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Possible Failure of Applying Conceptual Change Learning Strategies for Chemical Concepts: A Meta Analysis

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Abstract

This study aims to identify possible causes of the failure in applying conceptual change strategy by reviewing a number of research results related to the implementation of conceptual change strategy on learning chemical concepts. This research uses meta-analysis design, i.e by reviewing a number of research results in similar problems. The problem studied is about the failure of conceptual change implementation in improving individual misconceptions on chemical concepts. The sources of the study are articles of research related to the implementation of conceptual change strategy especially using conceptual change text (CCT). Data were collected by using documentation techniques. The stages of the analysis are: (1) identifying the ways in which the research group facilitates the four accommodation conditions according to Posner et al (1982), (2) calculating and visualizing the percentage among ways for each CCT in articles, and (3) drawing on conclusions. The results showed that indication of failure in the implementation of conceptual change strategy using CCT can be ascertained because it is not filled by condition number four according to Posner. Six CCT documents that the researchers studied did not yet contain ways to convince individuals of the benefits they would gain after understanding the concept.

Keywords: possible causes, conceptual change, chemical concepts

Introduction:

Conceptual change strategy is a series of activities designed to change one's conception, more specifically to convert misconceptions into conceptions. Implementation of conceptual change strategy on improving chemical misconceptions on school students and college students has been done by researchers for a long time, since many years ago. The evidence for that statement is the discovery of a number of articles in international scientific journals published in 1962 by Thomas Kuhn; Posner et al. (1982), Flick (1991), Özmen (2004), Duit and Treagust (2003), and Artdej et al. (2010) to recent years such as Taş et al. (2015) and Murray (2017). A number of researchers, from decades to decades such as Wang and Andre (1991); She (2004); Pabuçcu and Geban (2012); Armağan et al. (2017), and Sari et al. (2017) administrated conceptual change strategies in text form, thus known as conceptual change text (CCT).

One of the learning strategies for concept change is to use Conceptual Change Text (Özmen, 2007). Concept Change Text (CCT) is teaching material (writing) that is made in such a way, for example in the form of a worksheet, so that it can express conceptions early learners, alerting them to possible misconceptions, and comparing them with generally accepted by scientists through explanations and examples. CCT also is a teaching material based on conceptual change approach and designed to remedy alternative conceptions (Syuhendri, 2017). To prefer using CCT is more scientifically accurate in crowded classrooms because it is difficult to provide teacher-student and student-student interactions which are accepted is effective at conceptual change in small sized classrooms (Chambers & Andre, 1997). So in this TPC the learner is explicit challenged to make predictions of what will happen to an event.

In addition, according to Yiiriik (2007), many previous studies have proven that TPC helps learners change their alternative conceptions and improve conceptual understanding in various science topics. Ozmen (2007) also concludes from his research that TPC can help learners change alternative conceptions into scientifically accepted conceptions. Beside that, another research said that Suyono, Masriyah, and Muchlis (2016) through the Scheme of Excellence Research of Higher Education (PUPT) have also implemented various results of conceptual change strategy modification that is administered into worksheet form. Suyono and Muchlis (2018) have developed conceptual change modules on four chemical topics: chemical bonding, reaction kinetics, properties of conductivity, and Galvani cells with the objective of testing college students at chemistry study program of Universitas Negeri Surabaya. The conceptual change module developed proved to be effective in reducing the burden of chemical misconceptions of students. These findings reinforce the argument that the implementation of conceptual change strategy using text is able to reduce the burden of individual misconceptions on chemical concepts. Nevertheless, the implementation of CCT still has not succeeded in eliminating the overall misconceptions on individuals there is still a failure. Therefore, it is necessary to conduct an assessment to find the cause of failure of implementation of conceptual change strategy, especially those using CCT.

Reviewing articles which discuss the implementation of conceptual change strategies, including conceptual change text-related articles, researchers believe that accommodation is at the core of the conceptual change process (Stofflett, 1994). Accommodation is the creation of a new schema or modification of an old schema, which results in changes and development of schemata (Syuhendri, 2010). New balloons increase the number of existing balloons or the files in the file continue to grow. Accommodation is one of the variants of the concept of adaptation developed by Piaget (Suyono & Hariyanto, 2015). In addition, this accommodation model better reflects the conceptual change process. Hakkarainen (2006) suggests that the conceptual change is related to the question. Cognitive accommodation is understood as a process of altering the cognitive structures (schemes) one already possesses to adapt to external stimulus objects. It is so important that accommodation in the process of altering one's conception, to the extent that Posner, Strike, Hewson, & Gertzogdi (1982) examine and write down four important conditions that must be met in order to accommodate accommodation. The four conditions are: (1) there must be dissatisfaction with the existing conception, (2) a new conception presented must be understandable or clear, (3) the new conception presented must be reasonable, and (4) the new conception reveals the potential or opportunities can be exploited for further development such as opening new avenues for research/ inquiry. Despite the article by Posner et al was written and published long time ago, it has inspiredfuture researchers to extend research related to conceptual change strategies. As evidence, many studies have cited such Posner et al's work when reviewing or doing research related to conceptual change.

Furthermore, for identifying in the causes of failure to implement the conceptual change strategy is limited to the four conditions of Posner recommended for accommodation on individual cognitive (scheme) structures. Researchers associate with research of Suyono (2016) states that in chemistry learning, many teachers' lessons have not led students to learn within the domain of axiology. Axiology deals with benefits rather than the concept itself. When associated with the four preconditions according to Posner et al (1982), teaching a new concept to a level of benefit belonging to the fourth accommodation conditioning must be useful. The failure of implementing conceptual change strategy including CCT implementation is suspected because it has not been facilitated by the fourth Posner conditioning. So this assumption will be proven through a meta-analysis. Based on this problem, the purpose of this study is to identify possible causes of the failure in applying conceptual change strategy by reviewing a number of research results related to the implementation of conceptual change strategy on learning chemical concepts.

Methods

This research uses meta-analysis design. Meta-analysis is a review of a number of research results in similar problems. The problem studied is about the failure of conceptual change implementation in improving individual misconceptions on chemical concepts. The source of the study isarticles of research related to the implementation of the conceptual change strategy, especially using the conceptual change text (CCT). The sample of the study was taken by purposive sampling with the provisions of CCT articles which discuss the misconceptions of their samples of research at least 20% of the total number of samples. Instruments in this study used human instrument in which the researchers act as the main analyst. Data were collected through documentation techniques. The stages of the analysis are: (1) identifying the ways in which the research group facilitates the four accommodation conditions according to Posner et al (1982), (2) calculating and visualizing the percentage of ways for each CCT in articles, and (3) drawing on onclusions based on the results of the first stage and the second stage.

Results

Of the 11 CCT articles that researchers studied, there are 6 (six) articles that at the end of the process of changing the learners' conception still leaves more than 20% of individuals who still experienced misconception or still find chemical misconception more than 20% of the concepts tested for each of individuals. The six articles referred to are those written by (1) Ultay et al. (2015), (2) Pabuccu & Geban (2012), (3) Balci (2006), (4) Canpolat et al. (2006), (5) Gunay (2005), and (6) Suyono et al. (2018). This research group of six researchers implements the conditioning for the process of accommodation using CCT through various ways. The methods employed by researchers to create dissatisfaction with existing conceptions (condition 1) include (a) using anomalies, (b) using images, diagrams, graphs, demonstrations, and animation presentations that are thought to create cognitive conflicts, c) providing text containing different ideas from two different students on a similar concept, (d) providing an exemplary scientific explanation, and (e) posing a statement acknowledging an anomalous situation or condition, an interest, and an anxiety expected to create a cognitive conflict . The CCT group of researchers has conditioned that the new conception can be understood by the individual (condition 2) by means of (a) providing a text containing two ideas from different A and B students (there is a correct conception and incorrect conception), (b) using diagrams or drawings to represent conceptions, (c) providing an analogy or metaphor for representing students' conception, (d) using language and symbolic to represent conceptions to be

understood; (e) providing experimental or observational activities, visualizing images, video or modeling; (f) using phenomena or problems to be solved; and (g) using real-life examples in order to represent students' conceptions in order to be understood.

Efforts by the researcher to enable CCT users to accept new concepts as reasonable (condition 3) include (a) providing reasons for consistency between scientific conceptions and observational data, (b) using analogies or metaphors to represent conceptions (d) providing visualization of images or video to reinforce a new conception, (e) providing reasons that include an explanation of the causality or causal relationship of concepts, (f) providing assistance for equilibrium, through questions that require argumentative answers containing new conceptions, (g) providing texts developed with the stage of reconstructing individual understanding, by providing contextual questions or questions relating to phenomena in daily life, which demands students' answers accommodating a new conception,(h) providing texts developed with the stage of reconstructing individual understanding through the assignment of the preparation of the concept analysis table associated with the new conception.

To convince an individual that the new concept will benefit (condition 4) is done, it includes (a) providing assistance for the occurrence of equilibrium so that the new conception is useful, (b) providing a new phenomenon so that students can implement the new concept, (c) providing questions to express a more useful new conception, (d) giving statements as part of a possible conception in the future.

The results of the analysis that researchers have done on the CCT documents developed by the six research groups are reviewed on the basis of the existence of ways of creating four conditions by Posner is presented in Figure 1.

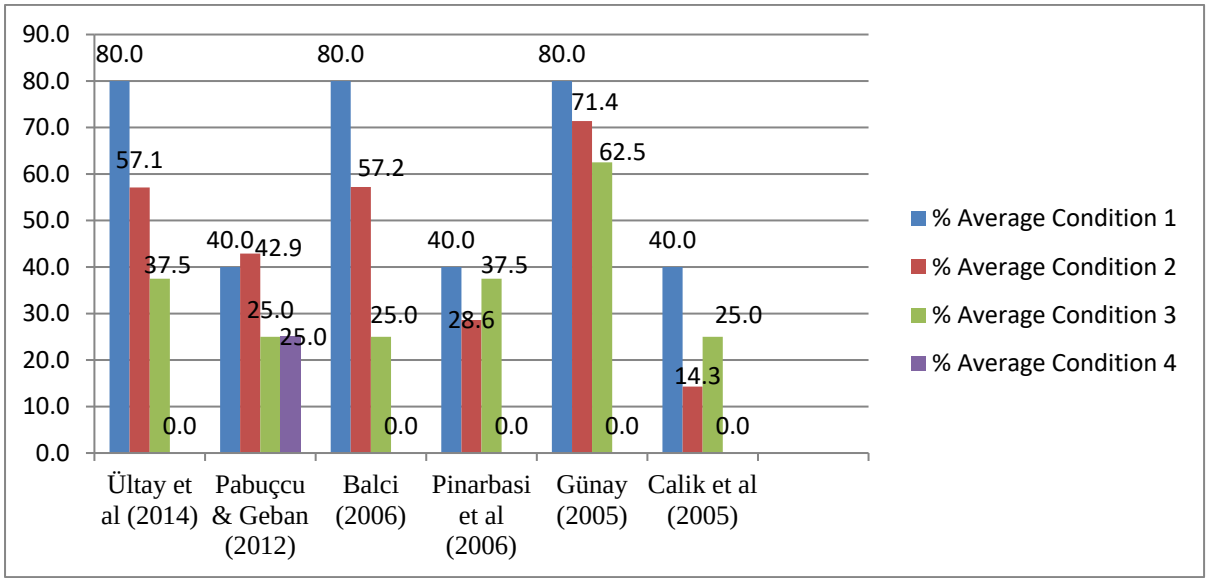

Figure 1 Four Conditionings to Have Accommodation Occurs

The 80% figure in the leftmost histogram in Fig. 1 represents that in compliance with the conditions 1 Ultay et al (2015) includes three ways from four possible ways (3/4 X 100%) into the developed and implemented CCT. Similarly, the explanation is applicable to the figures on the histogram of Fig. 1. In addition, figure 1 points out that the CCT implemented by Ultay et et al (2015), Canpolat et al (2006), Gunay [21], and Calik et al [22] did not facilitate the fourth conditioning (the new concept gained will benefit). When this fourth conditioning was

not met, CCT became ineffective, proven that it still leave the percentage of student misconceptions greater than 20%.

Discussion

Considering the overall results of the research described in the preceding paragraphs, it can be concluded that the efforts made to remediate students with misconceptions on a number of chemical concepts using CCT have not succeeded in eliminating the overall students'misconception. There arestill found individuals who experienced misconception or still find chemical misconception on each individual in a fairly large percentage (above 20%) after the individuals learn through conceptual change text (CCT). That is, it can be stated that there is a failure of the use of CCT to change the conception that has been built in the individual scheme. Of the six CCT articles that researchers reviewed at the end of the process of altering conceptions, there are still more than 20% of individuals experienced misconceptions. In addition, the misconceptions on chemistry also still present in each individual over 20% of the concepts tested. Referring to Posner et al (1982) that accommodation is central to the process of changing individual conceptions, failure to change students' incorrect conceptions can be ascertained due to the failure of the accommodation process within the student's cognitive (scheme) structure. The failure of the process of altering individual conceptions, based on Posner et al., probably because it is not fulfilled by one of the four essential conditions for accommodation to occur. The meta-analysis results found that conditions that were not at all facilitated by the six research groups were the fourth condition. Thus the notion that the cause of failure of the conceptual change strategy due to the non-fulfillment of the fourth conditioning which has been justified through the study of this meta-analysis.

Conclusion

In conclusion, based on the results of the research and discussion above, the failure to implement a conceptual change strategy using CCT can be justified because it is not filled with conditioning number four by Posner. The CCT documents studied in this study have not contained a way to convince individuals about the benefits that individuals will get after understanding the concept. So that the six documents have not been able to make sure that the benefits will be obtained after understanding a concept.

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