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Successful Experiences in Chemistry Teaching in Turkey: Teaching Activities Based on Inquiry and Argumentation

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Abstract

The aim of this research is to present examples resulting from successful implementations of the teaching activities in the field of chemistry in Turkey by inquiry based and argumentative method. One of the important factors of a sufficient chemistry teaching is the preparation of the teaching plan in respect to the subject. Thus, in every country, science education curriculums are continuously revised and new teaching approaches are implemented. In 2013, the determined teaching approach in educational sciences is the inquiry and argumentation based methods where the students are actively involved in the learning process. In this study, some applications are analyzed and successful experiences are exemplified.

1. Introduction

A decent science education is possible if the students are able to structure logically the scientific subjects and terms in their minds. The most important way of doing this is to assimilate the scientific subjects to daily life. In other words, science has to be learned by experiments, observations and the results of these [1;2]. According to this, the educational science teaching program which came into force in Turkey in 2005, has shown positive results.

If one considers the science education curriculum in secondary education in Turkey, it is possible to see that there are two curriculums - the first one is prepared for 9th and 10th grades, the second one for 11th and 12th grades - which consists of Base Level and Advanced Level phases. The Base Level Chemistry Education curriculum tries to provide the students a directly intimate education with the daily life- whose content is shallowly, whereas the Advanced Level Education provides an education based on the pre-knowledge of the individual student and with the supposition of being professional in this field. Therefore, principles, definitions, theories, legislations and mathematically based applications prevail in the Advanced Level Education's content [3].

Abstract concepts of Chemistry are aggravating the learning process. Science Education Researchers' biggest problems are to create teaching methods and strategies how students can imagine and understand these abstract concepts. In this context, the most important and most often implemented teaching method is structuralism which makes any individual student responsible for the own learning [4]. Reviewing the literature, one can say that inquiry - and argumentative teaching methods are based on structuralism.

2. Inquiry Based Teaching in Chemistry Education

The Inquiry-based learning is the continuum where students convert information into knowledge by asking questions, research and analyzing data. A different definition to this, the Inquiry based learning is a continuum where students try to find answers and solutions for encountered problems in the classroom. In this sense, the aim of Inquiry based learning is to create the learning process with the

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help of the students' problem solving skills and lets the students investigate information directly from life and develop skills in order to generalize them [5].

There are three forms of Inquiry-based learning: structured inquiry, guided inquiry and open inquiry. In the structured inquiry learning, the teacher stresses the problem and also provides the way for the solution, whereas in the guided inquiry, the learner has to find the way to solution by himself/herself. In the last one, the open inquiry, the learner determines the problem individually and the inquiry loop (dealing with the topic, developing problems, knowing what is essential, gathering data and analyzing, synthesizing data, transferring data and evaluating them) is also determined by the learner [6]. In order to make the guided inquiry effective, the learners need to get the chance to practice the in-classroom activities in a laboratory environment.

In Kizilaslan's investigation, the success of Chemistry teaching based on inquiry was observed. Here, the students' academic success and their perspectives were scrutinized. According to Kizilaslan, it takes a long time until the student structures the information. Often, students complain that this long term is affecting their motivation negatively. Besides this, a more sufficient guided inquiry will be provided if the experiments are not overlong at all. The reason for this is, the motivation of the students have to be kept at maximum level which leads to a better solution finding. It is assumed that the worries of the students about gathering information can be minimized with the help of assistants and additional teachers plus experiment papers. Therefore, it is appropriate to give the theory and process steps at hand which enhance the collection of information. In conformity with the students utterances, the inquiry-based learning has positive effects on the cognitive process. Seeing themselves in a position as a researcher led the students to positively behavior changes. Besides this, individual in the groups felt themselves more relevant to the issue and also as a part of the experimental process.[4]

In the works Köseoğlu and Bayir conducted, it is aimed to search the effect of learning method based on questioning-searching the teacher candidates' conceptual shifts in analytical chemical laboratories, their way of perceiving science and science learning, comparing with traditional verifying method. It is known that using teaching methods based on questioning-searching like learning circle in laboratory teaching with the aims such as interesting them towards science, provide the students with thinking creatively and scientifically, improve their ability of solving problems, improving to understand conceptually. According to the results of the research, questioning-searching learning is more effective in the teacher candidates' perceiving science and scientific learning than traditional verifying. It has been figured out that the teachers gained an insight, in that the function of the science is to understand the action of the nature, that considering logically in science is important, that there is not always only one correct explanation for the circumstances, that they should be included in the scientific researches to be able to understand science, and that doing experiments by using scientific processes in laboratories and having these processes by influencing one another make it easy learning science, that science should be learned to discover, not to verify what has been already known. Learning based on questioning-searching implemented on the experiment group is thought to be effective in the teacher candidates' perceiving science and scientific learning methods, in that it features scientific process skills such as hypothesizing, testing the hypothesis, gathering data, researching and commenting the results, namely, the processes which includes the methods of gathering scientific information. [7]

3. Argumentation Based Teaching in Chemistry Education

The attitude Argumentation-Based Science Learning (ABSL) is an attitude which is used for the fact that the students actively achieve conceptual learning by doing research. If the class based on this



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approach is planned or implemented well, the student's understanding important concepts will become easier. As it is mentioned in configuring learning theory, students learn their knowledge by configuring it and ABSL attitude also aims to present a learning environment which the students can attend the processes actively. In this learning environment, they will become more interested in learning in time, and they will learn further. The students are in cooperation in the classrooms where ABSL attitude is applied, they save their data and observations, they produce ideas and they support them with proofs. That's why, the students in the group are responsible for one another. The debates both in the group and among the groups have an active role in the students' sharing their ideas and in the phase of their configuring their knowledge. At the end of the laboratory activities, the students writes the experiment reports where questions, tests, observations and claims, ideas, proofs, reading and comparison, and reflections stand in a suitable way to ABSL report format. [8]

It is seen that the activities based on argumentation has a positive effect on understanding the concepts in the field of science. Argumentation in science education builds up a connection between ideas and data via reasons. A class environment in which argumentation is used enables students to use scientific theories, data and proofs to cover their own ideas about the topic or to refute. [9]

The result attained in the search conducted by Kaya illustrates that teaching science based on argumentation is effective in comprehension of the concepts. Moreover, It is an expectable result that the teacher candidates in the group where the activities based on argumentation are used produce arguments with higher quality in comparison with those in the group where traditional method is applied. Because the teachers in the group where argumentation is used has carried out a lot of activities about producing high quality arguments by using argumentation components, such as idea, data, reason and qualifier when they cover their ideas. [9]

However, in the study conducted by Tümay and Köseoğlu, a teaching chemistry class which was arranged with an open-minded teaching method in a way that enables chemistry teachers to comprehend the argumentation process, which is one of the scientist mind exercises, to realize that argumentation is important in teaching chemistry concepts to their students in future, and to see the examples of implementation examples by experiencing the argumentation process actively. In this class, the teacher candidates are provided with attending scientific implementations such as theorizing and reasoning, putting forward possible theories, presenting and refuting opposite theories in social interaction during this process. Teaching with argumentation showed the insight that it will have provide a lot of positive outcomes after the teacher candidates attended the teaching chemistry class based on argumentation. It has been figured out that most of the teacher candidates gained the insight that argumentation can improve various skills such as critical thinking, questioning and scientific thinking. The teacher candidates has improved the thought that in the process of argumentation, various thoughts are shared, discussed, strengthened by being questioned and meaningful learning and conceptual shifts can take place with all of these processes. It has been figured out that the teacher candidates will change when teaching with argumentation takes place, an environment where the active attendance of all students are supported will come into existence, they have gained the insight that social interaction will increase. It is also seen that most part of the teacher candidates have gained the thought that the students will understand the nature of science better and their interest for the class and their self-confidence will increase in consequence of argumentation implementations. All these results have illustrated that the teaching chemistry class based on argumentation will affect the teacher candidates' insight for teaching with argumentation in a positive way.[10]

That the argumentation has been taught in this way and they has proposed higher quality arguments has changed their comprehension of concepts in a positive way, too. On the grounds of the finding



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attained from the study, it can be concluded that argumentation is effective in teaching concepts. Because the activities based on argumentation is effective in teaching concepts, argumentation should be clearly taught in both in teaching teachers and in science classes in the level of primary education and secondary education and the students should be provided with the ability of composing high quality arguments.

4. Result

According to the studies conducted, in chemistry education, the students' way of learning and needs of learning are also different because they have different characteristics. That's why, using only one teaching method will be insufficient because of the students' different features. The teachers should enhance their teaching repertoire because the students have different styles of learning options. Because the students' methods of receiving information and processing them are different, the teachers should present the teaching materials in different way so that they can enhance learning. The very way of this is to use different learning method-techniques based on the configuring attitude. As a result of implementing the strategies which belong to the configuring attitude, the students' success in chemistry course is relatively higher than the group where the normal teaching is applied. Moreover, it is observed that the students attend the class more willingly, they don't become bored of being in the class and, furthermore, as a result of group debates carried out, an atmosphere of competition has arisen. All of these observations have illustrated that the students have become more willing to learn and meaningful learning has taken the place of learning by memorizing.

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