Learning progression of madrasah aliyah-students in remedial teaching about interaction of an electrically charged object with a neutral object concept using CSCCText

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Abstract. The objective of this study was to construct and test Computer Supported Conceptual Change Text (CSCCText) for facilitating students' learning progression in remedial teaching about static electricity concept. The pre-experiment method was using as a research method with a one group pretest-posttest design. The study is based on 30 students in one of Madrasah Aliyah in Bandung city. Students' conceptions and confidence levels are identified in the part-I and part-IV of CSCCText. CSCCText was designed based on students' misconceptions by following six-phase Conceptual Change Model (CCM) synthesized by Stepans with the reliability is 0.8 (high). Students' learning progression about the interaction of an electrically charged object with a neutral object concept was evaluated by comparing the initial conceptions of students identified in part-I of CSCCText with the final conception of students identified in part-IV of CSCCText. Data were analyzed using quantitative approach. The types of learning progression reviewed include: consistent with scientific conception type, well progression type, no progression type and degraded type. From quantitative analyses suggest that the use of CSCCText in the remedial teaching of static electrical concept were facilitated students' learning progression. Of the total subjects, 7 % were in consistent with scientific conceptions type, 73 % were in well-progression types, 20 % were in no-progression and 0% were degraded type. This results shows that the use of CSCCText has a medium effectiveness in facilitating students' learning progression in the well-progression type.

1. Introduction

Misconception is one of the most crucial issues in physics teaching and learning. Misconception is found in almost all Physics content at high school level. Misconceptions are resistant to change with scientific ones and students may reject accepting new ideas [1] and they are obstacles for students in learning and to make meaningful understanding of some concepts in science.

In the physics teaching which using traditional methods, the chances for the occurrence of misconception are considerable, especially for physical content containing abstract and microscopic phenomena. Misconceptions that occur in students should not be left and must be addressed so as not to affect the failure of students in understanding the whole concept of static electricity.
Many different methods and strategies have been used in removing misconceptions such as multiple intelligence theory, meaningful learning, constructivist learning, mind map, semantic analysis tables, concept network, conceptual change texts, work sheets, computer-assisted instruction, analogies (simile) and metaphors. Conceptual change texts and computer-assisted instruction have been used in this research in order to remove misconceptions on the subject of radioactivity.

Conceptual change text is one of the quite powerful approach used in the process of remediation of misconception Physics. Conceptual change texts were firstly developed by Wang and Andre in 1991 [2]. In conceptual change texts, firstly students are ensured to be aware of their misconceptions. After that, the reasons of these misconceptions are explained through examples and reasons. Students feel that their knowledge is insufficient in explaining new situations that they meet and conceptual change is ensured by showing them the concepts that are scientifically correct [3].

Until today, there have been different researches on the effect of conceptual change texts on removing misconceptions. In some researches, effects of conceptual change texts and traditional texts on teaching concepts and removing misconceptions were compared [4]. At the end of these researches, it was determined that conceptual change texts are more effective than traditional texts in teaching concept and removing misconceptions. On the other hand, in their study, Diakidoy, Kendeou and Ioannides compared the effects of conceptual change texts and traditional method on conceptual learning [5]. As a result of their study, conceptual change texts were more effective than traditional methods in terms of conceptual success. Yılmaz made a similar study and found out that conceptual change texts were more effective than traditional method in removing misconceptions [6].

To give student understanding on the physical contents that contain microscopic or abstract phenomena phenomena required a teaching media that can visualize the phenomenon. One of the media that can be used is a virtual simulation of microscopic physics phenomena [7]. Because the virtual simulation media microscopic phenomenon can only run on the computer, then CCText and virtual media must be integrated packaged in computer format. CCText packaging in computer format is then given the term Computer Supported Conceptual Change Text (CSCCText). In CSCCText can also be enriched with other visual impressions such as images (photos) and video.

One of the physical content that contains microscopic objects is the statical electricity content. One of the concepts covered in static electricity content is the concept of interaction between an electrically charged object and a neutral object. The electrical interaction between two objects is controlled by the type of electrical charge on both objects. The type of electrical charge on an object is determined by the electron content of the object. Both objects will attract each other when the positive charge on one object is confronted with a negative charge on another.

In this study, development and test of CSCCText related to the concept of interaction between electrically charged objects and neutral objects has been done. CSCCText was designed based on students’ misconceptions by following six-steps Conceptual Change Model (CCM) synthesized by Stepans, consisting of: The first step aims at helping learners become aware of their own thinking in order to help them commit to a problem or challenge and make predictions to an outcome before starting any activity. The second step aims at helping learners expose their beliefs and share ideas with classmates before testing these ideas. The third step aims at helping learners confront their existing ideas by testing them in small groups. The fourth step aims at helping learners benefit from class discussions to accommodate the new concept and resolve any existing conflicts. The fifth step aims at helping learners extend the concept by making connections between the concept they have learned in class and other related concepts and ideas. Finally, the sixth step aims at helping learners go beyond the concept through pursuing new ideas related to the concept they have learned in class [8].

Learning progression describes an ongoing series of how one's knowledge changes in a better over time [9,10]. Related to the conceptual change in the learning activity, learning progression can be used to describe the process of change of conception that occurs between the initial state and the final state of the remedial teaching process. Based on the tendency to change the conception from the initial state to the final state of remedial teaching, there are four types of learning progression that can be used to
describe patterns of conceptual changes that occur in students during the remedial teaching process, as shown in Table 1.

**Table 1.** Types of learning progression are associated with patterns change of conception during remedial teaching.

| No | Pattern of Conception Change | Type of Learning Progression |
|----|-----------------------------|-------------------------------|
| 1  | Scientific conception        | Tipe I : Consistent on scientific conception |
| 2  | Misconception/ Lack of knowledge | Tipe II: well progressed |
| 3  | Misconception/ Lack of knowledge | Tipe III: not progressing |
| 4  | Scientific conception        | Tipe IV: degraded |

This paper describes the results of CSCCText development related to the interaction between electrically charged objects and neutral objects concept and its implementation in the remedial teaching of statical electricity concept to facilitate madrasah aliyah school students to achieve type II of learning progression.

2. **Research method**

The method used in this research is the pre-experiment method with the one group pretest-posttest design. Participants in this study comprised of 30 students (13 boys and 17 girls) at one Madrasah Aliyah school in Bandung city. The sample was chosen purposely. Because of the CSCCText is used in remedial teaching, then as a sample selected students who have followed the static electricity content learning regularly in their class. Duration of the CSCCText activity in the remedial teaching was 45-min periods. To assess students’ learning progression as effect of CSCCText activity, a Static Electricity Conceptual Test (SECT) consisting of six items was developed based on the alternative conceptions in four-tier multiple choice test format. To identify the student conception at before and after following CSCCText activity based on conception test results, the data analysis technique as proposed by Kirbulut and Geban in ref. 11 has been used.

**Table 2.** Category of the effectiveness of CSCCText in facilitating students.

| Quantity of students (R) reaching the learning progression on a well-progressed type during CSCCText activity (%) | Category of effectiveness |
|---------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 75 < R ≤ 100                                                                                                                                                         | High                      |
| 50 < R ≤ 75                                                                                                                                                          | Medium                    |
| R ≤ 50                                                                                                                                                              | Low                       |


The effectiveness of CSCCText in facilitating madrasah aliyah students in reach the learning progression on a well-progressed type is determined by calculating the quantity of students who are in the well-progressed type during CSCCText activities. Table 2 shows the category of effectiveness of CSCCText in facilitating madrasah aliyah students in achieving the learning progression on a well-progressed type.

3. Result and discussion

3.1. Computer Supported Conceptual Change Text (CSCCText)

In the part-I of CSCCText, students' pre conception was elicited. Students are asked to watch the Picture about the electrical interaction between two electrically charged particles. Then the students are asked to express their conception about the interaction between an electrically charged object and a neutral object. In addition, students are also asked to provide an explanation for their conceptions and the level of confidence in their concepts. At the part-II of CSCCText, a confrontation process of conception takes place, students are asked to observe video about the interaction between an electrically charged object and a neutral object presented in CSCCText. The student is asked to compare the conceptions he has had with the actual phenomenon that he has seen on the video, allowing for the occurrence of cognitive conflicts in their minds. At the part-III of CSCCText presented scientific explanation about the interaction between an electrically charged object and a neutral object with explanation down to the microscopic level using various visual media such as virtual simulation, fixture of object and video. Interactively students asked to study the scientific explanation presented at CSCCText until there is an accommodation process of new scientific conception to replace the old false conception (see figure 1).

Figure 1. The attract interaction between an electrically charged object and a neutral object.

Figure 2 shows the simulation video of electrical induction that occurs on a neutral object such as pieces of paper when approached by an electrically charged object such as a plastic ruler that has been rubbed into the hair. When a neutral object is approached by a positively charged object, the negative charge on the neutral object will move closer to a positive electrically charged so that in the neutral object the electrical charge will be polarized. Because the negative charge on the neutral object faces each other with a positive charge on an electrically charged object, the two objects will attract each other. Similarly, when a neutral object is approached by a negatively charged electric object, on a neutral object the electrical charge will be a polarized which makes the positive charge formation on the neutral object to be faced with a negative charge on an electrically charged object so that the two objects will attract each other. So between an electrically charged object and a neutral object there will always be attract interactions.

Figure 2. The process of electrical induction on a neutral object when approached by an electrically charged object.
3.2. Students learning progression
Figure 3 shows a map of conceptual changes that occur during CSCCText activity from part-I to part-VI of CSCCText and to a delayed posttest.

![Map of conceptual change during CSCCText activity.](image)

It can be seen that 2 students are consistent with scientific conception, 16 students change from misconception to scientific conception, 6 students change from lack of knowledge to scientific conception, 2 students remain in misconception condition and 4 students remain in state lack of knowledge. Based on data of the number of students on each type of conceptual change in figure 3 can be determined the percentage of the number of students on each type of learning progression as shown in figure 4.

![Bar chart of the percentage of madrasah aliyah students on each type of learning progression that occurs in the interaction between an electrically charged object and a neutral object.](image)

3.3. Discussion
The success of CSCCText in the remediation of misconceptions is determined by the success of the confrontation of conception process presented in the part-II of CSCCText in creating cognitive conflict in the students’ minds who undermine their belief in their conception [11]. CSCText aims at helping readers to replace their misconceptions with scientific conceptions. According to Roth, stages of conceptual change text direct questions to the relevant individuals with the aim of uncovering their
existing misconceptions (dissatisfaction), challenge to existing misconceptions by using analogies (intelligibility), give the formal definitions of the concepts (plausibility) and provide new conditions for applying the new concept (fruitfulness) [12].

These results are consistent with the result of previous research on the use of CSIM (computer supported instruction material) in learning optical material [13]. The results showed that the learning activities using CSIM is effective in building scientific conception in students’ minds. However, despite the alternative conception in the minds of most students can be changed with the help of CSIM, it turns out there are a number of students who are resistant to concept modification. Students have difficulty in changing their former conception into the new scientific conception allegedly due to the fact or physical phenomena that are presented in the learning process are not so logically acceptable for them. It is closely related with the fact that each student has a learning style and intelligence of their own which can differ from one another, so that there is possibility of any individual cannot get the same results or benefits from the learning process carried out by the lecturer.

The effectiveness of CSCCText in the remediation of misconceptions that occured in the interaction between an electrically charged object and a neutral object concept that are classified as an abstract concept can not be separated from the role of visualization media used in concreting abstract phenomena to be real. Concretizing concepts that represent abstract issues is very important in order to understand them correctly. Computer assisted materials that are used to concretize concepts enable to show many processes to students which are imposible to show; thus, it becomes possible to remove students’ misconceptions and prevent any possible misconceptions [14].

4. Conclusion
The use of CSCCText on the remedial teaching of the concept of interaction between electrically charged objects and neutral objects has a moderate effectiveness in facilitating madrasah aliyah students to reach the learning progression on a well-progressed type

References
[1] Hynd C R, McNish M M, Qian G, Keith M and Lay K 2015 available from: curry.virginia.edu/go/clc/nrrc/phys_r16.html
[2] Wang T and Andre T 1991 Contemporary Educational Psychology 16 2 103-116
[3] Guzzetti B J, Snyder T E and Glass G V 1992 Journal of Reading 35 8 642-649
[4] Mikkila E M 2001 Learning and Instruction 11 3 241-257
[5] Diakidoy I A N, Kendeou P and Ioannides C 2003 Educational Psychology 28 3 335-356
[6] Yilmaz Z A 2010 (Turkey: Ataturk University/Institute of Science: Ph. D Thesis)
[7] Wibowo F C, Suhandi A, Rusdiana D, Ruhiat Y, Darman D R and Samsudin A 2017 Advanced Science letters 23 2 843-843
[8] Stephans S 2011 Targeting students’ science misconception: Using the conceptual change model (Sticloud, MN: Saiwood Publications)
[9] Plummer J D, Palma C, Flareand A, Rubin K A, Ong Y S and Botzer P 2015 International Journal of Science Education 37 9 1381-1401
[10] Torija B B and Alexandre M P J 2017 International Journal of Science and Mathematics Education 16 4 619 - 638
[11] Madu B C and Orji E 2015 SAGE Open 1-9
[12] Roth K J 1985 Annual meeting of the American Education Research Association Chicago
[13] Cepni S 2009 Energy Education Science and Technology Part B: Social and Educational Studies 1 2 51-83
[14] Yumusak A, Maras I and Sahin M 2015 Journal for Education of Gifted Young Scientists 3 2 23-50