Atom Core Interactive Electronic Book to Develop Self Efficacy and Critical Thinking Skills

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ABSTRACT
The purpose of this research is to develop interactive atomic electronic school book (IESB) to cultivate critical thinking skills and confidence of students grade 12. The method used in this research was the ADDIE (Analyze Design Development Implementation Evaluation) development procedure which is limited to the test phase of product design expert. The need analyze data is collected from students in Lampung Province Indonesia using questionnaires. Electronic book design tested by experts in the field of physics education. Data were analyzed quantitatively and descriptively. Based on the results of the questionnaire 65,2% of the students said that they need the IESB which contains an interactive question exercise with feedback for exam exercises and preparing for admission to the university. The current book has not given self efficacy to 83,9% of students. Expertial test results show that the IESB will be able to cultivate self efficacy and critical thinking skills is an interactive digital format with experimental simulation, interactive question on HOTS level with feed back, and hyperlink to other learning resources.

Keywords: critical thinking skills, interactive electronic book, self efficacy.

INTRODUCTION
Electronic books currently used in Indonesia are static and non-interactive. Meanwhile the students' needs are electronic books that can be used independently and are interactive. Books like this will get students interested in learning physics and eager in learning, especially for physics lessons are known quite difficult and abstract. In addition, the need for books that can be used independently for the grade 12 last semester is very urgent because the grade 12 last semester in Indonesia has little time to study due to being pressured by time for national exams.

For example, the matter of atom core in class 12 is in the even semester. Atom core is one of the physics material that discusses abstract and abstract microscopic matter in the real world that requires extra understanding. The material of the atom core includes the development of atom theory, atom core, radioactivity, and science & technology applications. It needs an IESB to help learners understanding.

One of the learning media that can be used to overcome the difficulty is interactive instructional materials in the form of electronic books. Interactive learning media can be used anywhere and anytime without teacher attendance. Thus, it is hoped that the media eliminates the learning barriers often experienced by teachers and students, especially in the learning process in the classroom and self-learning (Wu, 2016).

Based on research that has been done by Bakac, Tasoglu, Akbay (2011) that learning with Computer Assisted Instruction (CAI) can improve student academic success. The activities that teachers need to implement are activities that give students the opportunity to use the technology to practice their critical thinking skills in solving a problem according to one of 21st century skills.

Having knowledge or information is not enough. Students must be able to solve problems to make effective decisions, so they must be able to think critically (Peter, 2012). This is supported by research conducted by Rosida and Jalmo (2017) (2017) and Hussein, Herayanti, and Gunawan 2015), ie the effectiveness of the use of interactive e-books shows the growth of students' critical thinking skills. According to Peter (2012), the goal for educators who wish to instill critical thinking skills in a classroom is to think of students as not receiving information, but as users of information. A learning environment that actively engages students in information

inquiry and application of knowledge will promote students' critical thinking skills. It can be suggested that critical thinking skills should play an active role in educational programs (Semerci, 2005).

This kind of learning process is no longer teacher centered, but rather leads to student centered learning. This student-centered learning enables students to improve their self efficacy, because based on the results of questionnaires approximately 83,9% of students do not have high self efficacy. Self efficacy is one of the supporting aspects to achieve a goal. Students who initiate their learning activities with self efficacy and with self-directed learning strategies will produce better achievement, because students who are not really involved in the learning process will experience shallow knowledge and low academic achievement (Yusuf, 2011). A student with high self efficacy will not give up quickly in answering the doubts it has, because believing in self-esteem will increase learning motivation (Zimmerman, 2000). This is in line with research conducted by Askar and Davenport (2009) that students with high self efficacy are more likely to perform challenging tasks and spend much more effort to solve them.

Based on the problems described above, the availability of an interactive electronic school book that builds critical thinking and self efficacy of senior high school in Lampung Province, Indonesia is essential. The purpose of this research is to make interactive electronic book design on atomic core material for 12th classes so that students can understand physics well, foster self-confidence, and critical thinking skills. The books like this should be able supports student-centered learning strategies where learners take on their own responsibilities in the learning process (Teoh and Tse-Kian 2007).This interactive electronic book is designed to be used by students to study independently at home without losing the meaning of the scientific approach required by the 2013 curriculum, especially for 12th classes whose face-to-face time at school is very narrow.

RESEARCH METHOD

The research method used is research and development. The development model in this study follows a development model adapted from the ADDIE instructional design model that includes analysis, design, development, implementation and evaluation. The stages reported in this article are limited to the design of the Interactive Electronic School Book (IESB) validated by experts.

The first stage is the analysis. This analysis consists of data acquisition of requirement analysis and component component validation test. Needs analysis data were taken from 112 students and 3 high school teachers using questionnaires. Questionnaire needs analysis is done to get information about real conditions in the learning process which consists of 30 questions for teachers and 34 questions for students. Questioners for students similar to questionnaires for teachers, containing questions about their physics learning process, book availability, confidence in using the available books, how much book roles are available in building a physics understanding and confidence in the national exam, hope students to physics books. After obtaining the data of requirement analysis result from teacher and student, then that is doing expert validation test to atomic material component. This validation test aims to find out the depth and breadth of the atom core material for high school students.

The second stage is the creation of interactive electronic book design. Before creating an interactive electronic book design, expert validation testing of atom core material components is required. This test is used to find out what materials should be included in the electronic book, including the form of learning resources and the type of critical thinking. Validation test was conducted by 3 doctor of Physics Education at the University of Lampung who has experience in writing physics books for school. Validation test results are used as a guide for making electronic book design of atom core. Expert assessment test guides are presented in table 1.

Table 1: Expert Assessment Test Rubric

Choices	Score
Very Important	5
Important	4
Quite Important	3
Less Important	2
Unimportant	1

The instrument used has 5 answer choices. The results of the assessment are then searched average by using the formula:

$$Assesment\ Score = \frac{total\ score}{total\ of\ expert}$$

Once obtained the average is then converted to a grading statement to determine which material should be present in the IESB atomic core.

The result of the average score of expert test is converted to the assessment statement according to table 2, so it can be known which material is classified as very important, important, important enough, less important, and not important.

Table 2: Assesment and Decision Score

Average Score	Decision
4,20 – 5,00	Very important to be put in atomic core IESB
3,40 – 4,19	Important to be put in atomic core IESB
2,60 – 3,39	Quite important to be put in atomic core IESB
1,80 – 2,59	Less important to be put in atomic core IESB
1,00 – 1,79	Unimportant to be put in atomic core IESB

RESULT OF DEVELOPMENT AND DISCUSSION

The main result of the development research that has been done in 3 high schools in Metro City is the IESB design of atom core to foster self efficacy and students' critical thinking skills. Prior to making the design in advance conducted expert validation tests on atom core component materials. Expert tests were conducted by three physicists. Expert test results are shown in table 3.

Table 3: Expert Test Result of Atom Core Component Materials

Study Materials	Component Materials	Average Expertial Test Result	Information
Atomic Theory	Atom Dalton Concept	3,67	Important
	Atom Dalton Image	3,67	Important
	Atom Thomson Concept	3,67	Important
	Atom Thomson Image	3,67	Important
	Thomson's Experimental Scheme Image	3,67	Important
	Milikan's Experimental Image	3,67	Important
	Atom Rutherford Concept	3,67	Important
	Atom Rutherford Image	3,67	Important
	Atom Bohr Concept	4,00	Important
	Atom Bohr Image	4,00	Important
	Atom Hidrogen Concept	4,00	Important
	Atom Hidrogen Formula	4,00	Important
	Electron Transition Animation	4,00	Important
Atomic Nucleus	Atom Structural Concept	4,00	Important
	Atom Structural Image	4,00	Important
	Core Stability Concept	4,33	Very Important
	Core Stability Graphical Image	4,00	Important
	Defek Massa Concept	4,33	Very Important
	Defek Massa Formula	4,33	Very Important
	Binding Energy Concept	4,67	Very Important
	Binding Energy Formula	4,67	Very Important
Radioactivity	Alpha Rays Image in Magnetic Field	4,00	Important
	Alpha Rays Concept	4,33	Very Important
	Alpha Rays Translucency Image	4,00	Important
	Beta Rays Image in Magnetic Field	4,00	Important

Study Materials	Component Materials	Average Expertial Test Result	Information
Science and Technology Application	Beta Rays Concept	4,00	Important
	Beta Rays Translucency Image	4,00	Important
	Gamma Rays Image in Magnetic Field	4,00	Important
	Gamma Rays Concept	4,00	Important
	Gamma Rays Translucency Image	4,00	Important
	Radioactive Activity Concept	5,00	Very Important
	Radioactive Activity Formula	4,67	Very Important
	Radioactive Age Determination Simulation	4,67	Very Important
	Alpha and Beta Particles Decay Simulation	4,67	Very Important
	Alpha and Beta Particles Decay Video	4,67	Very Important
	Part-time Concept	4,67	Very Important
	Part-time Formula	4,67	Very Important
	Geiger Muller Working Enumerator Scheme Principle	4,00	Important
	Geiger Muller Enumerator Scheme Image	4,00	Important
	Wilson's Fog Room Working Principle	4,00	Important
	Wilson's Fog Room Image	4,00	Important
	Radiation Hazards Image	4,33	Very Important
	Radiation Hazards Video	4,33	Very Important
	Radiation Source Diagram Image	4,33	Very Important
	Fission Reaction Concept	5,00	Very Important
	Fission Reaction Image	4,33	Very Important
	Fission Reaction Simulation	4,67	Very Important
	Fission Reaction Video	4,67	Very Important
	Nuclear Reactor Video	4,33	Very Important
	Fusion Reaction Concept	4,67	Very Important
	Fusion Reaction Image	4,33	Very Important
	Radioisotope Benefits Concept	4,33	Very Important
	Radioisotope Benefits Image	4,00	Important

Based on expert test results it is found that important concepts are displayed in all chapters and sub sections, this concept contains the elaboration of the atom core material and these concepts are interrelated. By understanding the basic concepts of atom theory and atom structure, it is easier to study advanced conceptual materials such as radiation and core reactions. Then there are some suggestions given by the expert on the concept that, on the matter of atom theory should use a physics approach. For example explaining the cause of electrons do not fall when it surrounds the core.

Physics lessons also can not be separated from the use of formulas to solve the problem. This book presents formulas on the material of hydrogen atoms, mass defects, binding energy, radiation activity, and half-life. This book also contains the working principle of a radiation detector device. This is important raised because the radiation detector is still very layman in the eyes of students. Given this working principle students can get an idea of how radiation detectors work, such as the Geiger Muller counter and Wilson's fog room.

Besides containing concepts, formulas, and working principles, this book also features images, animations, simulations, and videos. This is because the material of the atom core is a very abstract material. Thus, to eliminate abstraction in the students then made a visualization in the form of images, animation, simulation, and video. Videos, images, text, animations, and sounds can be more contextual learning (Suartama, 2010).

The materials that display images are atom theory, core structure, core stability graph, radioactive ray, radiation detector, radiation source, core reaction, and radioisotope. Drawings are able to help students illustrate abstract material that students can not see visually. This is in line with research conducted by Agustina, Suyatna, and Suyanto (2017) that, still images can explain a concept concretely and realistically. Picture able to support existing material concept. Based on research conducted Herrlinger, Hoffler, Opfermann, and Leutner (2017) showed that, the picture improves learning outcomes.

Furthermore, it is animation. Animation is important on electron transition material. So students get an idea of how the electrons move the trajectory. Flash animation for learning technology can be used as a help in understanding the concept and to improve students' thinking more effectively. Agustina, Suyatna, and Suyanto (2017) and Anggraini, Suyatna, and Sesunan (2017) say that the use of motion picture media/animation can improve student learning outcomes. Flash animation is able to analyze existing concepts and can provide ideas that connect students with a basic understanding of new knowledge. Findings of Salim and Tiawa (2015) shows that learning by using flash animation can help students in comprehending abstract lessons significantly.

Simulations on radioactive material, fission reactions, and radioisotope benefits are essential. Simulations in learning can describe something complex or complex to be explained with only images and words only. This is in line with Moore, Chamberlain, Parson, and Perkins (2014), that the PhET simulation provides dynamic access to multiple representations, makes invisible ones visible, aids in investigations, and enables quick and secure access to multiple experiments, and makes students' fun excitement and teachers.

According to expert test results, a video on science and technology applications (fission reactions and nuclear reactors) is very important to display. Nuclear reactions do not always pose a danger like nuclear bombs, but there are also benefits such as power generation and are also used in some industrial processes in the future. This is in line with Permana (2005) and Alimah and Dewita (2008) that nuclear energy generated in a nuclear reactor is utilized into electrical energy that can be a competitive contributor with other electrical energy sources such as coal, oil, gas, water, and others. It also features alpha and beta particle decay videos, as well as radiation hazards. Ljubojevic, Vaskovic, Stankovic, and Vaskovic (2014) states that integrating video clips in multimedia lecture presentations can improve students' perceptions of important information and motivation to learn. Therefore, students can better understand and remember the subject of the lecture. So even with the study of physics, students more easily understand what is learned by looking at the video material. Video is also able to increase students' interest in studying difficult material like the material of this atomic nucleus. This is in accordance with Suartama (2010) that videos can stimulate more senses. Through the video can be displayed things or real events related to the material learned so that students more easily understand the material.

Having obtained the results of expert test component atomic material, then create an electronic book design interactive atom core. Figure 1 is an IESB design drawing of atom core.

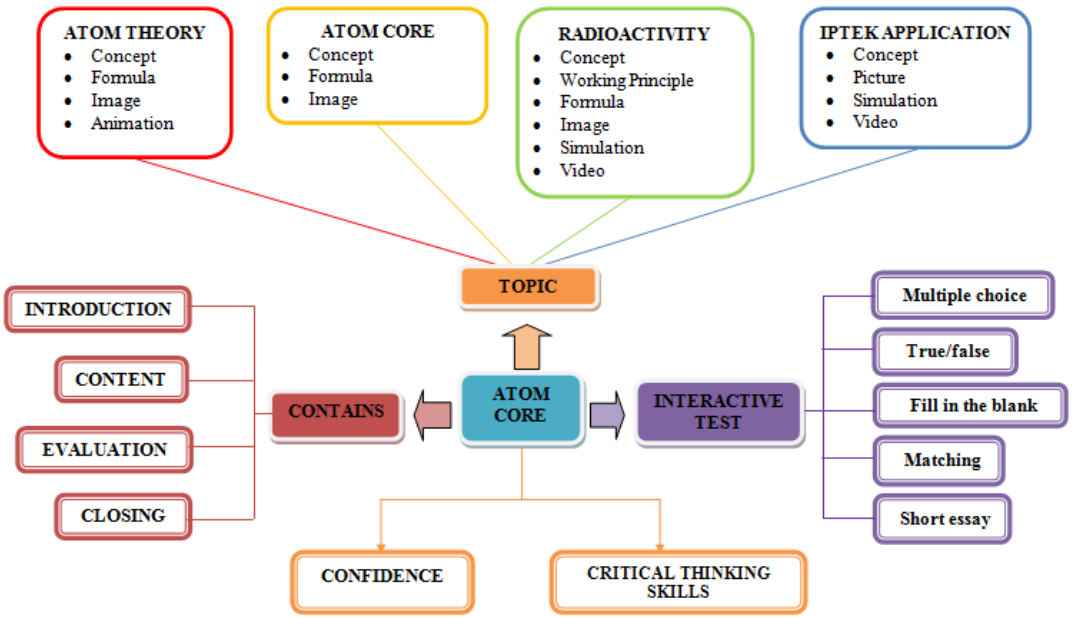

Figure 1: Atom Core IESB Design

This interactive electronic book is designed to foster students' critical thinking skills. The book comes with interactive questions at the High Order Thinking (HOT) level that comes with feed back and hyperlinks to other learning resources. High order thinking involves the transformation of information and ideas. This transformation occurs when students combine facts and ideas and synthesize, generalize, explain, hypothesize or arrive at some conclusions or interpretations. Manipulating information and ideas through this process allows students to solve problems, gain insight, and discover new meanings (Ramos, Dolipas, and Villamor, 2013) HOT is the best teaching and learning technique in real-world context and by varying scenarios students can use their newly acquired skills, so HOT is very important for the quality of education (Mainali, 2012).

The interactive questions are multiple choices, true/false, fiil in the blank, matching, dan short essay. Interactive questions are used to determine the level of mastery of the material and the achievement of basic competence of each material. Wallace and Jefferson (2015) says that the analysis of the value of the final exam proves the effectiveness of exercises to improve students' critical thinking skills. An interactive e-learning environment that not only generates generic skills such as critical thinking, analytical reasoning, problem solving, and written communication (Chellamani, 2014).

In addition to growing students' critical thinking skills, this IESB is also able to foster students' confidence. This is in line with research conducted by Alshaya and Oyaid (2017) on the effectiveness of e-books and their self efficacy in using them. The results show that students have the basic skills necessary to download and read e-books and utilize their characteristics, they also believe in their usefulness and are satisfied with it so that they intend to continue using e-books in the future. Another study by Kissinger (2013) states that students are able to have high self efficacy when using e-books.

In addition to prioritizing the content of the material, this interactive electronic book also prioritizes how it looks. This is intended to get students interested in using electronic books. Through interactive books students can learn in a fun way and acquire new skills (Solcova and Magdin, 2016). As research conducted by Kao, Tsai, Liu, and Yang (2016), that interactive e-book models should display attractive art designs and not only contain simple interactive buttons that will improve students' reading performance.

CONCLUSION

The IESB atom core will be able to cultivate self efficacy and critical thinking skills is an interactive digital format with experimental simulation, interactive question on HOTS level with feed back, and hyperlink to other learning resources.

The IESB atom core that can foster self-efficacy and students' critical thinking skills should contains concepts, working principles, formulas, images, animations, experiment simulations, and videos. IESB atom core is also equipped with interactive questions at HOT level along with feed back and hyperlinks to other learning resources. The interactive question are multiple choices, true/false, fiil in the blank, matching, dan short essay.

The limitations of this research is that the book has not been tested on the students in the field, therefore the next plan is to implement the book to the students in grade 12th final semester and evaluate its impact on students' critical thinking skills and self-efficacy.

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