Scientific Reasoning Abilities of Thai University Students

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Abstract. This study explored scientific reasoning abilities of engineering freshmen in Thailand (N= 686), using 24 multiple-choice questions of Lawson's Classroom Test of Scientific Reasoning (LCTSR). We found that there was no significant difference between LCTSR scores of male (73±16%; N=448) and female (67±18%; N=238) participants. Cluster 1 about the conservation of mass and volume (80±27%), and cluster 4 about the probabilistic thinking (80±24%) were the highest ability dimensions. In contrast, cluster 6 about the hypothetical-deductive thinking and reasoning was the lowest ability dimension (50±27%). Moreover, we found no correlation between the LCTSR score and high school GPA.

1 Introduction

Scientific reasoning is an ability and methodology that is significantly important for the successful management of real-world situations outside classrooms of learners. The major components of the scientific thinking and reasoning skills involve inquiry, experimentation, evidence, evaluation, interference, and argumentation that support the formation and modification of concepts about the natural and social world [1]. The scientific reasoning abilities may be not developed as a growth of content knowledge, but rather inquiry-based instruction can promote those abilities [2]. This research aims to investigate scientific reasoning abilities of the first-year Thai university students as a result of high school instruction and other prior experiences. Its findings will guide ways to improve the students' abilities to support their accomplishment in future careers.

2 Data Collection

A revised version of Lawson's Classroom Test of Scientific Reasoning (LCTSR), comprising 24 multiple-choice questions, was used to determine students' scientific reasoning abilities [3]. It was designed to assess 6 clusters: 1) conservation of mass and volume, 2) proportional thinking, 3) control of variables, 4) probabilistic thinking, 5) correlation thinking, and 6) hypothetical-deductive reasoning. The participants were the first-year engineering students (N=686) in one public university from the South of Thailand. Mainly, a traditional lecture-based instruction is common in high school levels in Thailand. We collected LCTSR data at the beginning of the first semester of the university, as well as asked for their high school grade-point-average (HS-GPA). The LCTSR was scored by individual item and converted into the percentage.

3 Results and Conclusion

Results of the LCTSR scores of the first-year Thai university students (N=686), divided into 6 clusters (C1-C6), were shown in table 1. It revealed that there was no significant difference between LCTSR scores of male (73±16%) and female (67±18%) participants. Cluster 6 involving the hypothetical-deductive thinking and reasoning was the lowest ability dimension of both male and female sample group (50±27%). It is the higher-order thinking skill, which is the most difficult to the students.

Table 1. LCTSR scores (in percentage) of the participants divided into 6 clusters (C1-C6)

Gender/LCTSR	C1	C2	C3	C4	C5	C6	Entire
Male (N=448)	84 ± 24	72 ± 30	72 ± 27	81 ± 24	77 ± 24	51 ± 30	73 ± 16
Female (N=238)	72 ± 30	63 ± 36	64 v 30	78 ± 24	76 ± 26	49 ± 25	67 ± 18
Overall (N=686)	80 ± 27	69 ± 32	69 ± 28	80 ± 24	77 ± 25	50 ± 27	71 ± 17

We calculated the correlation between LCTSR scores, HS-GPA, and grade for the introductory Physics-I course for a university level. The results disclosed no correlation between LCTSR scores and HS-GPA, as well as LCTSR scores and the physics grade. Regularly in Thailand, HS-GPA demonstrates students' performance, which mostly based on the content knowledge that matter for teaching in each high school level. Students with high HS-GPA will have a high body of knowledge for several subjects. It is similar to obtaining a high grade for the university physics course. However, the students, who had the high content knowledge, were not necessary to have high scientific reasoning abilities as exposed by no-correlation with the two variables in this study. Our consequence was consistent with a research of Bao and colleagues, which reported that content knowledge and reasoning skills diverged from the comparisons of Chinese and U.S. students [2]. Moreover, we found a medium correlation between HS-GPA and the physics grade, expressed by Pearson's correlation coefficient = 0.34. It means that what student understand help to develop the students' learning of physics concepts. From what we have found it indicates that the scientific reasoning abilities should more emphasize through the instruction methods, not only the content knowledge. Several studies addressed that the inquiry-based science instruction promotes scientific reasoning abilities of learners [4-5].

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