Level conceptual change pre-service elementary teachers on electric current conceptions through visual multimedia supported conceptual change

N Hermita1,2*, A Suhandi2,3, E Syaodih2,4, A Samsudin3, H Marhadi1, S Sapriadil1, Z Zaenudin4, C Rochman5, M Mansur3,6 and F C Wibowo7

1Program Studi PGSD FKIP, Universitas Riau, Pekanbaru, Indonesia
2Program Studi Pendidikan Dasar, Universitas Pendidikan Indonesia, Bandung, Indonesia
3Departemen Pendidikan Fisika, Universitas Pendidikan Indonesia, Bandung, Indonesia
4Program Studi PGPAUD, Universitas Pendidikan Indonesia, Bandung, Indonesia
5Program Studi Pendidikan Fisika, UIN Sunan Gunung Djati, Bandung, Indonesia
6Jurusan Pendidikan Guru Madrasah Ibtidaiyah, Universitas Islam Negeri Sultan Maulana Hasamuddin Banten, Serang, Indonesia
7Program Studi Pendidikan Fisika, Universitas Sultan Ageng Tirtayasa, Kota Serang, Indonesia

*Corresponding author’s e-mail: neni.hermite@lecturer.unri.ac.id

Abstract. Now a day, conceptual change is the most valuable issues in the science education perspective, especially in the elementary education. Researchers have already dial with the aim of the research to increase level conceptual change process on the electric conceptions through Visual Multimedia Supported Conceptual Change Text (VMMSCCText). We have ever utilized research and development method namely 3D-1I stands for Define, Design, Development, and Implementation. The 27 pre-service elementary teachers were involved in the research. The battery function in circuit electric conception is the futuristic concept which should have been learned by the students. Moreover, the data which was collected reports that static about 0%, disorientation about 0%, reconstruction about 55.6%, and construction about 25.9%. It can be concluded that the implementation of VMMSCCText to pre-service elementary teachers are increased to level conceptual change categories.

1. Introduction

Now misconceptions must be one of significant area research in science education. Misconceptions between learners on challenging and abstract science concept can be encountered commonly. Students are taught as if they had no prior ideas and experiences about science concept being studied previously. Misconceptions must be remedied because misconceptions will be carried over until prospective teachers become teachers later. Misconceptions are also resistant to the acceptance of new concepts; it is necessary to remediate misconceptions through remedial teaching activities. However, students’ minds are not empty; they are full of prior ideas and have several daily life experiences
related to scientific phenomena before coming to science course [1]. Students may have both scientifically acceptable ideas and some alternative conceptions in the same content area in science [2]. Students’ alternative ideas can be also referred to as alternative frame works [3] or misconceptions [4]. Misconceptions are resistant to change with scientific ones and students may reject accepting new ideas [5] and they are obstacles for students in learning and to make meaningful understanding of some concept in science. Students’ alternative conceptions in science can be originated from different sources; such as prior knowledge, daily life experiences, language, culture, teacher, textbooks and instruction [1].

Knowledge of composite substantial, such as concepts faced in science classrooms, can happen under at least three diverse situations of prior knowledge. First, a student might need not at all prior knowledge of the to-be-learned concepts, while they could have some connected knowledge. In this situation, prior knowledge is lost, and knowledge consists of addition new knowledge. Second, a student might have some right prior knowledge around the to-be-learned concepts, but that knowledge is partial. In this partial knowledge situation, knowledge can be considered of as hole substantial. In both lost and partial knowledge situations, understanding attainment is of the enriching kind [6-8]. In a third situation, a student might have attained ideas, either in college or after average practice, that are “happening conflict through” the to-be-learned concepts [9-12]. Understanding attainment below this third situation is of the conceptual change compassionate. It is expected to adopt in this situation that the prior “happening conflict through” knowledge is incorrect or misunderstood, and the to-be-learned information is correct, through selected normative average. Therefore, knowledge in this third situation is not addition new knowledge or hole substantial partial knowledge; relatively, Learning is changing previous misunderstood knowledge to correct knowledge.

If the students are given a convinced learning treatment, then several options will occur in the change of conception. Possibly the conception remains (unchanged), might change in a better direction and may turn near the worse. Since the initial state of student conception also varies, some are totally empty with no initial knowledge, some of which already have the correct initial knowledge and some who have erroneous knowledge, will also vary the forms of conception change taking place. In connection with this to label the changing forms of conception that occurred, introduced the term level conceptual change.

This study was conducted by aim to get a picture of the conceptual change level that occurs in prospective elementary school teachers during VMMSCCText activities on the concept battery function in circuit electric.

2. Methods
The method used to construct conception test in four tier test format is 3D-1I namely Define, Design, Develop and Implementation [13]. The define stage is done through field study and literature study to collect the misconceptions in battery function in circuit electric, the design stage is done to design the contents of VMMSCCText, the develop stage is done to construct the remedial teaching based on the design that has been made at the design stage. Implementation stage was conducted to remedial teaching developed in diagnosing the level conceptual change of prospective elementary school teachers at FKIP Universitas Riau. The number of respondent was 27 students who contract the basic science concept course. To categorize the state of conception that belongs to the students was used the guidelines of classify the students in the categories scientific conception from the beginning (SCFB), static (S) disorientation (D), revision or reconstruction (R) and construction (C).

3. Results and Discussion
The developing exploration in this situation attached with 3D-1I model (Define, Design, Develop and Implementation). For comprehensive analysis, we are going to pronounce follows.
3.1. Define
The conceptual change level is the level that describes the shape of conception change from the initial state before the learning is executed to the final state after learning. The conceptual change level is divided into several categories, as follows: 1) having a scientific conception from the beginning, 2) static, 3) disorientation, 4) revision (reconstruction) and 5) construction. Scientific conception from the beginning is a level of conceptual change in which students show the possession of a scientific conception both in the initial response and in the final response. Static is the level of conceptual change in which the student shows the possession of a fixed conception of misconception or lack of knowledge both in the initial response and in the final response. Disorientation is the level of conceptual change in which the student's conception turns towards a worse, for example from a scientific conception of the initial response to misconception or becoming a lack of knowledge in the final response. Revision or reconstruction is the level of conceptual change in which the student's conception changes to a better direction from the misconception of the initial response to a scientific conception of the final response. While the construction is the level of conceptual change where the student's conception also changes to a better direction of the lack of knowledge in the initial response into a scientific conception of the final response. Thus, to know the level of conceptual change achieved by the students, it must first be identified the conceptual state at the beginning and the end of the teaching activity, which is usually done by giving the conception test at the time before and after the learning activity.

3.2. Design
In the next level of 3D-11, we have previously built the VMMSCCText on battery function in circuit electric concepts. Based on the change of conceptual response from initial state to final state, then it can be determined conceptual change level as shown in Table 1.

### Table 1. Determination Guidelines Level Conceptual Change

| No | Level Conceptual Change                      | Determination Guidelines Level Conceptual Change | Pre-Conceptions | Change to | Post-Conceptions |
|----|---------------------------------------------|------------------------------------------------|-----------------|----------|-----------------|
| 1  | Scientific conception from the beginning (SCFB) | SC → SC | SC               |          |                 |
| 2  | Static (S)                                  | M → M | M                |          |                 |
| 3  | Reconstruction (R)                          | M → SC | SC               |          |                 |
| 4  | Construction (C)                            | LK → SC | SC               |          |                 |
| 5  | Disorientation (D)                          | SC → M | M                |          |                 |
|    |                                             | LK → LK | LK               |          |                 |

Notes: LK, M, SC stand for Lack of Knowledge, Misconceptions and Scientific Conceptions.

3.3. Develop
Is the process of appreciating the blueprint or design had developed an authenticity. This capital that at this step everything necessary or that would support the learning practice would have been thriving organized. As an illustration of the design, the development phase has been prepared based on storyboard as the following.
3.4. Implementation

Appeared design investigation data was the investigative effect of a profile of pre-service elementary school teachers’ conceptions that narrowing Basic Concept science course in the academic year 2017. Quantitative data were articulated in percentages while qualitative data was attained significant data about the VMMSCCText. To classify the state of student level conception results, the data analysis used as shown in Table 1 is used.

Table 2 presences that the students’ level conceptual change connected to pre-service elementary school teachers endured in concern. The data intelligences that mindfulness of students when they learn battery function in circuits electric concept at the elementary school level in the Basic Concept Science course to modification from the misconceptions to the scientific conceptions has previously.

| Level Conceptual Change | Student | Amount | % |
|-------------------------|---------|--------|---|
| Scientific conception from the beginning (SCFB) | - | 0 | 0 |
| Static (S) | 4,8,9,15,21 | 5 | 18.5 |
| Reconstruction (R) | 1,3,7,10,11,12,13,14,16,17,18,19,20,22,26 | 15 | 55.6 |
| Construction (C) | 2,5,6,23,24,25,27 | 7 | 25.9 |
| Disorientation (D) | - | 0 | 0 |

The table above showed the percentage of the prospective elementary school teachers’ number at each level of conceptual change that occurred. Of the subjects of the field trials of VMMSCCText use in remedial teaching, 0% was at the level of early scientific conception (SC), 18.5% was at static level (S), 55.6% was in Reconstruction (R), 25.9% is at Construction (C) level and 0% is at the disorientation level (D). This shows that the use of VMMSCCText has a high effectiveness in achieving the level of construction and reconstruction (55.6% + 25.9% = 81.5%). It can be claimed
that the use of VMMSCCText has a high effectiveness in the remediation of misconceptions that occur in elementary school student candidates related to a battery function in circuit electric concept.

The changes pattern in pre-service elementary school teacher conception on battery function in circuit electric concept begun the initial response to the final response (Figure 2.) showed that from 27 prospective elementary school students who are the subject of research have various responses. From the response there were zero stud (0) student who gave answers according to scientific conception, 20 people answered misconceptions, and seven (7) student had no concept.

![Initial Response](image)

**Figure 2.** Analysis pre-service elementary teachers’ conceptual change on battery function in circuit electric concept

The flow students’ conceptual change based on the characteristics of early thought, it turns out after VMMSCCText activity the state becomes inversed from the initial thinking that misconception becomes in accordance with the scientific conception. At the beginning, 27 students who have the answers according to scientific conception only zero (0) students, after seen in the final response after VMMSCCText activity of students who answered according to scientific conception increased to 22 students. Even so, there are still misconceptions as much as five (5) students.

The frequency distribution phenomenon of conceptual change flow has consequences at the conceptual change level of the student about the electric current concept during VMMSCCText activity. Conceptual change level as a whole can be seen in Figure 3 below.

![Figure 3](image)

**Figure 3.** Students’ Level Conceptual Change

The figure above showed that VMMSCCText has a high effectiveness in achieving the conceptual change level of construction and pre-service elementary school teachers’ reconstruction. The conceptual change occurrence from the initial state to the final state better indicates a good level that occurs in during students did the VMMSCCText activity. Learning progress that happened quite positive because there is no one student whose conception changed to a worse or experiencing disorientation. This shows that the use of VMMSCCText [14] has a high effectiveness in facilitating
the achievement of conceptual change level of construction and reconstruction of conception. All of the students who had previously had a scientific conception did not turn into misconceptions or have no conception, but remained steadfast in the state of scientific conceptions. This suggests that scientific explanations and the reinforcement of conceptions presented on VMMSCCText can help them in establishing the scientific conception they already had.

4. Conclusion
Has been successfully constructed the VMMSCCText has shown a good function in remedial teaching. VMMSCCText developed also has a high effectiveness in supporting the achievement of conceptual change level of prospective elementary school teachers. VMMSCCText has successfully facilitated the construction and reconstruction of conceptions in students’ minds. Students who initially lacked conception, at the end of VMMSCCText activity became a scientific conception that occurred through conception construction process, whereas students who initially experienced misconception, at the end of activity VMMSCCText conception changed into scientific conception, through reconstruction process. This indicates that the developed VMMSCCText has actually used constructivism. According to the constructivist theory of acceptance of new conceptions in the minds of the learners can be through two lines of assimilation and accommodation, this occurs in the way the learners come to the classroom with the state of conception vary, there is a really empty does not bring conception and some have brought conception Which of course the conception may be true or false.

For students who have an initial knowledge that matches the new teaching material presented, it will gain reinforcement of conception through the process of assimilation. As for students who have the initial knowledge that is not aligned (not suitable) with new teaching materials presented, there will be a cognitive conflict process that makes an imbalance (disequilibrium) in mind. From these circumstances there will be two possibilities, first there will be a deadlock (no conception) and the second will occur the process of accommodation that can enable the process of transformation and adaptation so that was not suitable to be fit and can accept a new scientific conception.

Based on decision and research conclusions, they are recommendation for next research:

a. VMMSCCText product is used to basic of science program lecturers’ in Pre-Service Elementary Teacher for get a picture of the conceptual change level that occurs in prospective elementary school teachers during VMMSCCText activities on the concept of battery function in circuit electric.

b. VMMSCCText can be established in alternative science subjects amusing remediate teaching in basic concept of science lecture.

c. VMMSCCText essentials to be advanced and providing in visual media.

5. References
[1] Cetin G, Ertepinar H, Geban O 2015 Effects of conceptual change text based instruction on ecology, attitudes toward biology and environment Educational Research and review 10 3 259-273
[2] Palmer D H 1999 Exploring the link between students’ scientific and nonscientific conceptions Sci. Educ. 8 6 639-653
[3] Driver R 1981 European J. Sci. Educ. 3 1 91-101
[4] Gilbert J K, Watts D M 1983 Concepts, misconceptions and alternative conceptions: Changing perspectives in science education Studies in Sci. Educ. 10 61-98
[5] Posner G J, Strike K A, HewsonP W and Gertzog W A 1982 Accommodation of a scientific conception: Toward a theory of conceptual change Science Education 66 2 221–227
[6] Celik H and Pektaş H M 2017 Graphic comprehension and interpretation skills of preservice teachers with different learning approaches in a technology-aided learning environment International Journal of Science and Mathematics Education 15 1 1-17
[7] Waldrip B and Prain V 2012 Developing an understanding of ions in junior secondary school chemistry International Journal of Science and Mathematics Education 10 5 1191-1213
[8] Carey 1991 *The epigenesis of mind* (Hillsdale: NJ: Erlbaum)
[9] Lee G and Yi J 2013 Where cognitive conflict arises from?: The structure of creating cognitive conflict *International Journal of Science and Mathematics Education* 11 3 601-623
[10] Young J 2011 *International Journal of Science and Mathematics Education* 9 5 1135-1166
[11] Budiman Z B, Halim L, Meera S M and Osman K 2014 The effects of cognitive conflict management on cognitive development and science achievement *International Journal of Science and Mathematics Education* 12 5 1169-1195
[12] Vosniadou 2004 Extending the conceptual change approach to mathematics learning and teaching *Learning and Instruction* 14 445–451
[13] Hermita N, Suhandi A, Syaodih E, Samsudin A, Isjoni I, Rosa F, Sapriadil S, Setyaningsih R and Johan H 2017 Constructing and Implementing a Four Tier Test about Static Electricity to Diagnose Pre-service Elementary School Teacher ‘Misconceptions *Journal of Physics: Conference Series* 895 1 012167
[14] Suhandi A, Hermita N, Samsudun A, Maftuh B and Coştu 2017 *Turkish Online Journal of Educational and Technology (TOJET)*, Special issue Oktober 2017 For INTE 2017