remote

learning. A study by Alizadeh harmonizes these findings by indicating that AR technology supports book reading in ESP classrooms resulting into enhanced interactivity and appeal [20]. The author further remarks that this increases motivation among learners and draw their attention towards real life experiences that correspond to the vocabulary being learnt. This makes learning more authentic and relevant hence increased learners' performance. However, there are also literary contributions that hold a contrary opinion [13] [17]. Ke and Hsu for instance, argues that AR technology is still new and as such, fewer teachers and even learners are competent in its use in learning [17]. As such, it is highly unlikely that it can enhance vocabulary and retention. This study seeks to empirically establish the impact of augmented reality technology in vocabulary learning and retention for medical students. As such, the following research question will be addressed;

RQ4: What is the impact of using Augmented Reality technology in the ESP classroom in terms of vocabulary learning and retention?

Methodology

This study adopts mixed research method in assessing the impact of augmented reality technology in vocabulary learning and students' motivation. According to Alavi and Hąbek, mixed research methods is a research design that combines both qualitative and quantitative approaches [21]. Qualitative approaches are used in analyzing existing literature on application of augmented reality technology in vocabulary learning while quantitative approaches are applied in empirical analysis of the data collected for this study. Within mixed research approach, there exists various research designs including triangulation design, the embedded design, the explanatory design, and the exploratory design. This study adopts triangulation research design. Turner, Cardinal, and Burton defines triangulation design as the use of more than one method in data collection [22]. The choice of triangulation design is also informed by the fact that it assures validity of the research results. The design also accommodates different samples, in this case, the control and the experiment groups. As such, this design enables actualization of the four research questions identified for this study through questionnaires and interviews [21] [22]. Subsequently, the impact of augmented reality technology on vocabulary learning and students' motivation is assessed holistically. Ultimately, more informed discussions and conclusions are drawn from the study.

Population and Sampling

The study population was drawn from a Higher Education Institution in Saudi Arabia that specializes in offering medical courses. Specifically, we focused on male students who had registered for English for Specific Purpose (ESP) course. The targeted students also had to be in B1/B2 CEFR level. Students in this level are an equivalent to first year college students. The total number of students that met this description were 230. This meant that the study population was finite. As such, Krejcie and Morgan sampling formula for finite study populations was used. Krejcie and Morgan table is attached as appendix 1 [23].

$$S = \frac{X^2 NP(1-p)}{d^2(N-1) + X^2 P(1-P)}$$

Where:

S = Required Sample size

X = Z value (e.g. 1.96 for 95% confidence level)

N = Population Size (230)

P = Population proportion (expressed as decimal) (assumed to be 0.5 (50%)

d = Degree of accuracy (5%), expressed as a proportion (.05); It is margin of error

$$S = \frac{1.96^2 \times 230 \times 0.5(1-0.5)}{0.05^2(230-1) + 1.96^2 \times 0.5(1-0.5)} = 144$$

As such, 144 students qualified to participate in the study. Subsequently, we proceeded to sample the study participants.

The first sampling method that we applied was stratified sampling. In this approach, two strata were formed. These included the control group and the experiment groups. These categorizations were based on the teaching techniques used in the study. The experiment group consisted of students who used AR technology in their ESP classes. The control group used traditional learning methods including paper flashcards and notes. Each of the stratum had a proportionate representation given the required study sample.

Purposive sampling was used in choosing research subjects in the two strata. According to Sharma, purposive sampling is also known as judgmental sampling [24]. It is a non-probability sampling technique where the study participants are selected

based on the judgment of the researcher. As such, the researcher applied this approach in identifying participants to be included in both the control and the experiment groups. The experiment group had 72 participants using AR technology in their ESP classes. This experimental group used the Learning Alive Augmented Reality Application. The researcher ensured that the students chose the application's Letters Alive option, which is largely used in literacy lessons. This also consisted of digital 3D flashcards. For the anatomy classes, Human Anatomy Atlas by Visible Body was used by the experiment group. This AR tool was used in teaching the students about the human body, the skeletal structure and the muscle composition. The use of the application was justified by the fact that it can go in-depth with 3D models of the human body. The control group, which consisted of students using traditional learning methods, made up the remaining 72 participants. In the literacy classes, this group was taught using paper flashcards, and they were expected to take notes. For the anatomy classes, they were taught using photographs of the parts of the body including the skeletal structure and the muscle composition.

Data Collection

Being a mixed research, we used both primary and secondary data in answering the research questions [21] [22]. Secondary data was obtained from previous studies that compare traditional learning methods and augmented reality technology. First hand data was obtained from data collected from the students through interviews and questionnaire. The entry point for data collection was the questionnaires which was administered to all the 144 students participating in the study.

Brown buttresses researches which argue questionnaires are most appropriate when using mixed methodology. This is attributed to the fact that it helps in quantifying findings for a study [21] [22] [25]. We distributed the questionnaires which contained both closed-ended and open-ended questions. The questionnaires assessed; learners' perception of augmented reality technology, perceptions of ease of use of the AR technology or traditional methods, the flow achieved when using AR technology or traditional methods, perceived playfulness of the AR technology or traditional methods, the levels of enjoyment in these forms of ESP classroom learning and satisfaction levels. Evidently, this approach helped us cover a wide area within a short time. Another justification for the approach was that respondents were able to express themselves freely [21] [22] [25] [26]. Since this approach relies absolutes on the honesty and accuracy of the participants' responses, we combined it with interviews to yield trusted results. Interviews were conducted to mitigate the negative effects of questionnaires. According to Wilson, Onwuegbuzie, and Manning, interviews are dependable in obtaining information about personal feelings, and perceptions of the 144 students [27]. The use of interviews was also justified by the fact that we were able to ask more detailed questions and seek clarifications on the incomplete answers obtained from the questionnaires [24] [27]. Similarly, the respective data was collected from 100 MCQs vocabulary questions. This also consisted of 20 items in the Technology Perception Questionnaire. Some of the factors that the questionnaire interrogated include perceived learning whereby they were expected to state whether AR had allowed them to learn faster and increased their learning efficiency. Still on perceived learning, they were also expected to answer whether AR had increased their understanding of things learnt. On perceived ease of use, the learners were asked whether AR is easy to use and whether using AR to complete course related tasks was easier. The ease to complete tasks was also interrogated as one of the determinants of ease of use. Another aspect interrogated was the flow. This mainly focused on learners' satisfaction with the interactivity. On perceived playfulness of AR, the extent to which students feel happy when they use AR in learning was measured. There were also questions on enjoyment while using AR. Here, students were asked whether they had fun while using AR in learning English compared to traditional teaching approaches. Lastly, students' were satisfied with AR's role in supporting their English classes.

Data Analysis

The research generated both qualitative and quantitative information on the study objective which aimed at establishing the impact of using augmented reality technology on English vocabulary learning and motivation. Information obtained from the questionnaires were quantitatively analyzed using SPSS version 21. Descriptive statistics were used in communicating research findings because they are able

to summarize the basic features of standardized responses [26]. Tables and graphs were used to enhance understanding of the study results. For the qualitative data generated from the interviews conducted during the study, we used content analysis [21] [22]. From the analysis, we were able to reveal the key themes in understanding the impact of AR technology in ESP classrooms. Our analysis was justified by Mugenda and Mugenda recommendations that any response rate of more than 50% is enough for analysis and reporting [28]. Being a controlled study relying on questionnaires and interviews in collecting data, we were able to establish a 100% response rate from the 144 male students sampled in the study.

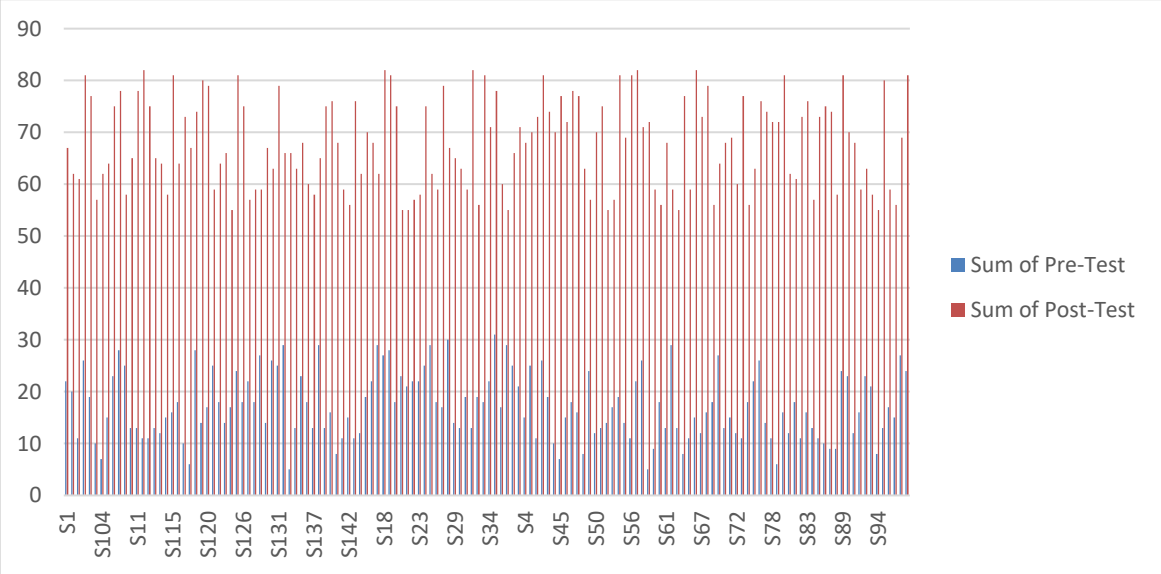
Results/Findings and Analysis

The research objective was to establish the impact of using Augmented Reality (AR) technology on English vocabulary learning and motivation of Saudi private undergraduate health science students before and after using a particular AR mobile application. The subsequent sections discusses the findings for each of the research questions in this study.

Student Learning Motivation and AR Technology

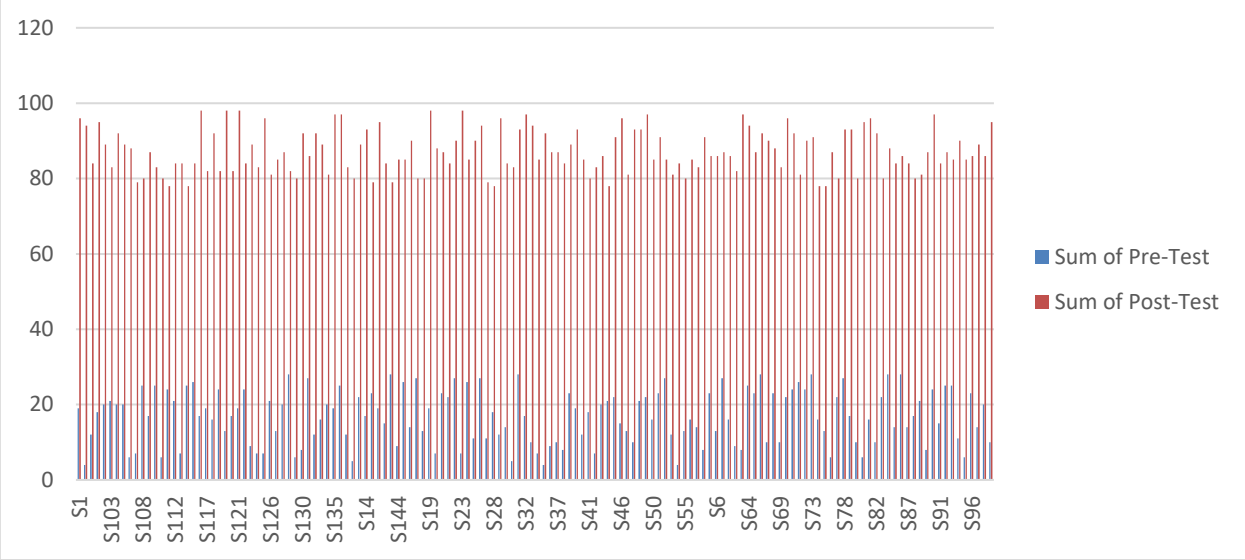
The first research question entails assessing the differences in student learning motivation and vocabulary learning with and without the use of AR mobile technology. Subsequently, we graphically presented the sum of pre-test and the sum of post-test for both the control and experiment groups using SPSS.

Fig. 1. *Control Group*



From the graph, it is evident that the use of traditional learning methods in ESP classrooms contributed to higher scores in the vocabulary test. These results were deduced from the graph where the blue bars represent the pre-test results while the red bars represent the post-test results.

Fig. 2. *Experimental Group*



For the experiment group, students used AR technology in their ESP classrooms. Form the graph, it is evident that the students scored highly in post-test compared to the pre-test. This is evidenced in the red bars and the blue bars respectively. However, a comparison between the control group and experiment group indicates that despite that fact that there was a recorded improvement, the students using AR technology in their ESP classes scored highly compared to those using traditional approaches. For the control group, most students scored below 80 while for the experiment group, a majority of the students got more than 80 vocabulary questions right.

Perceptions of ESP Classes using AR Technology

The second research question assesses health science students' perceptions on the use of AR in English for Specific Purposes (ESP) class. We used descriptive statistics in analyzing data related to this question. As such, (M=124.35, S.D=9.626), was the result obtained from students who strongly agree. For students who agreed the results obtained included M=18.15 and S.D = 8.756. Students who remained neutral were represented by a mean of 2.31 and a standard deviation of 1.888. These results are summarized in the table below.

Table 1. *Descriptive Statistics*

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Strongly Agree	20	99	138	2487	124.35	9.626
Agree	20	4	37	363	18.15	8.756
Neutral	13	1	8	30	2.31	1.888
Disagree	0					
Strongly Disagree	0					
Valid N (listwise)	0					

Traditional teaching vs. Teaching by AR technology

The third research question's objective was to establish if there was any significance difference between teaching with traditional methods as compared to teaching with Augmented Reality Technology in language classes. ANOVA was used to establish a statistical significance test as to the equality of more than one group. In addition, the generalization of t-test to more than a group was significantly evident as per the table findings below.

Table 2. *ANOVA[b] (Control Group)*

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	.474	1	.474	.012	.914[a]
Residual	5813.276	142	40.939		
Total	5813.750	143			

a. Predictors: (Constant), PostTest_Control b. Dependent Variable: PreTest_Control

Table 3. *ANOVA[b] (Experiment Group)*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.644	1	.644	.013	.910[a]
	Residual	7078.683	142	49.850		
	Total	7079.326	143			

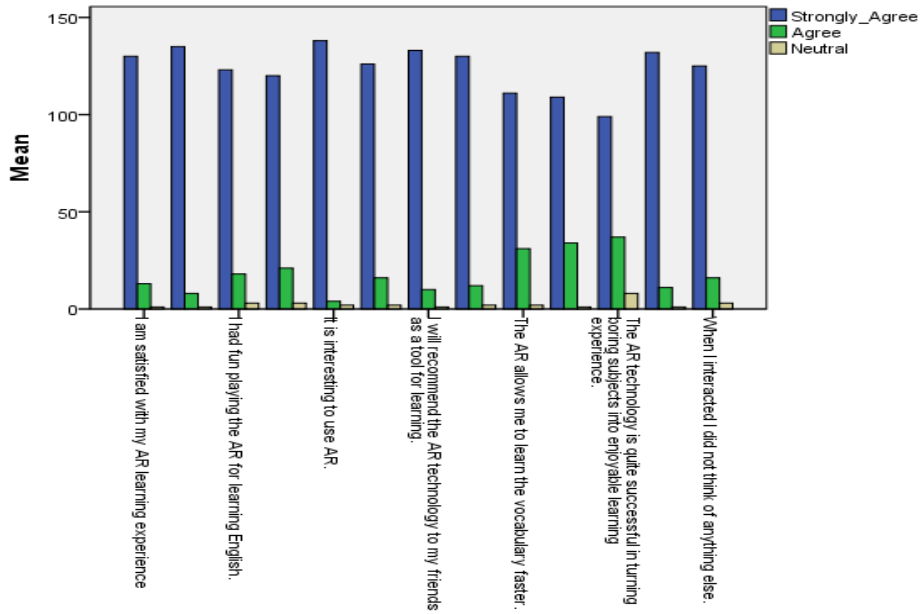
a. Predictors: (Constant), PostTest_Experiment
b. Dependent Variable: PreTest_Experiment

The summary finding shows a less than 0.05 significant (< 0.05) P value. This indicates that the both variables in the independent section that is traditional teaching and Augmented Reality technology together explain the degree of improved performance on the students test.

Impact of Augmented Reality Technology on Vocabulary Learning Retention

There is a significant impact in using Augmented Reality technology in the ESP classroom in terms of vocabulary learning and retention. This was evident by 129 students in experiment group who performed better than control group. However, 15 students in control group performed better than those in experiment group. In the overall observation, both groups performed better.

Fig. 3. *Impact of AR on Vocabulary learning and Retention*



As indicated in the methodology, qualitative results were generated from the interviews conducted with the students. Through coding, we were able to identify key themes relevant for the study. These themes included motivation, perception, and retention. From the interviews, these themes featured in a majority of the responses. For instance in an interview with participant S126, when he was asked about his views on augmented reality technology in ESP classrooms, this answer sufficed:

In my view, AR technology is more interactive and convenient. This motivates me to learn even in the absence of my teacher. As a result, my vocabulary retention has improved considerably. I feel motivated to learn more.

Another participant commented on Augmented Reality in terms of its potential in reducing the

cognitive load associated with learning new terminologies especially for non-native speakers of English. He commented:

Being a non-native speaker of English or Latin, learning and memorizing the names of body organs has been our worst nightmare because we work very hard in learning English before we study in college, and then we find that the language used in anatomy books is either Latin or Greek. Most of the time we find it demotivating to have to learn the prefixes and suffixes in other languages other than English. But with AR the story is different as learning what used to dull and boring has become interesting and enjoyable. I can now practice all day with my classmates and with my siblings at home.

Another participant found that using AR in the English classroom very convenient for his preferred learning style:
I am a visual learner. I found the AR technology really interesting and motivating because I was able to visualize the new terminologies whenever I wanted. The exercises that I had to do later to check my learning helped me a lot and showed how fast I was able to recall the terms.

It was interesting see some participants taking the experience to a different level where they reported that they would look for similar applications of the AR technology to use them for their future learning endeavors:

I learn faster when I practice. When I used the AR technology I was leaning by doing and that was really helpful. I will definitely look for other applications for this technology in my future courses. I am sure there will be a lot out there and that will help me a lot during my journey studying medicine.

In light of these statements, all the three themes needed for coding arose. This responded to the research objective on whether augmented reality technology had impacted on vocabulary learning and students' motivation. Consistency in these themes was an indication that AR technology considerably impacted factors such as student motivation, vocabulary retention and learning perceptions.

DISCUSSION

The main objective of this study was to assess the impact augmented reality technology on vocabulary learning and student motivation. Subsequently, the first specific objective of the study was to establish whether there are differences in learning motivation and vocabulary learning with and without the use of AR mobile technology. From the analysis, it is evident that both the control and the experiment group students' learning motivation improved. However, students using AR technology posted better results compared to their counterparts using traditional methods. These results are in tandem with previous researches which indicate that although traditional paper flashcards have been reliable tools in teaching vocabulary, augmented reality technology is a more appealing and interactive vocabulary learning method. For instance, studies by Bonner and Reinders which focused on the importance on the application of augmented reality in ESP classes indicate that traditional teaching methods such as paper flashcards present numerous challenges for students learning English as a second language [6]. The authors argue that vocabulary retention among such students can only be achieved when particular levels of practicability is achieved. This is not possible without the indulgence of an interactive teaching model. Kamphuis et al. in their contribution of AR technology learning in medical schools augments these outcomes by observing that human anatomy is complex and its vocabulary can only be learnt using a more interactive model [9]. The authors further observe that virtual reality gives students a sense of real-world learning which cannot be achieved using traditional learning methods such as notes and paper flashcards. This also conforms to findings by Yoke et al. who observe that traditional methods are far much less effective in ESP classes given that they are rarely relevant and are unresponsive to

emerging trends [29]. Consequently, the use of AR technology in vocabulary learning is likely to result into higher scores compared to their counterparts who use traditional vocabulary learning approaches [30].

The improved performance among learners can be attributed to positive perception of the use of AR technology in English for Specific Purposes class. According to Sydorenko et al. AR technology increases students' learning motivation given that it has the ability to reduce distractions, to block out visual and auditory distractions that might exist within the classroom and to enable the learners connect with the study materials [31]. According to Chang et al. the features of AR technology have continuously motivated learners [1]. The authors opine that motivation levels among learners usually improve when they can relate with the teaching model. As such, a teaching model that incorporates new knowledge using real-life experiences is likely to motivate students. Similarly, prompt feedback is an essential component in ESP classes given that learners are empowered to learn more within a shorter period of time [32]. When these prompt feedbacks are compounded with remote learning, the learners are further motivated [33]. This enhances learning outcomes. Similar outcomes have also been reported by Huang et al who observes that augmented reality technology motivates students because they are able to immerse themselves in their studies and make connections with the real world. Similar studies have also indicated that AR technology increases learners' motivation given that they can use it within both formal and informal settings. Additionally, the students have an opportunity to interact with each other [33] [34].

The third research question was to assess the significance between teachings with traditional teaching and teaching using augmented reality (AR) technology. From the results, there is a significant difference between teaching vocabulary in ESP classes using traditional teaching and teaching with augmented reality (AR). These results also echo the findings by Juan et al. who argues that students' learning capabilities are enhanced when they use AR technology in their classes [35] [36]. The researcher further elaborates that AR technology uses virtual reality which learners can easily relate to resulting into more comprehensive learning. Pérez-López & Contero, augments also conforms to these findings when it concludes that the technological tools used in augmented reality vocabulary learning results into more creative learning environment and helps in overcoming rote learning [37]. Similar sentiments have also been reported in previous studies [38]. The authors further argue that compared to augmented reality technology learning, traditional technologies such as 2D flashcards are less productive and less enjoyable [39] [40] [41]. From the study, this also explains the fourth research objective which was to assess the impact of using augmented reality technology in the ESP classroom in terms of vocabulary learning and retention. From the results, learners appreciated the importance of augmented reality in vocabulary learning [42]. It also showed how important it is to start thinking about improving the English language teaching methods in higher education by moving away from, or at least complementing the existing traditional English teaching practices, by implementing more innovative methods that depends on emerging technologies such as Augmented Reality [43] [44].

CONCLUSION

Based on the findings herein, the research concluded that there is a significant difference in students learning motivation and vocabulary learning with and without the use of AR mobile technology. As far as the vocabulary learning and retention are concerned, the scores were higher when the students learnt using augmented reality technology compared to the traditional learning methods. Additionally, there is a good perception from the use of AR technology in English for specific purposes class. This can be attributed to the learning ease and flexibility that comes with augmented reality technology. Thirdly, there is a statistically significant difference found

between teachings with traditional teaching as compared with AR technology language classes. Finally, there is a very big impact in using AR technology in the ESP classroom in terms of vocabulary learning and retention.

The findings of this study suggest that the AR technology could be an asset in the English language classroom owing to its potential in helping language learners learn vocabulary better and retain them for longer period of time. The findings also suggest that this technology is highly welcomed and applauded by language learners with high levels of satisfaction and acceptance of the methodology. While both the scale and sample size of the present study are too small for us to come forward with definitive prescriptive recommendations for incorporating AR technology into the English language classroom, the findings are in line with the findings of plethora of studies that all came to the same conclusion of successful adoption of AR technology in educational settings in general, and in the English language classroom in particular.

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