

A SCIENCE LESSON DESIGNED ACCORDING TO 5E MODEL WITH THE HELP OF INSTRUCTIONAL TECHNOLOGY

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ABSTRACT

Students enter the classrooms with a preexisting knowledge of science concepts. These science concepts sometimes show inconsistency with the accepted ones by the scientists and called as misconceptions. Studies showed that traditional instructional methods are ineffective to rectify students' misconceptions. Consequently, instructional methods that rectify students' misconceptions become important. We have designed science lessons according to 5E model with the help of instructional technology.

Learning starts from birth and occurs in every day of human life. Children learn from their own explorations of the environment. They also learn from their parents, siblings, peers, movies, television, radio, CDs, books, magazines, museums etc. Consequently, children do not enter the classrooms as blank slates, but they enter classrooms with a preexisting knowledge of science concepts. These concepts may be incorrect, incomplete or ineffective to explain the scientific phenomena. Students' conceptions which are inconsistent with the ideas of scientists have been called 'misconceptions' (Helm, 1980; Fisher, 1985; Huddle, White and Rogers, 2000; Marques and Thompson, 1977), "alternative conceptions" (Arnaudin and Mintzes, 1985; Lin and Cheng, 2000), "naive theories (Mintzes, 1984), or 'children science' (Gilbert, Osborne and Fresham, 1982).

For three decades, students' understanding of natural phenomena has become focus for the science education studies (Aguirre & Erickson, 1984; Erickson, 1979; Nussbaum & Novak, 1976; Smith & Anderson, 1984; Stewart, 1982; Bar & Travis, 1991; Erickson, 1979; Renner, Abraham, Grzybowski & Marek, 1990; Lawson & Thompson, 1988; Westbrook & Marek, 1991 and 1992; Abraham, Williamson & Westbrook, 1994). It is known that students at different ages hold similar misconceptions in science topics. Many of the misconceptions are pervasive, stable and resistant to change despite years of formal schooling in science (Driver and Easley, 1978; Fredette and Lockhead, 1980; Osborne, 1983). So it is important to question the effectiveness of instructional methods. Many teachers use traditional methods, which are usually teacher- centered methods. In teacher- centered instructional methods students are passive learners. When new information is provided, students have difficulty to link their existing knowledge with the new concepts. Consequently, instructional methods that rectify students' misconceptions become important.

5E model is an instructional strategy, which first assesses students' misconceptions and then promotes conceptual change. (Barman, 1989; Karplus & Their, 1967; Lawson, Abraham & Renner, 1989). 5E model promotes scientific understanding and thinking abilities among students. With the infusion of multimedia into the education, multimedia lessons provide the teacher with a more effective way to transfer knowledge and information to students. Multimedia lessons also enable the students to learn in a more productive way. We have combined multimedia and 5E model as an instructional strategy.

In 2003-2004, as "Rtb Educational Solutions" have designed science lessons for the Malaysian Ministry of Education. Siemens Business Services is the owner and Rtb Educational Solutions is the subcontractor of the project. The courseware is intended to be used as a teaching courseware for teachers of science. In the courseware we applied 5E model as an instructional design to the multimedia. We have prepared 3D models, animations and videos for the science lessons. This courseware is prepared for the grade level 7 and according to the curriculum for secondary school of Ministry of Education of Malaysia. We get positive feedbacks from the Ministry of Education of Malaysia at the end of the project.

The courseware consists of two parts: multimedia science lessons and teachersresources.

The multimedia part is an instructional tool for the teacher that (s)he can use in the lesson. This part is designed according to 5E model and also consists of additional parts for the students who have difficulty to understand the lesson and students who easily grasp the content and needs further explanation related with the topic.

Engagement: The basic purpose of engagement is to help students make connections with what they know and can do. The activities in this section capture the student's attention, stimulate their thinking and

help them access prior knowledge. A question containing a discrepant event, a warm-up question, a question related with a misconception is asked to students.

Exploration: In the exploration part an interactive exercise is designed for students to explore the concepts that will be introduced in the lesson. In this phase students explore the ideas by making observations. A simple experiment may be included in the exploration part.

Explanation: In the explanation part a suggested explanation for the concepts related with the lesson are given with the support of animations, 3D models, videos etc.

Elaboration: We usually design interactive exercises, experiments for the students to apply the concepts in new situations.

Evaluation: In the evaluation part, teacher assesses students' knowledge and skills. Evaluation part is helpful for the teacher to observe whether the students gained the concepts related with the lesson correctly or not. For the evaluation purposes, the printable version of the questions are provided to teachers so that teachers can hand out these questions to students. After the evaluation part, the teacher would have some idea about the level of understanding of students in the class.

Remedial: For students who did not grasp the material and need remedial instruction, re-teaching can be done with the help of this section.

Enrichment: For students who did grasp the material may be instructed further for comprehension.

Extension: This section gives students the opportunity to expand and solidify their understanding of the concept and/ or apply it to a real world situation

In the teachersresources there are pre-test, post-test, homework questions for each lesson, suggested readings and web links for the lesson, additional learning activities and lesson plans.

Lesson Mapping: It gives brief explanation of learning objectives and learning outcomes of the lesson. Also suggested teaching and learning activities are included in this part.

Lesson Plan: In the lesson plan there are brief explanations of learning objectives and outcomes of the lesson with the suggested teaching and learning activities, vocabulary, homework questions and the moral values. In addition to above components, the summary of each content screen page is given. By the help of these summaries, the teacher can follow up all the knowledge of the lesson step by step.

Homework: Homework questions are prepared for each lesson. The students can cover all the learning outcomes of the lesson by solving the related questions.

References: All the books and web pages that are used are given in this part.

Pre-Test and Post-Test with answers: The lesson based pre-test and post-test can be used to evaluate students' level of understanding.

Quiz: At the end of the lesson, the teacher can apply the quiz questions to the students to evaluate the learning outcomes of the lesson quickly.

Summary: In the summary, the content is introduced briefly. The teacher can follow up all the steps of knowledge and the interaction used step by step.

Activity Sheets: In class activity, by the help of activity sheets, the students can follow up the procedures and can give answers to critical questions.

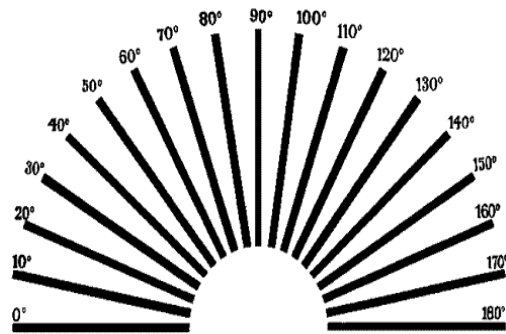
Additional Learning Activity: In the additional learning activities, the content is introduced by hands-on or different applications to enrich the subject. These applications aim to improve the students' skills for understanding the concept.

In the following pages you will find one of the science lessons we have designed in this project.

LESSON 13: ASTIGMATISM

In this lesson we introduced astigmatism.

Engagement:



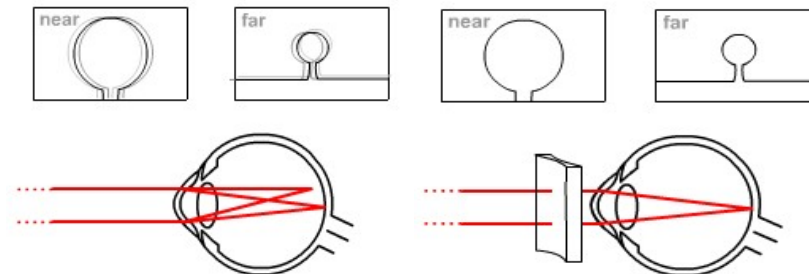
Do you know what this wheel is used for?

Exploration:

Place the chart in a well-illuminated area and stand about 6 meters from the chart. If you are wearing eyeglasses, take them off. Test one eye at a time. Can you see some of the lines in gray?

Explanation:

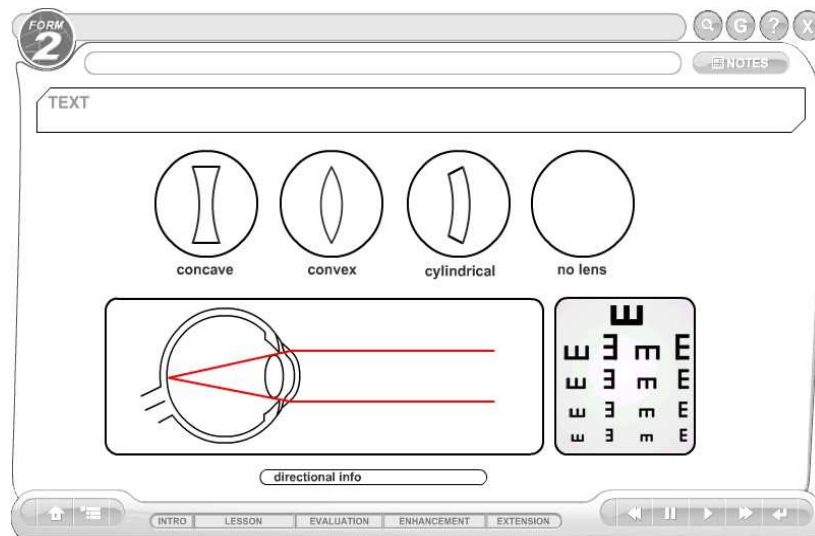
The shape of the cornea is round like a football. In some cases, the cornea may be deformed like a rugby ball. As a result, the cornea focuses the images on several different points on the retina. This condition is called astigmatism. This abnormality of the cornea results in distorted vision at all distances. Astigmatism occurs at birth and it is accompanied by short-sightedness or long-sightedness. Special cylindrical lenses are used to correct this type of vision.



Now let's answer our previous question. The figure shows the astigmatism wheel. It is a vision test to detect astigmatism. People who have astigmatism see some of the lines in gray. If you see some of the lines in gray you probably have astigmatism.

Elaboration:

In this part students make an interactive exercise and find whether there is a vision defect or not. If there is a vision defect we want students to choose the correct lens. If they choose the correct lens they observe that the light rays focus on the retina and the view of the object become clear.



Evaluation:

To see whether the students understood the shortsightedness and long-sightedness we asked several questions.

TF1: In astigmatism, the cornea focuses the image on several different points on the retina.
The answer is “True”. In astigmatism, the cornea focuses the image on several different points on the retina.

TF2: Astigmatism causes blindness.
The answer is “False”. Astigmatism causes blurred vision at all distances.

MC1: Which of the following lenses is used to correct astigmatism?

- A. A cylindrical lens
- B. A convex lens
- C. A concave lens
- D. A divergent lens

Answer: The correct answer is A. A cylindrical lens is used to correct astigmatism.

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