

Development of instrument critical and creative thinking skills on fluids motion

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Abstract. 21st century skills focus on critical thinking skills, creative thinking skills, communication skills and collaboration skills. The student critical and creative thinking skills are defined as the ability of student use their knowledge to solve problems of everyday life and create a new innovation. The main goal of this study developed to measured critical and creative thinking skills for student in senior high school. The instrument has 34 items consist of 18 items critical thinking skills and 16 items creative thinking skills. All instrument have been validated by three expert judgement. So, the instrument obtained 17 items consist of nine items critical thinking skills and eight items creative thinking skills. This research use descriptive qualitative research method. The results development instrument test show all items are valid through the Pearson moment correlation coefficient test. Based on expert assessment and data collection, instruments were well developed and could be used to measure students' critical and creative thinking skills on the concept of fluids motion.

1. Introduction

The skills considered most essential in our modern societies are often called 21st century skills [1]. The US-based partnership for 21st century skills [2] argues that student success in college and careers requires for essential skills:creativity and problem solving, critical thinking and problem solving, communication and collaboration. The 2012 NRC [3] has argued the importance of 21st century skills lie in society's desire for all students to attain levels of mastery across multiple areas of skill and knowledge that were previously unnecessary for individual success in education and the workplace.

In this research develop to measuared critical and creative thinking skills proposed by the Partnership for 21st century learning team. So, this instrument must be validated by an expert lecturer. According to Arikunto [4] a test is considered good if it has two test requirements, namely validity and reliability. So, researchers have to analyze each item they employed.

Generally teachers trained critical thinking skills during teaching by asking orally about physical phenomena. Whereas critical and creative students can be seen through experiment.

Problem finding is an important component of creativity, but research on it does not offer much guidance to teaching. The present research takes a step in that direction with two investigations [5].

Partnership for 21st century learning [6] explained creative and innovation have eight indicators namely use a wide range of idea creation techniques (such as brainstorming), create new and worthwhile ideas (both incremental and radical concepts), elaborate, refine, analyze and evaluate their

own ideas in order to improve and maximize creative efforts, develop, implement and communicate new ideas to others effectively, be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work, demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas, view failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes, and an act on creative ideas to make a tangible and useful contribution to the field in which the innovation will occur. And then, critical thinking and problem solving have nine indicators namely use various types of reasoning as appropriate to the situation, analyze how parts of a whole interact with each other to produce overall outcomes in complex systems, effectively analyze and evaluate evidence, arguments, claims and beliefs, analyze and evaluate major alternative points of view, synthesize and make connections between information and arguments, interpret information and draw conclusions based on the best analysis, reflect critically on learning experiences and processes, solve different kinds of non-familiar problems in both conventional and innovative ways, and identify and ask significant questions that clarify various points of view and lead to better solutions.

The development of test instruments used open-ended questions as a means for creative and critical thinking of high school students [7]. Based on research Rohayati Open-Ended is a learning approach that begins by giving non-routine issues that are open, meaning that the type of problem given has many correct ways of settling. In addition, Open-Ended learning can help develop creative activities and can provide an opportunity for students to investigate the various strategies and ways that he believes in accordance with his elaboration capabilities [8]. Pelfrey as cited in Azizah, *Open-ended problems* are questions or problems that have more than one possible answer and more than one strategies to answer [9]. Based on the above, the researchers interested in developing an open-ended questions-based creative and critical thinking skill instrument validated by several expert lecturers.

2. Method

This research and development is done until the level of development of the instrument until it is feasible to be tested. The participants of limited test were from one of the classes in senior high school in Kabupaten Bandung which has 42 students. They were selected using random sampling.

The developed assessment instrument of creative and critical thinking skills were examined on instrument validity sheets. Validity sheets contains assessments of instrument contents and constructions, and validated by three expert lecturers. Those assessment instruments were in the form of essays on *open-ended* problems, consist of 34 items, examined to the expert lecturers to obtain empirical validity, so the quality of the developed instrument can be tested to the students. so, the validation results can be used to measure students' creative and critical thinking skills.

Analysing items, including validity analysis, reliability, and discrimination power, were used to identify quality of instrument. Validity was counted by employing Pearson's correlation coefficient [10]

$$r_{xy} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{\{N \sum X^2 - (\sum X)^2\} \{N \sum Y^2 - (\sum Y)^2\}}}$$

3. Result and Discussion

This research were 17 items of assessment instrument which were validated by expert lecturers. They covered an 17 items from 34 items. The results of expert lectures validation were shown in the table below:

Table 1. Recapitulation Results of Content Validity 17 item from 34 item tests

Lecturer	CCTS Indicators	Comment
1	Use various types of reasoning; Analyze how parts of a whole interact in complex systems; identify various points of view and lead to better solutions; create new and worthwhile ideas; be open and responsive to new and diverse perspective	All indicators valid with improvement
2	17 indicators of CCTS	All indicators were validated and can be tested
3	Interpret information on the best analysis; Solve different kinds of non-familiar problems in both conventional and innovative ways; understand that creativity and innovations is a long term	All indicators valid with improvement

Table 1 shows that there are several indicators need to be improved to make it feasible use. And then, some phenomena about fluids motion described from the problem there is a phenomenon too broad and less challenging. So, the indicator of the problem must be fixed. All instrument consists of 34 validated test items consisting of 16 tests of creative thinking skill items and 18 tests of critical thinking skill items so that of 34 validation and feasible questions are 17 items. so the worthy instrument used consists of eight tests of creative thinking items and nine test items of critical thinking skills.

4. Conclusion

Present study concluded the characteristics of assessment instrument creative and critical thinking skills in physics for senior should still bring the concept implicitly. As a result, further instrument development should discuss the phenomena that occur in everyday life widely and deeply. Based on analysis the validation results by three expert lecturers found that 17 items that can be tested with various inputs, especially about the context of the problem that must be challenged to be tested in high school students.

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6. References

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