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INTEGRATION OF MOBILE BASED LEARNING MODEL THROUGH AUGMENTED REALITY BOOK BY INCORPORATING STUDENTS ATTENTION ELEMENTS

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ABSTRACT

The limitation of current e-learning technology has caused a lack of student attention in educational environment. Therefore, this study describes the integration of mobile based learning through Augmented Reality Environment to incorporate the student attention elements by computer-generated content. To incorporate student attention element, this study propose an integration model of mobile learning by utilizing Augmented Reality Environment. To validate the integration model, this study has developed the AR prototype called AF-LAR (Animal Fun Learning - Augmented Reality) through smart phone technology as mobile based learning device. (AF-LAR) is an AR Book that adapts learning concept via mobile devices and enables student to bring and access the learning content anywhere and anyplace. AF-LAR has been developed using Metaio and Junaio channel while the design is incorporated with visual learner styles from Visual Auditory Kinesthetic (VAK) model with information visualization approach. The result of this study was evaluated by using attention element in Keller's Motivation ARCS Model to prove the student attention attribute from the prototype based on the five experts. Descriptive statistics was chosen as a technique to evaluate the mean and reliability of attention attribute; perceptual arousal (PA), inquiry arousal (IA) and variability (V) inside the proposed integration model to achieve the student attention in education environment.

Keywords: mobile learning, augmented reality, education, student attention.

INTRODUCTION

As far as the progress of e-learning technology as a medium in learning process, many researchers try to improve the learning process by utilizing technology in particular, towards in enhancing students attention. Today, many mobile devices such as cell phones, notebooks and tablet computer are gaining more relevance to learning environments and education. The recent progress of Augmented Reality (AR) has brought this technology to the mobile computing area to generate more user experience on it. Hence, further facilitates the growth of user experience with AR environment. Furthermore, the emerging of technological concepts in education was generating the rapid development of education where it was bringing it into mobile based learning technology. AR is an effective ways to visualize the learning content, researchers was proven that AR supported particular learning activities such as problem solving, in a highly interactive and memorable fashion [1]. This emerging technology can also be used in any fields to facilitate user in visualizing the object or information in any particular situations.

The main objective of this paper is to embed AR into mobile learning to improve the learning technology in classroom using the AR. In order to actualize this aim, there are other objectives that need to be achieved which are:

a) To propose the model integration of mobile learning through Augmented Reality Book by incorporating student attention elements

b) To evaluate the prototypes of mobile based learning application through Augmented Reality Book

Apart from this objective, we were chosen the concept of AR Book to implement the model integration to be tested in enhancing the student attention.

AUGMENTED REALITY BOOK FOR EDUCATION

The implementation of AR for mobile learning purposes has been discussed and also presented in a number of studies. In order to achieve the objective, this paper is searching on current model integration of mobile learning to enhance the limitation through achieving the objective in this study. The visualization in AR must be embedded in mobile learning architecture to ensure the mobile learning through AR are fluently can use in learning environment to improve the learning process. In this research, the process of embedding of educational elements in the mobile AR for learning system derived from AR Magic Books that was develop by Billinghurst *et al*., (2001) in enhance the traditional normal text books through Augmented Reality Concept [2].

The integration of AR through mobile also successfully was done by Ramdas *et al*., (2012) which was developed the AR Eco System where the concepts of modules are based on four categories; player, context awareness, type of learning and mode of interaction [3]. To get the effective ways in enhancing learning experience among learners; we proposed that, the integration of AR in mobile learning will be implementing through AR Book where this will enhance the concept of Magic Book that proposed by [2].

In order to actualize the objective, image based tracking techniques is chosen to make the mobile phones camera can track the virtual object through the AR book.

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Besides that, Oh and Woo, (2007) was developing the AR Gardening System that implements the personalized pedagogical agent through the animated pedagogical agents to improve student's learning experience in educational system [4]. The gardening

system that consist the one garden and include flower, blue bird, scoop and sprinkle water to learn the process of growing flower in garden. Each of the objects is representing by a marker to make the tracking process.
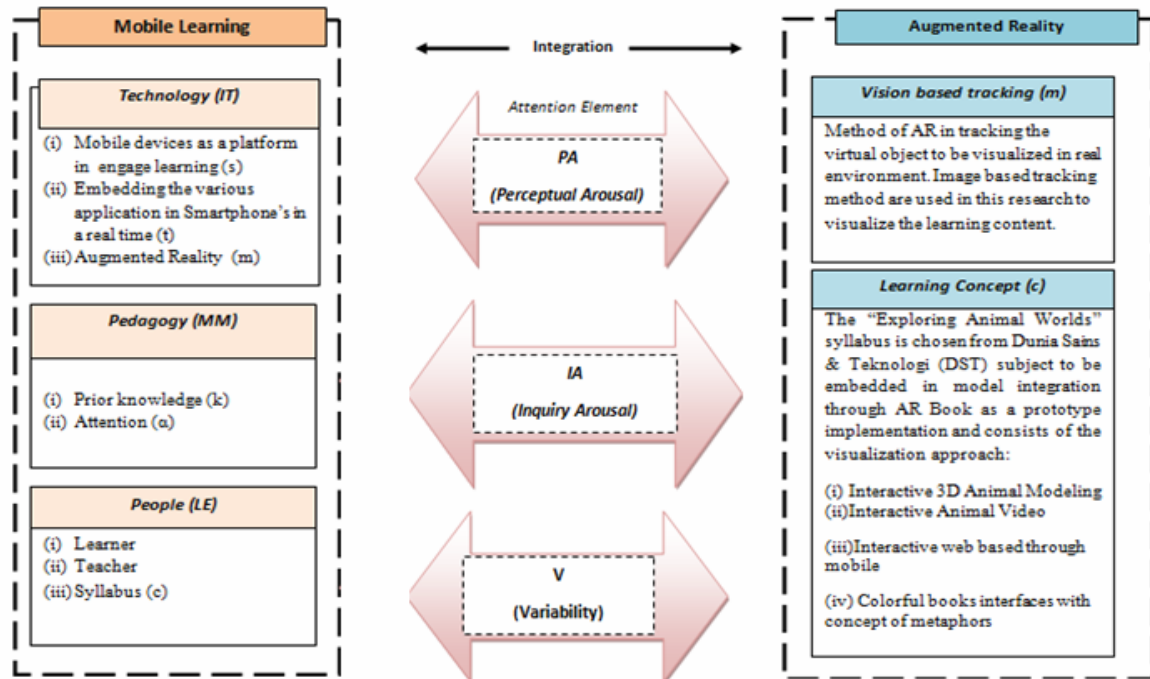

Figure-1. Integration model of Mobile Learning based on Augmented Reality.

METHODOLOGIES
To facilitate the evaluation process, the model was realized in a form of mobile based learning application. The mobile based learning application incorporates all the components of the models. In ensure this research successfully conducted, this section briefly explain the participants, data collection and data analysis that support the evaluation process.

Participants
Five participants of experts from five criteria were chosen to get the analysis in the limitation of current e-learning system in educational environment which conducted through questionnaire. The questionnaire is design to identify the limitation of current e learning technology in educational environment to achieve student attention during learning process which the criteria in the questionnaire will be map with the model integration and will be evaluated through the prototypes implementation. This questionnaire is distributed into five experts as a targeted respondent to identify the problem and limitation in the usage of technological element in learning environment in order to improve student attention.

Data collection
In this research study, the data collection about the current limitation of e-learning technology was get

from the five experts through the questionnaire. The Question for the data collection is based on the three main limitations in e-learning technology that identify Mahanta (2012) which consist by technology and hardware limitation, design issues and personal issues [5]. Based on that, eleven question was derives from the factor to analysis the current limitation of e-learning technology. Table-1 listed the data collection and analysis.

Data analysis
Statistical Package for Social Science (SPSS) was used to measure the mean resulted from the evaluation. The descriptive statistics was used to measure the prototypes in improving the student attention.
The process development of this prototype is start with designing the system flowchart where the design consists of two parts, the Book interface and the AR system. Analyzing the user is the first step in the development of AF-LAR Book.

FINDINGS
The conceptual of mobile learning model is derived from Prasertsilp (2013) where mobile learning was based on two factors, mobile learning environment and learning outcomes [6]. This research identified the model to be integrated with mobile learning system so that it can contribute in improving the limitation of current mobile

learning system because it covers the three aspects of mobile learning environment; users, technology and pedagogy to be implementing through AR. Figure-2 presented the model integration.

Mobile Learning dimension consists of three main attributes; technology, people and pedagogical elements while educational dimension consists of type of learning and mode of interaction. The model of mobile learning is derives from Pratersilp, (2013), where it consist of from three main factors; technology, pedagogy and people and the attributes inside of mobile learning are derives from Laouris and Eteokleous, (2005) which consists of space (s), time (t), method (m), prior knowledge (k), attention and learning environment (LE) [6, 7].

People are the target of user who will use the mobile learning application which consists by student in any related subject to enhance their learning experiences during class. The learning environment (LE) is a people which conducting the learning session successfully. In these factors, it consists by learner as a student who wants to gain their knowledge, using the AR Books to adding their information. Besides that, people in learning environment (LE) is also consists by teacher in give instruction to students for completing their task. Based on the Figure, the attribute of student attention is support by element attention in ARCS model to evaluate the model integration.

Variability is used to evaluate the model integration through the AR Book prototypes. In variability aspects, it emphasized the variety tactics to maintain the attention through the mobile technology, teacher's instruction, and integrated of learning content.

In order to emphasize the model integration, Vision based tracking was used to visualize the AR object. The main of Augmented Reality process are consistsof three main phases; tracking, registration and display the AR content.

Figure-2. Processes in augmented reality technology (Azuma, 1997).

Based on the model integration, the mobile learning attributes are strongly support the student attention when realizing it through prototypes implementation. The embedding of educational elements in the mobile AR for learning system derived from Ramdas *et al*., (2012) developed the AR Eco System where the concepts of modules are based on four categories; player, context awareness, type of learning and mode of interaction [3]. To get the effective ways in enhancing learning experience among learners; we

proposed that, the integration of AR in mobile learning will be implementing through AR Book. The book shows it displaying information visualization through the AR Book, where its focus on visualization and interactivity to improve student learning experience in educational systems. In order to actualize this research objective, the concept of AR Book was chosen to embed the model integration and to validate the conceptual framework of mobile through AR in support student attention to perform successfully. Based on that, this study was proposed the AR Book through mobile display that called AF-LAR (Animal Fun Learning through AR) that embedding with visual learner styles for designing and visualization approach through Augmented Reality Technology in order to improve student attention. Table-2 shows the results of AF-LAR design.

Based on the Table-2, the concept of designing AF-LAR is very interesting to get student attention in order to provide platform to tracking the AR object based on image based marker in this book through mobile. In aligning with primary schools characteristics, the concept of thematic stories and short stories are used to be adapt with the level of student in reading the information about the animal, in this case the concept of people in mobile learning model are emphasize which is, student must have their teacher or facilitator to help them in learning session. In order to construct the AR element to be integrated with the mobile, Table-3 illustrates the concept of Mobile AR and the explanation results in AF-LAR in achieve student attention.

The process of evaluation is implemented in objective to achieve the model integration that supports student attention through AF-LAR. This evaluation process has implemented in targeted respondent, which is consist by five experts that have some criteria using Samsung Galaxy Tab 3 10.1 and AF-LAR Tangible book as a marker based tracking. The evaluation process is based on the Attention element that derives from ARCS Motivation Model that support by Keller 2000. Table-4 presented the explanation of attention criteria that used to be evaluated in AF-LAR.

Based on the perceptual arousal, we can capture the student interest through the colorful images, picture, graphic element in the book, and usage of mobile and AR as a part of technology. To stimulate of an attitude of inquiry by learners experiences, it need the basic knowledge about the learning information and to achieve the variability elements, it can implemented through the mobile technology, teachers instructions and integrated of learning content. In order to full fill the element of attention in Table-4, we identify eleven questions that representative as Perceptual Arousal (PA), Inquiry Arousal (IA) and Variability (V) to evaluate the prototypes. In achieve the research contribution; Table-5 below indicates the details of descriptive statistic for the prototype testing results. Based on that Table, descriptive statistics on mean was performed to describe the level of student attention on five experts' participation.

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Perceptual Arousal (PAI) in Table-5 represents "visualization based approach is the best method in enhance student attention "has a spread of 0.447 over 4.80 mean with the maximum score is 5. Perceptual Arousal (PA2) in Table-5 represents "Smart phone's is the flexible ways to be used in educational environments "has a spread of 0.548 over 4.40 mean with the maximum score is 5. Perceptual Arousal (PA3) in Table-5 represents "The features of AR that allows multimedia element such as graphic, audio, video, and interactivity can able to attract student attention during learning session "has a spread of 0.548 over 4.60 mean with the maximum score is 5.Perceptual Arousal (PA4) in Table-5 represents "The usage of multimedia element can help the student attention in mobile learning "has a spread of 0.548 over 4.60 mean with the maximum score is 5.Based on the results of Perceptual Arousal, all the mean is >2.5 that indicates the element of perceptual arousal in the proposed model is strongly emphasized the technology element is support student attention attributes.

The attributes; are spaces (s), real time (t) and AR (m) a strong combination technology that used in enhances student attention. Spaces are provided through mobile devices and AR is a method that applying objects visualization in the learning content. Apart from that, real time (t) is representing by technology of AR and the prototypes are mobile is run in a real time to providing the spaces for students to conduct their learning activity. In AR, the element of technology also integrates with vision based tracking technique that conducted to produce AR content in the mobile devices. Based on the results, it proves the model integration of mobile learning and AR through technological element is strongly emphasized can improve student attention.

Inquiry Arousal (IA1) in Table-5 represents "The lack of student attention in mobile learning can be avoid through visualization approach "has a spread of 0.447 over 4.80 mean with the maximum score is 5. Inquiry Arousal (IA2) in Table-5 represents "The concept in Augmented Reality Technology is very appropriate to be adapted in Science Subject "has a spread of 0.447 over 4.80 mean with the maximum score is 5.Inquiry Arousal (IA3) in Table-5 represents "Visualization can give easier to student for remember the learning content because the conveying of object and information graphically to student "has a spread of 0.837 over 4.20 mean with the maximum score is 5.

Based on the results of Inquiry Arousal (IA), all the mean is >2.5 that indicates the entire element in inquiry arousal are support of attention element in pedagogical of mobile learning model. The attributes of student attention in pedagogical element are prior knowledge (p) and attention (α) is achieved to support the proposed model integration that proposed in chapter 5. Apart from that, the result proves the element of attention attributes is embedding in the prototypes successfully to achieve student attention.

Variety of tactics 1 (V1) in Table-5 represents "The features of Smart phone's that ubiquitous, easy to bring anywhere and can be access the internet is the main factor to encourage learning through mobile "has a spread of 0.548 over 4.60 mean with the maximum score is 5.Variety of tactics 2 (V2) in Table-5 represents "Learning through mobile is the new methods which must to introduce and monitored by teachers. "Has a spread of 0.548 over 4.60 mean with the maximum score is 5.Variety of tactics 3 (V3) in Table-5 represents "Mobile technologies can help teachers in get student attention "has a spread of 0.894 over 4.40 mean with the maximum score is 5

Variety of tactics 4 (V4) in Table-5 represents "Augmented Reality technology is very appropriate to be integrated with mobile technologies "has a spread of 0.447 over 4.80 mean with the maximum score is 5.

Based on the variability results, it strongly supports the people element in the model integration because all the variability analysis is >2.5. The people element in model integration are consists by teacher, learner and syllabus (c) as a learning environment (LE). Variability result was proves the people element has a strong relation with learning concept through visualization approach in Augmented Reality.

Learner and teacher is interdependencies attributes to ensure the learning session is fluency. Besides that, syllabus is needed to be embedding into prototypes development. Prototypes evaluation is implemented as the ends phase in the research methodology and to measure the model validation by incorporate student attention elements. To validate the accuracy of data, the calculations of mean and standard deviation are used to extract the results in order to evaluate the prototypes and the Cronbach's Alpha also is implemented to found the reliability statistics among the question. As a conclusion, the mean of the prototypes is >2.50, that means the prototypes can improve student attention through the model integration of mobile learning through Augmented Reality.
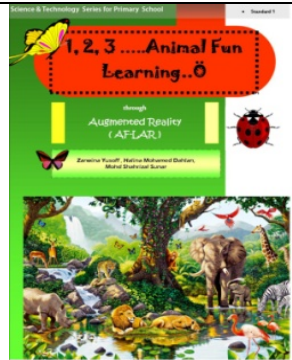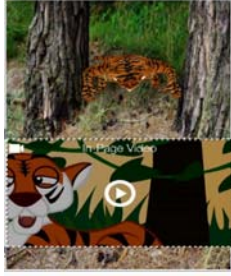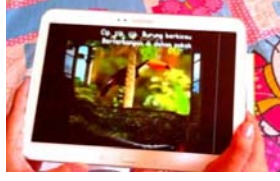
Table-1. Finding for data collection.

Limitation of element in e-learning technology [5]	Problem snalysis	Factors to achieve student attention through mobile learning model [6]
Technological and hardware limitation	The limitation of traditional method in learning process How the technological tools can help educational environment The current limitation of e-learning courseware technology The limitation of current educational application software	Technology
Design limitation	The appropriate combination color to attract student attention The effective and efficient ways in conveying learning content through visualization approach The visualization approach to maintain the student attention in classroom The suitable subject to be adapting in implementing learning through mobile	Pedagogy
Personal Issues	Factor that causes student lack of attention in learning and teaching process. The suitable approach to improve student attention in a classroom The factor of mobile based learning should to be implemented	People

Table-2. AF-LAR Design.

Animal fun learning book	Results
a) Book cover that shows the adaptation of visual learner concept to generate student interest in Explore the Animal World through the features below: i. The colorful graphics ii. The enjoyable concept through the images and pictures iii. The text styles is suitable for primary schools student	 **Figure-3.** The cover of AF-LAR.

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Table-3. Displaying learning content through Mobile AR.

Mobile AR	Results
Image based marker to display an AR object using mobile camera detection a. The picture background is based on jungle situations to make student feel more real with the animal world	 **Figure-4.** Image based marker.
b. During image based marker displays 3D object, the video about the animal presented. c. Visual mode presents the interactive 3D graphics and auditory mode present the video	 **Figure-5.** Interactive animation and video.
d. Learning through interactive web based also provides in showing learner the animal website with the real environment	 **Figure-6.** Interactive website about animation.
e. Learning through Animal Song, more interactive and attract student attention to sing together through the lyrics	 **Figure-7.** Animal song through Video.

Table-4. Explanation about attention criteria.

Attention	Explanation
Capture Interest (Perceptual Arousal)	What I can do to capture their interest?
Stimulate Inquiry (Inquiry Arousal)	How I can stimulate attitude of inquiry?
Maintain Attention (Variability)	How I can use a variety of tactics to maintain the attention?

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Table-5. Results of prototype testing.

Item	Likert scale points						
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation
PA 1				1	4	4.80	.447
PA 2				3	2	4.40	.548
PA 3				2	3	4.60	.548
PA 4				2	3	4.60	.548
IA 1				1	4	4.80	.447
IA 2				2	3	4.80	.447
IA 3			1	2	2	4.20	.837
V 1				2	3	4.60	.548
V 2				2	3	4.60	.548
V 3			1	1	3	4.40	.894
V 4				1	4	4.80	.447

CONCLUSIONS

This paper solved limitation of current e-learning technology by improving student attention in educational environment. This paper proposed the integration of mobile based learning through Augmented Reality Environment by incorporating the student attention elements. The objective of this paper was achieved when the elements of student attention that embedded in the AR Book can improve student attention based on expert perspective. The content of AR Book that display through mobile devices was proves the new model integration can be used in order to improve student attention in educational environment. Based on the finding, it was proven that the utilizing of technology can enhance the student attention through the AR Book concept. However, the mobile devices used must have the internet connection to ensure the right channel can be loaded to visualize the learning content. For the future work, a robust AR application is proposed in displaying the AR content during the tracking process.

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