The validity test of the lesson plan to reduce students’ misconceptions using the cognitive conflict strategy

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Abstract. Students' misconception will hinder the effectiveness of learning as well as disrupt the students' thinking in accepting the subsequent knowledge. The use of students' misconceptions is essential in improving students' conception through meaningful learning. One of the learning strategies to reduce the misconception is the cognitive conflict strategy. Therefore, it is necessary to develop a lesson plan to lessen students' misconception in learning using the cognitive conflict strategy. This study is limited to the analysis of the quality of the lesson plan on the topic of fraction by using the cognitive conflict strategy. The development method used in this research was the Plomp method focusing on the prototyping and assessment phase. The source of data for the validation test was obtained from three validators and one observer. The trial of the lesson plan was conducted for 14 Year 5 students in one of the elementary schools in Bireuen district of Aceh. Based on suggestions from the validators, the lesson plan needs to be revised. The results of the validity test showed that the lesson plan for reducing students' misconception using the cognitive conflict strategy satisfied the valid criteria and can be tested for its practicality and effectiveness.

1. Introduction

Students' misconceptions will affect the construction of the subsequent knowledge. A belief that is not in accordance with the scientific concept but is considered correct by the students is a sign of misconception [1]. The misconception is private, stable, and students who have the misconceptions do not feel the need for a coherent view [2]. The nature of misconceptions that is resistant to change, make it difficult for a misconception to be eliminated. Changing students' conceptions cannot be done by simply telling them what the misconceptions are since this strategy might only last temporarily in students' mind.

Students have learned fraction since the third grade of elementary school. However, many students’ still show a poor understanding of fraction concepts. Based on the results of the National Assessment of Educational Progres (NAEP), it consistently shows that students have a poor understanding of the concept of fraction [3]. Students who have lack of the understanding of these concepts might find difficulties in obtaining meaningful learning when solving procedural questions. Based on the results of diagnostic tests on the fifth-grade students in elementary school, it is known that 40% of students have misconception related to fraction. This shows that misconception is a problem that should be immediately addressed. Thus, it is paramount to develop a lesson plan to reduce the students’ misconception on fraction concept.

Several previous studies showed a wide range of misconceptions experienced by students in understanding the concept of fraction. Students compare the fraction by looking at the differences
between the denominator and the numerator, and this led to students' misconceptions in comparing the value of fraction \([4,5]\). Students sort the fraction by looking at the least denominator of the fraction \([4]\). Students are surprised to learn that multiplication on fractions does not necessarily lead to greater answers \([6]\). This suggests that students remain on their initial knowledge of integer operations; students have not been able to integrate their initial experience with newly acquired skills.

Correcting a student's misconception can be done by utilizing a prior knowledge owned by the students \([7,8]\). Using students' initial conception to improve students' conceptions will be a meaningful learning experience for the students. However, this is not easy because of the misconception experienced by the students are generally resistant to change. Therefore, it is necessary to apply a strategy that can stimulate the occurrence of conceptual changes. One of the concept-changing strategies is the cognitive conflict strategy. Cognitive conflict is the individual's consciousness about the conflicting information that impacts a concept on the cognitive structure itself \([9]\). Cognitive conflict strategies have a general pattern of explicitly exposing students' initial conceptions, discussing and evaluating the students' initial concepts, creating conceptual conflicts on the initial concepts as well as encouraging and directing students to restructure their concepts \([7]\). Based on the explanation previously mentioned, the research question in this study is "How is the quality of the lesson plan to reduce student misconception using the cognitive conflict strategy."

2. Method
This study used Research & Development (R & D) method, employing Plomp model consisting of three stages: a preliminary research, prototyping phase and assessment phase \([10]\). In the first stage, the initial research needs analysis of the characteristics of students' misconceptions affecting the subsequent knowledge construction process was carried out. In the second stage, the prototyping phase, the development or creation of a prototype in the form of a lesson plan and validation were conducted. The third stage, the assessment phase, the assessment or evaluation developed lesson plan were done by conducting field tests. This paper only discussed the results of the validation and trial results of a limited sample.

Three competent validators did the validity of the lesson plan draft on fraction using the cognitive conflict strategy. The draft of the lesson plan was tested on five students aged 14 years old. The instruments of the data collection in this study were the validation sheet and observation sheet of implementation of the lesson plan. Data analysis techniques performed were calculating the average validity score of the three validators and analyzing the implementation of the lesson plan from an observer (a classroom teacher). The criteria for the validity of the developed lesson plan are as follows \([11]\).

| Criteria         | Average       |
|------------------|---------------|
| Highly valid     | \(4 \leq KV^a < 5\) |
| Valid            | \(3 \leq KV < 4\) |
| Less valid       | \(2 \leq KV < 3\) |
| Invalid          | \(1 \leq KV < 2\) |

\(^a\)Average validation results from the experts on the learning instruments.

Based on Table 1, if the validation results indicating that the data obtained is valid or highly valid, the draft of the lesson plan is eligible to be tested for field trials. However, if the validation results are less valid or invalid, the draft of the lesson plan must be revised.
3. **Results and discussion**

The design of a lesson plan using the cognitive conflict strategy aiming to reduce the students’ misconceptions was based on the students’ needs related to how misconceptions experienced by the students. The learning steps were designed by uncovering, discussing and evaluating students’ initial conceptions, creating conceptual conflicts, and directing students to reconstruct their initial concepts. After designing the lesson plan using the cognitive conflict strategy, the product, a lesson plan, was validated by the experts on the lesson plan components and learning activities-aspects. The validation results of the lesson plan by the three experts are presented in Table 2.

| No  | Aspect of assessment                                         | Average | Criteria   |
|-----|--------------------------------------------------------------|---------|------------|
| 1   | Presentation of lesson plan components                      | 3,7     | Valid      |
| 2   | Material conformity                                         | 4,3     | Highly valid |
| 3   | Activities conformity with the cognitive conflict strategy  |         |            |
| a.  | Uncovering students' initial conceptions                    | 3,7     | Valid      |
| b.  | Discussing and evaluating students' initial conceptions     | 4       | Highly valid |
| c.  | Creating a conceptual conflict                             | 4       | Highly valid |
| d.  | Directing students to restructure the initial concept      | 4       | Highly valid |
| 4   | Language                                                    | 3,9     | Valid      |

Table 2 indicates that the validity of the lesson plan for each aspect was highly valid or valid. The criteria of material conformity, evaluating the students' initial conception, creating conceptual conflict, directing the student to restructure the initial concept aspects were highly valid. The presentation of the lesson plan components, uncovering the students' initial conception and the language aspects were valid. Thus, the designed lesson plan can be used with minor revision.

Based on the validation results by three validators, there were some suggestions for improving the lesson plan using the cognitive conflict strategy. The validators suggested that the numbering of the learning steps should be clarified, the compilation of the learning objectives should contain the elements of the audiences, behavior, condition, and degree according to the demands of the 2013 curriculum, and enclose the teaching materials. The validators also argued that revealing the initial conception of the students should be done through a written test, followed by a question and answer session while providing opportunities to students to complete the same written test as the reflection of the change in conception after the emergence of the cognitive conflict. Some examples of revisions to the aspects of the lesson plan are presented in Table 3.

| Before revision                                                                 | After revision                                                                 |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Numbering system using bullets                                                  | Numbering system using the number on each learning activity                    |
| Students can determine the pictures that represent a fraction                  | Through group discussion students are expected to be actively involved in the learning activities, be curious, and able to determine the pictures that represent the fractions correctly. |
| Without teaching materials                                                     | Attaching teaching materials                                                  |
Revisions were made to the aspects of the presentation of the lesson plan components to meet the demands of the 2013 curriculum implemented in elementary schools. The numbering would ease the implementation of the learning steps. The attached teaching materials were presented briefly so that teachers could gain a basic understanding of it that would be taught the material.

The validators’ suggestion for the initial conception of the students to be revealed through a written test, followed by a question and answer session while providing opportunities for students to complete the same written test as the reflection of the change in the conception after the emergence of the cognitive conflict, it was not just questioning. One example of the activities using a cognitive conflict strategy at the stage of uncovering students’ conceptions before and after revision can be seen in Table 4.

**Table 4.** The results of the activity revision of uncovering students’ initial conception.

| Before revision | After revision |
|-----------------|---------------|
| Teachers conduct a question and answer session for the students’ ideas in determining the pictures representing fractions. | The teacher asks the students to choose the pictures representing a fraction individually. Look at the following pictures! Put a tick (✓) for the shading picture representing \( \frac{1}{2} \). |
| a. ![Image](image1.png) | b. ![Image](image2.png) | c. ![Image](image3.png) |
| d. ![Image](image4.png) | e. ![Image](image5.png) | f. ![Image](image6.png) |
| g. ![Image](image7.png) | h. ![Image](image8.png) | i. ![Image](image9.png) |

Next, check students’ answers through questions and answers session and ask students to explore the reasons for choosing the picture.
The revisions of the activities for encouraging students' initial conceptions were made by providing students the opportunity to choose pictures representing a fraction. Based on these answers, the teacher dug up information of the students' conception through a question and answer session so that students can express the reasons for choosing the image. Revealing the students' initial conception is an important element in reducing misconceptions. Some attempts to reduce misconceptions do not work because teachers do not know exactly the reasons behind the misconceptions [7]. The revision results of the act of revealing the students' initial conceptions enabling the teacher to find the fault concept on fraction experienced by the students. Asking students to provide reasoning for choosing the answer was a way of knowing specifically how the misconceptions experienced by the students.

The validated and revised lesson plans were then tested for 14 of the Year 5 students. The trial results based on the observer observations are presented in Table 5.

Table 5. The trial results of the lesson plan.

| No | Aspect of Assessment                                      | Score | Criteria      |
|----|----------------------------------------------------------|-------|---------------|
| 1  | Introduction                                             | 5     | Highly valid  |
| 2  | Core activities                                          |       |               |
|    | a. Uncovering students' initial conceptions             | 4     | Highly valid  |
|    | b. Discussing and evaluates students' initial conceptions| 4     | Highly valid  |
|    | c. Creating conceptual conflict                         | 3     | Valid         |
|    | d. Directing students to restructure the initial concept| 3     | Valid         |
| 3  | Closing                                                  | 5     | Highly valid  |

Based on Table 5, it is noted that the lesson plan tested had valid criteria. The product of designed lesson plan was able to reveal the students' initial conception through written test followed by the question and answer session; the discussion of the students' initial conception makes students aware that there was something wrong with their ideas. The raised cognitive conflicts were managed to waver students' conceptions through a demonstration of the fraction. Emerging the cognitive conflict strategies by demonstration was an attempt to provide different stimuli to students' cognition [7]. One of the activities to create cognitive conflict is to demonstrate [12]. The inconsistency between students' initial conception and the results of the demonstration stimulates students to find the appropriate concepts so that the process of reconstructing the students’ conception occurs. Providing an opportunity for students to resolve the same written test was an attempt to obtain information about the changes in the students' initial conceptions.

Based on the validation results, the designed lesson plan can be considered valid. Student activities in the learning process can stimulate the emergence of the cognitive conflict and can reduce students’ misconception. Therefore, the designed lesson plan can be used with minor revision.

4. Conclusion
Based on the results and discussion, the validation and the limited test previously presented the developed lesson plan using the cognitive conflict strategy is considered valid and feasible to be used. However, the lesson plan needs to be further tested for its practicality and effectiveness.
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