

A PILOT STUDY EXPLORING AUGMENTED REALITY TO INCREASE MOTIVATION OF CHINESE COLLEGE STUDENTS LEARNING ENGLISH

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Abstract

With the advent and accelerated development of augmented reality (AR), an increasing number of studies have been conducted to test the effectiveness of this technique in education. Few, however, have investigated how AR might influence students' motivation toward the learning of a second language. To address this gap in the literature, we used a combination of convenience sampling and criterion sampling to select five Chinese college students to evaluate an English vocabulary learning application built upon augmented reality technology. To assess student motivation, the ARCS motivational model was adopted. A semi-structured interview with open-ended questions was used to collect data. Participants indicated that though they were attracted by this tool at the beginning, their motivation level decreased toward the end of the study. An interpretation of our observations in the context of the ARCS model suggests three motivational issues. First, predefined AR materials failed to establish relevance to subjects' personal interests and previous experiences. Secondly, subjects' confidence seemed to have been negatively influenced due to their difficulty in achieving the stated learning objectives. Lastly, technical issues delayed the computer quickly identifying the triggering image and thus resulted in a noticeable lack of system responsiveness. It seems this delay decreased subjects' satisfaction and distracted their attention from the learning task. These factors seemed most determinative in compromising AR's effectiveness as a tool to increase student motivation toward English vocabulary learning. It must be stressed that this study is a pilot with too low number of subjects from which to make any binding generalizations. Nonetheless, these findings should provide

useful insights toward the successful application of AR in the educational realm. The authors recommend further study with a larger number of subjects with a wider range of vocabulary samples and a more powerful computer capable of more quickly identifying the trigger image.

Keywords: English vocabulary learning, augmented reality, learning motivation, ARCS Model

Introduction

With the increasing number of Chinese students studying in America, Chinese students represent one of the largest groups of international students in the states. For better adapting study and life in an English environment, Chinese students need to have a good command of both spoken and written English. Language barriers negatively influence the Chinese students in developing to their full potentials not only on campus, but also in the more fiercely competitive society at large. In order to get better involved in American student life and to prepare for the career market in the future, improving students' English clearly seems a critical subject for the Chinese student in the U.S.

Learning vocabulary is the most foundational block and first step in learning English as a second language, since no language acquisition and application can take place without the accumulation of vocabulary [1]. Research has shown however that the problem of learning vocabulary was the biggest obstacle for second language learners to overcome [2]. Therefore, how to improve students' performance on vocabulary learning is a critical issue for both learners and educators. The significance of

motivation as a contributing factor in second language acquisition has been widely studied [3, 4, 5]. Studies have shown that motivation as the force that initiates and directs behavior had a direct influence on students' learning performance [6].

Argumented Reality (AR) has been used in the education area [7,8,9,10] because it enhances our sensory information with virtual information superimposed on top of real world information by digital means [11]. However the potential of AR as a motivation-stimulated factor in language learning and vocabulary learning remains unexplored. The purpose of this study is to explore the ability of AR in influencing the motivational factor of vocabulary learning.

A pilot study of a freely available augmented reality English vocabulary learning application was conducted to assess the AR's influence on students' learning motivation. Semi-structured interviews were used for gathering assessment data. By analyzing the qualitative data within the framework of the ARCS Model, the research results showed that AR does help with motivation in the beginning of the application session, but decreased towards the end. Three motivational issues were discovered.

Literature Review

The Role of Motivation in English Learning

Increasing student motivation toward learning a new language has long been a goal of teachers due to the role of motivation as a significant factor in improved academic performance [12]. Educational research in different countries has sought to find teaching strategies to facilitate meaningful and attractive learning experiences for students learning English as a second language [13,14,15]. Previous research has shown that motivation is significantly different depending on educational level with age and therefore it is necessary to choose different approaches to motivating students of different ages [16]. At higher educational levels such as college students, the more self-directed and

problem-oriented their learning style is thus presenting challenges in increasing their learning motivation [13]. Moreover, for international college students who have already learned a different language, developing new pronunciation habits is not as easy as when they were children. Chinese students, as one of the fastest-growing English learning groups, have already reached almost 235,000 according to the report of international college students enrolled in the U.S during the 2012-2013 school year [17]. However, the current situation of English learning, specifically the vocabulary learning, is not optimistic, according to the study of Liu [1]. A lack of systematic research in vocabulary learning, a passive way of learning vocabulary, and a lack of motivation contribute to students' diminished competence in actual use of English. As such, discovering more efficient means of motivating Chinese college students' English learning is highly important.

Previous research on increasing learning motivation indicated that the use of multimedia can exert a positive influence. Eight principles were proposed by [18] to better design a multimedia learning system. They are as follows:

- (1) Pictures are more effective than words alone,
- (2) Capturing the learners attention is important,
- (3) Redundant information should be excluded from the presentation of multimedia contents,
- (4) User control and interaction are better,
- (5) Helping students recall or acquire knowledge structures before exposure to multimedia content,
- (6) Animation can improve learning,
- (7) Multimedia is more effective when engaging users,

- (8) Let learners apply their newly acquired knowledge and receive feedback.

This study also pointed out that effectively using multimedia is not only putting multiple media together, but combining them in a meaningful way that utilizes the characteristics of each individual medium to their best.

Rationale for AR in Education

Augmented Reality (AR) has aroused much attention in the educational area due to several aspects of the technology that might positively influence students' learning process. These aspects are: to provide a novel context with which to engage students [7], to facilitate the collaboration between instructor and students [8] and to enhance students' spatial ability through direct interaction with 3D synthetic objects in virtual space [9,10]. According to [11], the term AR refers to technology that enhances the user's sensory perception of a real world with a computer generated imposed layer of information. With AR, it is possible to show the user a seamlessly coexistent virtual and real space, in which real-time 3D models, video, and text can be superimposed onto an image taken from a real environment. In addition, it enables ubiquitous, collaborative and situated learning. Comparative studies between AR and traditional classes have confirmed that AR could enhance learning performance in teaching mathematics and geometry [8] and also in second grade-level concepts by maintaining high levels of motivation among children [5].

Use of AR in English Learning

Regarding the research investigating the use of AR in language learning, one example was an AR-based game system named MOW [19]. The researchers adopted the construction of a 3D object vocabulary, which was superimposed on the object's text to help children associate each word with the 3D object. Through the comparison between the AR and traditional teaching methods, the results indicated that children who used the MOW system had

superior learning progress than those who used only traditional methods. This study only evaluated learning performance based on the statistical analysis of time and grade in a pre-test and post-test, but did not focus on motivational factors. Another two studies evaluated the user acceptance of the implementations of an AR-learning system for English vocabulary and showed that system quality was a critical factor affecting perceived satisfaction and that children preferred the AR game [20,21]. These studies built the first step in investigating the adoption of AR in English vocabulary learning, however several limitations still remain. First, all these studies only found a positive influence of AR on vocabulary learning among the population of children, adults were not tested. Similar research should be extended to college students who have more challenges in learning a second language. Second, prior research built their conclusion that AR has a positive effect on learning outcomes with quantitative data analysis while less focused on how AR influences students' learning motivation. Third, the three studies mentioned were not conducted among Chinese students, which naturally would not address any cultural factors that might be in effect. To address these issues, a semi-structured interview was used in this research to collect more qualitative data from Purdue Chinese students in terms of evaluating their vocabulary learning motivation through the use of AR.

Motivation Evaluation Framework

In order to measure and evaluate student motivation, a theoretical framework of motivation was selected before collecting the data – Keller's ARCS motivation model. The ARCS model is a descriptive model used for diagnosing problems associated with learning motivation [22]. This model had been used in evaluating learning motivation for instructional tools such as evaluating AR tools for visual art courses [6] and a computer-based tutorial [20]. According to Keller's definition, motivation in the educational area means the students' desire to engage in a learning environment [23]. To be more specific, four dimensions in Keller's

ARCS motivation model were used to explain the motivation, which were attention, relevance, confidence and satisfaction [23]. Keller posited that learner attention should be gained and sustained in two ways. One was using surprise or uncertainty to gain interest. Another was by stimulating curiosity. The second step was to establish relevance to increase a learner's motivation. Allowing a choice was one suggested strategy. Next in the confidence stage, students should understand their likelihood for success, for if they feel they cannot meet the objectives, their motivation would decrease. Satisfaction means if the outcome of a learner's effort was consistent with their expectations and they felt relatively good about those outcomes, they would remain motivated.

Methodology

There are two specific research questions in this study: (1). How does AR influence Chinese students' vocabulary learning motivation? (2). If there are any motivational issues, what are the factors that compromise the use of AR technology in vocabulary learning?

In order to address the questions above, we used a qualitative study approach and collected the data through interviews after user testing. The purpose of this study was not only to answer whether students feel AR is a compelling tool but also increase our understanding of the processes of how AR might influence students' motivation. Compared with pure quantitative research such as a controlled experiment, a major strength of qualitative research is in getting at the processes that led to some outcomes [24].

Participants

Before recruiting the participants, some criteria were predefined in order to screen the subjects. According to Patton, criterion sampling involves "selecting cases that meet some predetermined criterion of importance" [25]. Only Chinese students at Purdue were invited to participate in this study. Five subjects

were selected (Figure 1). All participants were graduate students who have been learning English for several years. Only one user had prior experience using AR technology. Subjects were asked what their current attitude was toward learning English vocabulary. Though some users indicated positive statements regarding their own methods, most users reported concerns and problems with their own learning approaches.

	Gender	Education	Previous Experience with AR	Attitude to their usual way of learning vocabulary
1	Female	Master	No	Not interesting
2	Male	Ph.D	No	Troublesome
3	Female	Ph.D	Yes	Boring
4	Female	Ph.D	No	Efficient
5	Male	Master	No	Time-consuming

Figure 1. Attributes of study participants.

Instruments

This study used a free to download AR application named *Aurasma* to investigate AR's influence on students' English vocabulary learning motivation. *Aurasma* is a mobile application built on AR technology and is available for IOS and Android systems. We chose this application primarily because the program does not demand technical expertise, thus decreasing the likelihood of novice users being intimidated.

The testing process was that participants were first required to move the device to find the triggering images (Figure 2) that were used to activate the "Auras" (a virtual overlay) (Figure 3). The Auras are the virtual objects (video, animation, and image) that are locked to the triggering image in the physical environment. After the virtual overlay is shown on the device, participants would be taught the accompanying word. For the next word, subjects were required to move the device to the next word card and repeat the process again. In this research six

English word flashcards were used as triggering images and attached to six separate videos online before testing. The English words were six nouns: Chipmunk, Platypus, Pelican, Hamster, and Hummingbird. In order to eliminate influence due to familiarity with the words, participants were only asked to choose the words they didn't know in order to complete the test.



Figure 2. Word flashcards as triggering image.

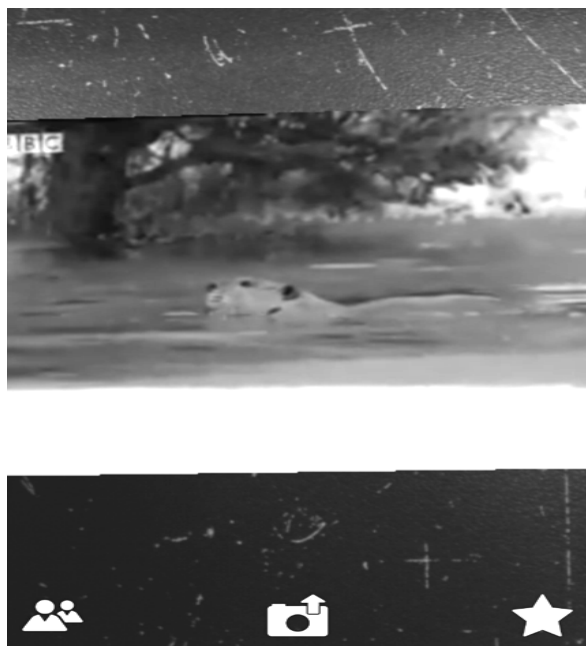


Figure 3. Virtual overlay.

Data Collection

After downloading the application on an iPhone4, each participant was scheduled with one hour to do the testing in a study room in a campus library. Before asking the participants to use the application, the researcher briefly introduced how to manipulate this tool and gave some time for participants' questions.

The six printed flash cards with both image and text of this vocabulary were then provided to the subjects. All flash cards were already attached with AR virtual elements, such as the 3D animation and videos. Each subject spent approximately 15 minutes using the AR application to scan over the flash cards only with the vocabulary with which they were unfamiliar and view the accompanying AR counterparts. When subjects completed the flash cards, a recorded semi-structured interview was conducted individually for 10-15 minutes per person. This method not only gives the researcher an opportunity to present prepared questions, but also provides flexibility such that informants are free to express their views in their own terms [26]. To facilitate communication, interviews were conducted in Mandarin. The interview questions sought to evaluate the motivational aspect of using the AR tool and explore the reasons supporting each user's attitude. A four-dimensional ARCS motivation model was used as the conceptual framework for interview questions.

Data Analysis

After data collection, all interview records were transcribed into documentation. Thematic analysis was used to identify, analyze, and report patterns (themes) that stemmed from the data [27]. Critical and representative patterns were extracted from the data and then coded into four major themes that indicated how AR influences student's motivation in vocabulary learning.

Reliability and Validity

To address validity concerns, five participants from different majors were selected in order to represent multiple viewpoints. To increase reliability, triangulation was used to analyze the data. Two researchers worked together to analyze the data and reach a consensus on the themes which emerged from the data. Each of the themes was supported by citation from the participants' responses. Moreover, the interview questions were framed based upon discussions with an expert in qualitative research in order to avoid leading questions and to minimize the researcher's personal interpretations of participant responses.

Results

The data collected from the testing was analyzed based on the interpretive paradigm for understanding how AR influences motivation in vocabulary learning. Thematic analysis was used as a method for identifying, analyzing and reporting patterns (themes) with data [27] and was also used to diagnose the motivational issues from the critical and representative phenomenon in the data.

There are four steps in our data analysis process. Firstly, the qualitative data from audio recordings were transcribed into text. Secondly, interesting features in the interview transcriptions were highlighted for initially coding the data. Third, focusing on a broader level of themes rather than coding, researchers sorted different codes into potential themes. Lastly, the themes were reviewed and refined by checking if any candidate themes should be discarded or combined. Based on the criteria that data within themes should be coherent together meaningfully, and the difference between two themes should be identifiable and distinguishable [27], four themes were generated. Each theme drawn from the interview data related to the four dimensions in the ARCS motivational model are described as follows.

Theme 1: First Impressions are Attractive

When participants were asked for their first impression about the AR app, nearly all (except for one) thought it was appealing and attractive. Participants used words like "amazing", "fantastic", "novel", "interesting" to describe their feelings when they first saw the superimposed layer appearing on the device. Four out of five participants liked this new form of presentation and showed curiosity in what would happen next. They indicated that the AR app provided them with a brand new interaction form for learning that they had never before accessed through other technologies. Following are some user responses:

*- "I am attracted with this tool. First when I move my mobile phone on the image, a popup window appears, really **amazing!** Attract me so much. I want to know what happened next so I will stare at the device."*

*-- "Really **fancy**, what a magic happening. It is my first time to use such a novel technology and I am full of curiosity about that. Especially I never expected it would show me another video clip when I just placed the iPhone on the image."*

Theme 2: Learning Materials are Limited

Though this AR tool made an impressive and appealing first impression on the participants, some critical opinions emerged afterwards especially when the researcher asked whether this tool can make them related to their prior experience. Participants felt that they were forced to view the materials they were provided without any choice. Sometimes they criticized the quantity and quality of the AR materials, which did not fully satisfy all their needs. Most participants indicated that they expected to have multiple choices of adding different media on that virtual augmented layer. A participant expressed the desire to have optional AR materials

"We were forced to accept the predefined AR material even sometime it was not related to the

word from their perspectives. If we are allowed to choose individually, we might find it more interesting.”

Another participant indicated that she preferred to have multiple AR materials according to different situations:

“A conversation video in daily life will help me enhance my memory for common expressions because I can relate the words in my real life and remember them through practicing in daily life. But if that is an academic word, I probably like to see an animation to explain that terminology.”

Theme 3: Benefit Varies in Different Scenarios:

When asked whether the AR app was a useful tool in vocabulary learning, all participants said that it can be helpful sometimes, but not always. The performance in helping with vocabulary learning of AR app might vary according to scenarios. One concern was that an AR app might be helpful for understanding vocabulary meaning but not for remembering spelling. Participants indicated that they preferred traditional means for memorization such as writing down the words several times.

-“After I use this, I feel the only thing I can remember is the meaning of the word. I feel that it makes me confident to understand the meaning of the word. Because the virtual materials are really helpful for me to reinforce my understanding of its meaning however ignore the spelling. If I have to remember how to spell the word, I don’t think AR is helpful, I probably just write down the word several times to memorize it.”

Another concern was that concrete and abstract words could not benefit equally from the AR application. Three out of five participants reported that they did not feel the AR app helped a lot in learning the concrete words. They felt they could learn the concrete word used in testing, “Chipmunk”, by easier and simpler methods instead of using the AR

application and they thought the AR application would be more helpful if the words were abstract.

-“I think the words you used here are not necessarily to use AR to teach, the word itself is concrete enough, I can use just image to help me remember. While if my purpose is to remember some abstract words related to the spatial relationship or a dynamic process in biology, which is hardly to be expressed by a fixed image, I think I would use AR tool. Because it shows me something that I cannot easily imagine through a still image.”

Theme 4: Image Triggering Does Not Work Well

Most participants complained about the effectiveness of the AR image triggering. Users had to hold the device and keep focusing on the image to trigger the AR overlay, otherwise the AR video would suspend. A participant said that

“It is hard to focus the triggering image, when I place my cellphone on the image, it doesn’t show the AR material immediately”.

In addition, they felt the image triggering problem increased the inconvenience of usage and even distracted their attention from learning.

“It is inconvenient for me to hold the device on the triggering image all the time. I feel tired for that, and sometime my attention will be distracted by the triggering image because I need to focus my cellphone on it otherwise the AR material will stop.”

Discussion

The results of this study indicated that AR as a novel technology has potential to increase students’ learning motivation however some issues arose that must be considered to use it most effectively. According to Keller’s ARCS motivation model, the first stage in increasing motivation is to capture the learner’s attention by using novel events [22]. In this study, AR

made an attractive, novel impression and therefore demonstrated potential as a tool for stimulating motivation. Most participants stated that their motivation decreased in the end of the study. We propose several reasons within the context of the ARCS model.

First, limited AR materials influenced the relevance factor in the ARCS model. Learning materials should be aligned with learners' goals and interests in order to be perceived as relevant [22]. Prior research revealed that adult learners' learning motivation was based on the perceived value of the learning materials and how much of their prior experiences could be related with the topic they learned [13]. In order to increase relevance, Keller [22] suggested allowing learners a choice of different methods to pursue their work which can make this relation with their past experiences tighter. In this application, predefined AR materials had been attached to the word without any customized choice on the basis of users' own needs, which might have violated this principle. Participants therefore passively accepted this method rather than intuitively building a relationship between the AR and the given word. A self-selection multimedia library is recommended in order to give learners freedom to choose virtual contents based on their personal preferences.

Second, the fact that some participants felt AR cannot help them memorize the spelling of a word influenced the confidence factor described in the ARCS model. Confidence according to Keller means that a tool needs to make sure a learners' objective can be achieved, otherwise they would feel no likelihood for success, and therefore their motivation will decrease [22]. For the learners', the task of learning vocabulary meant not only understanding its meaning but also remembering the spelling of the words. The AR tool only helped learners' better recall the meaning of the words, indicated by all participants in the study. While learners' didn't feel it was conducive in helping remember the word spelling. In order to address this problem, it was suggested we add a synchronized text box

simultaneously showing the spelling of the word while giving the virtual contents.

Third, the problem of triggering the image overlay negatively influenced overall satisfaction with the application. At the beginning of using the application, users paid close attention to the screen to see what would happen, however because of slow processing time for recognizing the target image, users' attention was diminished. According to the ARCS model, if attention cannot be maintained throughout the learning process, motivation will decrease [22]. The use of the triggering image itself can be a potential problem. Previous studies have shown that using a marker, which in this case is the triggering image, did not allow students to act in a natural way and as a result, influenced their satisfaction and overall effectiveness of the AR application [28]. This problem is technological and restricted by the computational power of the viewing device and the speed of the image recognition algorithms with the AR technology. This hardware limitation is essentially impossible to circumvent (barring future advances in hardware) and thus is of utmost priority for AR developers to consider as it compromises the effectiveness of any AR system.

Conclusion and Limitation

A previous study has already proved that AR has potential in producing more effective learning results compared with traditional ways of learning vocabulary [19]. Motivation is one of the most important influential factors on learning outcomes; however, there was not much research which examined how AR technology affected the learners' motivations, especially on vocabulary learning. This pilot study was the first one that investigated the AR's influence on students' motivation for learning vocabulary with a conceptual framework-- ARCS motivation model. Several themes were identified by the qualitative study. Learners' motivations were increased by AR in the beginning and decreased along with the disappearance of its novelty. The limitation of

learning materials and technology capability were recognized as motivational issues as well.

There were two limitations in this research. First, only five participants provided a small number of qualitative responses. A larger group would likely result in more themes emerging and diminish insufficiently supported themes. Though the sample size is small, it still reveals AR's promising role in vocabulary learning from intensive qualitative data analysis and gives some insights on follow-up research. Second, the testing vocabulary with AR needs to be well selected. According to participants' feedback, the influence of AR technology on learning motivation varies by different vocabulary categories, such as concrete or abstract words. Learners indicated that their motivations of using AR to learn abstract words were higher than pictographic words. This finding was supported by previous research that AR was effective in alleviating the problem of understanding symbolic and abstract representatives and helping students to see relationships between concrete objects and their symbolic representations in the same view [29]. A possible alternative to compensate for this limitation is to classify vocabularies into groups with personalized criteria and design suitable AR materials for better satisfying their learning requirements.

Future Work

The current study focused on how an AR application might influence the motivation of English vocabulary learning in a group of Chinese students. Future studies should be expanded to different non-native English speaking countries so as to increase the popularity of using AR as a language learning tool and might explore whether cultural background plays a role in influencing the AR's effectiveness of vocabulary learning. Other factors of interest that were not within the scope of the current study, yet are likely to be significant, include word selection, subject age, subject gender, and previous cross-language experiences.

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