Evaluation of Inquiry-based Learning with IRS in the Technique Course: A Pilot Study in Taiwan Industrial High School

Chia-Hung Lai  
PhD Candidate  
Department of Engineering Science, National Cheng Kung University  
Tainan, Taiwan, R.O.C  
E-mail: chlai.ncku@gmail.com

Shu-Hsien Huang  
Postdoctoral Research Fellow  
Department of Information and Learning Technology, National University of Tainan  
Tainan, Taiwan, R.O.C  
E-mail: shuhsienhuang@gmail.com

Yueh-Min Huang  
Distinguished Professor  
Department of Engineering Science, National Cheng Kung University  
Tainan, Taiwan, R.O.C  
E-mail: huang@mail.ncku.com.tw

Conference Key Areas:  
Engineering Education Research  
Curriculum Development

Keywords: Inquiry-based learning, learning motivation, Learning achievement, Technique Course, Interactive response system

INTRODUCTION

Lai, Huang [1] described the current development of vocational high school in Taiwan. It’s included six categories (Industrial, Business, Agricultural, artistic, maritime, and domestic) and divide into 80 departments. Industrial category was the common in the past few decades [2-4]. Most industrial high school students were learning a skill with high motivations and study theory course with lower motivations. And so on, enhancing learning motivation in the study theory course is become an important issue.

Inquiry-based learning is a way of interacting between teaching and learning which enhanced learning motivation [5]. Several learning approaches can be used to enhance the learning motivation and achievement [6-8]. Inquiry-based learning is one of learning approaches which grounded in the philosophy of John Dewey that begins with the curiosity of the learner[9]. Both Lin, Wen [10] and Shih [11] observed

Corresponding Author  
Chia-Hung Lai  
chlai.ncku@gmail.com
that inquiry based is growing up from an information relevance course. Chang and Lee [12] described that inquiry based learning approach is not universal in industrial high school.

Learning achievement is difficult to measure in inquiry-based learning [13]. The learning achievement is a complex progress in the inquiry based learning [14]. Demeule, Lowther [15] described that assessment step by step can be ensured the learning achievement. Some computer technology can be supporting the assessment, like Interactive response system [16]. For the IRS implementation, the possible limitation is related equipment. Some application can be implemented under lessness requirement, e.g. Plickers [17]. Therefore, this study purposed to investigate learning motivation and achievement with/without Interactive Response System (IRS) integrated into the inquiry-based learning. The result had been analysis and provide evidence for inquiry-based learning.

1 LITERATURES REVIEW

1.1 Currently development of vocational high school

Educational technology is an effectively technology of vocational education in Taiwan [18]. When the updated hardware, dealing with security policy issues. Education has become an important issue. Today, educational technology to Taiwan construction-paper [19]. Most private school building, not only to bring them information about the device, but also set to improve teaching skills [20]. Most school construction have been tested for their innovative teaching methods, but there is little emphasis on the use of inquiry-based learning methods [21].

1.2 Inquiry-based learning

Graves, Juel, & Graves Graves, Juel [22] indicated that inquiry-based learning is an effectively instruction which evoke learners’ deep thought. It’s include five stage, Ask, Investigate, Create, Descuss, Reflect, shows in Fig. 1.

![Fig. 1. The Inquiry Based Learning Process](image)

Bruce [23] also applied the inquiry-based learning on the website and provide a platform for literacy development. The learning approach provide systemic learning loop for own student self-regulated learning. Hmelo-Silver, Duncan, & Chinn [14] proposed that inquiry-based learning can increase the critical thinking ability than traditional learning.
1.3 Learning motivation

Keller [24] developed the ARCS model based on theories related to psychology and motivation and by integrating systematic instructional design. On the basis of the ARCS theory, Keller [25] developed learning strategies that can be used in the four stages and explored factors necessitating consideration at various stages. At the attention and relevance stages, teachers should consider inspiring learning motivation by showing students that the materials are worth learning; at the confidence and satisfaction stages, teachers should focus on using various learning methods to motivate students and enable students to develop confidence and self-diagnosis abilities for future learning. Small and Gluck [26] also mentioned that the ARCS model can enhance systematic instructional design, ensuring that the design of learning materials can motivate learners to participate and interact in class. In addition, a theoretical framework and practical applications were proposed to affect learner participation, learner effort, and the duration of learner participation. The ARCS model can be used to assess the internal factors of students and the external factors in learning. In addition, cognitive and behavioral philosophies of learning were incorporated to create learning materials that can satisfy the motivational needs of students [27]. Keller and Suzuki [28] indicated that applying the strategies of the ARCS motivation model to course content can increase learner attendance and motivate students to adjust their learning attitudes.

1.4 Interactive Response System (IRS)

The Interactive Response System proposed by [29], who provide the teaching system for instruction. There are several study implemented the IRS into educational experimentals. Fies [30] represented that the IRS can be immediately provide the response with software and add up the response distributed. In recently year, Plickers is a real time student assessment which using a free app and QR-code as tools to received the learners response[31]. Mahoney [32] also proposed that Plickers include several advantages, easy to use, low cost, and collect the feedback in real time. Its means the IRS tool, Plickers, which can be used in the information resources backward learning environment.

2 METHODS

2.1 Design and Sample

In the research design, inquiry-based learning approach in the learning activities was implemented with IRS, shown in Fig. 2. The application of IRS which applied in this study is Plickers. For evaluating the effectiveness, 35 participants ages 15-16 completed the learning activity used in this study. The topic of the learning activity was a mechanical drawing practice course in vocational high school.
2.2 Data collection and Procedures

The learning activity progress took a total of 8 weeks, including two stages as shown in Fig. 3.

**Fig. 3. The Procedures of this study**

First stage, normal inquiry-based learning was used in the instruction for 4 weeks. In the second stage, the inquiry-based learning with IRS took after the first stage. Each stage took 20 tasks for learning activity. The aim of this study was to determine the effectiveness of an inquiry-based learning approach with regard to improving vocational high school students’ learning motivation and achievement. When learners finished the learning activity, the ARCS motivation questionnaires and the exam for conceptual knowledge were taken. The paired t-test analysis of learning motivation and achievement, which evaluating the effectiveness between pre-test and post-test.
3 RESULTS

3.1 Learning achievement

An paired sample t-test was conducted both different variable and pre-/post- test, and the results in Table 1 indicate that using IRS to engage in inquiry based learning lead to better learning achievement than without IRS (p<.05). This shows that the IRS system in the inquiry based learning also helped the students, by letting them keeping them engaged in the task.

Table 1. Paired t-test of the learning achievement for with/without IRS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>With IRS</td>
<td>15.28</td>
<td>8.21</td>
<td>74.57</td>
</tr>
<tr>
<td>Without IRS</td>
<td>15.31</td>
<td>7.90</td>
<td>84.85</td>
</tr>
</tbody>
</table>

3.2 Learning motivation

An paired sample t-test was conducted, and the results in Table 2 indicate that using IRS to engage in inquiry based learning lead to better learning motivation than without IRS (p<.05). This shows that the distribution of tasks in the inquiry based learning also helped the students, by letting them receive more interest from the IRS system.
Table 2. Result of ARCS motivation questionnaire scale

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>With IRS</td>
<td>89.47</td>
<td>5.31</td>
<td>3.78***</td>
</tr>
<tr>
<td>Without IRS</td>
<td>73.21</td>
<td>8.54</td>
<td></td>
</tr>
</tbody>
</table>


