ACTIVITY 5 HW 2 Reading: Children's Ideas about Light

This article provides a broad overview of educational research on student ideas about light. In the educational research literature, student ideas have been referred to as misconceptions, pre-conceptions, naïve conceptions, and intuitive knowledge. Student's ideas are often consistent, reliable, and reasonable to students even though they are not necessarily consistent with scientists' ideas. Because a student's ideas make sense to the student and because teachers can utilize these ideas effectively in instruction, some educational practitioners and researchers are more comfortable using the term "resources" or "common ideas" to refer to students' ideas (Hammer, 2000).

Educational research has revealed that several common ideas about light exist among school age children. Common ideas that appear in children's written work and in children's talk are discussed below.

Common Idea 1: *The Source/Effect Idea*

Studies involving large samples of children suggest that 10 and 11 year old children tend to speak of light in terms of its source or its effects (Guesne, 1985). In a study conducted in a sunny room children were asked "Where is there light in this room?" Many responded by pointing to the light bulb on the ceiling (source) or by pointing to a spot of light on the wall (effect). When asked whether light moves, children responded in terms of the source. For example, children reported that the light on the ceiling does not move, but a flashlight or the headlights of a car do move. The source/effect idea makes it difficult to explain how we see things or how light is reflected from a mirror into one's eyes.

Another example of the source/effect idea can be found in children's common ideas about shadows. Elementary aged students often view a shadow as an independent entity that actually propagates from the object to the sidewalk or screen. According to this idea, light triggers the movement of a shadow from the object to the sidewalk or screen (Feher and Rice, 1988; Feher, 1990). In this view of shadows, light is only involved to the extent that it triggers the motion of the shadow. In order to develop the scientific idea of a shadow as the blocking of light, the learner must view light as an entity that moves through space and interacts with objects.

Common Idea 2: *Light as an Entity Idea*

Older children aged 13-14 also speak of light in terms of its source and effects. However they are more likely than younger children to speak of light as an entity located in space (Guesne, 1985). The idea that light is an entity in space between the source and the effect is consistent with the scientists' idea about light. This idea is useful for explaining shadows, reflection, and the process of seeing, since it allows us to discuss the interaction of light with an object and/or the eye. The notion of light as a source or as an effect does not provide as much versatility.

Common Idea 3: *The Mirror Reflects Light In All Directions Idea*

Both young and old students conceive of a mirror as a device that reflects. They typically view the reflection of light from a mirror as the scattering of light in all directions. While this idea is consistent with the notion of light as an entity, it is inconsistent with observations. The Mirror

Reflects Light in all Directions idea may be associated with everyday experiences such as getting blinded by sunlight when it is reflected by a car mirror or being able to shine an intense spot of light on the wall using a mirror. This idea is consistent with the notion that light is an entity in space because it describes the behavior of light when it interacts with a shiny surface.

Common Idea 4: *The Intrinsic Illumination Idea*

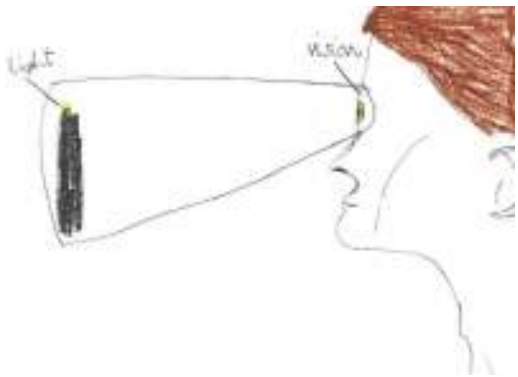
Children typically do not believe that non-shiny surfaces such as white paper reflect light. Instead, they describe this interaction in terms of the intrinsic illumination of the paper: when the light shines upon the paper, the paper becomes illuminated and glows like a lantern or a light source.

This view is consistent with the source/effect idea where the interaction of light with the white paper is explained not in terms of the behavior of the light, but in terms of the *effect* of illumination of the paper. Even students who explain light interaction with a flat mirror in terms of light as an entity in space often resort to source/effect ideas when explaining why they can see white paper when light shines upon it. In this case, the paper "absorbs" the light.

In the case of the white paper, the paper, not the light, has the property of glowing. Guesne (1985) argues that the conception of light as an effect may be due to children's sensory perceptions. She argues that children view light as an entity in space or as a source such as a flashlight only when the light is intense enough to produce a perceptible effect such as a blinding effect. When light is not seen to impact one's senses in this intense way, it is not seen as a thing, or an entity, it is only seen in terms of its effects.

Common Idea 5: *The Vision Idea*

When asked how one is able to "see" light or objects, children often associate the process of seeing with an active role of the eye rather than as an interaction of light with the eye. Children of ages 7-12 tend to draw lines of vision between the light source and the eye as shown in the pictures below.



In most cases, students do not think that something is actually coming out of the eye, but that the eye is seeing through its active "vision." This is consistent with the Source/Effect idea rather than the Light as an Entity idea because vision is attributed to the active processes associated with the eye rather than the behavior of light as it moves through space and interacts with objects.

It is not clear exactly what children mean by "vision" although it appears that they define vision as the thing or process that

allows us to see. The Vision idea is incomplete in the sense that it does not involve the interaction of light with the object or the eye. Nevertheless, it can be useful because it does involve both the eye and the object. Some children as young as 10 years old have built their idea of vision into an idea that also involves the brain.

Common Idea 6: ***The brain is involved in seeing things***

As shown in the picture below, to the child, vision appears to be the process by which people see and vision is associated with the brain. It is not clear from the diagram below that the light is actually entering or interacting with the eye, but the brain is clearly depicted as associated with the eye and the process of seeing.

Close inspection of the picture reveals an "image" of the flashlight in the students' brain.

Common Idea 7: ***In order for us to see things, light must enter the eye.*** This scientifically accepted idea is a less common pre-instructional idea than the common ideas about seeing discussed above. This idea requires that students conceive of light as an entity in space that interacts with objects including the eye. As mentioned in Common Idea 1: The Source/Effect idea, young students typically view light as a source (e.g. a flashlight or a lamp) or its effects (e.g. a spot of light on the wall) and rarely conceive of light as an entity that travels through space. An instructional implication of this is that it is important for a teacher to be aware that her students may need to develop ideas about light as an entity that interacts with objects before they can develop a meaningful understanding of how light is involved in how people see things such as the moon, a flashlight, or an apple.

Summary

The development of science knowledge in school is a process of connecting classroom observations and theories with one's own understandings of how the world works. As learners, it is important to keep in mind that we come into the classroom with our own ideas about how the world works. Some of these ideas have proved to work very well in the conditions under which we live. In science, however, we are often asked to imagine a broader range of possible conditions and to extend our explanations to account for them. As learners and teachers, we must become aware of our own ideas and the ideas of others. We must also be aware that our students' *misconceptions* or *pre-conceptions,* as well as our own, are actually *resources* that can be used toward the development of science ideas that have a broader range of application.

Awareness of children's ideas about various concepts in science has allowed teachers and curriculum developers to design lessons and curricula that can help students build on their own ideas. Our ideas, and our children's ideas, should be respected and valued. Through carefully crafted classroom experiences, children's ideas can be used as resources that actually facilitate, rather than inhibit, further learning about science.

References

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