

Evaluation of Thai students and teacher's attitudes in physics using Colorado Learning Attitudes about Science Survey (CLASS)

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Abstract. The Colorado Learning Attitudes about Science Survey, CLASS, has been used as a tool to measure respondents' beliefs or attitudes about physics and how they learn physics. It is composed of 42 Likert scale (strongly disagree to strongly agree) type questions which is classified into 8 categories, which are real world connections, conceptual connections, personal interest, sense making, applied conceptual understanding, problem solving general, problem solving confidence and problem solving sophistication. In this study, we asked 196 high school physics teachers and 211 students from 195 secondary schools in Thailand to respond to this survey along with a 6-open-ended-question survey. In this paper, we focus on two topics: "What is the difficulty in learning/teaching physics?" and "What is the goal in learning/teaching physics?" We found that physics teachers agree with the experts in most categories, except conceptual connections, applied conceptual understanding and problem solving sophistication. While students tend to disagree with the experts in both conceptual categories and all 3 categories in problem solving. We then compare teachers' to students' responses from these two open-ended questions. On the difficulty aspect: 19% of students believe that difficulty in learning physics is due to incomprehension of physics concept. While 43% of teachers thought that difficulty in teaching physics is because of insufficiency of mathematics background. On the goals aspect, 37% of students aim to enter the university; while 50% of teachers target on helping student to better understand physics.

1. Introduction

In the past twenty years, there were many attempts in developing Likert-scale surveys, e.g. the Maryland Physics Expectations (MPEX)[1], the Colorado Learning Attitudes about Science Survey (CLASS)[2-3], etc. to measure respondents' beliefs, expectations or attitudes in learning physics and compare their responses with the experts'. Such studies aimed to develop more expert-like view in those respondents. Experts think about physics as it correlates all concepts together to describe nature through experiments, while novices see physics as isolated pieces and learn by memorizing. Note that experts' opinions mentioned here are referred to the opinions from physicists with extensive experience in teaching introductory courses and physics education research mentioned in CLASS.

2. Data

In this work, we asked 196 high school physics teachers and 211 students from 195 secondary schools in Thailand to response to 42 Likert-scale questions in CLASS along with a 6-open-ended-question survey. For CLASS, we compared teachers' and students' responses in each category to the experts' ones. For the open-ended questions, we restricted ourselves to two questions: "What is the difficulty in learning/teaching physics?" and "What is the goal in learning/teaching physics?", and tried to see whether or not teachers' and students' responses were correlated.

3. Results and Discussion

The results from CLASS and the open-ended questions will be discussed here.

3.1. CLASS

CLASS can be classified into 8 clusters. Some questions can be categorized into more than one cluster. Figure 1 shows the percentage of agreement with the experts for student in blue (the left one) and teacher in red (the right one). Among 8 clusters, teachers and students agree with the experts >50% in personal interest, real world connection and sense making/effort as shown in figure 1a-1c. Teachers agree more with the experts than students in all clusters. However, percentages on certain questions are quite low.

The following questions are the ones which both Thai teachers and students agreed with the experts less than 50%.

Question 8 ("When I solve a physics problem, I locate an equation that uses the variables given in the problem and plug in the values."): This has the minimum agreement <10% with the experts for both teachers and students, however this is the question in which Thai teachers and students agreed on the most. The experts disagreed with this question. This might imply that both Thai teachers and students solve physics problem without trying to understand the situation and just try to find the corresponding formulae to plug in with the given information.

Question 34 ("I can usually figure out a way to solve physics problems."): Almost 50% of teachers agreed with the experts while only 20% of students did. This is the question in which experts, Thai teachers and students agreed on the least. This shows that Thai students are less confident when facing physics problems. Their difficulties may result from inappropriate learning approaches. They are accustomed to learning physics by memorizing equations and formulae then plugging the given information in the formulae. This also agrees with the results of Question 8 mentioned above.

Question 1 ("A significant problem in learning physics is being able to memorize all the information I need to know."): The results of this question support our interpretation of Question 8 and disagree with the experts on physics learning approach.

Question 5 ("After I study a topic in physics and feel that I understand it, I have difficulty solving problems on the same topic."): The results indicate that both Thai teachers and students feel that they do not really understand physics of a particular topic. This may be another indication that they learn physics by memorizing formulae rather than understanding the physical meanings for each problem. They lack of confident when encountering new problems even on the same topic. They cannot apply the same principle to the new problems which are less familiar.

Question 22 ("If I want to apply a method used for solving one physics problem to another problem, the problems must involve very similar situations."): The results are consistent with the ones for Question 5 however the situation is less severe for the teachers than to the students.

3.2. Open-ended questions

Two open-ended questions concerning about the difficulty and the goal in learning/teaching physics are discussed.

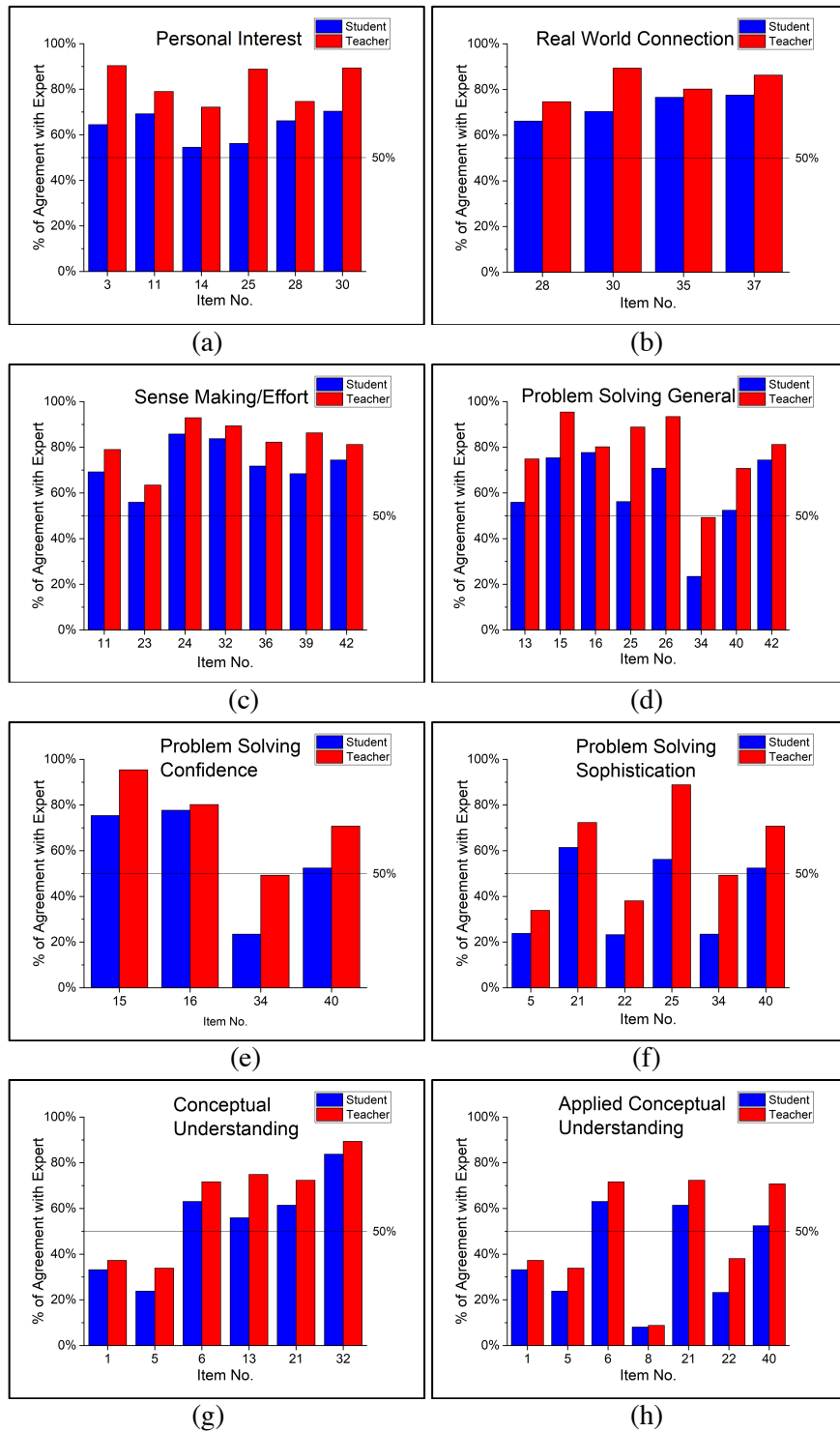


Figure 1. Histogram of percentage of students' and teachers' agreement with the experts in 8 clusters.

3.2.1. "What is the difficulty in learning/teaching physics?"

Students think that learning physics is difficult since they have to memorize many formulae without understanding the physics concepts nor being able to analyze problem statement. While teachers' difficulty in teaching physics is the students' insufficient skills in mathematics. The responses are shown in table 1.

Table 1. Students' and teachers' responses for question "What is the difficulty in learning/teaching physics?"

| Students' responses (%) | | Teachers' responses (%) | |
|--------------------------------------|-------|---------------------------------------|-------|
| Learn by memorizing the formulae | (21%) | Less basic mathematics knowledge | (43%) |
| Do not understand physics concepts | (19%) | Students have bad attitude in physics | (17%) |
| Teachers cannot convey the knowledge | (17%) | No equipment to do experiments | (12%) |
| Cannot analyze problem statement | (16%) | Less time in teaching | (10%) |

3.2.2. "What is the goal in learning/teaching physics?"

From table 2, students' main goal in learning physics is to enter the universities and want to apply physics knowledge in their lives. However teachers' goal is to help students understand physics and help their students to be able to apply the knowledge in their lives. Even though the students and teachers' main goal are different, they are in common in applying the knowledge in their lives. This implies that both students and teachers are concerned about physics that involves in their lives.

Table 2. Students' and teachers' responses for question "What is the goal in learning/teaching physics?"

| Students' responses (%) | | Teachers' responses (%) | |
|--|-------|--|-------|
| Enter universities | (37%) | Help students understand physics | (50%) |
| Apply physics knowledge in their lives | (29%) | Help students apply physics in their lives | (42%) |
| Understand physics | (15%) | | |
| Understand daily phenomena | (13%) | | |

4. Conclusion

We have asked 196 high school physics teachers and 211 students from 195 secondary schools in Thailand to respond to the Colorado Learning Attitudes about Science Survey (CLASS) along with a 6-open-ended-question survey. We have found that on average the teachers agreed with the experts more than the students did. The results indicate that both Thai teachers and students solve physics problem without trying to understand the situation and just try to find the corresponding formulae to plug in with the given information. This results in their lack of confident when encountering new problems even on the same topic and cannot apply the same principle to the new problems which are less familiar.

On the open-ended questions: "What is the difficulty in learning/teaching physics?" and "What is the goal in learning/teaching physics?" 19% of students believe that difficulty in learning physics is due to incomprehension of physics concept. While 43% of teachers thought that difficulty in teaching physics is because of insufficiency of mathematics background. On the goals aspect, 37% of students aim to enter the university; while 50% of teachers target on helping student to better understand physics.

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