Development and implementation of creative, solutive and smart teaching (CS2T) to improve 21st century capability on wave and optics

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Abstract. The aim of this research was to develop and implement Creative, Solutive and Smart Teaching (CS2T) to improve 21st century capabilities on wave and optics. The CS2T is a learning approach that encompasses clusters of students employed collected to elucidate a problematic, comprehensive assignment, or produce a creation. We have already utilized the ADDIE model (Analysing, Designing, Developing, Implementing and Evaluating) as a research method. The samples are 37 students (15 boys and 22 girls, their ages were an average of 18 years old) at one of the primary educations in the West Java province of Indonesia on wave and optics topic. The improvement of 21st century capabilities has been diagnosed through a creative thinking instrument (CTI), problem solving test (PST) and observation sheet (OS). In the evaluating phase, the CS2T is able to improve student’s capabilities in employed collected and improve the realization of learning effects. In conclusion, primary students' skills are able to be improved through CS2T on wave and optics topic.

1. Introduction
In 21st century, there are particular imperative challenges that will composition an essential part [1-3]. First, a hurriedly increase global inter requirement that will consequence in limited assortment as well as further recurrent and forceful struggles [4,5]. In the 21st century individuals need the abilities to the promotion and preserve supportive hard work to accomplish the growing interdependence in the midst of areas, states, societies, groups, and personalities. Schools could be the main situation in which persons will study how to ensure so. Furthermore, the other challenge is the need aimed at creative industrialists [6,7]. The financial forthcoming of civilizations be contingent on their competence to produce, fascinate, and sustenance gifted, innovative, and creative entrepreneurs [1]. For the reason that creative entrepreneurs are exceedingly movable, states through the uppermost feature of life expectancy will fascinate the highest quantity of creative industrialists. The trial for educational coordination in every
state is to create creative industrialists who will then subsidize to the forthcoming economic wellbeing of the state [8, 9].

The global challenges of 21st century have demanded the school to produce the students that have 21st century capabilities [10, 11]. Farisi [12] states that 21st century capabilities are the indispensable abilities which should be dispersed addicted to educational structure, together with (1) learning and improvement abilities (critical thinking, problem solving, creative, innovation, communication and teamwork), (2) information, media and technology abilities (data, media and ICT literateness), and (3) life expectancy and career abilities (litheness and adaptableness, inventiveness and self-direction, societal and multicultural abilities, output and responsibility, and guidance and accountability).

It is imperative to create students who sanctuary up and doing through modification, have critical thinking and creative, discovery functioning explanations to the problems that they entrance and countersign to the people they cognisant in. Therefore, learning innovation must be thorough to advance students’ 21st century capabilities, one of them is Creative, Solutive and Smart Teaching (CS2T). The CS2T is a learning approach that encompasses clusters of students employed collected to elucidate a problematic, comprehensive assignment, or produce a creation. The CS2T focused on student’s capability based on creative, solutive and smart ability as 21st century capabilities.

The improvement of 21st century capability is actually desirable through students [13, 14]. It is because their capabilities will be used in the learning process (especially in science learning) to understanding every concept and completes the problem solving [15]. However, often the students have the weak ability to described scientific phenomena [16, 17], such as in wave and optic concepts. Even though, the wave and optics concepts are very close with daily life as sound waves (music, reverberation, etc.), light waves (lamp, laser, etc.) or the rainbow formation after rain. For the rainbow formation, students cannot explain the phenomena through the scientific explanation that they have learned about reflection, refraction and dispersion. The colours of rainbow due to dispersion events will be the same with the dispersion of light by prisms in Figure 1.

\[\text{Figure 1. Dispersion of light by the glass prism}\]

Therefore, 21st century capability must be improved so students can think creatively, critically, solutively and solve any problem. So, the aim of this study was to develop and implement the CS2T to improve 21st century capability of the wave and optic concepts.

2. Methods

The ADDIE model (Analysing, Designing, Developing, Implementing and Evaluating) have already utilized as a research method [18]. The samples are 37 students (15 boys and 22 girls, their ages were an average of 18 years old) at one of the primary educations in the West Java province of Indonesia on wave and optics topic. The improvement of 21st century capabilities has been diagnosed through a Creative Thinking Instrument (CTI), Problem Solving Test (PST) and Observation Sheet (OS). The CTI and PST were used to analysis the 21st century capability and OS was used as a guide for observation during learning wave and optic concepts. The instrument was analysis to distinguish the improvement of 21st century capability.
3. Result and Discussion

We have been developed and implement the CS2T to primary education students. The ADDIE models have been encompassed spread stages: Analyzing, Designing, Developing, Implementing and Evaluating as weigh up as tracks below.

3.1. Analyzing

On the analyzing stage, we classify and choose some of the 21st century capability by undertaking literature studies and field studies as described in Figure 2.

![Figure 2. Process analysis to regurgitate CS2T learning method](image)

The literature studies were done for collecting the information such as learn about curriculum related with subject and time allocation which are obtainable. Furthermore, literature studies also were done to learning and organize the teaching materials. The field studies were done for observing directly about learning conditions in the classroom, potential possessed, learning process and students’ documents about outcome study. As of the unfathomable analysis, the CS2T was raised as a learning method. The CS2T provides a learning distinction that trained the problem solving and solutive capability, creative capability and smart as a substantial strengthening of basic science concepts.

3.2. Designing

At the designing stage, we design the learning process of CS2T. In other words, the design of learning process is a stage to assembly the syllabus. The creating of the syllabus contains some elements they are identification of core competencies, identification of student’s initial characteristics and capabilities, analysis and determination of basic competencies, formulation of achievement indicators, preparation of 21st century capability tests, development of learning strategies, and development of CS2T learning model.

3.3. Developing

After design the learning process, developed the CS2T learning method was done. The developing of CS2T can be described in Figure 3 as follow.

![Figure 3. Process develop the CS2T learning method](image)
At this stage, the entire component in the learning process such as learning media or 21st century capability test was developed based on the design stage. For example, the PST was developed from problem solving indicators (identification, hypothesis argument, analysis synthesis and alternative solutions). Another example is the development of learning media. The stages in the development of learning media are completed through the steps (1) create a flowchart that used as a navigation stream on the developed learning media, (2) collecting all of the support materials such as clip art images, animations, pictures, sounds and others that used to create media, (3) create a storyboard that used to create the correct frames, and (4) producing materials via computer using “professional macromedia flash 8.0” based on storyboard and flowchart.

3.4. Implementing
At the implementing stage, three kinds of trials are tested, they are one to one, small group evaluation and field trip trials. The purpose of one to one test is to obtain empirical evidence of the limited feasibility of the initial product. All data obtained at this stage are equipped and analyzed to revise the product. In small group evaluation, tested to a group of students by contributing the pre-test, asking students to study the learning media, giving the post-test, distributing questionnaires, analyzing the data collected and revising the media to be used. The stage trip field trials conducted with the aim to determine whether the resulting product already has a feasibility, whether viewed from aspects of lectures, content or material, display and programming accordingly feasible to use in the learning process with CS2T.

3.5. Evaluating
At the evaluating stage, we evaluate the instrument that was used in this research. The result of CTI and PTS with some indicators at post-test shown in Figure 4.

![Figure 4. The result of CTI and PTS](image)

From Figure 4, we can see that 34.61% students already exist have interpret the outcome of an investigate capability (reasoning), 50% students exist have concluding a right statement from a specified information fixed capability (rationale analysis), 18.26% students already have envisaged the likelihood of occurrence capability (possibility and falteringly analysis) and 71.15% students already have recognised the unsurpassed between a number of alternate in solving of problem capability (problem solving). From Figure 4 it can be concluded that the capability of possibility and falteringly analysis of students is stumpy. This is in agreement with the Corrado [19] and Palmer [20] opinion that the ability of possibility and falteringly analysis is difficult to be improved. After the scoring process, we can know more about the improvement of 21st century capability of students used normalized gain (n-gain).
Students’ score of pre-tests is 4.7 and score of post-tests is 8.6 for the maximum score is 10. After calculating with n-gain formula, we acquire 0.74 for n-gain. Based on the criteria, if n-gain more than 0.7 it can be concluding that CS2T can improve 21st century capability with high category [21]. Therefore, teachers can use CS2T in the classroom to improve student’s 21st century capability, especially on problem solving indicator.

4. Conclusion
Based on the analysis through ADDIE (Analyzing, Designing, Developing, Implementing and Evaluating) models to the development and implementation Creative, Solutive and Smart Teaching (CS2T), it can be unwavering that CS2T can improve primary student’s 21st century capability on the wave and optic concepts. From the data, problem solving capability increase to 71.15% and n-gain test show that CS2T can improve student’s capability in high category.

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