AWERProcedia
Information Technology
&
Computer Science

1 (2012) 68-72

2nd World Conference on Information Technology (WCIT-2011)

Blind student's experience about 3D electric circuits through bloom's taxonomical method

M. Sahin Bulbul [a] *

[a]*Middle East Technical University, Department of Secondary Science and Mathematics Education,Ankara 06800, Turkey*

Abstract

All the students use some electrical machines which include electric circuits in their daily life but this subject is not easy to understand as mechanics, optics or waves. The reason is simple and base on their perceptions before school years; electricity is dangerous. To take students interest, 3D electrical toys seems more attractive and also appropriate for blind students. This tangible set up has easy-to-handle components to design different circuits. It is safe and simple to operate. The procedure was designed according to the revised Bloom's taxonomy of cognitive domain. The method has six main steps; introducing the kit (Knowledge), listening student's explanation about some circuits (Comprehension), building a new circuit from the guide (Application), analyzing the function of components, circuit (analyzing), combining two situations (Synthesis), and making decision about circuit (Evaluate). After all these steps, it was seen from the interview that the responses to attitude questions on electric circuits changed positively.

Keywords:Blind Students, Physics Education, Bloom's Taxsonomy, Universal Design

Selection and/or peer review under responsibility of Prof. Dr. Hafize Keser.

1. Introduction

It is hard to use educating the electricity and blindness concepts together. In addition, students' different learning styles and traditional methods, materials make the electricity concept more difficult. The importance of the study appears on this way; this study aims to suggest a material and method which is appropriate for all

*ADDRESS FOR CORRESPONDENCE: M. Sahin Bulbul,*Middle East Technical University, Department of Secondary Science and Mathematics Education,Ankara 06800, Turkey*

students. The idea for preparing all students' needs is called "universal design" and this approach bases on inclusive schools [1,2-4]. In this century, discrimination for girls or boys and sighted or blind students in a school is unexpected situation; however, traditional figures of circuits are meaningless for boys who have more experience with electricity(Sencar&Eryılmaz, 2004). To develop a universal course design, we preferred Bloom's cognitive taxonomy which is appropriate for most students' cognitive process and 3D circuit material (figure 1) which is appropriate for both visual impaired and blind students.

Figure 1. Testing electrical motor circuit

2. Methodology

For this study Bloom's taxonomy was applied with two high school students who have visual problems. In 1960's, a committee of educators chaired by Bloom had defined the levels of cognitive domain. This classification helps curriculum developers, teachers to write learning outcomes. Every level defines what the learner can do, so this behavioral explanations guide us how to bring, support the learner to the highest one. If we follow the six phases defined by Bloom, we assume that cognitively the learner will reach more awareness about electrical circuits.

2.1. Knowledge phase

While this phase, we had given the 3D electrical set and let them play with it without giving any explanation. This wait time is so important for blind students to prevent their attention while investigation. The explanation about 3D set may be missed whether we ignore this wait time. After waiting, we gave information for all components of 3D set. Components of basic electrical circuit; power supply, wires, lamp, electrical motor and other electrical factor was introduced. Any question should be answered in definition level. In this phase of Bloom's method, definitions about components of basic electrical circuit should be given on an example (Figure 1). For this study in this phase, we gave electric motor as an example. They should be learned how to turn the slide switch on/off in this phase.

2.2. Comprehension phase

This phase let the student connect and create links among information. Every connected information network should be unique because it bases on background experiences. For this reason, we expect different explanations in this phase about components of basic electrical circuit. A circuit with one bulb was given to listen their explanations (figure 2). Visually impaired student perceived the bulb, however; completely blind student understand that bulb is working by feeling the hotness.

2.3. Application phase

In this phase, students should reinforce by facing new situations. We had read the list of circuits name and they chose the new one. Their explanation about components of electrical circuit should be consistent with

previous phases. The conductivity tester was their choice. It was one wire absent basic circuit with bulb. Other materials like pencil and iron stick were tested for their conductivity by putting instead of wire.

2.4. Analysis phase

For this phase, there should be added a new component to analyze its effect of on circuit. For this, phase new power supply was chosen as a new component. This was planned to construct a series circuit. Parallel and series are two main types to combine a circuit with multi-equipment; with this approach they will be used bulb and electrical motors together (figure 3). Combining two different situations; analysis for the new situation and pervious perceptions before analysis phase about circuit were expected in synthesis phase.

2.5. Synthesis phase

In this phase, learner should be needed to combine two situations, so we should pose a problem like giving an off circuit. Parallel connection of bulb and electrical motor (figure 4) was given with one absent wire which is between these two elements. They experienced one absent wire and had awareness about different connections; parallel and series. Synthesizing these two situations for new situation is this phase's aim.

2.6. Evaluation phase

This is the last part of the method; the learner should consider on the process and decide whether the 3D set is useful for blind students to learn electric circuits. This phase was completed with an interview.

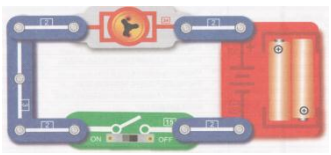

Figure 1. Electric Motor

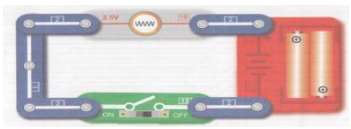

Figure 2. Circuit with one bulb

Figure 3.Lamp and motor in series.

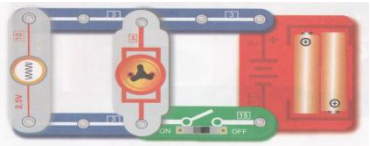

Figure 4. Lamp and motor in parallel

3. Findings

The question from the students about how to buy the set may be an evidence to show their interest and materials' appropriateness for blind's usage. A concept of circuit was new for both visual impaired and blind students; however, it was interesting that they tried to explain the situations with "water analogy". During the process, they discovered that we do not need the board to make the circuit. Their innovation was to put a paper propeller to feel its work (figure 1). The visual impaired student was more active to use than totally blind student but both of them expressed that their perceptions about the dangerous of electricity is not always correct. There are some observable findings about universal design principles [2] of 3D electrical circuit (table 1).

Table 1. Comments about universal design principles

Principle	Comments
Equitable use	Both visual impaired and totally blind students' usage is indicated that there is an equitable use for most students. We cannot discuss other disabilities with this study; however we may assume that students who are deaf or have physical problem can also use it. Any element has tactile information on it and guide is not appropriate for totally blinds. This feature is the way which should be develops for equitable use.
Flexible use	Some equipments in the set let the student make voice, light or movement. It may be used on the board or out of the board for 188 different circuits. These choices make the set flexible.
Simple and intuitive use	Connecting points on the set make the usage easy and the learner should only learn the role of elements. The success of the students who have not attended any course about electrical circuits may be the evidence for this item.
Perceptible information	The usage of different kinds of circuit elements may develop the perceptible circuit information.
Tolerance of error	The stable structure of circuits on 3D set protects the learner to make errors; unintended actions.
Low physical effort	There is no effort needed structure accept putting wires on the board
Size and space for approach and use	The set is portable and easy to find due to special box of the set.

4. Conclusion

From the research, it is clear that the portable 3D electrical circuit and Bloom's method are well-matched for both blind and visually impaired students to make an activity about electrical circuits. Moreover, this paper is a kind of guide for the teachers who has blind students in their class.

For further studies, if the designers prepare a guide with voice and if its sequence is appropriate to cognitive levels, this 3D sets will be investigated in terms of informal learning. Additionally, bulb and electrical motors are two examples from daily life, so this study may be renewed with context based approach. For instance, circuits with helicopter or door bellare two contexts which may motivate students to learn. Positive findings may be the evidence that 3D set is universal design; however, we should not forget that it is not a completed product; designing should be sustainable.

References

[1] Dolan, R. P. & Hall, T. E. (2001). Universal design for learnings implications for large-scale assesment. *IDA Perspectives, 27*(4), 22-25.

[2] Howard, J. B. (2003). Universal design for learning: An essential concept for teacher education. *Journal of Computing in Teacher Education, 19*(4), 113-118.
[3] Sencar, S. & Eryılmaz, E. (2004). Factors mediating the effect of gender on nith-grade Turkish students' misconceptions concerning electric circuits. *Journal of Research in Science Teaching, 41*(6), 603-616.
[4] Story, M. F. (1998). Maximizing usability: The principles of universal design. *Assistive Technology, 10*, 4-12.