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Scientific Imagination of Lower Secondary School Students in Thailand

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Abstract

Scientific imagination is an integration between imaginative thinking and scientific knowledge. It is the ability to construct the pictures, models and stories in an individual's brain in order to understand the problems or situations based on the accurate scientific knowledge which leads to the development of creativity. The purpose of this study was to study scientific imagination of lower secondary school students in Thailand using the scientific imagination test. This test was developed by adapting the Scientific Imagination Test-Verbal (SIT-Verbal) proposed by Wang, Ho & Cheng (2015) and was provided to lower secondary school students. The researcher created four problems in the test related to students' everyday life situations which are 1) The planet 2) Teka country 3) Electronic waste and 4) Songkran festival (water festival in Thailand). The test was verified by five experts and tried out with 45 lower secondary school students (Grade 7-9), 15 students in each level. The reliability of the test using Cronbach's alpha coefficient was equaled 0.888. The researcher collected data from 213 lower secondary school students who studied in Grade 7 (n = 85), Grade 8 (n = 64) and Grade 9 (n = 64) from six schools in Bangkok, Loei, Kanchanaburi, Rayong and Nonthaburi provinces. The results revealed that there was a statistically significant difference between groups of students as analyzed by one-way ANOVA (F =5.248, p = .006). Scientific imagination scores of students in grade 7 were statistically significant different from students in grade 8 (p = .008). In addition, there were no statistically significant differences between scientific imagination scores of students in grade 7 and 9 (p = .847), as well as, students in grade 8 and 9 (p= .060).

Keywords: *Scientific imagination, Lower secondary school students*

1. Introduction

Imagination is a unique system of human thinking. It is related to the process of finding and improving ideas. Imagination can promote students to memorize and continue upon what they think which leads to the process of creating innovation [1]. Indeed, imagination is considerably important to the educational field of study. The Council for Science and Technology (2001) has noted that education is the combination among understanding, imagination together with knowledge and skills [2]. In addition, education is the core surrounded by the imagination that is necessary for all subjects. Besides, imagination can promote meaningful and effective learning to teachers and students [3]. However, the understanding about imagination and its indicators are still unclear [4].

Putting emphasis on the context of Thailand, in an overall picture, Thai students have low abilities in learning science. In order to overcome this problem, promoting thinking ability in the science classroom is the best way for students to learn science more effectively [5]. Science is explicitly related to understanding nature and can help us to understand and explain the everyday life situations and phenomenon. To achieve a deeper understanding of nature, scientific imagination has taken an important role in science teaching and learning. In this study, scientific imagination was defined as an ability to construct the pictures, models and stories in an individual's brain in order to understand the problems or situations based on the accurate scientific knowledge that leads to the development of creativity. It can be stated that scientific imagination is an integration between imaginative thinking and scientific knowledge. Likewise, scientific theories and ideas are also discovered by scientists and their scientific imagination [6]. The results from the study of 270 Thai in-service science teachers' opinions toward scientific imagination revealed that scientific imagination is important for both students and teachers. It is the main key to success in the goal of learning science. However, these teachers thought that students still lack scientific imagination which should be promoted more in science classrooms [7].

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Despite the essential role of scientific imagination, there were few published studies of scientific imagination. As aforementioned, scientific imagination is the foundation of creativity, which is one of the necessary skills for the 21st century [8]. Therefore, in order to promote creativity to the students, we primarily need to start promoting students to think based on accurate scientific knowledge. However, thinking ability is quite difficult to measure. The research instrument, which is related to thinking ability, needs to be a well-designed tool with appropriate criteria. From the related literature, Scientific Imagination Test-Verbal (SIT-Verbal) proposed by Wang, Ho & Cheng (2015) was used to reflect the four main components of scientific imagination that are; 1) brainstorming, 2) association, 3) transformation and elaboration, and 4) conceptualization, organization and formation. This test was used for primary school students and completely provided the practical learning progression [9]. According to Piaget's theory of cognitive development, students in the lower secondary level are able to think logically and reasonably [10]. Moreover, the situations used in the test are also important. Using familiar situations related to students' lives will help students to further their thinking ability. In this perspective, the purposes of this research were to develop scientific imagination test by adapting from Scientific Imagination Test-Verbal and to study and compare scientific imagination of lower secondary school students among grade 7-9 students in Thailand. The results from this study will be useful for developing the suitable learning method and activities to promote scientific imagination and meaningful learning in the science classroom.

2. Research objectives

This research aimed 1) to develop scientific imagination test for lower secondary school students and 2) to study and compare scientific imagination of lower secondary school students among grade 7-9 students.

3. Research methodology

3.1 Population and samples

The population in this study was lower secondary school students who studied in Grade 7-9 in Thailand. The samples used in this study were 213 lower secondary school students who studied in grade 7 (n = 85), grade 8 (n = 64) and grade 9 (n = 64) from six schools in Bangkok, Loei, Kanchanaburi, Rayong and Nonthaburi provinces. The samples voluntarily applied to join this research by themselves and using purposive sampling.

3.2 Research instrument

The steps of development of the test are as follows;

1) Identifying the objectives and the situations
   The scientific imagination test was composed of four situations; 1) The planet 2) Teka country 3) Electronic waste and 4) Songkran festival (water festival in Thailand).
2) Creating the question structure
   The questions were created in the form of open-ended questions consistent with learning progression and the four components of scientific imagination. The questions were related to the context of Thailand and divided into three items, two missions in each item.
3) Verifying the test
   The test was verified by five experts to evaluate the appropriateness of the test (5 Likert scales) and the congruence between questions and learning progression of scientific imagination by considering the Index of Congruence (IOC).
4) Revising and trying out
   The test was revised by the researcher based on the experts' feedback and tried out with 45 lower secondary school students, 15 students in each grade level. The reliability of the test using Cronbach's alpha coefficient was equalled 0.888.
5) Collecting research data
   The test was revised again after trying out. The researcher collected research data from the samples.

3.3 Data analysis

Content analysis was used to analyse the qualitative data. Researcher compared the qualitative data to the test criteria and converted into scores. Then, researcher triangulated all data with two experts. The quantitative data were analysed using descriptive statistics and one-way ANOVA.

4. Results

The results of this research are presented as follows;

1) Considering the quality of the test, the appropriateness mean scores were in the range between 4.20 – 4.80. The congruence scores were equalled 1.00 in all situations. Moreover, the congruence mean score between questions and criteria was also equalled 1.00.
2) To study scientific imagination of lower secondary school students, the descriptive statistics were presented as shown in Table 1.

Table 1 Descriptive statistics

Levels of study	n	Mean	SD
Grade 7	85	30.76	9.242
Grade 8	64	35.69	10.655
Grade 9	64	31.67	8.621
Total	213	32.52	9.703

3) There was a statistically significant difference at .05 level between groups of students as analysed by one-way ANOVA (F =5.248, p = .006). Scientific imagination scores of students in grade 7 were statistically significant different from students in grade 8 (p = .008). Additionally, there were no statistically significant differences between scientific imagination scores of students in grade 7 and 9 (p = .847), as well as, students in grade 8 and 9 (p= .060) as shown in Table 2 and 3.

Table. 2 One-way ANOVA

	df	SS	MS	F	p-value
Between Groups	2	950.039	475.019	5.248	.006
Within Groups	210	19009.153	90.520		
Total	212	19959.192			

Table. 3 Multiple comparisons

Comparisons	MD	Std. Error	p-value
Grade 7 and 8	- 4.923*	1.575	.008
Grade 7 and 9	- .907	1.575	.847
Grade 8 and 9	4.016	1.682	.060

5. Conclusion and discussion

In brief, the quality of the scientific imagination test was in a high level emphasizing on the appropriateness and congruence mean scores the experts. There was a concern from the experts about students' responses to the test. The experts thought that students might not write down their answers. One of the experts suggested that researcher should conduct in-person interviews with some students in order to receive in-depth data. Developing a new research instrument that suits the research objectives is the most important step of doing research. The researcher needs to put considerable focus on the research types, characteristics, language used and the proper method to verify the quality of the research instrument. This analysis has also noted that scientific imagination scores of students in grade 7 were statistically significant different from students in grade 8. However, there were no statistically significant differences between students in grade 7 and 9 and students in grade 8 and 9. These results lead us to consider the mean score of scientific imagination in each level of the students. The mean scores of students in grade 7-9 were in the same level and clearly not much different. This study has some limitations which can be addressed here and in future research. According to the open-ended type of questions, some students did not answer the questions. Moreover, most of students' answers did reflect their imagination but not scientific imagination.

Therefore, we can conclude that Thai lower secondary school students have the ability to think imaginatively with the accurate knowledge of science in the medium level and still need to improve. If we can create the proper method, strategies, activities or curriculum to promote and develop scientific imagination for these students, it will further contribute to the development of creativity and innovation.

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