Incorporating Student Attention Elements by Integration of Mobile based Learning through Augmented Reality Book

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Abstract — The current e-learning technology has a limitation; such as lack of interactivity, lack of interest and lack immobility which decrease students' attention in using it. In realizing the element of student attention; this article will propose the model integration of mobile learning through Augmented Reality by incorporating student attention elements. In validating the model integration, this study developed the AR prototypes that called AF-LAR (Animal Fun Learning - Augmented Reality) through handheld display. AF-LAR is the AR Book that implements learning through mobile devices that enable students to bring and access the learning content anywhere, ubiquitously without limitation of space. AF-LAR was developed using Metaio and Junaio channel and the design is incorporated with visual learner styles and the visualization approach .The subject of "Science and Technology" is used as a syllabus to implement the learning content through AF-LAR. Descriptive statistic was used as a method to validate the prototype based on model integration. The result of this study is evaluated using Keller's Motivation ARCS Model which deriving the Attention element ;perceptual arousal (PA),inquiry arousal (IA) and variability (V) to prove the student attention from the prototypes based on the five experts as a targeted respondent which fulfill some of the criteria.

Keywords – visual learner; visualization; augmented reality; attention; ARCS Model

1. INTRODUCTION

This study will focus on integrating mobile learning model through Augmented Reality Technology (AR) in order to incorporate the student attention from the limitation of current e-learning technology. The current research shows that many students lack of attractions in the current learning session because the limitation in the current e-learning system   [1]. The concept of traditional book that is used in primary school is having some limitation in conveying the information especially in engaging their attraction during learning process. In realizing the enhancement of engaging student attraction through mobile learning, AR was chosen in enhancing the features of m-learning in term of visualizing the learning content to appear in the real environment. This is because AR can make the learning environment more conducive and dynamic through the concept of visualizing the object as a learning content through the features of AR which is registering the object in 3D, interactive in real time and combining the real and virtual object to be augmented in real environment [2].

Augmented Reality (AR) is an effective way in visualizing the learning content to enhance students' attention especially in science and technology subject [3]. This emerging technology can be used in any fields to help user in visualizing the object or information in any situations. The progress of technology is to change e-learning into mobile learning to be adapting with the current embedding software in mobile. Although mobile learning is the powerful platform in conveying the learning content, it still has some limitations in conducting the current research in mobile learning in order to enhance student attention.   In order to enhance the student attention through mobile, this study will propose the concept of mobile learning model to be integrated with Augmented Reality in enhancing students' attention in conveying the learning content through the adaptation of traditional books into AR Magic Book that from mobile perspectives [4]. The concept of AF-LAR derived from AR Magic Book and was embedded with the visual learner concept. AF-LAR was developing using Metaio Creator software and integrates with the Junaio Channel to be able uploading it into the cloud server [5]. This application is derived via the QR barcode that represents the AF-LAR channel ID to be scanned using Smartphone's as a mobile learning platform.

The rest of the paper is structured as follows: Literature review has been discussed in section II, methodology is presented in section III, section IV describe complete application of augmented reality (AR) book , section V elaborated the findings, section IV presents discussion, and the paper is concluded in section VII.

2. MOBILE LEARNING CONCEPT

A. The usage of E-Learning Technology in Educational Environment

The progress of mobile technology are parallel with the progress of AR usage through mobile because the package of smart phones consist of a camera, microphone, a touch screen, an accelerometer to sense motion and GPS, compass to tracking the location where it requires the sensory inputs. The adaptation of mobile learning through AR is one technique to improve the mobile learning content through visualization approach. The characteristics of AR can be embedded into mobile platform to construct the model integration to be proposed in this study. The traditional education approach are causing some limitation; likes students are facing difficulty in memorizing and understanding the learning process, which is not suitable for disabled students with down syndrome. This would not be suitable for kindergarten students as well. With Mobile learning system through AR, it appeals to students at a more personnel level, and promoting both engagement and motivation among its user [5][6].

Besides that, traditional learning method like the formal learning in classroom without any computer aided technology will make student having less focus and concentration as the flow of teaching process is disrupted, although the teachers try to create the two ways communication between students. Mobile learning was conceptualized the nature mobile learning as a mediated learning through mobile technology [7].   The most profound technologies are those that disappear where it brings that ubiquitous computing as an environment to integrate with the computer and it is absorbed in our background daily [8]. The features of m-learning through AR are mostly interactive, blended with real environment, ubiquities and portable. All the features can be adapted with AR environment because the character of AR is also interactive and blended the virtual and real environment. The three important phases in AR are tracking, registration and displaying the virtual object into real environment.

B. Learning through Mobile Dimension

The term mobile has similarity with mobile phones where it is a device that has ubiquitous features and can be brought anywhere, any places and has communication systems. Parallel with development of computer technology, the mobile phone goes one step further and it remarks as a new organ in evolutionary of time line because it have directly integrates with the brain [9]. The powerful technology will be used and can be adapted in learning process as a new platform in improving the effective and efficiency of the technology in acceptance for user. The Mobile Learning System through AR is a very great application that will show to all students what they learn in real time, without going anywhere because this application is ubiquitous and portable. It seems that with the m-learning characteristics, a device must be portable, ubiquitous, blending hardware and software, also interactive in a real time.

C. The Need of Student Attention through mobile learning for Science & Technology Subject in Primary School

Students attention is an important element that must be embedded in each of student during learning process. In educational perspectives, attention can generate the motivation, which it can be defined as the student's desire to engage in a learning environment [10]. The impact of student's motivation on student's achievement and learning outcomes has been addressed in several studies; In order to improve the student attention, AR can solve the learning process through the highly interactive and memorable fashion. There are five directions of AR in education that previous researchers use in generating the memory and ideas in learning process; where it includes; AR Books, AR Gaming, Discovery based learning, skills and Training and object and modeling [11] .For this research, it will focus on adapting the learning science into AR environment through the concept of AR Books in the part of Learning Science modules. The concept of AR Books will be used to adapt the learning process to look more real, interesting through the visualization. The improvement of mobile based learning system through AR will be the base in generating the mobile based education concept through visualization with considered the AR design that can be implemented for educational purposes.

ARCS model that was proposed by Keller's 2000 [12] will be highlighted to be used as an evaluation to engage with student's attention in proving the learning through AR concept in mobile. In order to realize the objective, this study analyzed the characteristics of visual auditory kinesthetic (VAK) model which proposed by Fleming's 1987, to be adapted in designing the Book interface where the visual learners tend to learn through seeing, think in pictures and need to create vivid mental images to retain information[13]. Besides that, a visual learner enjoys looking at maps, charts, pictures, videos and movies. Based on that, this study implements the interesting combination of color such as green and red, green and orange or others light colors to be influences the learning and generates the student attention. The picture of animals are embedded in the books to look realistic and the concept of metaphors are used to indicate the area, habitat, foods, size and the baby of animal to gain the student attention in learning.

3. METHODOLOGY: AUGMENTED REALITY TECHNOLOGY IN MOBILE ENVIRONMENT

A. 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 criteria of expert such as; a teacher in primary school that teaching Science/ "Dunia Sains Technology Subject", an expert in Educational Technology Division, Ministry of Education, an expert in multimedia technology including the student pedagogical and technological aspect in combining it into one platform and an expert in Visualization approach in Augmented Reality Technology to validate the model integration that can be merged in improving student attention and an expert in educational research background; such as mobile learning, interactive multimedia, and educational technology aspect. The questionnaire is designed 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 to the five experts as targeted respondents to identify the problem and limitation in the usage of technological element in learning environment in order to improve student attention.

B. Data Collection

In this research study, the data collection about the current limitation of e-learning technology was retrieved from the five experts through the questionnaire. The questions for the data collection are based on the three main limitations in e-learning technology that identify from Mahanta [1] which consist of technology and hardware limitation, design issues and personal issues. Based on that, eleven questions were derived from the factor to analysis the current limitation of e-learning technology. Table 1 listed the data collection and analysis.

TABLE 1: Finding of Data Collection

Limitation of Element in e-learning technology [1]	Problem Analysis	Factors to achieve student attention through mobile learning model [14]
i. Technological and Hardware limitation	1. The limitation of traditional method in learning process 2. How the technological tools can help educational environment 3. The current limitation of e-learning courseware technology 4. The limitation of current educational application software	Technology
ii. Design limitation	1. The appropriate combination color to attract student attention 2. The effective and efficient ways in conveying learning content through visualization approach 3. The visualization approach to maintain the student's attention in classroom 4. The suitable subject to be adapted in implementing learning through mobile	Pedagogy
iii. Personal Issues	1. Factor that causes student lack of attention in learning and teaching process. 2. The suitable approach to improve student attention in a classroom 3. The factor of mobile based learning should to be implemented	People

C. 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 students' attention. The process development of this prototype starts 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.

D. Development Process

By studying the visual learner characteristic through the review, the results we get are visual learners' characteristics, behavior and their interest besides of the Syllabus in "Dunia Sains & Teknologi" (DST) subject. These factors will be considered and adapted in the design and development process to be mapped with the model integration. For example, In DST syllabus, there is one topic that entitled " Living and non-Living Things" where the topic contains three of living things; Human, Animal and Plants. In order to be adapted with the concept of visual learner and AR, this study chooses tiger as an avatar in AR System. Next, the analysis of the DST about the animal's life; the features, characteristics, the real life and the information gathering to develop and design the AF-LAR Book. As soon as the design and development is completed, it will be assessed by the experts to evaluate the contents, reading approach and book interface and design in order to improve student attention. In contrast, the process of development for AR Object Design uses the same flow as the development of AF-LAR Book except in design and development phase. In the design process storyboard, interface and interaction methods are the output from this stage. The development process produces the storyboard contents, program code, 3D graphics, and animation for AR Object. Both of the steps must fulfill the visual learner concept to achieve the criteria of students' attention. The development process will be implemented if AF-LAR Book implementation and AR Object Implementation fulfill the criteria of students' attention based on the concept of visual learner styles through the visualization approach using Augmented Reality tools. In this phase, the model integration are proves through both step implementation in developing the prototypes before evaluation phase conducted. Evaluation phase is the final step to test the prototype either it fulfill the requirement in improving the student attention and validating the model integration.

4. FINDING

A. Integration of mobile learning model through Augmented Reality

In order to actualize prototype development, the model integration between mobile learning and Augmented Reality are identified first before designing and developing the prototypes. The design and development of prototypes in this study are based on ARCS model that proposed by [12]. There are ten steps in order to implement the learning content with the prototypes used. This is to ensure the process integration can be achieved. The conceptual of mobile learning model is derived from Prasertsilp where mobile learning was based on two factors, mobile learning environment and learning outcomes [14]. 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 1 presents the model integration.
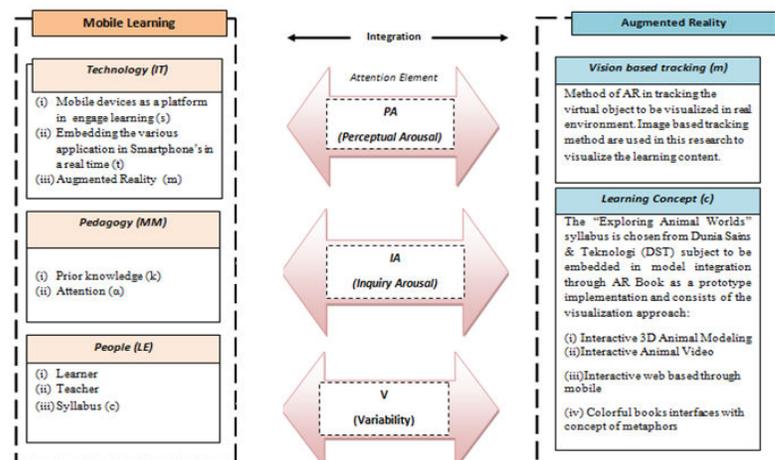

FIGURE 1: Integration model of mobile learning based on Augmented Reality

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 derived from where consists of three main factors; technology, pedagogy and people and the attributes inside of mobile learning are derives from previous research which consists of space (s), time (t), method (m), prior knowledge (k), attention and learning environment (LE). [9][14]

B. Prototype Development

Based on the model integration, the mobile learning attributes strongly support the student attention when realizing it through prototypes implementation. The embedding of educational elements in the mobile AR for learning system was used based on AR Eco System, where the concepts of modules are throughout from the four categories; player, context awareness, type of learning and mode of interaction [15]. To get the effective ways in enhancing learning experience among learners; we proposed that, the integration of AR in mobile learning will be implemented through AR Book. The conceptual of AR Books through mobile is presented in figure 2.
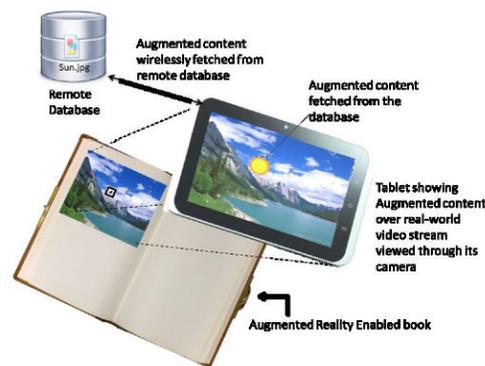

FIGURE 2: Concept of AR Book to enhances learning experience [15]

The book displays information visualization through the AR Book, where it focuses 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 proposes the AR Book through mobile display that called AF-LAR (Animal Fun Learning through AR) that is embedded 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 figure 3, 4 and 5, 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 adapted with the level of student in reading the information about the animals. In this case, the concepts of people in mobile learning model are emphasized where students 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.

FIGURE 3(a) : The Cover of AF-LAR (b):Facts about animal

Figure 3 (a) shows The Book cover that indicates the adaptation of visual learner concept to generate attention in 'Explore the Animal World' through the features, such as the colorful graphics, the enjoyable concept through the images and pictures, and the text styles which are suitable for primary schools students. Figure 3 (b) shows the graphic in Animal Fun Learning Book where each animal's story has its own graphic through the features such as; the colorful images and picture to represent the type of animal, the type of introducing animal will capture the student interest, and the usage concept of metaphors with the text explanation to present the animal information (area, habitat, food, size and babies). There are three reading levels; easy, intermediate, advanced that is visually presented in Figure 3 (b). Area, Habitat, Food, Size, Babies, I'm a Tiger area examples of easy reading level. For intermediate reading level, it is a combination of more than two words such as; scattered, small areas size in Asia, tropical rain forest, pigs and dear , 8 -10 per feet and an average litter is 2 to 3. For the advance level, it shows the description about the tiger. Tigers are carnivores. They are quiet, patient hunters with large paws, and teeth to help them to catch and eat their prey. Some of their favorites meals include pigs, dear, rhinoceros and even small elephants.

FIGURE 4(a): Image based marker (b): Interactive animation and video

Figure 4 (a) visually presented the Image based marker to display an AR object using mobile camera detection. The picture background is based on jungle situations to make student feel more real with the animal world. During image based marker displays 3D object, the video about the animal presented. Visual mode presents the interactive 3D graphics and auditory modes present the video.

FIGURE 5(a): Interactive website with Animation (b): Animal Song through video

Figure 5(a) indicates the Learning through interactive web based also provides in showing learner the animal website with the real environment. Figures 5(b) presented the Learning through Animal Song, in a more interactive way and attract student attention to sing together through the lyrics.

Based on the element of the Book and mobile AR on those tables, the prototypes that are formed strongly supported the model integration which is clearly proposed in this study. All the elements that are stated in the table 2 and 3 can improve student attention. Based on that element in these prototypes, it fulfills the criteria of attention element in ARCS Model. In order to measure the proposed model integration of mobile learning through AR, AR Books was implemented to emphasize the element of model integration which consist of attention attributes are strongly construct through the prototype. Based on that, the next section explains about the evaluation of AR Books in improving student attention based on model integration.

5. EVALUATION

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 2 presented the explanation of attention criteria that used to be evaluated in AF-LAR.

TABLE 2: 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?

In achieving the research contribution; Table 3 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. Overall conclusion for prototypes testing phase shows that, all implemented of student attention attribute characteristics can increase student attention during learning process. In achieve the research contribution; Table 3 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. Finally, the significant value for reliability test is shown to measure internal consistency that is, how closely related a set of items are as a group.

TABLE 3: Results of Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PA1	5	4	5	4.80	.447
PA2	5	4	5	4.40	.548
PA3	5	4	5	4.60	.548
PA4	5	4	5	4.60	.548
IA1	5	4	5	4.80	.447
IA2	5	4	5	4.80	.447
IA3	5	3	5	4.20	.837
V1	5	4	5	4.60	.548
V2	5	4	5	4.60	.548
V3	5	3	5	4.40	.894
V4	5	4	5	4.80	.447
Valid N (listwise)	5				

Perceptual Arousal (PA1) in table 3 represents "visualization based approach is the best method in enhancing student attention "has a spread of 0.447 over 4.80 mean with the maximum score is 5. Perceptual Arousal (PA2) in table 3 represents "Smartphone'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 3 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 3 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 Augmented Reality is a method that applies objects visualization in the learning content. Apart from that, real time (t) is represented by technology of AR and the prototypes, runs in real time to provide the spaces for students to conduct their learning activity. In Augmented Reality, the element of technology also integrates 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 strongly emphasized can improve student attention.

Inquiry Arousal (IA1) in table 3 represents "The lack of student attention in mobile learning can be avoided through visualization approach "has a spread of 0.447 over 4.80 mean with the maximum score is 5". Inquiry Arousal (IA2) in table 3 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 3 represents "Visualization can make it easier for a student to remember the learning content because the conveying of object and information is graphically presented 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 3 represents "the features of Smartphone's that ubiquitous, easy to bring anywhere and can be accessed on 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 3 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 3 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 3 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 that represent in chapter 5 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 are inter-dependable attributes to ensure the learning session is fluency. Besides that, syllabus is needed to be embedded into prototypes development.

5. CONCLUSSION

In conclusion, the proposed integration of mobile based learning model through Augmented Reality can incorporate student attention's element. The findings shows that the information found regarding the previous mobile learning model and the attributes are closely related to this study, the concept of Augmented Reality, and the element of student attention from ARCS model strongly supports the model integration with the mobile learning environment to enhance student attention. New model integration is proposed and the adaptation into AR Book is the results in building the students' attention during learning session through mobile technology. The results from expert evaluation proven that the model integration can gain student attention through AR Book as prototypes.

REFERENCES

[1]   D. Mahanta and M. Ahmed, "E-Learning Objectives , Methodologies , Tools and its Limitation," no. 1, pp. 46–51, 2012.Mahanta, Devajit, and Majidul Ahmed. 2012. "E-Learning Objectives , Methodologies , Tools and its Limitation." (1): 46–51.

[2]   R. Azuma., A Survey of Augmented Reality.Presence :Teleoperators and Virtual Environments 6:4, 3-3, (1997)

[3]   J.K. Gilbert (ed.), Visualization in Science Education, pp 43-60. 2005 Springer,printed in the Netherlands.

[4]   M. Billinghurst, H. Kato, and I. Poupyrev, "The MagicBook: a transitional AR interface," *Computers & Graphics*, vol. 25, no. 5,   pp.   745–753, Oct. 2001.

[5]   http://www.junaio.com

[6]   E. Klopfer,, Education, T., & Squire, K. (n.d.). Environmental Detectives – The Development of an Augmented Reality Platform for Environmental Simulations., 1–50.

[7]   R. Luckin, & D. S. Fraser, (2011). Int. J. Technology Enhanced Learning, Vol. 3, No. 5, 2011, 3(5).

[8]   Winters, N. (2006). What is mobile learning? In M. Sharples (Ed.), Big issues in mobile learning: Report of a workshop by the kaleidoscope   network of excellence mobile learning initiative, University of Nottingham

[9]   Laouris, Y., & Eteokleous, N. (2005). WE NEED AN EDUCATIONALLY RELEVANT DEFINITION OF MOBILE, (June).

[10]   Keller & Litchfield, (2002)

[11]   Yuen, S. C., & Johnson, E. (2011). Augmented Reality : An Overview and Five Directions for AR in Education, 4, 119–140.

[12]   J. Keller, "Integrating motivation 1," 2000. How to integrate learner motivation planning into lesson planning: The ARCS model approach

[13]   Fleming, N. D., Fleming, N. D., & Mills, C. (1992). Not Another Inventory , Rather a Catalyst for Reflection Not Another Inventory , Rather a   Catalyst for Reflection.

[14]   P. Prasertsilp, "Mobile Learning : Designing a Socio-Technical Model to Empower Learning in Higher Education Mobile Learning : Designing a Socio-Technical Model to Empower Learning in Higher Education," 2(1). (2013).

[15]   C.V. Ramdas, N. Parimal, M. Utkrash, S. Sumit, K. Ramya, B.P. Smitha, " *Application of Sensors in Augmented Reality based Intearctive Learning Environments", 2012 Sixth International Conference on Sensing Technology (ICST), IEEE 2012*