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SCIENCE EDUCATION ADAPTIVE LEARNING SYSTEM AS A COMPUTER-BASED SCIENCE LEARNING WITH LEARNING STYLE VARIATIONS

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Sujiyo Miranto

Abstract. *Students with their different learning styles also have their own different learning approaches, and teachers cannot simultaneously facilitate them all. Teachers' limitation in serving all students' learning styles can be anticipated by the use of computer-based instructions. This research aims to develop ScEd-Adaptive Learning System (ScEd-ASL) as a computer-based science learning media by accommodating students' learning style variations. The research method used is a mixed method at junior high schools in Tangerang Selatan. The final product of the research is a special learning media appropriate to students' visual, aural, read/write and kinesthetic learning styles. The uniqueness of the media is its form of integrated science materials, accommodating fast and slow learners, and appropriate to their learning styles. ScEd-Adaptive Learning System as a developed computer-based science learning media was declared as good and valid by four media experts and five learning material experts. ScEd-ALS for kinesthetic style has a high effectivity to improve students learning mastery (100%), consecutively aural (63%), read/write (55%), and visual (20%). This media development can be continued with the Android version or iOS to make it more operationally practical.*

Keywords: *adaptive learning system, science learning media, computer-based instruction, learning style.*

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Introduction

Indonesia still finds obstacles in the implementation of learning and assessment during the learning process of Integrated Science at Junior High School. Some of the obstacles are identified by various factors, such as teacher competence, facilities and infrastructure, and learners' low literacy ability which impact on the achievement of learning outcomes. Thus, in accordance with Wenno (2010) who indicates science subject is a school subject that has always become problematic for both schools and teachers in terms of students final learning results. The science subject has become the school subject with the last ranking on both general and islamic schools' national exam. The National examination average scores for the science subject at the level of general and islamic junior high schools in DKI Jakarta since 2011 and 2012 are 7.24 and 7.47 respectively (Puspendik, 2016). Meanwhile, based on the data from Simdik Info (2016), the science subject national examination average score for general junior high schools of 2014 in DKI Jakarta is 73.38. This achievement average is not that good if it is seen from the minimum achievement average for the science subject, which is 75. Problems also arise at the school level, where the students' learning mastery on science subject is still considerably low on each level of general junior high schools and islamic junior high schools (Halim, 2012; Medriati, 2013).

On each islamic school level, students categorized as slow learners are generally found. This slow learner category is seldom handled by the teachers, so the expected learning result has never been achieved. The number of this slow learner category is not small, about 35% from the overall students in both experiment and control groups (Shofiana, 2014). This incomplete learning is generally experienced by the slow learner category. The implementation of Curriculum 2013 stipulates an Integrated Science material for the general and islamic junior high schools. From the preliminary research reports the concepts of Movement and Simple Machines are the material for biology (Movement) and physics

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(Simple Machines), and in the odd semester is covered as Integrated Science. The research result shows 35% of the students (Movement concept) and 55% of students (Simple Machines concept) experienced remedial or incomplete result.

The treatment for these incomplete learning students does not receive enough attention and serious preparation either from the schools or the teachers. The treatment for the incomplete learning students in general and islamic schools is managed mostly through remedial test. The improvement on the number of complete learning students after the remedial test was not resulted from the improvement of students' competence. The lower quality and difficulty level and the low monitoring are the main causes. This will of course only have a brief effect, where this is definitely invalid. On a different concept, the same result will be achieved, where the same students will again experience low learning results.

The students' low learning result and low level of learning mastery are resulted from the incorrect selection of learning stimulus or teachers' mono stimulus. Each student has a different background, habits, intellectual competence, and physical appearance. The difference influences the students' competence in responding to the teacher's selected learning stimulus. The way the students respond to the teacher's given stimulus inside the classroom is known as learning style. Theories about learning styles were heavily debated in order to explain the differences in individual learning and related ideas were popular in the 1970s (Coffield, Moseley, Hall, & Ecclestone, 2004) and greatly influenced each level of education (Pashler, McDaniel, Rohrer, & Bjork, 2009). Researchers suggest that teachers should identify the learning styles of learners and adjust the learning methods according to each participant learning styles. There are at least seven theories related to learning styles: David Kolb Model, Peter Honey and Alan Mumford Model, Learning modalities, VAK/VARK Neil Fleming Model, Anthony Gregorc Model, Cognitive Approach, and NASSP Model. Hawk and Shah (2007) investigated five learning style instruments (Kolb Learning Style Indicator, Gregoric Style Delineator, the Felder-Silverman Index of Learning Styles and the VARK questionnaire and the Dunn and Dunn Productivity Environmental Preference Survey) reports validity, reliability and recommends adjustment of classroom activities based on learning styles. The VARK learning style model in Eicher (1987) is an extension of the earlier neurolinguistic model (Hawk and Shah, 2007) classifies learners based on teaching preferences to convey and obtain information; used to assess the learning style (Liew, Sidhu, & Barua, 2015). This model is very useful to enhance learning (Marcy, 2001). The third model is the VARK Model (Fleming, 2001), a sensory model that is an extension of the earlier neuro-linguistic model (Eicher, 1987) The third model is the VARK Model (Fleming, 2001), a sensory model that is an extension of the earlier neuro-linguistic model (Eicher, 198

Student's learning style is different from one another. Some students are aural learners, some visual, and others are kinesthetic. Visual learners are easier to learn with images, graphics, charts, while aural learners remember anything they listen to and they can express it verbally. Kinesthetic learners love to touch objects and are physically involved with whatever they learn (Beck, 2007). Most teachers do not pay attention to this when they are teaching. When the teacher selects only one stimulus from one of the learning styles, then the students with different learning styles will face difficulties to receive knowledge or to understand it. The students need appropriate stimulus with their learning style.

The Individual difference on the students is supposed to be the teachers' focus of attention in using multiple approaches and stimuli. If the teachers pay attention to this factor, the students will receive the learning opportunity appropriate to their learning style, and they can achieve an optimum learning mastery appropriate to their ability. The research result shows the identification of student's learning style is found to be a significant factor in effectivity (Aisami, 2015). Further, students with different learning styles also have a different learning approach (Baeten, Dochy, Struyven, Parmentier, & Vanderbruggen, 2015; Balakrishnan & Gan, 2016). The teachers' success in identifying students' learning style will direct the teachers to a variety of learning strategies (Magdalena, 2015). Škoda, Doulík, Bílek, & Šimonová (2016) apply Inquiry Based Science Education (IBSE) in science subject that can accommodate the variation of learning styles in15-year-old students.

Providing various learning methods, strategies, approaches in each classroom session will technically make it difficult for the teachers. Teachers have to serve all students' learning style at the same time, and this is impossible to be maximally done. The problems above will be difficult to be solved conventionally.

The use of computer media in learning may assist to solve those mentioned problems. Aisami (2015) asserts that visual literacy in the form of visual presentation can connect students' learning style with multiple intelligence. Other researchers prove that technology/multimedia technology can be used to improve students learning comprehension through a variety of learning styles (Balakrishnan & Gan, 2016). Further,

the use of audiovisual presentation provides a better effect compared to a standalone visual presentation (Brünken, Plass, & Leutner, 2004). Computer-based instructions can help teachers in serving students in slow learner category who had an incomplete learning with their different learning styles to maximally improve their learning at relatively the same time.

Therefore, computer-based science learning media/computer-based science instructions have to be appropriate to the students' aural, visual, read-write and kinesthetic learning style. The development of media/multimedia/IT related to the learning styles have often been reported (Balakrishnan & Gan, 2016; Brünken et al., 2004; Nilsson, Östergren, Fors, Rickenlund, Jorfeldt, Caidahl, & Bolinder, 2012; Pruet, Ang, & Farzin, 2014with three types of modules (learning content, self-assessment questions and interactive ECG interpretation training; Halim, 2012; Truong, 2015). Besides, the resulted media will not give an extra burden for teachers, remedial teaching can be done outside of the classroom or school session, which is at the students' own homes. This will make it easier for the teachers' task, but it can facilitate the students with their material preparation using a thoroughly prepared stimulus (Balakrishnan & Gan, 2016). The existing media are generally informative through providing evaluation items, and by having the program designer's general view or perception, or a specific learning mode. The existing media have not been made specific for slow learner students, to provide additional supplements for fast learner students, and not specifically made based on students' learning styles.

Based on the background above, the researchers develop a science learning media Science Education Adaptive Learning System (ScEd-ALS), which adopts the Minnesota Adaptive Learning System (MAIS) Program (Tennyson, 1984). MAIS Program designed an artificial intelligence on computer-based instructions. The program initiated rewards for the varieties of students' learning styles (Siadaty & Taghiyareh, 2007). The quality of presentation technique on this program was made valid with the development of the current information technology, where information is accessible both offline and online (Stash, 2007; Sterbini & Temperini, 2009; Truong., 2015).

The developed media is used to improve students' learning mastery according to each of their learning style. Media is on offline state, means that students can use it outside the class and have enough time to fully understand of certain cases the learners are still confused about.

Research Questions

1. ScEd-ALS as what kind of a computer-based science learning media that can accommodate the varieties of students' learning styles at the level of general junior high school and islamic junior high schools?
2. What is the validity level of ScEd-ALS as computer-based science learning media/computer-based science instructions with the students' varieties of learning styles at the level of general junior high school and islamic junior high schools?
3. What is the effectiveness of ScEd-ALS as computer-based science learning media/computer-based science instructions with the varieties of students' learning styles at the level of general junior high school and islamic junior high schools?

Methodology of Research

The research uses a mixed method. The taken research procedures use Akker, Gravemeijer, McKenney, & Nieveen (2006) as follows: a preliminary research, prototyping stage, summative evaluation, systematic reflection and documentation. The research lasts for 10 months, starting from January 2017 to November 2017, odd semester academic year 2017/2018 at three general and islamic junior high schools in Tangerang Selatan. The following is the explanation for each stage.

1. Preliminary Research

The preliminary research covers both literature study and field research. The literature study is aimed at identifying the existing problems, while the field research is aimed at finding the information on the existing problems related to learning style and the students' response on the learning media commonly used by the teacher.

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2. Prototyping Stage

In this stage, the prototype for the computer-based science learning media/computer-based science instructions is developed using the variations in students' learning styles. The developed prototype is the result of the design stage. In this stage, a test is performed using formative evaluation on the design of computer-based science learning media/computer-based science instructions with the variations in students' learning styles. The result of the formative evaluation on the product is used to perform technical reparations on the developed media prototype. The prototype stage covers the following: *design guidelines for media development* (teaching material selection, media design, software design), *prototype design optimization* (software selection, media development procedure, formative evaluation, and revision).

Design guidelines for media development

The stage of designing science learning media consists of several steps, such as the following: (1) teaching material selection, (2) learning media design, (3) software media design. Teaching material selection is one of the factors to pay attention to the process of prototype media development. The scope for the selected materials in this research is as follows:

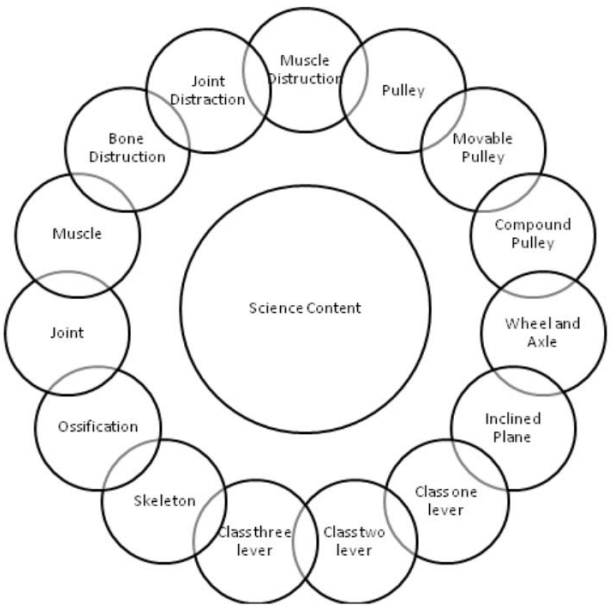

Figure 1. Teaching material selection.

Computer-based science learning media/computer-based science instructions with the developed variations of students' learning styles have the following characteristics: the media provide various learning processes based on the students' learning styles, such as visual learning, auditory learning, read/write learning, kinesthetic learning, which refer to the Neil Fleming's VARK model learning style theory (Fleming and Neils, 1992); the media interfacing each of the four learning styles is different. The following is the characteristic of the learning model for each of the learning styles in the Science Education Adaptive Learning System (ScEd-ALS) learning media (Table 1).

Table 1. The characteristic of the learning model for each of the learning styles in the ScEd-ALS

Visual learning model	Auditory learning model	Read/Write learning model	Kinesthetic learning model
Presenting interesting interface design	Providing music options, narration audio, conversation	Presenting article/text, a lot of supplementary information readings	Performing a lot of options through click-a-button activity
Showing diagrams, graphics, experiment results	Expert narration recordings	Presenting narrations of experiment procedures	Showing demonstration in the forms of films/animations
Showing repetitive texts.	Makin predictions (making scenario), planning (imagining), can be in the form of question like "what will happen if?"	Rewriting (creating a resume/summary)	Students are requested to try to do an activity or to perform.
Planning.	Explaining (close gaps to fill in or to write explanations are provided).	Showing sections of the materials in the form of images.	Performing experiment (offline experiment), reporting the result of the offline experiment.
Making predictions.	Discussions in the form of voices, voiced questions.	Making plans for experiments	Practice the theories, being assertive.
Showing demonstration in the forms of films/animations.	Recordings on the material explanation (auditory narration).	Reading other people's conclusions/ comments/testimonies.	Straight to practice.
Showing images.	Expert explanations (auditory narration).	Demonstrate events through analogy.	Has to be scientific explanation (reasonable).
Following in the forms of diagrams (flowcharts, concept maps).	Discussing with friends (plenty of conversations).	Reading instructions.	Straight to practice.
Selecting thoroughly (interpretation).	Reading out loud.	Searching for additional information, comparing, searching in the form of texts.	Writing.
Searching for clues.	Discussion.	Finding ideas from passages, "what is the main idea of this passage", showing relevant writings.	Practice.
Drawing/making concept map.	Discussion	Making details	Practice.
Seeing aesthetics.	Considering the information from several experts.	Providing passages (features).	Practice.
Using graphics.	Searching for experts' opinions and discussion.	Make a written review (summary).	Ask about the experience ever done.
Diagrams, flow chart.	Discussion.	Detailed explanations.	Practice, direct evidence.
Diagrams, charts, with detailed notes	Discussion online, chatting, lecture.	Books, modules.	Problem base learning, video, practice.
Making diagrams or graphics	Writing keywords and practice them, retyping. (typing activity) and dictation.	Rewriting and reading it repeatedly.	Compiling material related facts, selecting real examples.

The media are completed with the following menus: material, item examples, material summary and item practice. For the students who have not understood the concept, there are some requirements that they need to repeat the concepts they have not understood before they continue to the next material. Figure 2 portrays the scenario of ScEd-ALS learning media software design.

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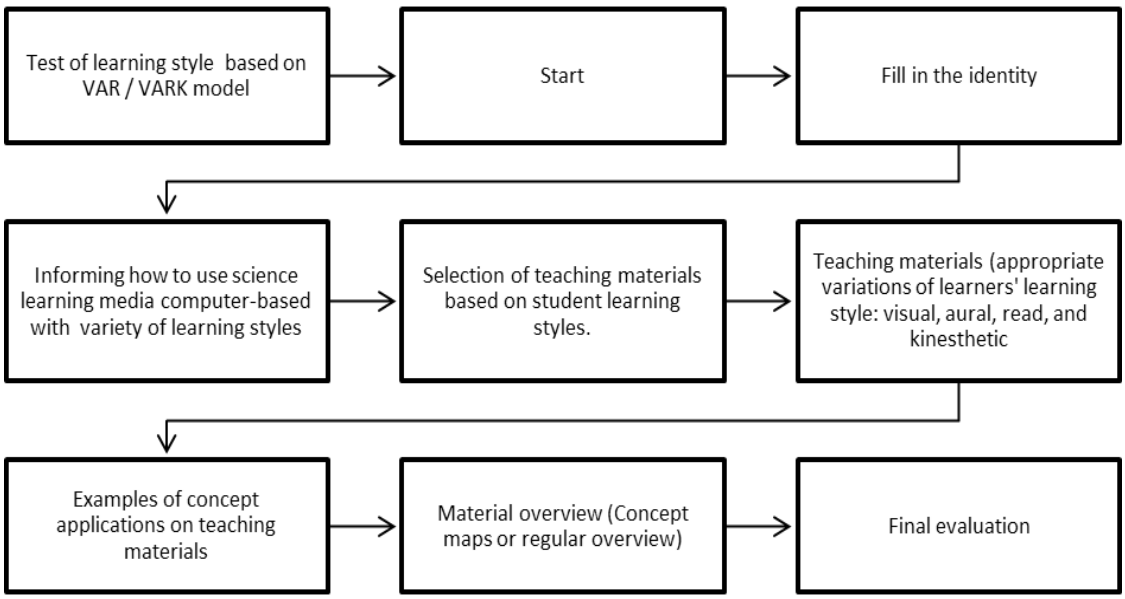

Figure 2. The scenario of ScEd-ALS learning media software design.

Prototype optimization

Prototype optimization is done through several steps. Appropriate software selection with the characteristics of the developed media prototype. Software selection is considered as one of the important stages of material selection in the process of prototype making. The software used is Adobe Flash Profesional CS 5, Audacity, Format Factory, Microsoft power point, Blue Stacks android for Windows, T2S Google Narration, and Camtasia studio. Besides the software, the hardware also influences the process of prototype making where the use of recommended hardware is minimum a laptop or a personal computer with an i3 specification above, i7 preferred with a minimum RAM of 4 Gb. The steps to perform prototype optimization are the following (Figure 3).

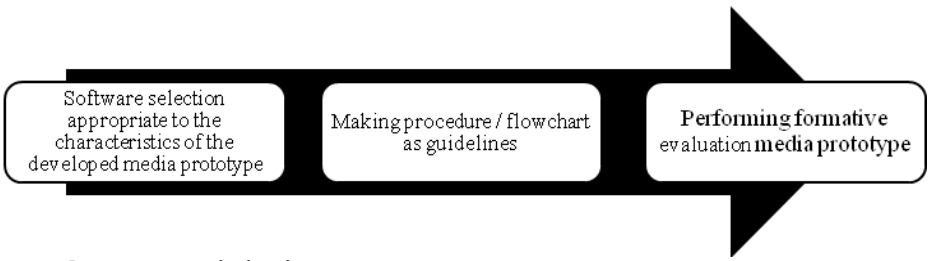

Figure 3. Prototype optimization.

Formative evaluation is the stage to evaluate the built product prototype. The used formative evaluation is the formative evaluation from Tessmer (1993), which consists of expert review, one-to-one evaluation, small group evaluation, and field research. The field research is the testing phase of the product in the field. At this stage, the prototype tested has become a prototype that assembles all the criteria and is a result of improvements from previous revisions. The effectiveness of the product can be identified through administering a post-test to the students and calculate the percentage of the students' achievement with the minimum achievement criteria. To identify the product's practicality, the teacher and the students are requested to fill-in a response questionnaire on the practicality of the used media.

3. Summative Evaluation Stage

Summative evaluation is a stage to identify the effectivity and practicality of the developed science learning media prototype addresses broad range. This stage is not done on this research.

4. Systematic Reflection and Documentation

The stage of systematic reflection and documentation is the final stage of Akker's development procedure. This stage has to visualize the process of the science learning media development, starting from the design, specification, its conceptual principles and relations are systematically narrated to picture of the research process and flow.

Sample

There were teachers and students from three schools, i.e Islamic Junior High School A, General Junior High School B and Islamic Junior High School C in Tangerang Selatan, Indonesia. Selection of the research at junior high school with respect using the following characteristics. The basic considerations of school selection include the availability of Information and Computer Technology (ICT) tools, teacher constraints, science laboratory facilities, teaching tools and material, schools which have implemented Integrated Science as Indonesia's 2013 National Curriculum recommended. The demographics sample is shown in Table 2.

Table 2. The demographics sample.

Research stage	Sample	Number	Male	Female
Preliminary research	Students from Islamic Junior High School B.	30	12	18
	Teachers from Islamic Junior High School A, Islamic Junior High School B and General Junior High School C	3	3	
Expert review	Media expert	4	2	2
	Science materials expert	5	2	3
One to one evaluation	Students from General Junior High School C	2	1	1
Small group	Small groups of students General Junior High School C	6	3	3
Field test	Students Islamic Junior High School B	30	12	18

Research Instrument

The instruments used in the research are the following: (1) preliminary research instruments, (2) product validation instruments, and (3) product effectiveness instruments.

1. *Preliminary research instruments*. It consists of VARK instrument, structured interview instrument, and questionnaire. Instrument VARK (Fleming, 2014), the preliminary instruments used to identify student's learning style as the information on the profile of the learning style appearing on year 8 students. The number of the items are 16 test items consisting of four options, visual, aural, read/write, and kinesthetic learning style characteristics. *Structured interview instrument*, the preliminary instruments used to collect information from teachers on the issues of science learning in year 8 and learning style at schools, and the use of learning media at schools. *Questionnaire,* preliminary instrument used to identify the science learning process, and the use of learning media such as computer/laptop in the science learning at schools, especially year 8. The agreed instrument uses Likert scale. The instrument employed the use of a five-point Likert scale (5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree).
2. *Product validation instruments*. The instruments used to identify the validity of the developed media. The instrument for validation is a rating questionnaire given to the educational technology experts and material experts. The questionnaire used is a rating-scale with five rating categories (4, 3, 2, 1, 0). The

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experts perform the validation on the ScEd-ALS media product in the materials of simple machines and movement apparatus (muscle and frame). Then product is divided into four categories: visual ScEd-ALS media product, aural ScEd-ALS media product, read/write ScEd-ALS media product, and kinesthetic ScEd-ALS media product. Each of the products consists of four meetings (sub concepts).

3. *Product effectivity instruments*. The instrument used to identify the media effectivity and the practicality is through the response from the users of the developed product. This instrument uses a rating-scale questionnaire with five categories (4, 3, 2, 1, 0) given during the field test. Besides using user response questionnaire, the effectiveness is also decided from the students' post-test results who have used the science learning media. It is calculated based on the percentage of the students' achievement.

Data Analysis

The collected data is then analysed. The data in this research consist of the preliminary research result (interview and students' questionnaire), expert review questionnaire (validity), students and teachers' response questionnaire. The following is the analysis on the data:

1. *Preliminary research data*, the data in this stage are in the forms of qualitative and quantitative. *The quantitative data* are: science students' learning style conditions in the general and islamic junior high schools were analyzed with the help of excel to identify the percentage of the students with visual, aural, read, or kinesthetic learning style.

   The percentage of students with the learning style:

$$= \frac{Type\ of\ learning\ style}{The\ number\ of\ students\ doing\ the\ VARK\ test}\ x\ 100\%$$

   The qualitative data are: the condition of science learning in the islamic junior high school (literature and field), the conditions of science learning mastery in both general and islamic junior high schools, and the interview result with the teachers are analyzed by taking the gist out of the data and converted through tally to change the qualitative data into quantitative data.
2. *Prototyping stage data*, the data in this stage is the program design evaluation from the following: Media/IT experts, material experts, and students. Experts' validation data was analyzed using a rating scale. The *rating scale* used are five alternative answers made into numbers 4 - 0. For a very good response is given the score = 4, good = 3, good enough = 2, not good enough = 1 and not very good = 0. The rating scale criteria are as follows (Sugiyono, 2014):
   To draw the conclusions from the media validity on each item, the following method is used:

$$Percentage = \frac{\sum Mean\ score\ of\ all\ respondents}{maximum\ score} x100\%$$

   The experts' validation conclusion used the Guttmann scale. The instrument used the "valid or invalid" scale. The decision making note is as follows:
   0 - 50% = Invalid
   51% - 100% = Valid

   Field test data, the data in this stage are quantitative data on the effectiveness of ScEd-ALS media product use. Based on the user response data: were received from the students in form of post-test score on the field's try-out. Then product effectiveness was seen through students' achievement percentage during the field research. The achievement score was received from the post-test results (Table 3). The students were deemed to have made achievement if their score is higher than the (Minimum Mastery Criteria). The calculation for the effectiveness percentage is the following:

Table 3. Effectiveness criteria based on cognitive learning results.

Percentage	Note
≥ 80%	Very effective
70% - 79%	Effective
60% - 69 %	Quite effective
50% - 59%	Less effective
< 50%	Not effective

3. *Systematic reflection and documentation data,* the following research data documentation was performed in this stage: photographs, questionnaire data, expert validation questionnaire data, ScEd-ALS media use portfolio at the general and islamic junior high schools from the preliminary study and the field research. The students and teachers' response questionnaire was analyzed using a rating scale. With the rating scale, the collected data were interpreted qualitatively. In a rating scale model scale, the respondents respond to one of the provided quantitative response. The questionnaire data were processed in two ways, the percentage of each item's response and by calculating the mean of the responses based on the score of each respondent's response.

Results of Research

Preliminary Research Stage
1.Learning Style

There were two stages on the preliminary research, which were performing literature study and field research. The results from the literature study were the variables ScEd-ALS product development as computer-based science learning media/computer-based science instructions with learning style variations. Learning style studies from 195 students (Figure 3). Then, based on the preliminary data students' learning style distribution was found to be unimodal dominated by four VARK learning styles, visual (24%), aural (63%), read/write (42%), and kinesthetic (22%) compared to multimodal learning style.

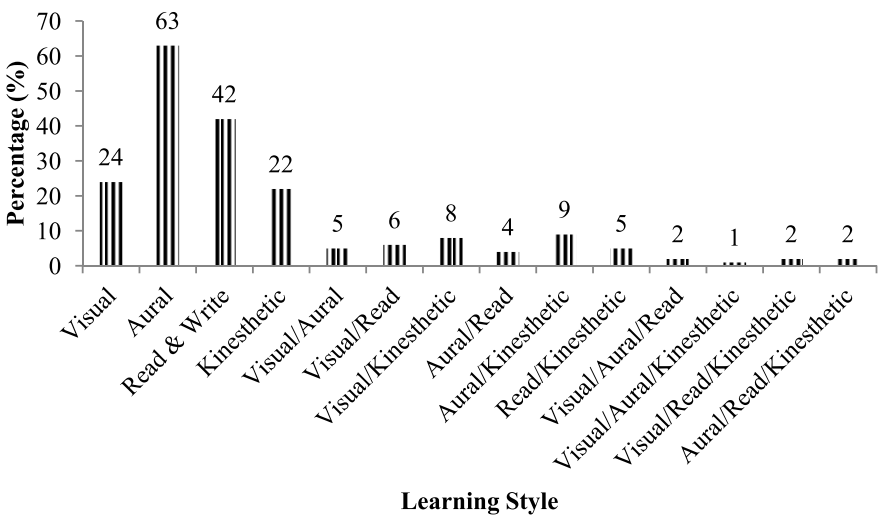

Figure 4. Learning style from 195 students for 13-14 years old.

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2. Science Learning at Schools

It can be concluded from the interview result with the teachers that in the odd semester 2017/2018 on the general and islamic junior high school level, the materials on Integrated Science, such as movement concept (35% of students) and simple machine (55% of students) have a remedial and the remedial process was done through providing new assignments or by providing extra time to study at home to be retested. The schools have had an interactive CD, science learning media, computer lab, and the laboratory to teach the materials on movement and simple machine. Then, the teachers required an alternative technique to perform remedial teaching. So far, assignment instructions were initiated through the use of internet, email, or google classroom. The use of computer-based media that accommodate science materials learning style is interesting and needed to gain quick feedback process and better material visualization. The use of this computer-based media is expected to improve the students' learning results. The next field research is through providing questionnaires to 30 students of Islamic Junior High School B in Tangerang Selatan. The preliminary research questionnaire results are the following (Table 4)

Table 4. Student response on preliminary research.

No.	Subject	Mean	SDV
1.	Science teacher often uses computer-assisted learning media such as power point, prezi and others.	3,97	0,88
2.	I understand the science materials delivered by my teacher through the use of the existing learning media.	3,97	0,60
3.	The learning media used by the teacher can improve my ways of thinking deeper on the concepts of science.	3,67	0,55
4.	I expect for computer-based learning media that show images, material explanation videos, and science evaluation items.	4,00	0,86
5.	I expect for the learning media that can relate the science concept with the daily life.	4,00	0,80
6.	I usually make use of a computer/laptop at home to work on my papers or if the assignment requires typing.	4,17	0,80
7.	I often use a computer/laptop for entertainment (social media, play games, watch movies) than for learning.	3,57	1,19

Note: Scale strongly agree (5), agree (4), neutral (3), disagree (2), strongly disagree (1)

The questionnaire results show that the students have been used to make use of computer-assisted learning media, especially to understand the science materials, to improve their deeper thinking on the concepts of science. The existing learning media can interest them to learn science. The students expect for the learning media that can show images, animation, material explanation videos, and science evaluation items. The students expect for the learning media that can relate the concepts of science in their daily life. The students can make use of their computer/laptop at home to work on their papers or if the assignments require typing.

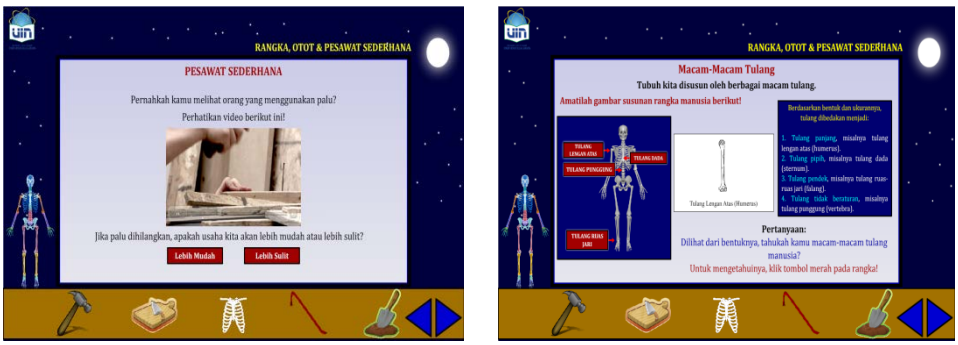
Prototyping Stage

1. Teaching material selection

The teaching materials for this research are the materials on movement and simple machines learned in year 8 semester 1st for Indonesia's 2013 National Curriculum. The material selection was based on the problems of the learning for the materials of movement and simple machines. The consideration was based on the results of the preliminary study through interviews with the teachers.

2. ScEd-ALS design development

The ScEd-ALS concept design development refers to two following components: display and content. The first component is displayed. The designed display consists of the homepage, apperception in the form of conversation, and texts accompanied by images, animations, videos, item examples and item practice (Figure 5).



Figures 5. ScEd-ALS media display development: Texts, images, animations, videos.

The second component is content. The content designed by the researchers is expected to be able to improve the students' learning result for the remedial teaching using the learning style variations. The materials on the computer-assisted media, therefore, are presented through four pedagogic acts made appropriate with the VARK learning styles.

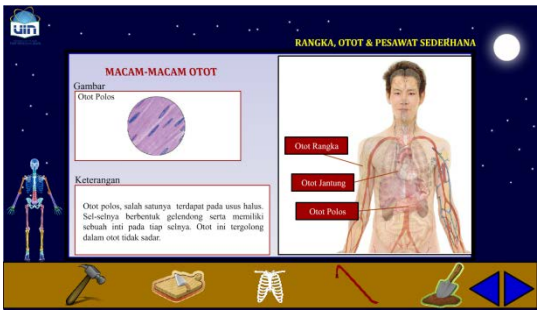
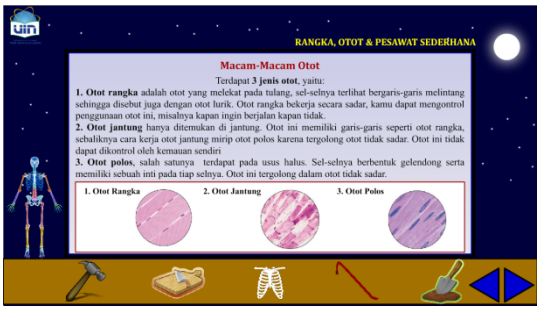
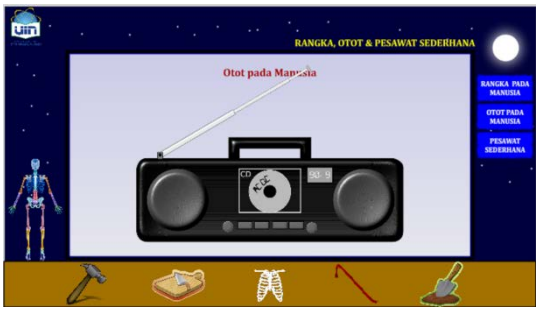
Visual learning style Design	Read & Write Learning style Design
	
Kinesthetic Learning style Design	**Aural Learning style Design**
	

Figure 6. The Examples of ScEd-ALS content design result.

2.1 ScEd-ALS software technical design

ScEd-ALS is technically designed to have a screen splash of UIN Jakarta logo after the application is run. After that the student (user) enters the user identity page, and after the identity is filled-in the student enters the homepage consisting of the buttons on the instructions manual, learning objectives, material 1, material 2, material 3, practice demo video, references, and designer profile.

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2.2 ScEd-ALS design optimization result

Software selection for the ScEd-ALS is with adobe flash professional and ispring quiz maker. Both have the function and time placements on the ScEd-ALS program design (Table 5)

Table 5. Software selection result.

Software Name	Function	Time
Adobe flash professional CS 6	Make the main template such as background and supporting animation.	Beginning to the end of the media development
Ispring quiz maker	Make the evaluation items	After the objective of the media is completed

Expert Review Result

1. Evaluation result according to media expert

Media expert declares the ScEd-ASL in each learning style is possible to use or valid. The result of media expert with four learning styles is as follows in Table 6.

Table 6. ScEd-ALS media evaluation result with four learning styles according to media expert.

Indicators	Mean Score			
	Visual	Aural	Read/ Write	Kines-thetics
Software Engineering Aspect				
Efficiency	4	4	4	3
Reliable	3,5	3	3	4
Maintainable	3,5	4	4	4
Usability	3	4	4	4
Software selection appropriate	3	4	4	3
Compatibility	3	3	3,5	4
Program maquette	3,5	4	4	4
Documentation program	3,5	4	4	3,5
Reusable	3,5	4	4	4
Visual Media Communication Aspect				
Communicative	4	4	4	3
Creative	4	4	4	4
Simple and attention getting	3,5	4	4	4
Visual	3,5	3	3	4
Layout interactive	3	3	3	3
Font selection and text size appropriate	3	3	3	3
audio selection appropriate	3	3	3	3
Image quality	4	4	4	4
Animation quality	4	3,5	3	3
Media user-friendliness	3,5	4	4	4
Mean	**3,47**	**3,66**	**3,66**	**3,61**
%	**86,84**	**91,45**	**91,45**	**90,13**
Conclusion	**Valid**	**Valid**	**Valid**	**Valid**

Note: Maximum score (4)

2. Evaluation result according to teaching material expert

Teaching material expert states ScEd-ASL is feasible to use or valid. The result of teaching material expert is as follows in Table 7.

Table 7. Evaluation result according to teaching material expert.

Indicator	Mean Score			
	Visual	Aural	Read/ Write	Kines-thetics
The appropriateness of images, animations, observation videos, and explanation videos with the materials	4	3.5	3.5	3.5
The clarity in explaining the physics formula and organ parts through texts or learning video	3.5	3.5	3.5	3.5
The clarity of item example of each material	3.5	4	4	4
The accuracy of evaluation item answer on each material	4	4	4	4
The accuracy of an answer (systematic) and does not lead to misconception on each material	4	3.5	3.5	3.5
The scope and depth of the materials	4	3.5	3.5	3.5
Mean	**3.83**	**3.67**	**3.67**	**3.67**
%	**95,75**	**91,75**	**91,75**	**91,75**
Conclusion	**Valid**	**Valid**	**Valid**	**Valid**

Note: Maximum score (4)

One-to-One Evaluation Result

The one-to-one evaluation result was performed with two students. Each of the student's from General Junior High School C, ScEd-ALS visual learning style media were used and the students were asked for their opinion (Table 8). Overall, the students gave a good opinion on the developed media.

Table 8. The evaluation result of ScEd-ALS visual learning style on One-to-one evaluation.

Aspect	Mean Score	Note
Material	3.5	Good
Learning Design	3.5	Good
Implementation	3.5	Good
Technical Quality	3	Good
Mean	**3.34**	**Good**

Note: Maximum score (4)

Small Group Evaluation Result

Small group evaluation was performed with six students and two teachers' opinions on the media from General Junior High School C were expressed. Six students have three learning styles, two students in each learning style, kinesthetic, aural, and read/write. Table 9 describes the evaluation result for three learning styles of each. The results show ScEd-ASL kinesthetic has a good response comparing to two other media (ScEd-ASL aural and read/write).

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Table 9. Student's evaluation result of ScEd-ALS kinesthetic-aural-read/write learning style on Small group evaluation.

Aspect	Mean Score					
	Kinesthetic	Note	Aural	Note	Read/Write	Note
Material	3,4	Good	2,5	Good enough	2,6	Good enough
Learning Design	3,5	Good	3,17	Good	2,33	Good enough
Implementation	3,25	Good	3,25	Good	2	Good enough
Technical Quality	3	Good	2,6	Good enough	2,9	Good enough
Mean	**3,29**	**Good**	**2,88**	**Good enough**	**2,46**	**Good enough**

Note: Maximum score (4)

Field Test

A Field test was done at Islamic Junior High School B in Tangerang Selatan with a number of 30 students. Field test was meant to identify the ScEd-ALS media effectivity to improve students' learning mastery. The students then use the ScEd-ALS media in class, where each of their learning styles has been identified. A post-test was performed at the end of the learning. The following is the result of pre-test and post-test in Table 10.

Table 10. Learning result based on learning style.

Learning style	Number of student (N)	Pre-test	Post-test	Mean n gain	N Mastery Score >75	Effectiveness (%)
		Mean/SDV	Mean/SDV			
Visual	5	52.10/5.30	68.00/9.55	0.30	1	20
Aural	8	62.5/67.13	77.50/5.63	0.24	5	63
Read/Write	11	58.9/58.19	75.27/6.65	0.51	6	55
Kinesthetic	6	57.67/5.71	79.33/3.59	0.30	6	100

The result showed the effectiveness of the use of ScEd-ASL kinesthetic (100%), aural learning style (63%), read/write learning style (55%) and visual learning style (20%). Then, each student was requested to give their opinion in relation to the ScEd-ALS media use implementation (Table 11).

Table 11. Students' evaluation result on each media aspect in the field test.

Aspect	Mean Score	Conclusion
Material	3	Good
Learning Design	3	Good
Implementation	3.5	Good
Technical Quality	3.5	Good
Mean	**3.25**	**Good**

Note: Maximum score (4)

From Table 11, student response is good to all aspects of the media, including material, learning media, implementation, and technical quality aspects.

Discussion

This result produces the Science Education Adaptive Learning System (ScEd-ALS) product as a computer-based science learning media. ScEd-ALS can become a solution to improve the students' learning result to achieve learning mastery. The developed ScEd-ALS learning media is holistically following the development procedure, appropriate, effective, and practical.

The preliminary research aims at identifying the concrete problems found in the field and to find their solutions. The researchers found that implementation of Indonesia's 2013 National Curriculum 2013 has resulted in the complexity of science learning at schools, i.e science learning is emphasized on both its learning process and evaluation. It was found that in the year 8 odd semester, incomplete learning mastery existed in the concepts of movement and simple machine. This is indicated by the percentage of 35% of student (Movement concept) and 55% (Simple Machines concept) of students following remedial test on those concepts. The full learning hours have often caused teachers to give remedial test or assignment to the students to achieve learning mastery. The commercial interactive CD has also been used as the schools' own device. The packaging of the materials is interesting, although the pedagogic intervention has not fully accommodated the students' learning style variation. Besides, feedback on the evaluation item has not precisely provided a clear guidance. The ScEd-ALS media is developed by accommodating students' learning style variation and pedagogic intervention can give a positive effect on the learning result and to achieve mastery.

This prototyping stage consists of *prototype design*; *optimizing the result of prototype design*; *formative evaluation* that consists of *expert review*, *one-to-one evaluation*, *small group evaluation*, and *field test*. In this stage, the researchers perfect the ScEd-ALS learning media by identifying the appropriateness and the students' response on the ScEd-ALS learning media. Then, the researchers revised the ScEd-ALS learning media based on the suggestions from the experts, teachers and the students, so the ScEd-ALS learning media's quality becomes better. In Field Test stage, the researchers tested the effectivity and practicality of the revised ScEd-ALS learning media. The effectivity of the *ScEd-ALS* learning media can be seen from the percentage of students who have the score ≥ Minimum Mastery Criteria (MMC) and from the teachers' response on the effectiveness of the ScEd-ALS learning media. The practicality of the ScEd-ALS learning media was obtained from the teachers and students' responses on the given ScEd-ALS.

ScEd-ALS learning media is declared worthy and appropriate by nine experts. These nine experts are four media experts and five teaching material experts. According to the media experts, the ScEd-ALS learning media has validity from the aspect of software engineering and the aspect of visual media communication. Likewise, from the material expert, the media has validity from teaching material aspect.

The *One-to-one evaluation* results show the ScEd-ALS media is good in the components of material, learning design, implementation and technical quality. The result of *Small group evaluation* shows the aspect of media (ScEd-ASL with kinesthetic) a 'good' was awarded several notes for the betterment of the media interface. From the *Field test,* it was found that the ScEd-ALS media with kinesthetic learning style is highly effective to improve the students learning mastery. Meanwhile, the lowest effectivity is on the ScEd-ALS media with visual learning style.

The research results are in line with the development of Kamardeen's (2014) adaptive e-learning that an adaptive learning approach can facilitate a more meaningful learning since it provides participation, interaction, real-time feedback, improved flexibility. Besides, the implementation of adaptive e-learning gives a good learning experience and quick feedback to immediately check for comprehension. In line with that, the development of adaptive learning in a mobile setting is a successful teaching method (Tortorella & Graf, 2010). The fact is people learn in different ways and with different learning style (Graf, Lan, & Liu, 2009; Popescu, 2010). Further research in AeLS or hypermedia has provided a fun experience for the students using internal logic system to create a specific model for the students' needs and to use the model to provide the students with an adaptive learning experience (McNutt & Brennan, 2005).

Conclusions

Research result shows the identification of students' learning style as a significant factor in learning effectiveness. Students with different learning styles also have their own different learning approach and a teacher cannot facilitate all of them at the same time. Teachers' limitation in serving all students' learning style can be anticipated through the use of Computer-Based Instructions. The conclusions from the developmental research result are the following:

1. ScEd-Adaptive Learning System as developed computer-based science learning media/computer-based science instructions is declared appropriate. The characteristics of ScEd-Adaptive Learning System as computer-based science learning media/computer-based science instructions integrate learning with the varieties of visual, aural, read/write, and kinesthetic learning style students.

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2. ScEd-Adaptive Learning System as computer-based science learning media/computer-based science instructions having kinesthetic learning has a high effectivity in improving students' learning mastery.

The unique ScEd-ALS media in the Integrated Science material is accommodating fast and slow learner according to their learning styles. ScEd-ALS as developed computer-based science learning media/computer-based science instructions is declared appropriate. Kinesthetic ScEd-ALS has a high effectivity in improving students' learning mastery. The expected effects are the following: (1) for the government, as one of the alternatives to make the process of science learning in schools more efficient with limited laboratory facilities. (2) for schools that do not have an adequate number of science teachers, but they have good IT facility can have the media to replace the needs for teachers; (3) for the students, the media can accommodate slow and fast learners by giving quick motivation/feedback; (5) for teachers, the media can be used for remedial teaching.

ScEd-Adaptive Learning System learning media as computer-based science learning media/computer-based science instructions with the learning style variations have not been measured for their mass effect. For further research, the use of the media in a setting of quasi-experiment to achieve high generalization can be used. Learning media ScEd-Adaptive Learning System as computer-based science learning media/computer-based science instructions with learning style variations are declared good by both experts and students, and the development of the media can be continued with the Android or iOS versions, so the media can be more operationally practical.

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