The development of virtual conceptual change laboratory (VCCLab) for conception reconstruction through lab virtual activity

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Abstract. The research aimed to get a valid and tested VCCLab model product complete with syntax and supportive materials. This research is encouraged by the need for a VCCLab model for remedial teaching oriented towards remediation of students' misconceptions through the mode of virtual laboratory activity. The research method used is research & development which consists of four stages, namely: Need Analysis, Product Development, Field Testing, and Product Revision. From the development research process, the VCCLab model product is produced with syntax consisting of five stages of lab activity. The results of expert judgement on the VCCLab model product indicate that the VCCLab model and supporting materials have a construct and content validity. The results of limited field testing indicate that the use of the VCCLab model in remedial teaching activities with the mode of virtual lab activity has high effectiveness in remediating students' misconceptions regarding the concept of parallel electric circuit. Another field testing result is that there is no gender bias in the use of the VCCLab model in the students' conception reconstruction process related to the physics concept being reviewed.

1. Introduction
To develop significant learning, considerate formation essentials to be continued by problem solving, and accepting conception is more substantial than memorizing concepts. Students’ thoughtful of the key ideas related to the physics subject has become an interesting study area and has been studied by researchers in the physics education arena. According to cognitive theory, students build a reasonable and coherent understanding of the phenomena that exist in nature from their point of view. Intended for better empathetic and acquiring eloquent learning, misconception distresses students' learning of scientific concepts that need to be rehabilitated. Although the best learning is seen as a process of change or conception [1]. Then the transformation of formation is the revision or variation or rejection of one's conception beliefs when unfilled in an inconsistent condition [2].

In the last few years of this decade, research on misconceptions is still being conducted intensively by researchers in the field of education, including the field of Physics education at various levels. Research on misconception is focused on two areas, namely, the area of misconception identification
and the area of misconception remediation. Research in the area of identifying misconceptions has produced various forms of instruments to identify misconceptions, such as conception tests in the two-tiered test format [3], in the three-tiered test format [4], and the four-tiered test format [5]. While research in the area of misconception remediation has produced a variety of strategies for learning physics oriented to remediation of misconceptions (conceptual changes), such as cognitive conflict strategies [6], discreet event strategies [7], and bridge strategies (bridging) analogy [8].

According to various literature, many things can be a source of causes of the emergence of misconceptions in the minds of students, including preconceptions, physical experiences in daily life, language, culture, teachers, textbooks, and learning processes [9]. One source of the occurrence of misconceptions in the minds of students is the physical experience in everyday life. In daily life, students often observe physical phenomena that involve many variables that affect them, but because in reality, not all physical variables that can be observed in their daily lives, most students think that the amount of physics that affect the physical phenomenon only what they observe. For example, because in everyday life learners are of the view that the electric current flowing in a branch of a parallel electric circuit changes in value if the circuit is added or subtracted from the parallel electrical circuit with the same resistance value. Whereas conceptually, the addition of identical branches in parallel circuits will not change the amount of electric current flowing in each branch of the existing circuit because of the potential difference and the resistance value at the parallel branches does not change.

Misconceptions must be remedied because misconceptions will identify where the student's mistakes are. Misconceptions are also resistant to the acceptance of new concepts, it is necessary to remediate misconceptions through remedial teaching activities. One remedial teaching mode that can be used is a virtual laboratory mode and can be used for remediation of misconceptions virtual laboratories conception conversion (virtual conceptual change laboratory or VCCLab). Virtual conceptual change laboratory (VCCLab) is a virtual laboratory activities type that is deliberately developed for remedial-oriented remedies of misconceptions experienced by learners. To carry out improvements through practicum activities in the laboratory, VCCLab model is needed, complete with syntax and supporting tools. This research was conducted to produce a valid and tested VCCLab model product complete with syntax and supporting tools to meet the field needs of a practicum model oriented to changing the conception to improve solutions according to the objectives of the students. This research was conducted using research and development methods. This article describes the research processes carried out on the products it produces.

2. Methods

This research is based on the need for a VCCLab model as an alternative mode for learning remedial physics oriented towards changing students' conceptions. This development process is carried out using the research and development (R & D) method formulated [10] which includes stages: needs analysis, product development (design, manufacture and product validation), field trials of the products produced, and product improvement based on field trial results. The flowchart of the study is shown in Figure 1.

![Figure 1. The development model used in this study](image)
VCCLab model product was carried out using the pre-experiment method with a one-group pre-test post-test design, as shown in Table 1.

| Initial Test | Treatment | Final Test |
|--------------|-----------|------------|
| O            | X         | O          |

Table 1. Formatting sections, subsections and subsubsections

The instrument used to identify the initial conception and final conception of students related to a physics concept is the conception test in the Four Tier Test format. This test consists of four parts, namely the phenomenon of physics questions related to the concept of physics, the belief in the answers to questions related to physics concepts, the reasons for answering phenomena questions related to physics concepts, and the belief section on the reasons for answering phenomena related to concepts of physics. This test is constructed in the form of reasonable multiple choices that are equipped with a level of confidence in the answers and reasons for the answers.

Data obtained from the VCCLab model product implementation test results in the form of data from the students' conception physics test were analysed quantitatively to determine the state of the conception of students before and after participating in VCCLab activities by using the guideline for determining the state of conceptions developed by Gurel [11]. The effectiveness of using the VCCLab model in remediating students' misconceptions related to a physics concept is determined based on the quantity decreasing the number of students whose misconceptions can be remediated after participating in VCCLab activities. The use of the VCCLab model is stated to have a high effectiveness in remediating misconceptions if its use can reduce the number of students who have misconceptions with a high decrease category [12].

3. Result and Discussion
In this section, the results of a limited trial of the implementation of the VCCLab model product assistance with supporting devices in the improvement activities are related to the concept of parallel electrical circuits. The concept of parallel electrical circuits was raised to a concept that was reviewed in research trials implementing the VCCLab model because this concept led to many misconceptions among high school students. As found in several previous studies of direct current circuits, many parallel electrical circuits cause misconceptions among students [13]. Misconceptions that occur in high school students related to the concept of a parallel electric circuit that is electric current flowing in a branch of a parallel circuit changes in value if the circuit is added or subtracted parallel branches with the same resistance value. For this purpose VCCLab LKPD have been developed related to the concept of parallel electrical circuits and virtual practicum using PhET. The state of conception students have before and after participating in VCCLab activities can be in Figure 2.
By knowing the state of students' conceptions before and after VCCLab activities, the pattern of conception changes that occur from before to after participating in VCCLab activities can be described. Based on the pattern of conception changes achieved by students, the effectiveness of using the VCCLab model in remediating the misconceptions of high school students can be determined. In Figure 2 it appears that 88.9% of female students and 83.3% of male students experienced a change in conception from a state of misconception to a state of scientific conception. Clearer comparison of the number of students having misconceptions related to the concept of a parallel electric circuit between before and after participating in VCCLab activities is shown in Figure 3. In the figure, it appears that there was a significant decrease in the number of female and male students who had misconceptions from before to after VCCLab activities.
Figure 3. Bar chart of the number of female and male participants who have misconceptions on the concept of parallel electrical circuits before and after VCCLab activity.

Table 2 shows the percentage of female and male learners whose misconceptions related to the concept of parallel electrical circuits can be remediated through VCCLab activities.

Table 2. The number of female and male learners whose misconceptions are related the concept of parallel electric circuit can be remediated

| Concept                        | The number of students who misconceptions before VCCLab | The number of students who misconceptions after VCCLab | Decreasing the number of students who are misconceptions | Decline category |
|--------------------------------|---------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|------------------|
| Parallel electrical circuits   | F 18 M 18                                               | F 2 M 3                                               | F 0.88 M 0.83                                         | High High        |

In Table 2, the quantity of misconceptions female students decreased by 0.88 and male students decreased by 0.83. These results indicate that the use of the VCCLab model in remedial teaching activities in the concept of parallel electric circuits has high effectiveness in remediating misconceptions. In Table 2 also appears that female and male learners who experience remediation of misconceptions are balanced in number. This condition shows that the VCCLab model has the same potential when applied to female students and to male students in the teaching process of remedial physics. These results indicate that there is no gender bias from the application of the VCCLab model in the process of teaching remedial physics oriented towards conception change.

4. Conclusion
Through research and development activities, a valid and tested VCCLab model product has been produced for teaching physical remedial physics in a virtual laboratory mode. The use of the VCCLab model in limited trials shows high effectiveness in reducing the number of students who are misconceptions related to the concept of parallel electrical circuits. Its use also does not because of gender bias in the process of remediation of misconceptions related to the concept of parallel electrical circuits.
5. References

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