Identifying 9th Grader Students’ Previous Knowledge and Misconceptions about Plane Mirrors

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SYNOPSIS

INTRODUCTION

The findings of the studies on science education have revealed that students develop certain ideas that are different from scientific views (misconceptions) and fail to give up these ideas throughout their education (Driver, Guesne & Tiberghien, 1985; Wandersee, Mintzes & Novak, 1994; Treagust, Duit & Fraser, 1996). It is for this reason that when introducing students with new science concepts, science teachers should take adequate care and structure teaching processes well to help their students attain scientifically accepted conceptions. In this context, the first step to be taken to achieve effective learning is to identify students’ incorrect ideas about various science concepts (Osborne & Freyberg, 1985).

PURPOSE OF THE STUDY

This study aims to identify secondary school ninth-grade students’ previous knowledge and misconceptions about plane mirrors. Accordingly, the study problem is “to identify the students’ previous knowledge and misconceptions about plane mirrors which they have carried from their primary school years and daily experiences to their secondary education process and to reveal the origins of their current ideas through the views of students”.

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METHODOLOGY

The data were collected by using “the Conceptual Understanding Test on the Unit about Mirrors” and “Semi-structured Interview Forms”. The conceptual understanding test consists of a total of four questions about “image formation”, “image characteristics” and “visual field”, the titles under the unit on plane mirrors. The test was administered to a total of 310 students from two different high schools. In evaluating the conceptual understanding test, the researchers first wrote down the correct responses to the questions and categorized the students’ responses as “codable”, “uncodable” and “no response”. Codable responses were further grouped under the categories “scientifically acceptable” and “scientifically unacceptable”; and the data were then analyzed.

In line with the data obtained from the conceptual understanding test, semi-structured interviews were held with students so as to examine in detail how students arrived at such ideas and how they structured them differently from scientific concepts. In the course of preparing interview questions, the students’ responses in the conceptual understanding test were subjected to a detailed examination. In accordance with these responses, questions on different subjects (plane mirror, visual field etc.) were formulated for each student to determine how they arrived at their misconceptions. During the interviews, the students were also asked additional questions in line with their responses in order to reveal how they attained these ideas.

DISCUSSIONS, CONCLUSION and RECOMMENDATIONS

As a result of the examinations on the data obtained from the conceptual understanding test and the interviews held with a total of 16 students, it was identified that students had misconceptions about “the relationship between observer’s position and image”, “the position of image on a plane mirror”, “the relationship between the object and image”, “image characteristics”, and “the factors upon which visual field depends”.

It was observed that some of the misconceptions obtained during the research process overlapped with the misconceptions obtained in previous research on the same subject (Galili, Goldberg & Bendall, 1991; Osborne, Black, Meadows & Smith, 1993; Şen, 2003). These misconceptions are as follows.

- If the observer facing a plane mirror moves, the position / size of the objects’ images in the mirror change.
- An image in a plane mirror is on / inside / in front of the mirror.
- Objects’ images appear when we look into the mirror. There is no image in the mirror while we are not looking at it.
- When there is a barrier in front of the object, the image of a part or whole of the object is not formed in the plane mirror.
- An observer can see the image in the mirror if s/he stands in the same direction with the object; otherwise s/he cannot see it.
- The distance of the image in a plane mirror to the mirror itself is greater than the distance of the object to the mirror.

Below are the misconceptions identified in this study as different from those reported in the literature.

- The image in a plane mirror is real.
- The larger a plane mirror, the larger the image in it.
- A plane mirror shows objects as larger / smaller / upside down.
• If we move away from a plane mirror, objects’ images become smaller, and they become larger if we move closer.
• Visual field does not rely on our distance to the plane mirror / the size of the plane mirror.
• Visual field becomes smaller as we move toward the mirror, while it is enlarged as we move away from the mirror.
• Visual field becomes smaller as the mirror size is larger, while it is enlarged as the mirror size is smaller.
• When there is a barrier in front of the object, its image is displaced.

The reasons for students to have such misconceptions include the following:
• They think that the rays of light from the object disperse only in a single direction,
• They think that rays are dispersed not from the object, but from the observer,
• They think that images in plane mirrors can be seen as they are formed on the mirror,
• They consider the distance between the image and the object when determining the distance between the image and the mirror,
• They think that the rays of light reflected from a plane mirror intersect in front of the mirror,
• They think that the image size in mirrors changes depending on the observer’s position,
• They think that a change in mirror size will cause a change in image size,
• They cannot distinguish between the concepts of “visual field”, “image” and “the number of objects on which an observer focuses”,
• They confuse the characteristics of plane mirrors with those of spherical mirrors.

The study found that misconceptions identified in one area triggers other misconceptions with different content. As an example, the data of an interview with student 8 who has a misconception about image types are presented below.

**Interviewer:** What are the characteristics of an image in a plane mirror?
**Student 8 (A1):** An image in a plane mirror is real because it forms in front of the mirror.

**Interviewer:** How did you conclude that?
**Student 8 (A2):** The image in a plane mirror is real because it forms in front of the mirror or on our side. If it is formed behind the mirror, then it is virtual.

**Interviewer:** How does an image form in front of the mirror?
**Student 8 (A3):** The rays from the object hit the mirror and are reflected. The reflected rays form the image in front of the mirror.

An examination of the interview data reveals that student 8 tried to explain his misconception about the type of image with another misconception concerning the position of an image in a plane mirror (see A1). The student cannot make correct sense of the relationship between the type and position of the image in plane mirror. As is clear from the example, students’ attempts to generalize misconceptions to different content lead to their perception of the current misconception as an immutable piece of information, adversely affecting the meaningful learning process.

It is usually observed that students hesitate to give up their misconceptions in favor of scientific concepts throughout their education process, alternating between their current
knowledge and scientific knowledge. It has been concluded that the scientific knowledge and misconceptions in students’ minds are used alternately depending on conceptual content (Singley & Anderson, 1989; Andre & Windschitl, 1998).

Concepts and interconceptual relationships should be taught more clearly in science courses for it has been observed that some students actually assign meanings to concepts, but fail to associate them with each other (Anderson & Smith, 1984; Fetherstonhaugh & Treaugust, 1992).

When they are introduced with new content, students should be reminded of previous similar content. More importantly, the similarities between the previous and current concepts should be underlined. It is only possible in this way to make most students realize knowledge transfer (Singley & Anderson, 1989).

In this context, teachers should provide a learning environment that supports conceptual change teaching and create opportunities for debates and thinking activities about misconceptions. The subject of mirrors is covered by elementary and secondary curricula and is frequently confronted in daily life. In order to eliminate possible misconceptions about this subject, activities to assist conceptual change should be offered more frequently to students who will more actively participate in them.
REFERENCES


