



Development of an Effective Learning Quality Assessment Model for a 3D Augmented Reality Application for Early Childhood Education in Thailand

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Abstract The purpose of this research is to develop a model for evaluating the quality of learning and augmented reality applications. For early childhood learners in Thailand, using IEEE and ISO/IEC standards, The model comprises six quality characteristics: functionality, reliability, usability, efficiency, maintainability, and portability. Usability and performance to study the effectiveness of suitability. Assessment model that studies the relationship between academic achievement after using the augmented reality model and compares the academic performance scores and pre- and post-test scores of students' satisfaction with the application-based learning model. The sample consisted of 35 Kindergarten 3 students of Phadungkit Witthaya School, who experimented with a sample of 35 people using a purposive sampling and used the satisfaction questionnaire created to collect data.

The results showed that the developed learning quality assessment model was effective according to the specified criteria of 85.60/82.20, and users could easily understand the system and content. There is a relationship in the same way. The average achievement before and after learning using the learning model was statistically significantly different at the level of .05, and the students were satisfied with learning using the developed model at a high level of 4.80 and were able to increase the learning efficiency. The average score of 4.40 in content design and 4.25 in measurement and evaluation has been carried out with a group of content experts at a good level. It was found that the research results showed that the quality of the learning quality assessment model of the Augmented Reality Application The quality of the quality assessment model is of high quality, and the result of this research can be used to develop the website in accordance with IEEE ISO/IEC standards with the highest effectiveness. The results of the research can reflect the actual condition of the learning quality assessment model of the augmented reality application, which helps in planning. Enhancing school development and operations, which helps in planning. Enhancing development school operations in Thailand to be developed in a standardized and continuous manner. This is a tool to develop learners to learn in various forms. Outside the system it is a motivation for developers to develop effective electronic teaching and learning materials and to enhance the skills of learners.

Introduction

National education, which emphasizes the educational management process that encourages learners to develop naturally and to their full potential. In addition, according to the National Strategy on Education, which promotes and develops electronic education, which is the creation of knowledge and abilities using information and Communication Technology (ICT) as a tool for advancing to a society of wisdom and learning, The University is an educational institution at the higher education level that develops knowledge and abilities for individuals to develop themselves to lead to the development of the country to progress.

Augmented Reality Technology is a technology used in teaching materials for fun and interest to create a new form of learning by using A-Z vocabulary that can be conveyed through a tablet camera with an application that allows the letters to move. Students can remember words through media that use modern technology, in stereoscopic images, text, sounds, readings, translations, etc. This makes them more effective in their concentration on their studies.

The positive effects of teaching and learning that support the positive effects of 3D AR-supported teaching and learning have been demonstrated in a systematic review that demonstrates learner outcomes, participation in teaching and interaction (Akçayır & Akçayır, 2017). AR technology has the potential to be an effective way to teach innovation in higher education for two reasons. Firstly, as a result, AR applications have gained increased attention and are widely used in various fields, including medicine (Mahrous, Elgreatly, Qian, & Schneider, 2021), basic sciences (Wong, Tsang, & Chiu, 2021), and engineering (Alvarez-Marín, Velazquez-Iturbide, & Castillo-Vergara, 2023) AR 3D for Early Childhood.

Quality assessment is information on the development and improvement of learning to meet the needs of learners and teachers to develop learning styles effectively. It uses the standards of the International Organization for Standardization/International Electrotechnical Commission 9126 (ISO/IEC 9126) and the Institute of Electrical and Electronics Engineers Standard 1061 (IEEE 1061), which are standards for determining quality characteristics. (Software Assessment) to be used as a Standard indicator for the learning style.

Objectives

In this research, the main objectives of the researcher were as follows

1. To develop a model to assess the quality of learning for 3D augmented reality applications for early childhood in Thailand according to standards.
2. To compare achievement before and after learning.
3. To evaluate the appropriateness of the content and media quality format.
4. To assess the satisfaction of using the 3D augmented reality application.

Research methodology

Content Scope

In the teaching and learning research, the researcher used the subjects in the school education curriculum, which is English, and also created a 3D augmented reality application learning model.

1. Learners can study the teaching and learning system in subjects that determine the learning format of 3D augmented reality applications.
2. Learners can study and learn on their own through the system.
3. Learners can interact with the instructor as well as activities.
4. Students are allowed to test their knowledge before and after the end of the lesson.
5. Knowledge is processed after the student finishes the lesson.

Sample Scope

Population and sample used in the research include:

1. Population: The population used in this study is Kindergarten 3 students at Phadungkit Witthaya School, 100 students' English courses
2. The sample used in the experiment was 35 students of kindergarten
3. who were obtained by group random method to determine their academic achievement and assess their satisfaction with the learning model of 3D augmented reality application for early childhood in Thailand.

The ISO/IEC 9126 quality characteristics are defined in 6 quality areas.

1. Functionality
2. Reliability
3. Usability
4. Efficiency
5. Maintainability
6. Portability

By sampling and using the ready-made tables of Robert V. Krejcie and Earle W. Morgan (Krejcie & Morgan, 1970) as the website, instructors create courses that are developed and freely accessible. Then it is used to evaluate the quality of augmented reality 3D applications for Early Childhood. The average quality assessment was based on the John W. Best (Best, 2006) approach.

An average of 00.00-20.00	means the least quality.
An average of 20.01-40.00	means low quality.
An average of 40.01-60.00	means medium quality.
An average of 60.01-80.00	means very high quality.
An average of 80.01-100.00	means the highest quality.

Related Research

Conducting research and technology to enhance the durability of memorizing English vocabulary. In the design of the memorization persistence study, the tools used in the research are augmented reality technology, quality assessment, and quizzes by modifying learning objectives according to learners based objectives and learner behavior.

For example, Juhee Lee (Lee, 2022) designed a role-playing educational game for second language learning, in which learners have communication and collaboration.

Teaching and Learning Format, 3D Augmented Reality Application Learning Model

Currently, technology is used to help with learning. Teaching 3D Augmented Reality Application Learning Model

Multimedia is a technology in which computers combine numerical data. Still images, animations, and sound (National Center for Electronics and Computer Technology, 1999)

Multimedia Preparation Process

1. Preparation stage
2. Data collection
3. Contents
4. Lesson development and design
5. Lesson presentation materials
6. Learn the content
7. Generate ideas

Multimedia Learning: The concept of designing augmented reality technology teaches English to achieve durability in Mayer's Cognitive Theory of Multimedia Learning explains that the system involved in the learning process has three the systems: 1. The sensory system in which learners perceive things with the five sensory organs: eyes, ears, nose, tongue, and skin. When the five senses receive information in the form of sound or image, it is recorded in the sensory register, which is the first system responsible for storing various information in a short period of time so that learners can Therefore, in the process of recording touch, it will not receive all the information, but will only choose to receive information or stimuli that the learner knows or is interested in. Some of them will be recorded in working memory and arranged in groups to produce knowledge in the form of images and sounds stored in a short-term period that will be in a period of temporary memory.

Lesson design is the transmission of ideas. Conceptual analysis, first stage design, revision and design evaluation.

Flowchart writing process, Storyboard Creation Process, Programming Creation Stage, Lesson Creation Stage, Lesson Revision Evaluation Stage

Augmented Reality (AR) technology is a combination of augmented reality and virtuality. There are real-time interaction and three-dimensional work that magnifies the virtual state in the real environment (Milgram, Takemura, Utsumi, & Kishino, 1994).

Virtual technology integrates the real world is not new, it is a technology that increases learning potential, reducing the interaction between the real world and the virtual world. The appropriate technologies are applied to the learning environment by using virtual reality technology mixed with visual technology to create a three-dimensional image on the screen. It helps learners control their perception of the real world around them. Learners have the freedom to see what they learn. Learners can move around with the visible view. the real and virtual worlds interact with each other. The virtual world is integrated with the real world through software and a webcam used to capture the location of the device. The virtual image that appears will interact with the user immediately. In the form of a three-dimensional still image or there may be sound effects.

1. Marker indicates movement position.
2. Motion detectors such as phone cameras, webcams, etc.
3. Display Computer Monitor Phone Screen
4. Equipment software that processes to create images or display three-dimensional objects.

Augmented Reality Technologies Internal processes consist of (Carmigniani & Furht, 2011).

1. Image Analysis: Marker Finding Process
2. Calculation of the three-dimensional position value of the marker compared to the camera
3. The process of creating a two-dimensional image from a three-dimensional model is to add data to the image using a three-dimensional position value calculated from a virtual image.

Types of augmented reality technologies: Image-based and coordinate-based Analytics to create data in the virtual world Use an image called Marker or AR Code to see 360 degrees.

Augmented reality technology can be divided into two application types

1. On a mobile device, it is used on the Android operating system, such as searching for places by turning on the camera, rotating in different directions to find the place.
2. For computer-based use, a webcam is used to process and display graphics on the screen.

AR 3D can be used as a 20% practice tool for courses with strict learning requirements, such as computer programming, to provide operational guidance or feedback around the clock. For example, AR is used to teach surgical positions on the body to medical students (LogiShetty et al., 2019). Embedded visual programming problems in AR to display real-time performance and create learning improvements for learners to collaborate and solve problems in learning different programs.

The concept of designing augmented reality technology for English language learning is intended to promote durable learning outcomes based on the Cognitive Theory of

Multimedia Learning, which was developed from the Dual Coding Theory. This theory explains that the learning process involves three interrelated memory systems.

1. Sensory Receptive System: Learners perceive information through the five senses: sight, hearing, smell, taste, and touch. When sensory organs receive information in the form of images, sounds, or other stimuli, the information is temporarily stored in the sensory register. However, learners do not process all incoming information; rather, they selectively attend to stimuli that are relevant, familiar, or interesting to them.

2. Working Memory: Information selected from the sensory register is transferred to working memory, where it is actively processed and organized. Working memory integrates verbal and visual information, allowing learners to construct meaning from multimedia content. Since working memory has a limited capacity, instructional materials should be designed to reduce cognitive load and facilitate understanding through appropriate combinations of text, images, symbols, animations, and audio.

3. Long-Term Memory: Information that has been successfully processed and integrated in working memory can be stored in long-term memory. This memory system retains knowledge and experiences for extended periods, enabling learners to retrieve and apply previously learned information when needed.

Therefore, the design of augmented reality technology for English vocabulary learning should incorporate multimedia elements that effectively attract learners' attention and support cognitive processing. Research on visual media indicates that large, bright, and clearly visible images can capture learners' attention more effectively than surrounding objects. Furthermore, the use of color contrasts, highlighted focal points, and meaningful symbols can enhance learners' interest and improve memory retention, thereby supporting the transfer of vocabulary knowledge into long-term memory (Bannaphesat & Bunnaphesat, 2025).

Results

Augmented Reality Application Learning for Early Childhood in Thailand Instructors and learners must interact with each other and have a teaching and learning Management process. In the university

1. Objectives of the study Augmented reality applications
2. Analyze learners Augmented reality applications
3. Design Course Content English Augmented Reality Application For Early Childhood
 - 3.1 Curriculum-based content and in line with learners' needs Augmented reality applications
 - 3.2 Prioritize the content, classify topics according to the principles of learning augmented reality applications.
 - 3.3 Determine the duration and schedule of study for each topic. Augmented reality applications

- 3.4 Determine the study methodology of augmented reality applications.
- 3.5 Determine the media used to study augmented reality applications.
- 3.6 Determine the evaluation methodology Augmented reality applications
- 3.7 Determine the basic knowledge and skills required for augmented reality applications
- 3.8 Create a curriculum code Augmented reality applications
4. Create teaching and learning activities for augmented reality applications For Early Childhood
5. Prepare for the environment, including:
 - 5.1 Survey of resources to support teaching and learning of augmented reality applications
 - 5.2 Locations and equipment required for service and contact
 - 5.3 Knowledge content according to the topic of teaching and learning. Augmented reality applications
6. Orientation of learners:
7. Organize teaching and learning according to the prescribed design on the web page, there are techniques and activities that can be created, including: evaluation Instructors can use in-class assessments and assessments at the end of the class. At the end of the study, including the evaluation of the instructor.



Figure 1. Augmented reality application learning model



Figure 2. Augmented reality application learning model

The 3D AR learning process: 1. Strengthen the learning process by making learning materials engaging. It makes learning materials easier to understand and more visible 2. The use of AR according to the principle of ordering can be done. 3. Learners and teachers see that the use of AR helps the learning process. (Nurbekova & Baigusheva, 2020)

The results of the research consist of the following main components:

1. AR-Classroom is a virtual classroom.
2. AR-Lab is the creation of a supplementary reality application Laboratory System that emphasizes that learners can practice following virtual lessons in the real world.
3. AR-Course Template is a teaching project creation format.
4. AR-Evaluation Teaching and Learning Evaluation System for Augmented Reality Applications for early childhood in Thailand, which consists of a System evaluation from a number of qualified people.

Evaluation results of content and design of augmented reality applications for early childhood in Thailand, in the overall 4 aspects, it was found to be the most appropriate criterion $\bar{x} = 4.40$ in content design, at the level of $\bar{x} = 4.25$, and the work was carried out with a group of content experts at a good level with an average of $\bar{x} = 4.40$. Supplementary reality application lessons for early childhood in Thailand. The developed model had an efficiency of 85.60/82.20, which allows users to easily understand the system and content, which allows teachers to teach students to understand better .01 and the relationship between academic achievement scores. There is a relationship in the same way. The average academic achievement before and after learning using the learning model was statistically significantly different at the level of .05, and students were satisfied with learning using augmented reality lessons. It can also increase learning efficiency and save learning time. Results of student satisfaction assessment and opinion A total of 35 students found that the level of opinion was at the level of agreement at 4.80 with the introduction of augmented reality application learning for early childhood children. In Thailand, teaching and learning

are combined in the regular classroom to develop a model for assessing the quality of learning in augmented reality applications. For Early Childhood in Thailand.

The results of the analysis should contain the same evidence as in the primary research that supports the claims made by systematic review. What are the essential technical features and affordability of AR in higher education applications? What are the instructional design approaches used to facilitate teaching and learning in higher education that support AR and the moderating factors in this meta-analysis. Additionally, the results of the meta-analysis should provide evidence that supports the claims derived from the systematic review (Pigott & Polanin, 2020).

Discussion

Development of Augmented Reality Application Learning Model for early childhood children, in Thailand, there is a model that is very suitable for learning, as evidenced by the evaluation of experts and the use of the school, especially for learners, who can learn at any time and help to supplement teaching and learning in a regular room more effectively. In addition, it has been found that studying can reduce costs and save a lot of time compared to studying in a regular room. The overall results showed that learning augmented reality applications For Early Childhood In Thailand, it consists of many sub-components. Learners have the opportunity to review lessons after school according to their needs. For early childhood in Thailand, it is used as a component or supplementary media to make normal learning more effective. Importantly, learners must be disciplined and responsible and optimize the learning system. For Early Childhood in Thailand. Research Results 3D AR technology can be effectively integrated into the teaching and learning of most disciplines with a positive and significant effect size. In addition, the largest effect size in various fields (Elfeky & Elbyaly, 2021). These disciplines have high requirements for the direct participation of learners. However, the application of AR in the field of language learning has been found to have poor results, which could be due to two factors. Firstly, there have been only a few relevant studies on the application of AR in the field of language learning, which has resulted in potential bias in the results. Second, there may be a mismatch between the technical characteristics of AR and pedagogy for language teaching. Language learning generally focuses on auditory information and conversational training. whereas 3D AR is primarily a process of learning visual stimuli. Therefore, in a language learning setting, teachers and learners prefer traditional teaching methods.

The results of the research that have been experimented with augmented reality technology for English learning Considering the average test score before learning and the average test score after learning English with instant augmented reality technology, the test score is positive. The post-test score was higher than the pre-test score. It Shows that

kindergarten students 3 who have learned vocabulary from augmented reality technology, English is not born from traditional knowledge. Augmented reality technology is highly durable in English. Results Persistent English memorization This may be due to the involvement of augmented reality technology as a stimulus medium in teaching English vocabulary to create excitement. This augmented reality technology is designed according to the theory of multimedia learning by using Therefore, the concept of designing animation to accompany the narration is to create long-term memory, which is a memory that has a long-term retention for kindergarten students, where students do not have a sense of what exists, but when they take the test after class, they can recall and use it. In addition, the augmented reality technology designed is able to interact with the user. Combining modern art and technology, it is provided for students. Both hemispheres of the brain are born together. The function of thinking and analyzing language, symbols, and creative functions. Therefore, augmented reality technology promotes English vocabulary teaching, which is the most beneficial link for both language analysis and imagination, helping to understand and use English well and have persistence in learning. From observing students' behavior while using augmented reality technology, they will be excited about teaching English. Students found the activity fun, and augmented reality technology complemented The learning of 3 D augmented reality applications for early childhood.

References

- Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*, 20, 1–11. <https://doi.org/10.1016/j.edurev.2016.11.002>
- Alvarez-Marín, A., Velazquez-Iturbide, J. A., & Castillo-Vergara, M. (2023). The acceptance of augmented reality in engineering education: The role of technology optimism and technology innovativeness. *Interactive Learning Environments*, 31(6), 3409–3421. <https://doi.org/10.1080/10494820.2021.1928710>
- Bannaphesat, P., & Bunnaphesat, K. (2025). The development of an effective electronic book for learning augmented reality technology in Thailand university. *Suan Sunandha Asian Social Science Suan Sunandha Asian Social Science Journal*, 19(2), 144–155. <https://so05.tci-thaijo.org/index.php/ssajournal/article/view/282902>
- Best, J. W., & Kahn, J. V. (2006). *Research in education* (10th ed.). Pearson Education.
- Carmigniani, J., & Furht, B. (2011). Augmented reality: An overview. In B. Furht (Ed.), *Handbook of augmented reality* (pp. 3–10). Springer. https://doi.org/10.1007/978-1-4614-0064-6_1
- Elfeky, A. I. M., & Elbyaly, M. Y. H. (2021). Developing skills of fashion design by augmented reality technology in higher education. *Interactive Learning Environments*, 29(1), 17–32. <https://doi.org/10.1080/10494820.2018.1558259>

- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610. <https://doi.org/10.1177/001316447003000308>
- Lee, J. (2022). Problem-based gaming via an augmented reality mobile game and a printed game in foreign language education. *Education and Information Technologies*, 27(1), 743–771. <https://doi.org/10.1007/s10639-020-10391-1>
- Logishetty, K., Western, L., Morgan, R., Iranpour, F., Cobb, J. P., & Auvinet, E. (2019). Can an augmented reality headset improve accuracy of acetabular cup orientation in simulated THA? A randomized trial. *Clinical Orthopaedics and Related Research*, 477(5), 1190–1199. <https://doi.org/10.1097/CORR.0000000000000542>
- Mahrous, A., Elgreatly, A., Qian, F., & Schneider, G. B. (2021). A comparison of pre-clinical instructional technologies: Natural teeth, 3D models, 3D printing, and augmented reality. *Journal of Dental Education*, 85(11), 1795–1801. <https://doi.org/10.1002/jdd.12736>
- Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1994). Augmented reality: A class of displays on the reality–virtuality continuum. *Proceedings of SPIE - The International Society for Optical Engineering*, 2351, 282–292. <https://doi.org/10.1117/12.197321>
- Nurbekova, Z., & Baigusheva, B. (2020). On the issue of compliance with didactic principles in learning using augmented reality. *International Journal of Emerging Technologies in Learning*, 15(15), 121–132. <https://doi.org/10.3991/ijet.v15i15.14399>
- Pigott, T. D., & Polanin, J. R. (2020). Methodological guidance paper: High-quality meta-analysis in a systematic review. *Review of Educational Research*, 90(1), 24–46. <https://doi.org/10.3102/0034654319877153>
- Wong, C. H. S., Tsang, K. C. K., & Chiu, W. K. (2021). Using augmented reality as a powerful and innovative technology to increase enthusiasm and enhance student learning in higher education chemistry courses. *Journal of Chemical Education*, 98(11), 3476–3485. <https://doi.org/10.1021/acs.jchemed.0c01029>