

Thematic Analysis of Graduate Theses on Alternative Concepts and Conceptual Change in Biology Education

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Abstract

Our social needs on the behalf of our education and training processes are constantly changing. Considering this study in our country, it has been seen that studies on “providing conceptual change in graduate theses on alternative concepts” are insufficient. Therefore, the number of studies conducted in our country should be increased in order to ensure both individual and social development and progress in the field of “Biology”. In this research, it is aimed to determine to current situation in the field and to reveal the missing aspects by making the “descriptive analysis of graduate theses in the dimension of conceptual change of alternative concepts”. In this study using “Descriptive Scanning Method”, “The graduate theses made between the years 2012-2022 on the conceptual change or alternative concepts in the biology education” were selected by scanning the official website of the “YOK National Thesis Center” database and reached 32 graduate theses. In the themes of the graduate theses, frequency distribution and graph were drawn by classifying them according to “4N 1K Literature Scans Model” of the “year, sample, type, approach model and realization of the conceptual change”. According to data obtained, conclusion that the most studies were between “2015-2019”, “Quantitative” in the approach and “high school-secondary pupils” in the sample were more preferred, master’s studies were more than doctoral studies and “providing conceptual change” is ignored has been reached. This study increases it is importance in terms of determining the missing places in the field and being a guide for future studies.

Keywords: alternative concept, misconception, conceptual change, biology education, content analysis.

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1. Introduction

People cause the world to change due to their needs and the results of the changes in the world cause people to change constantly. As a result, our social needs are constantly evolving. In order to meet these needs, we need to adapt our education and training processes to this situation.

Biology, which is a valuable part of education and training processes, is important for people to make sense of the events they encounter in their normal lives, to better recognize their environment and to produce solutions. In addition, it contributes to the scientific development of individuals in many aspects such as learning the characteristics of living things. For this reason, "Biology Education", which is of great importance for social development in this field, requires continuous learning.

Learning is defined as a product of the interactions between what has been taught to the individual and his/her existing thoughts, knowledge or concepts that he/she has formed by adding to them (Posner et al. 1982). It is clear from this definition that learning concepts and establishing relationships between concepts are of great importance in learning. A concept is the naming, in a sense labeling, of phenomena, phenomena and objects by bringing together their common characteristics. In this respect, concepts constitute units of thought. Thanks to concepts, we think, express our thoughts and write down concepts as permanent texts (Şimşek 2019). Concepts serve as a stepping stone for organizing and grouping information and for individuals to learn new things. For this reason, in order to learn concepts, individuals need to configure the information they have just learned with the experiences, attitudes and skills they have previously brought from their own experiences in their minds. In the light of this information, concepts are the building blocks of learning that illuminate complex thoughts and help individuals produce new ideas (Zirbel 2006). Since learning continues continuously from birth to death, the mental equivalents of concepts in individuals are constantly changing. In this process, there are difficulties in learning the meanings attributed to objects, phenomena or events that cannot be seen visually through written or verbal communication (Atılğanlar 2014). The learning life of teachers and students in classroom environments is exactly the same.

Oftentimes, the knowledge that students gain through their daily learning experiences can create false beliefs that are deeply rooted in their minds. These scientifically inaccurate beliefs involve unique perspectives and are learned by students from different environmental sources. For example, students may develop unscientific concepts about "the process of the formation of the earth and the occurrence of life forms on earth" (Janiuk 1993). Therefore, while teaching and learning biology, more attention should be paid to abstract concepts than other concepts. Because an incomplete or incorrectly learned concept will deeply affect the learning and understanding of the concepts related to it. As a result, "misconceptions", which are often difficult to correct or eliminate, will emerge (Atilboz 2004; Bahar 2003).

One of the factors that deeply affect learning experiences is misconceptions. "Misconceptions" are the concepts that are formed as a result of individuals' personal experiences, that make it difficult to learn concepts whose accuracy and reality are determined by science, and that individuals attribute meanings in their own way and that are far from scientificity (Yürük et al. 2000). It is seen that many terms such as "persistent traps, instantaneous reasoning, general sense concepts, child science, self-generated ideas, alternative concepts, primitive beliefs, personal erroneous ideas and preconceptions" are used in relation to misconceptions in education (Baki 1999; Köse et al. 2003; Tekkaya et al. 2000). Among these terms, the terms "alternative concept and misconception" are mostly preferred in the literature.

"Alternative concepts" cause both difficulties in the reconstruction of the information learned by students and disruption of the integrity of meaning in students' minds. Therefore, there will be difficulties in teaching some theories, rules, principles and concepts in Biology to students in a meaningful and improvable way (Stavy et al. 1987). It is very difficult to make conceptual change meaningful and reduce its negative effects by eliminating alternative concepts not only in Biology education but also in all fields of education. Therefore, applying the strategies, methods and techniques developed to ensure "conceptual change" during teaching will eliminate the difficulty (Gödek et al. 2019). Scientists have developed many strategies and framework models to ensure conceptual change. All these framework models and strategies serve the same purpose. Applying these frameworks, models and strategies, which provide conceptual change during individuals' learning, together or separately, will ensure the change of information in their minds with scientific ones (Güneş 2020).

Chi et al. (1994) stated that conceptual change occurs as a result of the retransfer of a concept between different categories and that learning occurs during the assignment of concepts between categories. From a different perspective, conceptual change during learning is the process of assimilating and adapting schematic patterns. It is stated that conceptual change occurs when students question the existing concepts in their minds during the learning process and attribute new meanings to these concepts (Posner et al., 1982). In this way, it is emphasized that students will use these concepts in their minds to overcome extraordinary events that they have never encountered before. When students encounter unusual events, conceptual change will occur by exhibiting one or more of the reactive behaviors such as "ignoring, rejecting, excluding, holding, reinterpreting, making small changes and developing theories" (Chinn & Brewer 1993).

According to Vosniadou (1994), in order for conceptual change to take place, concepts need to be passed through "revision and enrichment" filters. In this way, it was stated that the mental knowledge of individuals in their unique worlds develops by making progress. diSessa (1993) defined conceptual change as a process in which students use the right pieces of information in the right place at the right time in their minds. One of the common teaching strategies applied in this regard is to confront learners with contradictory and inconsistent events that do not match the concepts in their minds. Therefore, in order to facilitate the learning and teaching process, learner-centered learning situations should be placed at the center of teaching. At the same time, teachers should manage the process well within the framework of a specific plan. In this plan, it should be well known which topics should be covered in depth and which ones should be covered superficially.

It has been observed that the studies on alternative concepts in postgraduate theses in our country are insufficient in terms of providing conceptual change. Therefore, in order to ensure both individual and social development and progress in the field of Biology, the number of researches conducted in our country should be increased. This research aims to determine the current situation in the field and to reveal the missing aspects by conducting a "thematic analysis of graduate theses carried out in the dimension of conceptual change of alternative concepts". Therefore, the importance of the study increases even more in terms of being a guide for future research in this field.

The problem of this study was determined as "How is the classification of the postgraduate theses on the dimension of conceptual change of alternative concepts in biology education from 2012 to 2022 in Turkey in terms of year, sample, type, approach model and realization of conceptual change?". The following sub-problems were

determined and answers were sought in the direction of these five categorizations.

1-How is the distribution of the postgraduate theses on the conceptual change of alternative concepts in biology education according to years (2012-2022)?

2-How is the distribution of the postgraduate theses on the conceptual change of alternative concepts in biology education according to the sample group?

3-How is the distribution of the postgraduate theses on the conceptual change of alternative concepts in biology education according to their type?

4-How is the distribution of the postgraduate theses on the conceptual change of alternative concepts in biology education according to the approach model?

5-How is the distribution of the postgraduate theses on conceptual change of alternative concepts in biology education according to the realization of conceptual change?

2. Materials and Methods

This study is a "Descriptive Survey Model" research. Descriptive survey is to describe and explain what the existing phenomena are, what is currently available, what is experienced and what is experienced (Sönmez & Alacapınar 2019). In accordance with the purpose of the study, the current situation and general trends in the field are determined with the "Descriptive Content Analysis Method" (Çalık & Sözbilir 2014).

The thematic analysis of the postgraduate theses examined in the study process was carried out in two stages. The first stage was to make the documents obtained as a result of literature review meaningful according to the "4N 1K Literature Review Model". The second stage is the creation of frequency distributions and graphs of the obtained data in line with the five sub-problems using the "Excel program" (Köroğlu 2015).

"Postgraduate theses on the conceptual change dimension of alternative concepts in biology education between the years 2012-2022" were examined in this study using the Descriptive Scanning Model. The official website of "YÖK National Thesis Center" was selected as the database. A research that is not managed properly will both cause a lot of time loss and result in not reaching the desired content. Key words should be determined in order to manage the research process well, to conduct in-depth research and not to drown in this process (Köroğlu 2015).

Therefore, "Alternative Concept", "Misconception", "Biology Education" and "Science Education" were determined as keywords during the search. As a result of the research, a total of 32 theses were reached in the "dimension of conceptual change of alternative concepts in biology education". Since this article is a "descriptive review and document analysis", it is in the type of "articles that do not require ethics committee permission".

3. Findings

A thematic analysis of the postgraduate theses in biology education for 10 years between 2012 and 2022 was conducted in the dimension of "conceptual change of alternative concepts". In this study, the postgraduate theses in the last 10 years were analyzed according to "the years they were conducted, sample group, type, approaches and the realization of conceptual change" and explanations were made over the reference distributions. The graphs of the findings of these thematic analyses were drawn with the "Excel program" and presented below..

"Findings on the classification of the postgraduate theses on conceptual change of alternative concepts in biology education between 2012-2022 according to years":

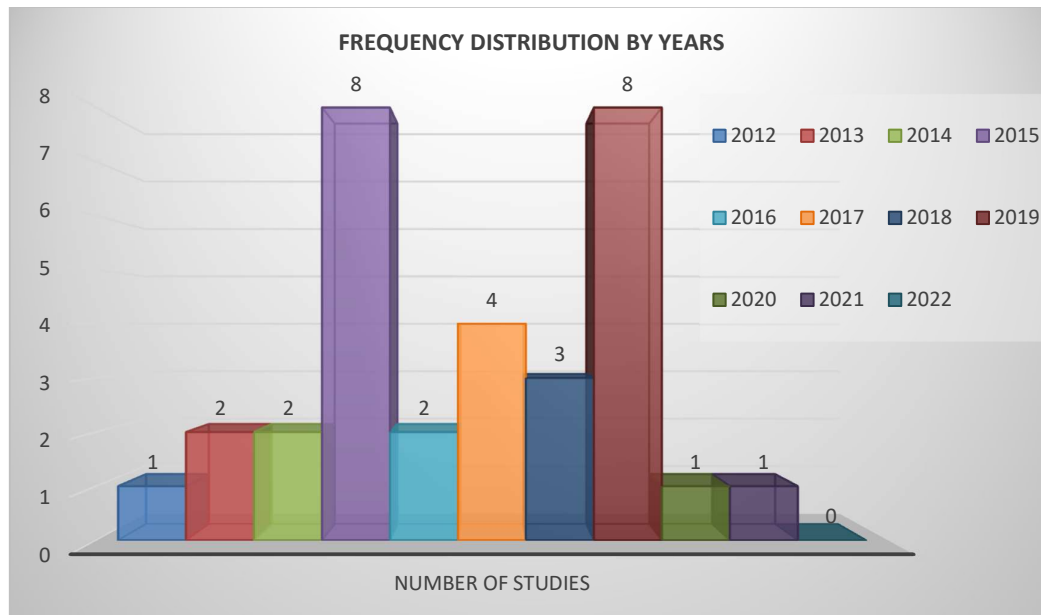


Figure 1. Frequency distribution of graduate theses in Biology education by years.

According to the findings in Figure 1, we can say that the number of theses in the field of Biology increased until 2015. The majority of the studies, 25 theses, were conducted between 2015-2019. The fact that there were 8 theses in 2015 and 8 theses in 2019, totaling 16 theses in these years, showed that the number of studies increased in these years. In the following years, the number of theses conducted gradually decreased and in 2022, it was revealed that there were no published studies.

"Findings related to the classification of postgraduate theses on conceptual change of alternative concepts in biology education between 2012-2022 according to the sample group":

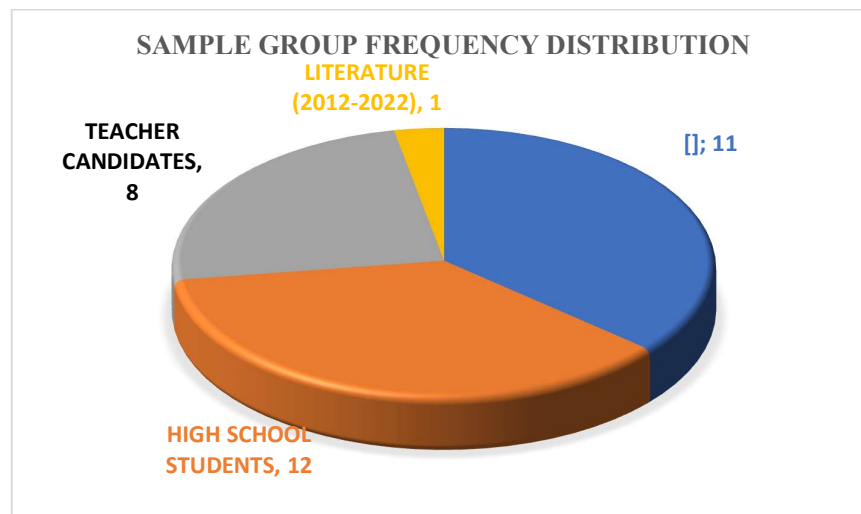


Figure 2. Frequency distribution of graduate theses in Biology education by sample group.

According to the graph in Figure 2, it is seen that there are more studies on high school and middle school students. In addition, it was revealed that the studies conducted on pre-service teachers were insufficient. Among the theses conducted in the last 10 years, one study was found to be a literature study. Considering the education and training of Biology, which deals with almost everything about living things, it is thought-provoking that teachers and pre-service teachers are less preferred as the study group.

"Findings on the classification of postgraduate theses on conceptual change of alternative concepts in biology

education between 2012-2022 according to their type":

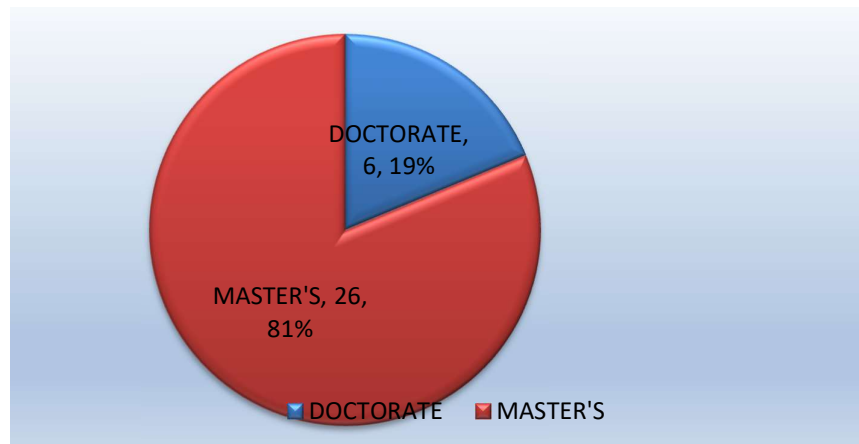


Figure 3. Frequency distribution of graduate theses in Biology education by type of theses.

According to Figure 3, when the postgraduate thesis studies are examined, it is revealed that %81 of the studies are carried out in master's (26) and %19 in doctorate (6) types. It is noteworthy that the density of doctorate theses is low in the studies conducted.

"The findings of the classification of the postgraduate theses on conceptual change of alternative concepts in biology education between 2012-2022 according to their approaches":

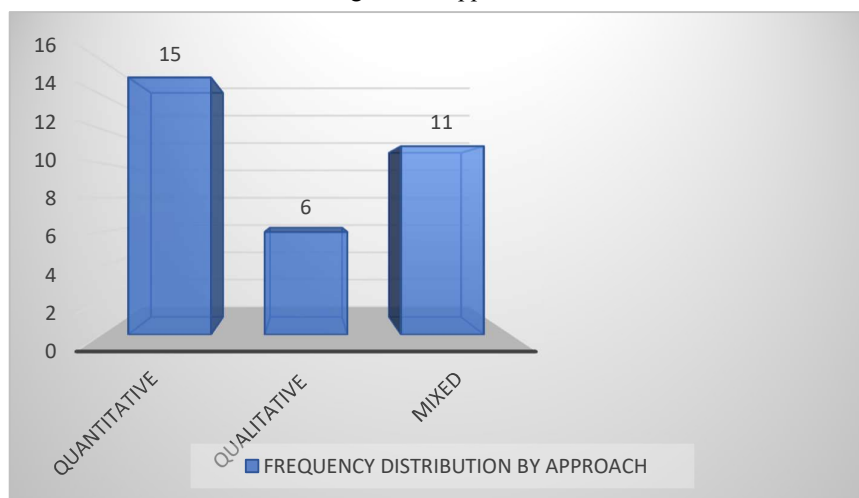


Figure 4. Frequency distribution of graduate theses in Biology education by approach of theses.

According to Figure 4, it was concluded that most of the studies were conducted in the "Quantitative approach (15)" type. It was determined that the number of studies in which the "mixed approach" model, in which both quantitative and qualitative types were used together, was 11. According to these results, the fact that the number of studies conducted by adopting the "qualitative approach" was 6 revealed that it was less preferred. Considering the postgraduate theses conducted in the last 10 years, most of the studies were conducted in the form of quantitative studies.

"Findings on the frequency distribution according to the realization of conceptual change in postgraduate theses on conceptual change of alternative concepts in biology education between 2012-2022":

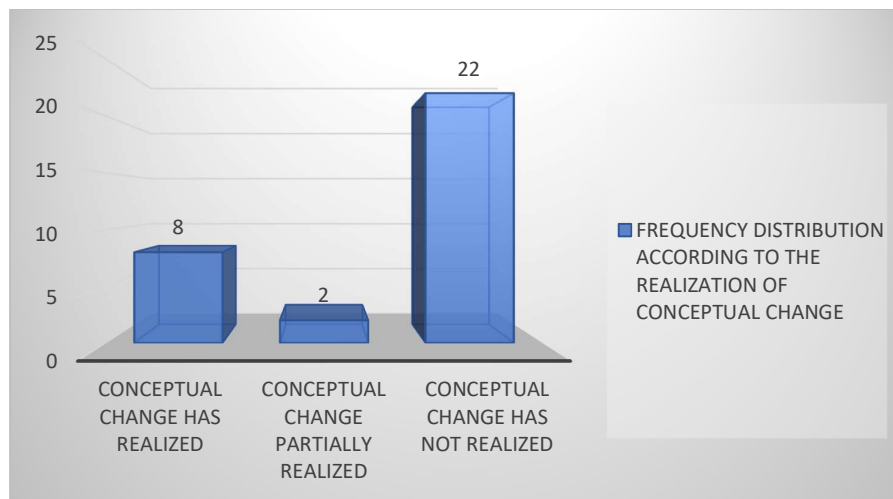


Figure 5. Frequency distribution of graduate theses in Biology education by the realization of conceptual change.

When the graph in Figure 5 is analyzed, it was determined that "conceptual change" of alternative concepts was realized in 8 of the studies. In 2 studies, "conceptual change was partially realized" and in 22 studies "conceptual change was not realized". These results show that the researchers have mainly tried to identify alternative concepts, but conceptual change has not been achieved or studies have not been conducted to achieve conceptual change.

5. Discussion and Results

In this study, 32 postgraduate theses belonging to the last 10 years between 2012-2022 in biology education were accessed from the official database of "YOK National Thesis Center". The theses were analyzed at five points of interest and remarkable results were found. According to the results found, both the limited number of postgraduate theses and the researches conducted on the conceptual change of alternative concepts in Biology education are insufficient. Therefore, it reveals that future studies on conceptual change, which is the main subject of these studies in the field of Biology, should be increased.

Considering the "years" in which the postgraduate theses were conducted, it can be said that the studies increased until 2015. Similarly, Kula and Sadi (2016) stated that studies in the field of Biology increased in some specified years. Most of the studies took place in the 5-year period between 2015 and 2019. At the same time, a total of 16 studies were conducted only in these 2 years, 8 thesis studies in 2015 and 8 thesis studies in 2019. The years 2015 and 2019 have emerged as the peak years of graduate thesis studies on "conceptual change of alternative concepts in the field of Biology education".

It can be said that the reason for this situation is that studies are emphasized to increase the quality of education in the field of Biology and in this determined subject. In 2020 and 2021, it was concluded that the research was limited to 1 study. In 2022, no postgraduate thesis study was obtained within the framework of the criteria determined until the moment this research was conducted. This situation shows that in the last 3 years, researchers have not preferred to carry out studies together in terms of "identifying false learning and alternative concepts and providing conceptual changes" in Biology education.

When the "sample group" of the postgraduate theses on the subject of this study in the last 10 years was examined, it was concluded that the studies focused more on high school and middle school students. The focus of the studies on high school and middle school students as the sample group can be shown as the reason for the researchers' preference because abstract concepts or invisible living beings and systems are intensively covered, considering the angle of learning Biology subjects at these grade levels. In the light of the data, it was seen that teacher candidates as the sample group were rarely investigated in the study processes. Bozpolat and Bolat (2020) also reached similar results in their research. Another result of the research on this issue is that it shows that "literature review" has been selected as the sample group in a study that has started to work in this field in the last 10 years. It is also very surprising that "teachers and graduate students" were not selected as the study group. When the education and training process of the Biology course, which deals with everything that belongs to living things, is taken into consideration, teachers and teacher candidates should be determined as the study group in order to prevent wrong and inadequate learning and teaching. Because it should not be forgotten that teachers are in the

field of education during the teaching process and teacher candidates will be teachers in the future. In fact, it is important to consider graduate students within this framework and include them in the research (Gül & Köse 2018).

When the "classification by type" of the postgraduate theses on the conceptual change of alternative concepts in biology education between 2012 and 2022 was carefully examined, it was concluded that the majority of the postgraduate studies (26 = %81) were master's theses, which overlapped with the study conducted by Küçükaydın (2020). Doctorate theses in this field, on the other hand, are far behind in terms of number (6 = %19). The reason for this can be said to be that there are few courses or studies in courses that include conceptual change in Biology education in the doctoral programs of universities. In addition, the fact that the number of students participating in master's degree programs is higher than the number of students participating in doctoral programs can be shown as a factor of this result. For this reason, in order to increase the number of doctorate type studies, increasing the quotas of students participating in the doctorate program and the number of doctorate courses in this field will bring this situation into balance and ultimately to a solution. Thus, academic studies in this field will contribute more to the field. At the same time, this situation, which triggers each other, will pave the way for other new and original studies.

When the "approaches" of the postgraduate theses conducted between 2012 and 2022 on the conceptual change of alternative concepts in biology education were examined, it was found that most of the studies (15) used the "quantitative approach". The number of studies conducted with the "mixed approach" model, in which both quantitative and qualitative approaches are used together (11), is higher than the number of studies conducted with the "qualitative approach" (6). Yanarateş (2022) supports this situation with a similar study. According to the results of these studies, "quantitative approach" has been applied more in graduate studies in the last 10 years. The reason for this may be that Biology is a quantitative field where experimental studies are used intensively.

When the "realization of conceptual change" of the postgraduate theses on the conceptual change of alternative concepts in biology education between 2012 and 2022 were analyzed, remarkable results emerged. According to the results of this analysis, "conceptual change has occurred" in 8 graduate studies, "conceptual change has partially realized" in 2 graduate studies and "conceptual change has not realized" in 22 graduate studies. When the results of the last 10 years are analyzed, it is seen that "identifying and diagnosing alternative concepts" has been preferred in the studies in the field. However, it was determined that planned researches were not carried out at the point of "eliminating misconceptions" and incomplete and erroneous learning was not prevented.

As important as it is to identify incomplete and erroneous learning and to define its type, it is more important to eliminate it. In addition, we can say that it is more valuable to create learning processes in which permanent, flexible and conceptual change is achieved. Instead of identifying the type and existence of alternative concepts in students and then stepping aside, research should be focused on ensuring conceptual change. In fact, the difficulties experienced in the process of conceptual change, teaching methods and techniques that work and do not work should be written (Ecevit & Şimşek 2017).

Suggestions:

- 1-It would be appropriate to increase postgraduate studies to provide conceptual change in the field of biology.
- 2- Studies with teachers, teacher candidates and graduate students should be increased.
- 3- Increasing the number of quotas for Biology doctorate programs in universities will contribute to the field.
- 4-It would be useful to expand the number of postgraduate courses and course curricula in the field of Biology related to the subject being researched.
- 5-Preferring the mixed approach model in such studies would be appropriate.
- 6-Research on the determination of erroneous and insufficient learning and research on the provision of conceptual change should be carried out together.
- 7-Learning processes should be well planned and managed by researchers.

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