

# The Relationship between Vocational High School Students' Problem-Solving Attitude, Learning Interest in Inquiry-Based Learning, and Problem-Solving Competency

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## ABSTRACT

*This study investigated the relationship between vocational high school students' problem-solving attitude, problem-solving competency, and learning interest in inquiry-based learning methods after taking an electrical machinery course. The results of this study can also be used as a reference for educators when conducting inquiry-based learning methods.*

*The participants were 30 second-year vocational high students who took an electrical machinery course. Research tools included an inquiry-based instruction interest scale, problem-solving attitude scale, and problem-solving competency scale. After a six-week inquiry-based learning class, it was found that (1) students with more positive problem-solving attitudes had better problem-solving competencies; (2) students with more positive learning interests in inquiry-based learning methods had better problem-solving attitudes; (3) students with more positive interests in inquiry-based learning methods had better problem-solving competency.*

**Keywords:** interest in inquiry-based learning methods, problem-solving attitude, problem-solving competency

## INTRODUCTION

Many educational scholars believe that problem-solving and reasoning processes are educators' main focus during teaching. Electrical machinery is an important course for vocational high school students; however, it is more difficult because students must combine theory with technique and deal with unexpected circumstances. Thus, the educators expect students to understand the content of the course, develop thinking habits, and attain a better problem-solving competency.

In recent years, the Taiwan Ministry of Science and Technology High scope Program has aimed to promote inquiry-based learning (IBL) methods and encourage students to learn proactively because vocational high schools focus more on proficient techniques and neglect reasoning and problem solving skills. Many studies have proclaimed the efficacy of IBL methods. For example, Banerjee (2010) indicated that IBL methods can help students gain a better understanding of science and that students' professional knowledge and techniques were related to science exploration. Canan et al. (2012) pointed out that after high school students took courses regarding problem-solving, there was no significant difference between problem-solving competency and self-esteem between genders; however, there was a

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significant difference between different grade levels. Thus, this study aimed to investigate the relationship between IBL methods and problem-solving competency.

Few IBL related studies have considered students in vocational high schools; most studies have focused on students in elementary and middle schools. However, if students can be trained and gain the abilities to think and solve problems in vocational school, they will have greater advantages in their future careers. Thus, this study also investigated the relationship between problem-solving attitude and problem-solving competency.

The objectives of this study were as follows: (1) to investigate the correlation between vocational high school students' problem-solving attitude and problem-solving competency, (2) to investigate the correlation between vocational high school students' learning interest in IBL methods and problem-solving competency, (3) to investigate the correlation between vocational high school students' learning interest in IBL methods and problem-solving attitude, and (4) to provide suggestions for IBL implementation.

## RESEARCH DESIGN AND IMPLEMENTATION

### Research Design

A single group post-test quasi-experimental design was adopted in this study (Table 1).

Table 1. A single group post-test quasi-experimental design

<i>Group</i>	<i>No. of Participants</i>	<i>Experimental Method</i>	<i>Post-test</i>
Experimental Group	N=30	X (Implementation of IBL methods)	T

### Participants

The participants were 30 second-year vocational high students. The transportation to the vocational high school was convenient, yet the students' parents were busy at work and had insufficient time to help students with their studies. Most of the teachers in the school adopted traditional teaching methods and most of the students lacked learning motivation.

### Inquiry-Based Learning Methods

IBL methods are centered on asking questions, allowing students to think by themselves and try to find a way to solve problems, and thereby build their own knowledge structures. The process of IBL methods has eight steps detailed below.

1. Signification: ask students, "Have you ever seen or used an electromobile?" to guide students in thinking about the applications of and ways to control rotational speeds of direct current motors.
2. Inquiry: where can students see a direct current motor and for what are they used?
3. Explanation: use figures to explain the structure and principles of a direct current motor.
4. Cross-examination: ask students to point out the corresponding position of a direct current motor in the figures and name the parts, functions, and the reason behind the functions.
5. Experiment: group students and ask each group to provide assumptions and rationale; then ask each group to conduct an experiment and fill out a form with the experimental data.

6. Discussion: ask each group to make a curve diagram based on the experimental data and to determine whether the assumptions were consistent with the experimental results. If the assumptions were inconsistent, ask the students to provide new assumptions and state why they changed their assumptions.
7. Presentation: ask each group to present their results and state the relationships between the magnetic flux, armature resistance, armature voltage, and rotation speed in a direct current motor.
8. Review: ask the students what they learned in this process and their opinions on scientific exploration.

## **Study Tools**

### ***Problem-Solving Attitude Scale***

The problem-solving attitude scale developed by Lu (2002) was used in this study. The scale had excellent validity and reliability for cognitive orientation, escape tendency, self-control, and confidence, where escape tendency was a negative dimension. The scale had a total of 30 questions and adopted a five-point scoring system with higher scores indicating a more proactive attitude toward solving problems.

### ***Problem-Solving Competency Scale***

The problem-solving competency scale developed by Li (2003) was used in this study. This study revised the sentences and wording in Li's scale and developed a scale with a total of 25 questions. The new scale employed a five-point scoring system with higher scores indicating a better problem-solving competency. The scale included problem clarification, proposing possible strategies, deciding solution strategies, taking action according to the strategy, and efficiency review.

### ***Inquiry-Based Learning Interest Scale***

An inquiry-based learning interest scale proposed by Lo (2008) was used in this study. This study revised the sentences and wording in Lo's scale in order to investigate vocational high school students. The scale included interest in cognitive inquiry, interest in affective inquiry, interest in action inquiry, and interest in after-school inquiry. A five-point Likert scoring was adopted with higher scores indicating a higher interest in IBL methods.

## **Method Description and Circumstances**

This study was consistent with the High scope Program promoted by Taiwan's Ministry of Science and Technology. The program valued IBL methods in order to cultivate student competencies in problem discovery, spontaneous inquiry, and problem solving. This study was conducted at a vocational high school that was founded over 50 years ago and had a convenient location. Students at the school were average. In recent years, the school has been aggressively seeking a strategic alliance to attain innovation in education. In order to implement the High scope Program, the school established a teacher professional learning community. The community meets twice a month and holds an activity held for all teachers attending and a community activity held by each department. A developed schedule, videos shot during the learning community, a feedback form, a review report, in-depth interviews, and observation methods were adopted to examine the process and efficiency of the learning community. During the second year of its implementation, IBL methods were also adopted. Teachers were asked whether they were willing to employ IBL methods in their classes. The course "electrical machinery" was chosen to conduct the IBL methods and analyze the

efficiency via quantification. The IBL methods were conducted mainly through student observation, inquiry, action, problem discovering, re-inquiry, reflection, verification, feedback worksheet, explanation, and ability to understand and summarize scientific knowledge.

**Research Process**

The research process was as follows: (1) collecting literature, (2) research tool modification, (3) pre-test, (4) IBL method implementation, (5) post-test, and (6) quantitative data analysis and report writing.

**Data Analysis**

SPSS software package was used, including descriptive statistics and Pearson's product-moment correlation.

**RESULTS AND DISCUSSION**

**Correlation between Problem-Solving Attitude and Problem-Solving Competency**

Table 2 shows the correlation between problem-solving attitude and problem-solving competency. In terms of problem-solving attitude, escape tendency did not reach a significant difference with problem clarification, deciding solution strategies, or taking action according to the strategy. In terms of problem-solving attitude, cognitive orientation, self-control, confidence, and overall reached significant differences with problem clarification, proposing possible strategies, deciding solution strategies, taking action according to the strategy, efficiency review, and overall.

**Table 2. Correlation between problem-solving attitude and problem-solving competency**

	<i>Problem Clarification</i>	<i>Proposing Possible Strategies</i>	<i>Deciding Solution Strategies</i>	<i>Taking Action According to the Strategy</i>	<i>Efficiency Review</i>	<i>Overall</i>
Cognitive Orientation	.86**	.74**	.80**	.54**	.71**	.88**
Escape Tendency	.32	.42*	.34	.22	.37*	.39*
Self-Control	.78**	.70**	.73**	.61**	.70**	.81**
Confidence	.61**	.46*	.57**	.47**	.50**	.60**
Overall	.78**	.70**	.73**	.55**	.68**	.79**

\* p < .05; \*\* p < .01

**Correlation between Learning Interest in IBL Methods and Problem-Solving Competency**

Table 3 shows the correlation between learning interest in IBL methods and problem-solving competency. In terms of problem-solving competency, taking action according to the strategy did not reach significant differences with interest in cognitive inquiry, interest in affective inquiry interest in action inquiry, interest in after-school inquiry, and overall. In terms of learning interest in IBL methods, interest in after-school inquiry did not reach significant differences with problem clarification, proposing possible strategies, taking action according to the strategy, efficiency review or overall. In terms of learning interest in IBL methods,

interest in cognitive inquiry, interest in affective inquiry, interest in action inquiry, and overall reached significant differences with problem clarification, proposing possible strategies, deciding solution strategies, efficiency review and overall.

**Table 3. Correlation between learning interest in IBL methods and problem-solving competency**

	<i>Problem Clarification</i>	<i>Proposing Possible Strategies</i>	<i>Deciding Solution Strategies</i>	<i>Taking Action According to the Strategy</i>	<i>Efficiency Review</i>	<i>Overall</i>
Interest in Cognitive Inquiry	.66**	.62**	.58**	.33	.61**	.65**
Interest in Affective Inquiry	.35*	.36*	±36	-.10	.43*	.35*
Interest in Action Inquiry	.57**	.50**	.43*	±34	.50**	.54**
Interest in After-School Inquiry	.30	±28	.35*	-.13	.23	.26
Overall	.54**	.51**	.51**	.11	.51**	.52**

\* p < .05; \*\* p < .01

**Correlation between Learning Interest in IBL Methods and Problem-Solving Attitude**

Table 4 shows the correlation between learning interest in IBL methods and problem-solving attitude. In terms of learning interest in IBL methods, interest in cognitive inquiry, interest in action inquiry, and overall had significant and positive correlations with each dimension and the overall for problem-solving attitudes. In terms of learning interest in IBL methods, interest in after-school inquiry did not reach significant difference with cognitive orientation, self-control, confidence, or overall for problem-solving attitudes.

**Table 4. learning interest in IBL methods and problem-solving attitude**

	<i>Cognitive Orientation</i>	<i>Escape Tendency</i>	<i>Self-Control</i>	<i>Confidence</i>	<i>Overall</i>
Interest in Cognitive Inquiry	.65**	.67**	.64**	.41*	.69**
Interest in Affective Inquiry	.36*	.50**	.36*	.30	.45*
Interest in Action Inquiry	.55**	.47**	.59**	.52**	.64**
Interest in After-School Inquiry	.27	.47**	.21	.27	.35
Overall	.53**	.62**	.51**	.44*	.62**

\* p < .05; \*\* p < .01

**CONCLUSION AND SUGGESTIONS**

In summary, this study found that (1) vocational high school students' problem-solving attitudes were significantly and positively correlated to problem-solving competencies; in other words, students with a more positive problem-solving attitude had better problem-solving competency. (2) Vocational high school students' learning interests in IBL methods were significantly and positively correlated to problem-solving attitudes. That is, students

with a more positive learning interest in IBL methods had a better problem-solving attitude. (3) Vocational high school students' learning interest in IBL methods were significantly and positively correlated to problem-solving competency. That is, students with more positive interest in IBL methods had better problem-solving competency.

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