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Design of Augmented Reality Book for Economic Mathematics Course

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Abstract

The type of this research is a development research that aims to produce android-based learning media using AR on a economic mathematic which is feasible to use and can easily know the results of students learning ability. The method used is ADDIE method which consists of 5 stages, namely Analysis, Design, Development, Implementation and Evaluation. Data analysis was done by normality test, homogeneity test, t test, and learning mastery test. The results of this study concluded that (1) the results for the percentage of media expert validation amounted to 89.2%, material experts 86.1% and learning design experts 87.5% with the criteria of each very good. (2) the result of practicality test based on student response obtained percentage equal to 88,9% with very good criterion. (3) data from the field show that the learning outcomes of students who obtain android-based learning media using AR better than students using learning by lecturing method (conventional learning).

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INTRODUCTION

Cognitive resources of a given society are influenced by the importance and constant evolution of Information and Communication Technology (ICT) and therefore by the effects of introducing such innovations into the daily life of general population, companies and institutions. Such modifications require an additional learning capacity, innovation or creativity, necessary to access actual conditions of information and knowledge. The representation of the real world in a virtual space can provide multiple perspectives and points of view. Nowadays, without multimedia the teaching and learning process would be inefficient or, at least, boring. This paper presents previous research results, practical development and testing of a product called AR Book, which uses the concept of augmented reality interfaces, and proposes a novel tool that may impact learning efficiency.

Augmented Reality (AR) is a multidisciplinary field of computer science, involving areas like 3D Computer Graphics, Computer Vision and Human-Computer Interaction, which deals with the combination of real-world and computer-generated data (virtual reality), where computer graphics objects are blended into real video footage in real time. According to Azuma, R., et. al. (2014), AR requires the following 3 characteristic environments; (2) is interactive in real-time; (3) registers 3D objects in real environments.

There are some recent advances in Augmented Reality in the area of medical displays, information and sports and entertainment (Zhang, S., et.al, 2009) and commercial applications. Medical imaging technology is an example of AR application. During the last decades, AR provided physicians with an increasing amount of patient specific anatomical and functional data. In this context, AR is proposed as a paradigm, bringing new visualization and interaction solutions into perspective. Recent work by Sielhorst, T., Feuerstein, M., & Navab (2008) describes how AR technology facilitates surgical workflow or how 3D user interfaces can reveal their power in tasks where reduction to 2D is problematic.

Up until now, AR applications oriented to education have not been so deeply exploited. Mishra, S. and Sharma, (2004) suggested interactive multimedia learning as "computer-based learning systems that provide interactive user controls to choose media elements like text, images, sound, video and animation in an integrated manner and influence effective learning". They also add that the multimedia when integrated within an instructional design provides a necessary base to meet the learning objectives (Mishra, S. and Sharma, 2004; & Shin Y. S., 2004). Animation, audio and video elements support informative and emotive aspects of learning (Wu, T. and Chao, 2008). The "MagicBook" Billinghurst, M., Kato, H. and Poupyrev (2001) presented an interface which allows readers to look at one book and enjoy the story by seeing its virtual models using augmented reality displays. MagicBook's interface uses pictures from "normal books" with text and pictures on each page. These pictures have thick black borders that are used as marks for a computer vision-based head-tracking system.

Bastos, R. and Dias, (2008) introduced a novel approach to real-time scale, rotation and luminance invariant natural feature tracking. They proposed a solution to the camera pose initialization registration and tracking problem in the field of AR, using totally automatic procedures. In this case, black borders aren't needed any longer as tracking marks and thus books may have its natural, traditional aspect concerning pictures. The technique is applicable for the case of several simultaneous planar objects with arbitrary topologies and natural textures, and has been used as an underlying technology in AR Book framework. This late work has allowed further possibilities in the field of educational contents and enhanced learning. Nevertheless, the actual major challenge relies on the continuous development of this innovative idea as an underlying technology in the field of enhanced and mobile learning and to develop the ideal

business models so that this innovation may be accepted in the market.

Development of education and utilization of technology in the world of education is growing, thus demanding reforms to compensate for these developments. In essence, these tools are not made specifically for educational purposes, but these tools can be utilized in the world of education (Budiman, 2017).

Education is one effort to develop and improve quality human resources. In Indonesia, still, the fundamental problem in the world of Education is the low learning outcomes of learners on the subjects of mathematics. It happens because mathematics is the core of science where the development of other sciences depends on mathematics. The level of mastery will affect the mastery of other subjects such as physics, chemistry, and others (Buchori, A., & Yusuf Ilyas, 2014). So, in university level, making basic digital book which can be used by students in learning materials is very less developed (Suparno, 2017).

According to Sari (2013) one of the causes of low student learning outcomes is the method of learning used by teachers is only lecturing methods. The result is students are not motivated to learn. Related to this, teachers need to improve the effective and efficient learning so that students can more easily understand the math lesson, therefore student learning outcomes will be more optimal.

The scope of mathematics learning in schools at the elementary level includes algebraic numbers, geometry and measurement and statistics and opportunities (A. S. Sari, 2017). The scope of geometry is more easily understood by students. This is because the idea of geometry has been introduced by students before they go to school. Buchori, A., et. al. (2017) said basically geometry has a greater chance for students to understand it than any other branch of mathematics. However, in reality, students still have difficulty in studying geometry material, so that their value can be low. In economic lesson, media can make students understand very easily (Akbarini, N. R., Murtini, W., Rahmanto, 2018).

One of the sub subjects of economic mathematics studied in University is linear programme. It is very important to be understood by learners because it is one of indicators of the post-test. According to the analysis conducted by KKNI in the Semarang PGRI University, the linear programme building material has presentation of pre-test result at least at school level reach 36.32, regency/city reach 38.47, province reach 44.03, and national reach 52.04. This shows the lack of mastery of students to economic mathematic building materials and the need for models and media that can improve the mastery of student materials.

In accordance with the observations made by researchers at economic education Universitas PGRI Semarang which show less active learning process and less interesting course. It is due to lack of media that support in the learning process. Other obstacles are due to lack of school facilities such as unavailability of LCD Projectors in each class that support teachers in delivering materials.

The use of instructional media should get teachers' attention in learning activities. According to Saputro, R. E., & Saputra (2014) the learning media apparently follow the development of existing technology, ranging from printing technology, audio visual, computer to technology combined between printing technology with computers, so for financial accounting learning in university, media is the best solution to make student understand easily (Putri and Wardoyo, 2017).

One of the benefits taken from the existence of this technology is to useit as an effective, creative and educative learning media. Hence, educative media applications can continue to be developed which one of them is Augmented Reality (AR) technology. According to Buchori, A., et. al. (2017) learning media android that can be selected in accordance with the characteristics of geomotor is android media using Augmented Reality. Augmented Reality is a technology that combines two-dimensional and three-dimensional virtual objects into a real three-dimensional in

our environment and projecting virtual objects in real time with android phones (Azuma, R., et. al. 2014). Saputro, R. E., & Saputra (2014) AR technology can also be referred to as Realitis Added is the integrity of digital elements that are added to the real world directly (real world data) and follow the real-world environment that can be applied to mobile devices.

Based on the description, this study aims: (a) to know the process of developing android-based learning media using Augmented Reality on the material of economic mathematic, (b) to know whether android based learning media using augmented reality used in economic mathematics learning in university, (c) to find out whether android-based learning media using Augmented Reality on the material of economic mathematics is practically in university, (d) to find out whether android based learning media use augmented reality in waking material flat side space effective when viewed from the results of student learning.

METHODS

The method used in this study was research and development, which consisted of the questions on how to hold research, design, produce, and test the validity of products that have been generated (Sugiyono, 2015). The development itself was defined in general as an attempt to improve technical, theoretical, conceptual, and moral skills of the students according to their needs through education and training. Development was a method used to develop a product through some determined stages in accordance with the analysis of effective learning design models used at the schools. From the definitions above, it could be concluded that development was a process of developing something and generating a new product.

The steps of the research or development process consisted of a study of product research findings that would be developed, developing products based on the findings, conducting field tests based with the setting in where the product would be applied, and revising the results of the field tests (Setyosari, 2012). The model in this study was ADDIE model. It stands for Analysis, Design, Development or Production, Implementation or Delivery and Evaluations. The ADDIE model was developed by Dick and Carry to design a good learning system. In addition, this model could be used for various forms of product development such as models, learning strategies, learning methods, media, and learning materials.This model consisted of five main stages namely (A)nalysis, (D)esign, (D)evelopment, (I)mplementation, dan (E)valuation.

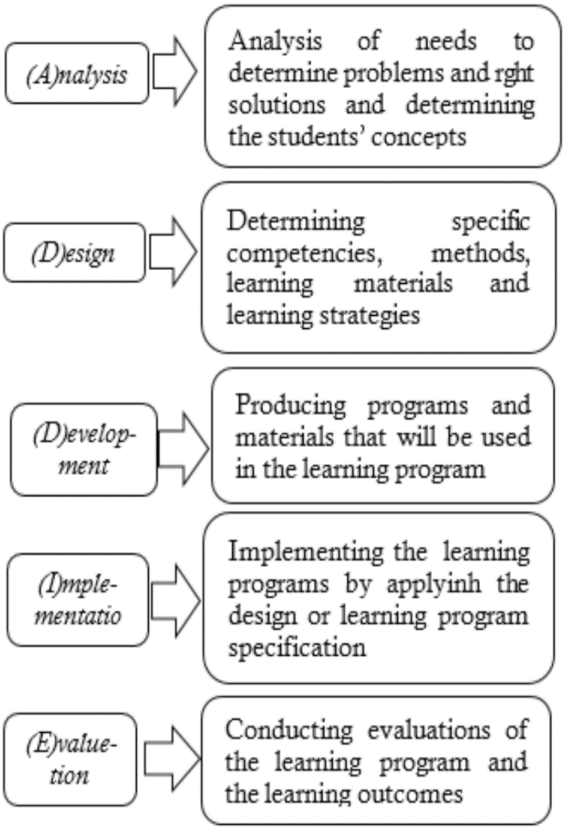

Figure 1. ADDIE Model Stages

The development type in this study was the development research used by the writers to generate products in the form of AR Book for Android learning media with the ADDIE development model. The population and sample in this study were students of class economic mathematic. The research type is Research and Development of ADDIE model, ie Analysis, Design, Development, Imple-

mentation, and Evaluation.

The analysis stage consisted of two stages, namely performance analysis and needs analysis. Design stage was done to prepare and design the device by compiling: syllabus which refers to curriculum, designing worksheet for Special economic Mathematics done by adapting worksheet held by students and designing the android application. Development stage was validated by validator product. There are three categories in this study including validation of media experts, material expert validation and design validation of learning. Implementation stage of the researcher implements or implements the design of media that had been developed in real situation ie. an experiment class. Researchers guided students to achieve learning objectives and solutions to overcome learning outcomes. The evaluation stage of the researcher performed the final test in the form of a post test at the last meeting to find out the students learning outcomes after implementing learning using android-based media. Products were assessed from three things: validity, practicality and effectiveness. The validity assessment instrument included the action plan validation sheet, the economic Mathematics worksheet validation sheet and the android application validation sheet. Practical tools used students' assessment sheets of economic Mathematics and android applications.

Effectiveness assessment instrument was conducted to know the difference between learning using media and conventional learning. Sheets of validity and practicality using a range of 5 scales among them very agree, agree, not opinion, disagree and strongly disagree. The data was then converted into qualitative data using the following criteria on the Table 1.

The effectiveness data was obtained from the experimental class test result and control class. The data of each class were tested by their effectiveness using the right-hand side t test. Then tested Student's Completeness to know the success of student after using learning with medium of augmented reality for experiment class and conventional learning for control class.

Table 1. Range of Percentage and Quantitative Research Programme

No	Interval	Criteria
1	81% - 100%	Very Good
2	61% - 80%	Good
3	41% - 60%	Sufficient
4	21% - 40%	Less
5	0% - 20%	Very Less

Source: Processed Primary Data (2018)

RESULT AND DISCUSSION

This type of research is Research and Development (R & D) which is product oriented. Development of android-based learning media using Augmented Reality on economic mathematics materials using ADDIE model, which consists of 5 main stages: *(1) Analysis, (2) Design, (3) Development, (4) Implementation, (5) Evaluation*.

The first stage of analysis (analysis), researchers conducted field observations with interviews with teachers concerned about learning in school. From the interviews obtained information that in the process of learning media used in the form of worksheet and book packages. The worksheet is also seen less attractive to students because it only discusses the material in general and lack of visualization of images that support. Based on this problem researchers developed android-based learning media using Augmented Reality on the matter of building a flat side Geometry. According to (Buchori, A., et. al. 2017) learning media android that can be selected in accordance with the characteristics of economic student is android media using Augmented Reality. The Augmented Reality is a technology that combines two-dimensional and three-dimensional virtual objects into a real three-dimensional in our environment and projecting virtual objects in real time with android phones (Azuma, R.,

et. al., 2014)

Design stage (planning), at this stage the researcher will prepare and design the device by compiling: syllabus which refers to curriculum designing worksheet Special Mathematics done by adapting worksheet held by students and designing android application, make validation sheet expert for assessment product, make questionnaire of student response to product, evaluation question, lattice, answer key and rubric of scoring matter. At this stage the researchers produced a product design where researchers designed the initial product that will be made for research.

The Augmented Reality Book (AR Book) is a new tool providing a responsive environment and an interactive learning, which handles with different types of content. It may represent a notable instrument for enhanced learning (for individual use or in the classroom) as well as it can represent a great step forward, regarding the enhancement of current digital libraries. Additionally, the integration of different interactive teaching materials will provide a better learning environment that will allow students to step forward in their learning experiences, both in the classroom as well as in their home place. The AR Book is the combination of a printed book (or its digital format) with the respective audiobook and its 3D models (as well as the 2D graphics). Using Augmented Reality and Multimedia as frameworks to present and interact with audio-visual content, miBook represents a major facility in order to enhance mental comprehension of its content, by allowing a faster knowledge acquisition. Technologically, miBook environment consists of a handheld camera, a personal computer (to generate user's individual scene views), and a physical book. The AR Books uses "normal books" with text and pictures on each page and have an additional audio content – the correspondent audiobook.

By supporting a real-time AR texture-tracking algorithm, which uses the novel feature detection technique from (Bastos, R. and Dias, 2007) (see Figure 1), the enhancement of global algorithm performance allows the support of different hardware profiles, both in desktop and mobile setups. It also includes the possibility of tracking several images/textures at the same time and it supports several 3D standard formats (3DS, VRML, OBJ, DXF, Cal3D, among others). As we can see on Figure 1, there is no need to have the black borders as tracking marks. The first picture on Figure 1 (left side) is the 2D sheet of a book and the right side one shows a 3D object registration where someone is interacting in real time with miBook. As for interactivity enhancement, miBook features provide a physic engine to enable scientific simulations. It will also enable audio storytelling with virtual elements interaction (script) and both artificial intelligence and speech recognition algorithms for user guidance. All features may be available both in desktop and mobile (PDA or Smartphones) setups, being one of the biggest breakthroughs for the AR community.

These innovative technological approaches allow a rich end user experience concerning sensorial stimuli, allowing for an enjoyable simultaneous interaction with the content (e.g. reading, hearing and display of static images and moving in 3D virtual models through augmented reality), thus enhancing the learning process.

The service and technology-based products development impact every aspect of our lives and books are no exception (several types of contents and not only books). From classic printed books to audiobooks, electronic books and other possible audio-visual contents, the innovation process surrounds every natural aspects of audio-visual evolution. The global access of population to printed literature, written contents and audio-visual content is already disseminated in a wide variety of media. However, when it comes access and learning effectiveness and/or efficiency, and due to actual technological possibilities, the answer is ambiguous and depends on individual groups of users' needs and requirements and different purposes for accessing different type of information material.

There is an increasing number of educators adopting learner centered models in which students are engaged in problem solving and inquiry activities (Hannafin, M., and, S., & Oliver, 1999); (McLellan, A. T., et. al., 1996); (Stratford, et.al., 1998). AR Book may represent an adequate solution for a transition in teaching-learning models given that it is focused on the improvement of the interactive learning experience, by exploring optimal combinations of educational materials, learning methodologies and capabilities of common devices.

AR Book supports for traditional pedagogical approaches, such as reading books or viewing pre-recorded classes, as well as innovative pedagogical approaches by providing rich media (automatically generated audiobooks and/or 3D virtual interpretations of educational context), during reading, watching or listening. The application of the miBook is a solution to new forms of learning naturally and fully under control of users (both students and educators). The new interactive way of linking traditional pedagogical approaches (such as reading printed books), common devices capabilities (like handheld devices with camera) and the potential of multimedia technologies (audiovisual interpretation technologies) can provide a better understanding, knowledge acquisition and enhanced learning experience. Accordingly, this solution stands for an educational methodology based on natural learning (e.g. learners may in fact achieve knowledge by individual construction held through the learning process).

AR Book aims to provide an integrated access point over a diversity of content formats, respecting the plurality of people educational needs and skills. First step, in every educational process, will lie on the assessment of what has been achieved in leading countries and on the definition of a direction that should be taken to foster digital libraries, audiovisual and written information. The presented solution may contribute to move forward on state-of-the-art by introducing new means of using, interacting and enhancing traditional educational concepts and contents. AR is helpful providing a significant enhancement to the user's cognitive perception of the real world and situational awareness, both indoor and outdoor environments, as it is appropriate for mobile or fixed workplaces. Virtual objects generated by AR systems can display information that the user cannot directly detect using his senses. This information conveyed by the user can also help while performing real-world tasks.

At the development stage, validation of the product was done by the validator. In this study there were 3 categories of validation including validation of media experts, material expert validation and design validation of learning. Validator appointed as media expert was one lecturer of mathematics education and one lecturer from education of informatics technology Universitas PGRI Semarang. The researchers also produced validation results by material validator which becomed a reference to improve the product he made. While the validator of learning design was one economic mathematic lecturer. From the results of validation by the three categories of experts, the researcher was able to know the advantages and disadvantages of the product, and repaired by the researchers before the trial.

Then, after improving the product that had been validated by the experts, the researchers produced a decent and ready-to-use product for the school's learning to be researched. At the implementation stage, the researcher implemented the design of media that had been developed in real situation that is experiment class. Researchers guided students to achieve learning objectives and solutions to overcome learning outcomes. At the phase evaluation, researcher performed the final test in the form of post test at the last meeting to know the student learning outcomes after implementing learning using android based media.

Data Validity

There are 3 categories of validation in android based learning media using Augmented

Reality include, media expert validation, material expert validation and design validation learning. Media experts validate worksheet economic Mathematics and android apps, material experts validate the wake-up materials contained in worksheet Mathematics and android apps, and design learning experts validate Action Plan and syllabus. There are 3 validator for media expert namely 2 lecturers of PGRI University of Semarang each lecturer from mathematics education program and informatics technology program.

Table 2. Learning Device Validation Result Score

Validator	Validated Product Score		
	Media	Material	Learning Design
1	99	66	35
2	91	56	
3	91	59	
Total Score	281	181	35
Percentage	89,2%	86,1%	87,5%
Criteria	Very Good	Very Good	Very good

Source: Processed Primary Data (2018)

After performing expert validation, the development of instructional media based on android using Augmented Reality on the economic mathematic that are then revised in accordance with criticism and suggestion of validator before doing product trial. Based on the results of the discussion of the validation of experts, it can be concluded that android-based learning media using Augmented Reality on the matter of flat economic mathematic are valid and feasible to disseminate.

In accordance with the results of research Sari, W. S., Dewi, I. N., & Setiawan (2012) that multimedia presentation with AR technology can be applied to replace conventional learning (Nincarean, D., et. al., 2013). The Augmented Reality (AR) is one of the emerging technologies that has tremendous potential that has been enhanced and recognized by educational researchers. With the ability to combine the virtual world and the real world has spawned new possibilities in improving the quality of learning.

Data of Practicality

Furthermore, students' responses through instructional media were given to 33 students of experimental grade 2 to be assessed feasibility by using student questionnaire.

Table 3. Scores of Student Assessment Results on Learning Media

Total Score	Percentage	Criteria
1760	88,9%	Very Good

Source: Processed Primary Data (2018)

Based on the results of the students' responses, it can be concluded that android based learning media using Augmented Reality on the material of economic mathematic can be practically used. Mustaqim (2016) stated that the use of Augmented Reality is very useful for interactive and real learning media directly by learners. According to Antonioli, M., Blake, C., & Sparks (2014) AR has proven to be an interesting way for students to participate in their learning. This new technology allows student-centered learning and creates opportunities for collaboration that foster a deeper understanding of the material.

Nowadays learners have access to many types of educational materials. However, traditional books still play a significant role in education. There is a need for an educational process to integrate the mentioned media resources in a way that facilitates their usability. It is a long time since there is common knowledge that listening is fundamental area of development in learning languages (Rost, 1994);Vandergrift, 1999) but at the time, learning by listening has also been regarded as one the most problematic areas for students to use a variety of different approaches, skills and strategies (Wilson, 2003).

If we imagine that we have to explain to someone what is and how does it feels to listen before that person actually listens to any audiobook it is easy to guess we would have hard task to perform. When we get to the field of AR, one can also imagine the difficulty in explaining what is and what it feels like interacting with AR Book. That is something that we just will really understand when actually experiment.

The learner is listening to the audiobook (abridged version) while seeing the physical book itself (detecting the differences from the original written text/ 2D pictures and the audio resume) as well as he can explore and interact simultaneously with the 3D virtual objects' registration. Left and right side of the photo regard the interaction with exactly the same sheet of the book, the difference consists in the chosen type of exploration of the same content – in this case, the learner is interacting with the evolution of the economies graphic and he explores the several aspects he desires. AR Book's vision is to accelerate each individual's acquisition of knowledge and learning skills, through the provision of a responsive and inspiring learner environment, which enables him/her to "illustrate" educational materials (traditional printed books, audio-visual, 3D virtual models).

A preliminary usability evaluation of AR Book was carried out with 5 adults 11. They were exposed to a simple task - to interact with AR Book content in AR context - and they answered a satisfaction questionnaire related to the task. We concluded that the AR Book's enhanced features impact on learning process: (1) Adding visualization to a standard text book will enhance its value as an educational material; (2) The visualized text is easier to understand, and thus learning process will be fostered; (3) Audio-visual content is more attractive than standard text books; (4) Adding visualization features to a standard text book creates a new media concept and possibilities, resulting in completely new educational instruments; (5) A very intuitive and easy to use authoring tool will allow for unlimited creativity during educational material preparation.

Data of Effectivity

Data from student learning outcomes described in this study consist of preliminary data and final data. Preliminary data was obtained from the result of final test value of first Semester and final data obtained from result of post test. In summary, a description of the control and experimental class learning outcomes is presented in Table 6.

Table 4. Learning Result Data

Description	Normality		Homogenity
	E	K	
Start Data	0,1272	0,1009	1,0800
End Data	0,1200	0,1029	1,0207,

Source: Processed Primary Data (2018)

Based on Table 6, values for normality and homogenity tests were obtained. Test normality initial data experimental class obtained value of L count=0,1272<L Table=0,1542 and from control class obtained value L count=0,1009<L Table=0,1542. From Test of homogeneity of experimental class and initial data control class obtained value. F count=1,0800<F Table=1,8045.

From The Test of normality of the experimental class data obtained value L count=0,1200<L Table=0,1542 and from the Class Control are obtained value of L count=0,1029<L Table=0,1542. and From Homogenity test of experiment class and control class obtained value F count=1,0207<F Table=1,8045. So it can be concluded for the initial data of the class and experimental data and the control class is normal and homogeneous distributed.

It is known that the two classes of initial and final data are normally distributed and homogeneous. Then t test will be conducted to determine whether student learning outcomes after using android-based learning media

using Augmented Reality is better than conventional learning.

Table 5. T Test

Aspect	t count	t Table
Learning Result	6,0714	1,6690

Source: Processed Primary Data (2018)

Based on Table 7, the following value are obtained: t count=6,0714 dan t Table=1,6690. Because t count=6,0714>t Table=1,6690, so it can be concluded that the average learning outcomes of students who use android based learning media assisted augmented reality technology on the material of economic mathematic is better than the average student learning outcomes that use conventional learning. Then look for the test of learning to mastery to complete student classically.

Table 6. Learning Mastery Test

Class	t count	t Table
Experiment	9,53845	1,694
Control	1,4157	1,694

Source: Processed Primary Data (2018)

Based on data from Table 8, The Experiment Class obtained value of i t count=9,53845 dan t Table=1,694, because value t count>t_ Table that is 9,53845>1,694, so it can be concluded that the class experiment is completely classical. For the control class obtained value of t count=1,4157 dan t Table=1,694, because value t count<t Table that is 1,4157>1,694, so it can be concluded that the control class has not completed classically.

This research is supported by the results of research Setyosari (2012)which says by applying technological innovation AR in learning, it will create an effective new atmosphere and provide an overview of the real world environment in the learning system. Suharso, A., & Muhaimin (2016) say there are significant differences in results before and after using magicbook augmented reality based magic media. Buchori, A., et.al, (2017) in his study said the cognitive learning outcomes of the group of students with the treatment of MAR (Mobile Augmented Reality) learning strategy is superior to the group of students with non-mobile direct strategy MAR (Mobile Augmented Reality).

Based on the previous discussion, it shows that "Development of android based learning media using Augmented Reality on the building material of economic mathematic" is suitable for learning activity according to media expert, material expert, design learning expert, student response, and learning result. The research result shows that android-based media using Augmented Reality on the economic mathematics material is better than learning outcomes with conventional learning.

For computer graphics have become much more sophisticated, looking all too real. In the near future the res archers plan to make the graphics on the TV screen or computer display and integrate them into real world settings. This new technology called augmented reality, further blur the line between reality and what is computer generated, improving what we see, hear, feel and smell. The concept of innovation has been described in terms of research as discovery, development, imitation and adoption of new products, new processes and new organizational forms (Dosi, G., et.al, 1988), while Lundvall (1992) says almost all innovations reflect previously existing knowledge, combined with new forms of use. Following the European Commission definition innovation consists of the successful production, assimilation and exploitation of novelty in the economic and social spheres (European Commission, 2003).

Among other factors, the importance of economic competence is crucial, given that the use and benefit from enhanced learning depend on efficient systems (Howells, J. and Roberts, 2000). A modern society requires the fast adoption of an overall education and a training program for all ages at all levels. For

this modern society to become real it is necessary to change global economies in what concerns to innovative business models, efficiency and information sharing. Words must be put into action to promote a completely new learning paradigm. In this work I have presented, through a technological approach, a novel tool that can provide a better understanding, knowledge acquisition and enhanced learning experience. Distribution through electronic channels, such as Internet, presents specific needs to business models and content production design. This fact is due to several reasons. First of all, the difficulty in creating value for a global (and heterogeneous) audience.

Then, all the technological issues related to content access and mobility. Internet is no longer a computer exclusive and recent trend in medium consolidation show the way services and products should act, if they want to succeed in electronic environments. Mobile devices (PDAs, Smartphones, integrated multimedia reader) will gradually allow the incorporation of augmented reality (AR) applications and contents, voice recognition tools, file formats converters and advanced search functionalities. Firms should keep in mind all ways of content access and usage possibilities. Up until now, mobile hardware performance has favored classic software concepts that use simple graphics. The next step will move toward 3D graphics.

Although the common mobile devices are technologically behind a specialized game machine, it is obvious where the market is heading. The migration of the software supporting augmented reality into mobile environment by itself is a considerable advance on the state-of-the-art. The implementation of this technology in handheld devices will soon provide valuable results for evaluation in learning processes context. Solutions presented by miBook also aim at boosting innovation through crossfertilization between science, business and education resources. It is clear that conceptual ideas must be transformed into real market-oriented innovations. The big challenge is actually to draft the methodology process of designing and to integrate interactive multimedia into the existing teaching and learning scenarios.

CONCLUSION

The result of the research shows that: (1) The development of android based learning media using Augmented Reality is made by through several stages including, the stages of making worksheet of Special economic Mathematics which is used as mathematics teaching material which have marker to support Augmented Reality feature and stage make android application which contains quis, games and Augmented Reality features; (2) The development of android based learning media using Augmented Reality on the building of economic mathematics is valid or feasible to be used in learning activities according to media expert, material expert, design learning expert and student response; (3) The development of android based learning media using Augmented Reality on the material of economic mathematics is practically used in learning by looking at the percentage value of the student response of 92%. (4) Based on field trial results, the average learning outcomes in the experimental class using Augmented Reality-based android media were better than the average learning outcomes in the control class using conventional learning. It can be said that the development of Learning Media based on android using Augmented Reality is effective.

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