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Development of learning instrument of active learning strategy integrated with computer simulation in physics teaching and learning on makassar state university

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Abstract. One of the physics learning strategies in the university is active learning. Active learning strategy requires students to be able to learn independently. So that this can be realized learning should be integrated with computer simulation.This research aims to produce learning instrument of active learning strategy integrated computer simulation which are valid, and reliable on Physics Department, Makassar State University. The type of this research is a 4D Development model. The development procedure was referred to Four-D model consisted of definition phase, design phase, development phase and dissemination phase. The data analysis used Content Validity Ratio (CVR), Content Validity index and continued with reability analysis. Before used in the real class then first was conducted a limited trial test. a limited trial test aimed to avoid biased data by taking 5 students as a limited trial sample. The results obtained that physics learning instrument of active learning strategy integrated computer simulation were valid and reliabel.

1. Introduction

Higher Education in this case the lecturer has a very important role in preparing qualified human resources. Lecturers are expected to be able to choose and use learning strategies that are appropriate to the subjects as well as high thinking skills such as the ability to think critically because these skills are needed students to succeed in life. The achievement of critical thinking skills has become one of the competencies of the goals of university education in Indonesia and stated in the Competency Based Curriculum. To achieve these competencies, students need to be given learning activities that lead to the ability to understand the concepts and skills of critical thinking or high-level thinking and based on the meaningfulness of learning in accordance with their environmental context. So, to improve understanding of concept and critical thinking skills needed qualified lectures by applying learning strategies that lead to the achievement of these two competencies.

One of the functions of physics at the university is as a means of student rationalization. By studying physics, students are expected to reason and think logically, analytically, critically, and creatively. Furthermore, by studying physics, students are expected to solve all problems encountered, both problems related to the physics lesson itself and related to everyday life. In the Curriculum of Physics Department 2009, the objectives of physics learning are: (1) to train thinking and reasoning in drawing conclusions, for example through investigation, exploration, experimentation, showing similarity, difference, consistent and inconsistent; (2) develop creative activities that involve imagination, intuition, and discovery by developing divergent, original thinking, curiosity, predictions and guesswork, and experimenting; (3) developing problem-solving skills; and (4) developing the ability to interpret and explore ideas, among others, through spoken speech, charts, maps, diagrams, in explaining ideas [1].

Of course, to design and implement innovative learning oriented to the development of conceptual understanding and thinking skills required an educational tool or learning media. The application of instructional media should be able to train ways to develop the ability to comprehend the concept and thinking skills, one of which is implementing learning tools integrated with computer simulation. Computer simulation is a software that can be utilized as the main media in learning to improve the understanding of concepts and thinking skills. This is supported by the results of research Kulik found that computer simulations felt interesting, fun, improving understanding of concepts, and improve the achievement of learning outcomes when compared with traditional teaching methods especially in natural science [2].

However as good as any integrated learning device computer simulations are developed if not implemented using the right strategy then it will also not be effective. Therefore, physics lecturers are not only required to master the concept and development existing learning devices but also required to choose the right strategy for students to learn. Lecturers are required to be able to use technology as well as choosing the right learning strategy to achieve the learning objectives. In this case methods, media and time are components of learning strategies. As Dick and Carey point out, the learning strategy describes the common components of a set of instructional materials and procedures to be used with those materials to produce particular learning outcomes among students [3].

Active learning strategies can involve students with a number of activities doing certain learning activities and thinking about what they are doing. This strategy may involve students in achieving learning goals about (1) critical or creative thinking, (2) discussing in small group members or among friends, (3) conveying ideas through writing (scientific), (4) developing attitudes and (5) deliver and receive input from his or her friends, and (6) reflect on the learning process that has been done or also about the understanding of the material he or she has learned.

Therefore, based on the above description the researchers think that the importance of developing an integrated learning device computer simulation applied in physics learning used active learning strategies with the aim of students' critical thinking skills can be improved. Interesting learning process makes students more easily understand the concept. There are several characteristics of active learning strategy that is (1) encourages deep rather than surface learning; (2) is encouraged by the use of spaces which are not conventional raked lecture theatres; (3) encourage students to take ownership of their own learning; (4) tends to be more resource intensive in terms of staff time, running costs and capital investment than “chalk and talk”; and (5) can reduce the number of lecturer, releasing staff time for more active engagement with students.

2. Research method

2.1. Type of research

This research uses four-D model covering stage of definition, design, development and dissemination [4]. The results of the deployment stage are described in the next article. The definition stage aims to define the requirements of physics learning include the initial analysis of students, tasks, concepts and specifications of learning objectives. The design stage aims to prepare learning tools with active learning strategy integrated computer simulation which includes steps of media selection, format and initial design. Development stage aims to produce learning tools that have been revised by experts then conducted a limited trial of five students. after learning device and computer simulation is valid then product in this research can be used in physics learning

2.2. Subject of research

Research subjects in the learning instrument development process of this model is a learning device characterized by active learning strategy integrated computer simulation which includes textbooks, student worksheets and computer simulations.

2.3. Instruments of research

The instruments used in this study are media expert evaluation questionnaires, evaluation of physics concept experts, student activity instruments, student perception questionnaires and critical thinking skills instruments.

2.4. Data analysis techniques

Data obtained from the expert judgments were analyzed by coding, and then qualitatively described and depicting data on a continuum basis for the assessment category. Then calculate Content Validity Ratio and Content Validity Index. Assessment is valid if the CVR or CVI is in the range of 0 to 1, as follows [5]:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}} \quad (1)$$

Information:

n_e :The number of validators that provide an essential value (good or excellent)
N : Number of validators

Based on the validity of each item statement, it can be determined the validity of each aspect by using the CVI equation as follows:

$$CVI = \frac{CVR}{\sum n} \quad (2)$$

Information:

n: Number of items from each aspect if the calculated reliability value is greater than the reliability of the table.

If a statement is valid, a reliability analysis is performed using the following equation [6]:

$$r_{11} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum \sigma_b^2}{\sum \sigma_t^2}\right) \quad (3)$$

Information:

r_{11} = instrumen reliability
k = number of questions
σ_b^2 = number of questions variance
σ_t^2 = total variance

The reliability value obtained is consulted with the table reliabilitas value. Instruments are said to be reliably if the reliability of the count is greater than the reliability of the table. Data obtained through coding then analyzed descriptively quantitative.

3. Result and discussion

3.1. Result of research

Validation of learning media is done by media experts to know the validity of the media in terms of software engineering aspects, instructional design, and visual communication. Validation by expert subject to know the validity of learning device in terms of quality of content, quality of construction, and cognitive appropriateness. In addition, validation of learning tools includes Semester Learning Plan (RPS), Student Handbook (BPM), and Student Worksheet (LKM) which contains work procedures and evaluation. Here's the validation results for learning tools.

Table 1. Result of validation analysis of learning instrument.

No	Learning Instrument	Percentage (%)	CVI	Reliability
1	Computer Simulation	89,93	1,0	0,9989>0,6411>0,5140
2	Semester Learning Plan	93,435	1,0	0,9993>0,6411>0,5140
3	Student's Worksheet	90,375	1,0	0,9990>0,5751>0,4555
4	Student's Handbook	90,375	1,0	0,9990>0,5751>0,4555

From the data above can be seen that the percentage assessment of experts around 90%, with the value of CVI for all learning instruments are 1.0. This shows that all learning instrument are valid. Likewise, also with reliability count. All calculated reliability values are greater than table reliability values for 5% and 1% significance levels. While the result of validation analysis for supporting instrument as evaluation tool for student as follows:

Table 2. Result of validation analysis of supporting instrument.

No	Supporting Instrument	Percentage (%)	CVI	Reliability
1	Critical Thinking Skill	91,875	1,0	0,9992>0,7346>0,6021
2	Students Perception	97,29	1,0	0,9996>0,7346>0,6021
3	Students Activities	97,04	1,0	0,9997>0,6319>0,7646

From the data above can be seen that the percentage assessment of experts above 90%, with the value of CVI for all supporting instruments are 1.0. This shows that all learning instrument are valid. Likewise, also with count reliability. All count reliability values are greater than table reliability values for 5% and 1% significance levels. Trial stage was conducted before the actual stage on the real classroom, a limited trial of 5 students was conducted to evaluate the learning instrument integrated computer simulation that had been created.

3.2. Discussion

Based on the assessment analysis by four validators, it was found that in the assessment of learning tools that include Student Worksheets, Material Books, and Computer Simulations are in valid categories. Likewise, also with supporting instruments that include the instrument of critical thinking skills, student activity sheet and student perception questionnaire are in valid category. From reliability analysis also obtained reliable results, although there is still some content that needs to be improved, in accordance with the statement of Edward Hasted that a valid application program if it can function in accordance with its purpose and reliable if the program is able to operate accurately [7].

Computer-generated simulation program contains subjects equipped with relevant images, animations, and interactive simulations. Inclusion of images, animations, and interactive simulations is expected to help students understand the concept well. The design of computer simulation programs created in accordance with Bruner's approach to learning. The assumption states that the acquisition of knowledge is an interactive process. This interactive learning flow is an effort to stimulate students' motivation to be actively involved during learning. The series of learning that can lead the students in line with what suggested by Bruner that students should learn through active participation in learning so that they can understand the concepts or principles of an experiment conducted. With computer simulation, students can observe directly how abstract particle behaviors are in the form of simulation.

The use of technology in the teaching of science must have an enormous impact on improving the ability of science students. According to Amanda, the landscape and technologies of sciences are rapidly evolving and, for many, the scientific processes, tools, and thinking about which they are trained to promote and enhanced practices of modern sciences [8]. In addition, it is not uncommon for the sciences faculties to have little or no training in teaching methods and practices, relying on traditional appro-sors that they are familiar, such as direct instruction by lecturer, rather than diverse non-traditional approaches to teach that are advocated by current research [9].

Some studies in the field of education show that science lectures are not effective because there are still many lecturers who teach in one direction, this learning system leads to passive students in following the lectures. Active learning is the only way to engage students on levels beyond knowledge and understanding, and that, to reach higher orders of science literacy, we must engage not only in theories of history and theory that represents science, but the process, context and practices as well [7]. Active learning, or Interactive Engagement shifts the concept of scientific thinking, application of process skills, problem solving and modeling of the behaviors of science in tandem with scientific concepts [10]. This includes the use of discussion, group engagement, scenarios, and other hands on and "minds on" exercises that both student knowledge and knowledge in undergraduate sciences [11, 12]. This is quite difficult for learning with a large number of students, but with the development of technology it can be overcome. Technology gives us wide range of options to activate learning course on learning and interest in the course of science courses [7]. In addition, with active learning strategies integrated with computer simulations, a major obstacle facing science faculty about the lack of laboratory equipment and time constraints as Robinson's opinion states that many faculty members in teaching positions have little to no formal training in pedagogical approaches to teaching and limited time to devote or changing their approaches [13], can be overcome.

4. Conclusion

Based on the data of the research results, it can be concluded that learning tools are characterized by active learning strategies integrated with valid and reliable computer simulations. Likewise also with the developed instrument is in the category valid. Therefore, these tools and instruments can be used in physics learning.

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References

[1] Physics Department 2009 *Physics Department Curriculum of Mathematic and Natural Science Faculty*, Makassar State University

[2] Kulik J A 2003 *Effects of Using Instructional Technology in Elementary and Secondary Schools: What Controlled Evaluation Studies Say* (Arlington VA: SRI International)

[3] Dick W and Carey L 1985 *The Systematic Design of Instruction* (2^{nd} Ed.) (Glenview, Illinois:Scott, Foresman and Company)

[4] Swandi A, Amin, Haris A and Subaer 2015 Development of Virtual Laboratory Hypermedia Based on Atomic Physics at Sman 1 Pinrang *Proceeding of International Conference on Research, Implementation And Education Of Mathematics And Sciences* **1**(1): 7-8

[5] Lawshe C H 1975 *A Quantitive Approach to Content Validity* Chicago: Personal Psychology.

[6] A Swandi and B D Amin 2016 The Development of Student's Worksheet Based on Virtual Simulation and Its Influence on Physics Learning Outcomes of Students *Proceeding of International Conference on Mathematics, Science, Technology, Education and Their Application*: **244-**251

[7] Hasted E 2005 *Software That Sells: A Practical Guide to Developing and Marketing Your Software Project* (Indianapolis: Wiley Publishing Inc)
[8] Amanda L G 2018 Teaching and Learning Science in the 21st Century: Challenging Critical Assumptions in Post-Secondary *Sciences Educ. Sci*. **8**,12
[9] Brownell S E and Tanner K D 2012 Barriers to faculty pedagogical change: Lack of training, time, incentives and tensions with professional identity *CBE Life Sci. Educ.* **11** 339–346.
[10] Talbot B B 2014 *Active Learning in Undergraduate Science*
[11] Freeman S, Eddy S L, McDonough M, Smith M K, Okorofoar N, Jordt H and Wenderoth M P 2014 Active learning increases students performance in science, engineering, and mathematics *Proc. Natl. Acad. Sci. USA.* ***111*** 8410-8415
[12] Mathias A 2014 *Active Learning in the Science Classroom*
[13] Robinson TE and Hope W C 2013 Teaching in higher education: Is there a need for training in pedagogy in graduate degree programs. *Res. High. Educ. J*. **21** 1–11