

# The reconstruction of preservice elementary teachers' conception about free fall using cognitive conflict strategy

*By* Subuh Anggoro

## The reconstruction of preservice elementary teachers' conception about free fall using cognitive conflict strategy

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**Abstract.** Misconception about Free Fall have many experienced by preservice elementary teachers. It was caused by their teachers has not understood these concepts and how to teach it. This study aim analyzed a conceptions reconstruction on remedial teaching using Cognitive Conflict Strategies developed about Free Fall concept. The research method used is mixed methods with Intervention Mixed Methods Design. The participants are preservice elementary teachers' in one of private university in Central Java who take the Second Basic Concept course. The results have shown that Cognitive Conflict Strategy is effective to reconstructing the conception of preservice elementary teachers on Free Fall using remedial teaching. This is indicated by most of them have experienced conceptual change with the revision level in every misconception that occurred in the prior conception. The research recommendations are the lecturer of Basic Science, which have elementary school graduates background generally, should have to collaborate with Physics and Biology lecturer to develop a scientific concept understanding by using learning model that can reconstruct the student conception.

### 1. Introduction

Preservice elementary teachers' have been experienced misconception about Free Fall concept [1]. The results of a survey of a first and third year of them in one of the private university at Central Java showed that 92.5% of them had misconceptions about it. This results have corresponded with previous research [2-6]. The misconception may occur because the teacher does not understand the concept and/or how to teach it [7-9]. In addition, many teachers are not prepared for the teaching of science that is compatible with accepted scientific theory [10]. So that students' understanding tends to rely on intuition and gave tactile experiences [3-4,11-12].

Cognitive conflict strategies have been widely used in improving misconceptions of students', teachers' and preservice teachers' on various science concepts. Hermita et al. explained that cognitive conflict strategies reconstruct the misconceptions of preservice elementary teachers' about electrical concepts [13]. Later, Laburu and Niaz reported that this strategy could reconstruct conceptions of thermal energy and temperature [14]. Thus, Akpinar explained his study about misconceptions



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reconstruction of Turkish sciences teachers used this strategy [15]. Several previous research findings explained how cognitive conflict strategies can reconstruct the misconceptions of some concepts in physics, chemistry, and biology [16-19].

The use of remedial learning can remediate misconceptions, constructs, and reconstructions of scientific understanding, thinking strategies, and improving learning outcomes [13, 20-21]. The reconstruction process of conception can be done with classroom learning, CCText or laboratory practice. This study aims to describe the reconstruction of conceptions that occur in preservice elementary school teachers' using cognitive conflict strategy on the remedial teaching about Free Fall with their conceptual change viewed.

## 2. Methods

### 2.1. Participants

The participants were preservice elementary teachers' who taking of Second Science Basic Concept (57 participants from Science Class at Senior High School Graduates and 48 non-Science). Meanwhile, to see the conceptual reconstruction (or conceptual change), the participants used remedial teaching to 34 elementary teachers who consisted of 17 participants from science and 17 participants from non-science.

### 2.2. Research procedures

Mixed methods with Intervention Mixed Methods Design Research was used [22-23]. The data sources were based on a conception that written at before and after learning. The data were collected by participant's conception of an of Free Fall phenomenon. The data were classified based on the similarity of conceptions. Then, data were analyzed to obtain the level conceptual change of participants. The conceptual category and conceptual change level adapted the response model to the discrepant event developed by Kaltakci & Didis, Kaltakci-Gurel, Eryilmaz & McDermott and Kristianti [24-26].

## 3. Result and Discussion

Freefall is a basic concept of physics and the subject of study from Aristotle, Galileo to the time this study was conducted [1, 4, 6, 27-28]. The reconstruction of the conception of preservice elementary teachers' is presented in Figure 1 and 2.

Figure 1 shows the conception change of participants about Free Fall concept. Most of them have a misconception preconception that heavier objects will fall faster. Through a cognitive conflict strategy, most participants then believe that the weight of the object has no effect on the speed time of object fall. Even, more than half of participants have a scientific conception that the speed of falling objects is affected by gravity and altitude.

There are some participants who know the concept of free falling body motion correctly, but the concept is still intuitive. This is indicated by the explanation of some participants who understand that the object falling speed have not influenced by it mass but does not provide an explanation of factors that affect it scientifically. Besides, it is still a small percentage of participants who have misconceptions at the end of learning. This indicates that misconceptions are not easily converted into scientific conceptions in a short time.

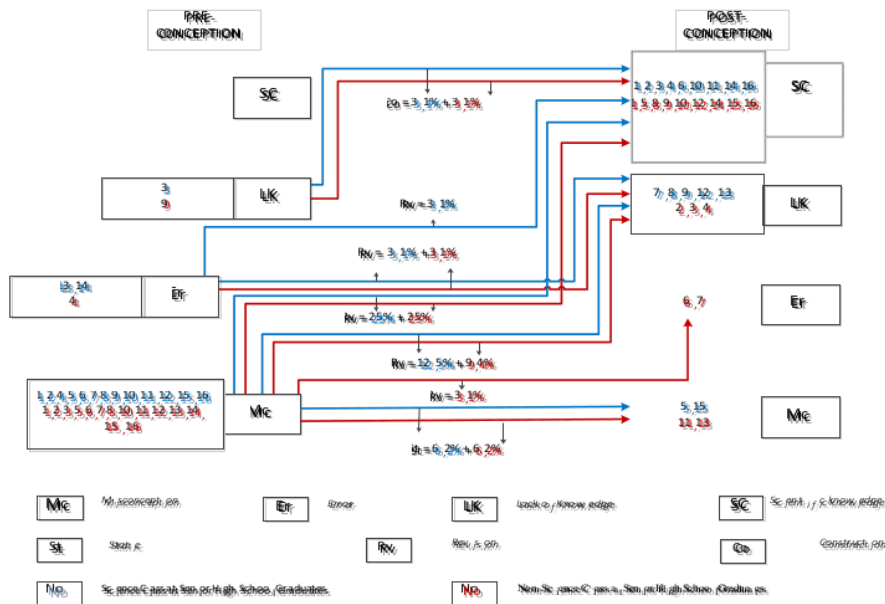


Figure 1. Preservice Elementary Teachers' Conception Change on Free Fall

Figure 2 shows the conception reconstructed profile of preservice elementary teachers about Free Fall. The result indicates that cognitive conflict strategy was able to improve their conception on this concept. Most of participants, both of Science and non-Science backgrounds, have conception reconstructed at the revision level after experimenting with different weight balls and dropping at the same altitude and time. However, only a half of participants had scientific conception. Thus, the final conception of most of them, referring to Vosniadou & Brewer's opinion is on synthetic conception [29-30].

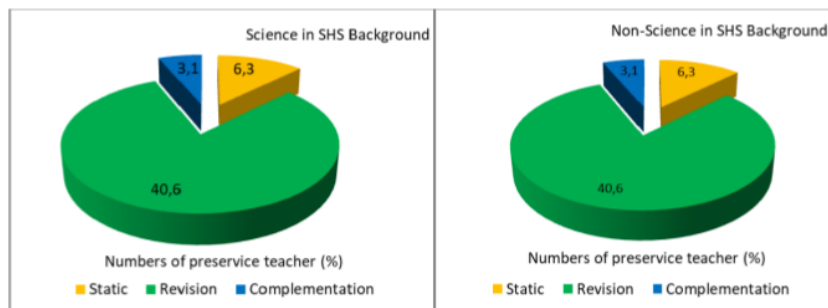


Figure 2. Conception Reconstructed Profiles of Preservice Elementary Teachers' about Free Fall

In a cognitive perspective, the reconstruction of the conceptions of learners using cognitive conflict strategies in remedial teaching of Free Fall Movement leads to a change of knowledge scheme through a process of imbalance (disequilibrium) [31]. The reconstruction of the conception that occurs begins with the identification of the initial conception and through a structured learning process, resulting in the restructuring or assimilation of knowledge of learners or knowledge acquisition [31]. Sfard argues that conception as "like acquiring them and then adding to them or revising them over time" [32]. Whereas Yin et al argues to facilitate the reconstruction of the conceptions of learners to a scientific of

natural phenomena or scientific concept, teachers should (a) identify the current early conceptions of learners about the topics to be taught; (b) guide learners to be aware of the lack of the conceptions; and (c) guiding learners to recognize the scientific conception [33].

Students' observations are often contrary to their predictions, it's because of their misconceptions. By creating a discrepant event with their initial conception, cognitive conflict strategies helped learners to understand of their misconceptions and accept the scientific concepts easily. The effectiveness of a cognitive conflict strategy relies on reconstructed their misconceptions, through the argumentation and social construction of scientific explanations. Through cognitive conflict strategy, students' are guided to build scientific conceptions through hands-on activities and multimedia visuals [34-35]. Thus, learners developed and accepted a scientific conception [33].

In a constructivist view, students must build their own knowledge. There assumption that students must activate and motivated learning. Sinatra & Pintrich argued that in the conceptions reconstruction process, students as active learners [36]. It means, the reconstruction of conception depends cognitive, metacognitive and affective factors [36]. The main purposes of science learning is to develop scientific knowledge consciously [37].

Learning models influenced the cognitive conflict of learners [17]. This means when the students received the contradictory or anomalous data, they would compare it with their knowledge before. In addition, students' who are given learned using meaningful learning would respond to the problem by asking themselves, then connecting and elaborating ideas [38]. This contributes to learning successfully.

Cognitive conflict strategies effective to remedial teaching has been proven through research results that have been conducted in various subjects [39-40]. Cooperative learning using cognitive conflict strategies in Mathematics courses has increased critical and creative thinking skill [39]. In addition, cognitive conflict increases the students' understanding of the concepts of physics better than traditional learning [40]. Students that used cognitive conflict strategies have better analyzed and understood the anomaly between anomalous phenomena or discrepant event, scientific concepts and their conception [41].

Learning with aided simulations based on cognitive conflict strategy has been increased meaningful conflicts [42]. Then, visual multimedia-aided this strategy can be used to higher conceptual understanding [43]. This suggests that the combination of the effectiveness of cognitive conflict strategies along with visual multimedia can make learning process meaningfully.

Deeper learning can occur when teachers used integrated media [44-45]. Self-exploration, collaboration, and active participation were enabled students to solve problems by use visual multimedia. Through integrated media simulation, modeling and media-riched materials (such as image utilization, animation, video, and audio) [46].

The result shows that traditional teaching methods such as lectures or media such as textbooks are not effective in reconstructed misconceptions [47-50]. Hands-on activities, CCText and visual multimedia are several alternative models, methods or learning media that used to improve the student conception [35,50].

#### **4. Conclusions**

According to this study, the reconstruction of conception can be used by remedial teaching with visual multimedia-aided cognitive conflict strategy. Through this strategy, students were challenged to reconstruct their conception by solve problems through self-exploration, collaboration, and active participation. Students have better analyzed and understood the anomaly between phenomena in the universe, scientific concepts and their conception.

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