The Effectiveness of the Use of Guided Inquiry Learning-Based Work Sheet in Electric Circuit

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Abstract

Subject related to electricity is one of the subjects frequently taught to vocational and technical vocational electives streams students which have been introduced by the Ministry of Education. However, several studies have shown that most of the students in the class of physics and engineering are facing the problems in understanding the concept of electricity and suffering from misunderstanding of the subjects. Therefore, to help students understand the electrical subject deeper and effective, a form of alternative teaching and learning materials which have the capacity to form a permanent memory in the minds of students need to be designed and built. The purpose of this study was to seek the effectiveness of teaching methods using Guided Inquiry Learning-Based Work Sheet (GILWS) and Circuit Construction Kit (CCK) among the students form 4 MPV Domestic Wiring (DW). A total of 72 respondents form four...
MPV students from southern zone was chosen at random. Quasi-experimental research design has been chosen and the respondents were separated into two groups, namely the experimental group and the control group. The students from the control group were underwent traditional teaching method, whereas the experimental group was given an intervention which was a learning based on GILWS and CCK. Instruments used in this study is pre-test and post-test (ECAT). T-test was used as a method to analyze the data. Outcome studies show that the achievement of group of students experiments revealed with GILWS method was higher as compared to the traditional groups. As conclusion, the use of GILWS as student studying activities have the potential to improve understanding of the concepts students in the field of electricity.

**Key Words:** Level of understanding, Work Sheets, Guided Inquiry Learning.

1 INTRODUCTION

Subject related to electricity is one of the subjects frequently taught to vocational and technical vocational electives streams students which have been introduced by the Ministry of education (MOE) in 2004 and has long been introduced in secondary schools as well as vocational skills in institutions throughout the country. In 2008, a total of 83,000 students have dropped out from academic education because there is not a passion for continuing education to upper secondary.

Teaching theory in the classroom for example requires a strategy to provide deeper understanding to the students and to increase student motivation. Therefore, the form of inquiry learning, web-based and computer simulation is a method that is suitable to use in class in order to improve understanding of the students\(^1\). Learning to use computerized simulations, for example, can help students develop a better understanding of abstract concepts compared to learning lecture\(^2\). Therefore, to attract and to make students to be more focus in class, one activity or methods such as simulations, games or learning kits can be planned by the teacher by engaging students actively in the learning sessions\(^3\). Activities used to de-
liver the content of the subject should be appropriate to the topic and can provide understanding to students. The common problem faced by the students in electrical subject is they are difficult to relate learning theory of electricity to the electric circuit, difficult to understand the basic concepts of electricity and less confidence to make a decision on modifying the electrical circuit. Several studies also have shown that most of the students in the class of physics and engineering are facing the problems in understanding the concept of electricity and is suffering from misunderstanding of the subjects.

In learning concept of electrical subject such as electric current, parallel circuit, conduction current in the circuit requiring more than one method such as analogy, simulation and laboratory work, electrical kit-based learning to help students make visualization, understand and see the application of the concept. Thus, the use of a work sheet by using the method of Guided Inquiry Learning (GIL) for example is a method that can be highlighted in the teaching and learning (T&L) process in order to improve understanding of the students. Question in work sheet also can help designing orientation process, the formation of concepts, exploration and learning among weak student. The combination of all these features needs to be applied by the teacher during the process of T&L because it could provide a big impact on students as they learn something about it by touching, seeing and the students able to experience new way of learning, which improve their motivation to learn.

2 DESIGN OF GILWS FOR DOMESTIC WIRING SUBJECT

In order to improve the students learning in Domestic Wiring subject, combination of GIL and work sheet has been developed by the researcher and it is called as GILWS. In order to design and establish the GILWS, a preliminary study has been conducted in order to identify the appropriate elements and characteristics that need to be included in the GILWS. The construction of GILWS was based on the guided inquiry activity design by Hanson and constructivism theory. The design of the GILWS is consists of
eight elements, which are: i) Activity for the lesson, ii) Title of the project/lesson, iii) Purposes of the GILWS, iv) Learning Outcomes for the lesson, v) Information / Input for the lesson, vi) Questions for the lesson, vii) Glossaries used in the lesson viii) Practical / Experiment for the lesson. In order to evaluate the appropriateness of GILWS to be used in T&L, seven expert teachers and nice teachers in electrical field have been chosen. They were given a questionnaire in order to fill up their evaluation on GILWS. The overall evaluation shows that GILWS is suitable to be used in T&L with the value of mean 0.86.

3 METHODOLOGY

This study conducted quasi-experimental research design with control group pretest-posttest. 72 students of form four from MPV that take DW subject were chosen as the respondents for this research. The students were separated into two groups equally, namely experimental and control group. The experimental group was intervened with GILWS and usage of CCK software in learning DW subject. In order to make sure the T&L process is running smoothly, the teacher that was teaching the DW subject with GILWS and CCK was given a training to make sure the teacher is familiar with the material and able to deliver effectively to the students. On the other hand, the control group was learning the subject traditionally, which was based on normal lecture, text book and white board. The students in both group were given a pretest and posttest, which called as Electrical Circuit Achievement Test (ECAT). ECAT was given in the first week (pretest) and the seventh week (posttest) of the subject.

4 FINDINGS AND DISCUSSIONS

Table 1 below show the result for the pretest for both group. t-test shows that there is no significant difference between the groups in term of the result in ECAT since the significance value (0.384) is greater than 0.05. Thus, the existing knowledge among the students in both group is at par.

Table 1. Result of t-test of pretest
In order to evaluate the effectiveness of GILWS, the t-test was conducted for pretest and posttest for both group respectively. Table 2 and table 3 below shows the result for both group.

Table 2. Result of t-test between pretest and posttest for experimental group

<table>
<thead>
<tr>
<th>Test</th>
<th>Score Mean</th>
<th>Sig. (2-tailed)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>43.036</td>
<td>0.000</td>
<td>There is positive difference</td>
</tr>
<tr>
<td>Posttest</td>
<td>76.759</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Result of t-test between pretest and posttest for control group

<table>
<thead>
<tr>
<th>Test</th>
<th>Score Mean</th>
<th>Sig. (2-tailed)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>45.714</td>
<td>0.000</td>
<td>There is positive difference</td>
</tr>
<tr>
<td>Posttest</td>
<td>58.769</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The result from table 2 and table 3 shows that both group experience positive significance difference. However, based on the differences of mean scores of pretest and posttest of both group, the experimental group score increased by 33.703, whereas the control group increased by 13.055. Thus, further t-test need to be done in order to find whether or not there is significance difference between the mean scores from both group. Table 4 below shows that there is significance difference between the scores. Therefore, the experimental group was having higher improvement in term of knowledge and understanding compared to the control group.

Table 4. Result of t-test of score differences between control and experimental groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Score Mean</th>
<th>Sig. (2-tailed)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>13.053</td>
<td>0.000</td>
<td>There is positive difference</td>
</tr>
<tr>
<td>Experimental</td>
<td>33.703</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The findings prove that the experimental group score were increased by 33.70 percent after they were exposed to the use of the GILWS method. This shows that the use of GILWS and CCK for group treatment is very effective in helping the students to understand in learning electrical circuit. This finding corresponds with what been obtained by other researchers such as Jaakkola and Nurmi and Kaftanolu and Cesur, which they test the effectiveness of using both simulation and laboratory activities based on guided inquiry in the subject of basic science-based investigations. They found that using real simulations and laboratory experiments to learn the contents of the complex science has a positive impact to the achievements of score in students test and improvement of understanding towards the concept of the student. Thus, some researchers such as Hoskyn and Swanson, proved that the main problem faced by the students with low academic achievement is to remember important information. They are also view that this problem related to short term memory. But the review done by Jones et al. demonstrated that such problems can be overcome by using strategies and cognitive constructivist teaching methods that are appropriate. Cognitive constructivist teaching methods enable students to master skills of thinking like compares and differentiate, making generalization, decision making, make prediction, creating metaphor, describing the reason and solve problems. This method can be adopted through a teaching of computer simulation because by using computer simulation methods students can master the skills to think better and effective.

5 DISCUSSIONS

From the data analyzed, a new framework for PjBL was established in order to develop non-technical skills as shown in figure 1 below. The framework consists of three main elements namely coaching and supervision, continuous assessment and real world experience. These elements were identified from in depth interviews and observations that have been conducted for one semester.
6 CONCLUSIONS

Teaching and learning process will become more interesting if included visual elements and self-assessment activities. Combination of GILWS and CCK for DW subject is very helpful for improving students understanding. This method is effective in shaping attitudes, interests and confidence in students who have low academic achievement. However, student-centered learning is one way that should be practiced by the teachers to form independent knowledge exploration among students, which is based on the theory of constructivism itself that each individual construct their own knowledge rather than just receiving knowledge from others. Knowledge that developed by students themselves will generate better understanding and can be remembered longer compared with the developing understanding with the help from others. For further research, GILWS can be expanded to the other field such as building construction field and technology field in order to deliver better understanding to the students.

References


Learning Achievement Inquiry Process Skills Inquiry-based Learning Methods Inquiry-based Science Teaching (IBSE) Learning Gain. These keywords were added by machine and not by the authors. This process is experimental and the keywords may be updated as the learning algorithm improves. This is a preview of subscription content, log in to check access. Notes. This work is supported by the Akademickie Centrum Kreatywności research project funded by the Polish Ministry of Science and Higher Education within Innovative Economy Programme, action POIG.01.03-00-001/08, grant agreement MNISW/2014/DIR/614/ACK which received funding from the European Union under European Structural Funds. To determine the effectiveness of inquiry-based learning method over traditional instruction, an achievement test about sciences which consisted of 30 items was administered as pre-test and post-test to students both in the experimental and control groups. For the statistical analysis, Analysis of Covariance (ANCOVA) was used. In inquiry-based science education, children become engaged in many of the activities and thinking processes that scientists use to produce new knowledge. This type of inquiry learning is used to teach a specific concept, fact or skill and leads the way to open inquiry where the student formulates his own problem to investigate. Keywords: inquiry-based learning, 3D virtual world, perceived effectiveness, perceived experience, perceived knowledge gain. INTRODUCTION. State of the literature There are dozens of works propose to use the 3DVW for the simulated scientific experiment. One big challenge of learning in this world, however, is how to effectively enhance students™ engagement. Many researchers claim that inquiry-based learning can offer proper solutions. However, little literature has reported how to conduct inquiry-based learning and to what extent it influences learning in the 3DVW. The perceived effectiveness is studied by many literatures. However, few of them address it from the perceived experience combined with perceived knowledge gain. Numbers of studies on the learning of electrical circuits indicate that students still have many difficulties and misunderstandings after systematic instruction (McDermott & Shaffer, 1992; Duit & von Rhneck, 1998). Results of these studies provide rather inconsistent picture about the effectiveness of simulations compared to laboratory exercises. Some studies speak in favour of simulations (Ronen & Eliahu, 2000). The worksheets of the activities were created based upon the following National Science Education Standards (Olson and Loucks-Horsley). Use the guides of the worksheets to answer the questions. Observe the experimentations and save your experimental findings in your notebook so that you can use that information for analyzing them, drawing the graphs, etc.