Extended Summary

Analysis of Knowledge Structures About Light Concept of The Fifth Grade Students According to Conceptual Change Theories

Zeki APAYDIN, Emrah AKMAN, Erol TAŞ, Evşen AYMEN PEKER

Introduction

That there are so many descriptive and theoretical concepts in science lessons and the number of alternative conceptualization given by the researches made in this field give rise to the importance of conceptual change theories in forming scientific and meaningful conceptualization. Students, as seen in several units in science courses, have different conceptual structures on the concept of “Light” in the unit “Light and Sound” (Baysen, Güneyli and Baysen, 2012). The purpose of this study is to determine whether the knowledge structure of first level elementary school students for the “light” concept can be explained by “knowledge-as-theory perspective” or “knowledge-in-pieces perspective” and to contribute to the development of new teaching and learning techniques. For students, attending lessons with priorconceptions have been creating negative influences on their learning scientific concepts (Başer and Çataloğlu, 2005). For this reason, determining priorconceptions of the students in respect to which knowledge-structure theory has been constructed and the formation of suitable learning activities is extremely significant. For the concepts that students have constructed, different knowledge structure and conceptual change theories have been developed. According to these theories, conceptual change process has been explained in different ways.

Theory like knowledge structure theory is based on the schema concept in the cognitive development theory of Piaget (Piaget, 1950). These schemas are those which the student started to form beginning from birth and they are first knowledge structures that they used to explore their environment. According to this theory, when students face a new knowledge that don’t fit to teir existing schema they get into a contradiction and realize a conceptual change by making some changes in their existing schemas or by forming a new schemas. Assimilating contradicted new knowledge, the students adjust this knowledge to their existing ones, and thus they ensure that this conceptual framework continues.
that the related conceptual framework cannot explain the existing natural problem or phenomenon has been created a new conceptual framework. Students use these schemas which they have formed by developing a theory like knowledge for any concept, and while answering a question their answers will be consistent by means of these schemas (Ioannides and Vosniadou, 2001). For instance, the students’ conceptualization of up-down for the physical world, of being motionless is natural and no needs to be explained and being in motion is necessary to be explained is a conceptual framework. The students’ differently perceiving the forces affecting the objects moving in space, according to their moving direction, is the result of such a conceptual framework. Here is virtually stated that this conceptual framework is to be changed (Vosniadou, 1994). According to this theory, at the beginning the students have a consistent conceptual framework, that is, theory like knowledge structure. During the learning process, the students gradually try to relate the newly learned patterns to their existing ones, and thus they try to form a synthetic concepts. Although these synthetic concepts are instable or changeable and hybrid they are still coherent in the continuing period. Namely, first, the conceptual framework is the form of a mixture of the new and previously existing ones. At the end of the learning process, with the formation of the required conceptual framework, former and hybrid consistent structures are replaced by the new consistent scientific structure (Vosniadou, 1994). According to the knowledge-in-pieces theory, throughout the conceptual change process, rather than having a change or leaving knowledge pieces which negatively affects learning, during the acquisition period of new knowledge, it depends on mentally a reorganizing one’s knowledge into complex system (Özdemir, 2007). That is the students’ prior knowledge for any scientific fact are different from scientists and they starts with unstable, small and simple knowledge pieces for explaining their scientific experiences. These intuitive knowledge systems called phenomenological primitives (p-prims). At the end of formal learning processes the p-prims may gain a coherent structures like as scientists’ (diSessa, 1993). According to this theory, the students try to understand and explain a scientific experience with the other p-prims that are quasi-dependent to each other. diSessa who is the pioneer of this theory corresponding the conceptual ecology approach of Strike and Posner (1992) points out that a student hasn’t learned the true scientific meaning of a concept tries to understand related scientific experience he has faced newly by using different information parts in different contexts. In
these circumstances, students facing with factual problems (e.g. related to force and energy) will prompt different knowledge particles related to the same problem and give inconsistent answers to the question or set of questions. In this research, clinical interview method was used. In this study 21 fifth-grade students were selected and interviewed as participants. When the answer that students give to 9 sets of questions were evaluated in terms of 4 different concepts (the movement of light, relation of seeing and light, relation of shadow and light, relation of transparency and light); it is observed that conceptualization of relation of seeing and light, relation of shadow and light, relation of transparency and light are consistent while conceptualization of movement of light is inconsistent.

Seeing these evidences it is not difficult to get the result that conceptualization of different dimensions of light concept, which is a meta concept in our study, occurs both according to knowledge-as-theory perspective and knowledge-in-pieces perspective. This circumstance is different in general literature findings and results. It is seen that concepts are divided into different forms in literature. One of the most important classification is Lawson’s classification (1995) and it is supported by different findings and results in our study. According to Lawson if concepts such as light and ray of light are evaluated in terms of qualifications which are perceived directly, they are descriptive, if they are related to facts such as atom, sub-atom particles and photon, they are theoretical. It was concluded that the knowledge structures about light concepts of students are suitable for "knowledge-in-pieces perspective" in theoretical concepts and "knowledge-as-theory perspective" for descriptive concepts.

Conceptual change theories point out that each concept cannot be changed by the same method and model and two different concepts cannot be structured in the same way. Thus, it is important that different teaching and learning methods and techniques should be developed based on different theories (diSessa, Gillespie and Esterly, 2004; diSessa, 1993).