Gender Differences in Students’ Attitude towards Science

D Sofiani*, A S Maulida¹, N Fadhillah² and D Y Sihite³

1 Pendidikan IPA, Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Bandung, Indonesia
2 Pendidikan Matematika, Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Bandung, Indonesia
3 Pendidikan Fisika, Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Bandung, Indonesia
4 Pendidikan Kimia, Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Bandung, Indonesia

*desrisofiani@student.upi.edu

Abstract. This study investigated the students’ attitude towards science and the effect of gender on students’ attitude. A total of 77 secondary school students participated in this study that were selected randomly in cluster, from various schools of Bandung, Indonesia. The attitude questionnaire consisted of 23 items related to four dimensions: enjoyment, self-confidence, value and motivation. Data collected by questionnaire were converted into interval scale using Method of Successive Interval (MSI) and further analyzed using Statistical Package for Social Science (SPSS). The use of MSI for analyzing the questionnaire data is still fairly new. Results showed that students’ positive attitude towards science was at medium level and there was no significant difference in attitude towards science between the female and male students. The study is of great significance to science teachers in order not to be gender biased when teaching science learning.

1. Introduction

One of the goals of the science learning is to cultivate students’ positive attitudes towards science [1]-[3]. The outcomes of attitude dimension is as important as the cognitive outcomes [4]. Unfortunately, in most traditional science learning, teacher only focuses on the cognitive domain [5].

Students’ attitude and interest in learning are actually the key in the concept mastery [6]. Some previous studies reported the significant relationship between the attitude towards science and achievement in science, where the students who had positive attitudes achieved better learning outcome [7]-[9]. Another study showed that students’ attitude towards science will lead their career choices [10]. In addition, investigation of the effect of gender on attitude towards science has also attracted attention of some researchers [4],[11],[12]. Some studies conducted in the UK confirmed that male students had more positive attitude towards science and chose science-related career paths more often than the female [13]. On the contrary, a study conducted in the USA showed different result, where the female more interested in science than males and more often planned a science-related field as their future career [11]. On the other hand, a research from Japan reported that there was no difference between boys and girls with respect to their attitude towards science [14]. These results are interesting because the effect of gender on attitude towards science varies among the countries.

The present study focuses on exploring the attitude towards science among Indonesian students and investigating whether gender difference affect students' attitude or not. This study is useful in order to
predict their career path and provide information for science teachers in development of science learning.

2. Literature Review
Attitude is defined as feelings, that can be either unfavorable or favorable, positive or negative, and are typically directed towards some specific object [15]. Attitude implies a psychological construct which is inferred from responses to a given stimuli [16]. There are six dimensions regarding attitudes: confidence, anxiety, value, enjoyment, motivation and expectations [17].

Students’ attitude towards science varies among the students, depends on several factors. First, factors that are associated with the teacher, such as teaching methods, classroom management, and teachers’ content knowledge and personality. Second, factors that are related to the environment, such as educational background of parents and parental expectations. Third, factors that come from student including students’ achievement, anxiety, extrinsic motivation, and experiences. [18]-[21].

3. Research Method
A cross-sectional survey method was implemented in this study, where the information was collected at just one point in time [15]. A total of 77 tenth-grade students participated in this study, including 40 female and 37 male students (aged 14-16 years). They were selected randomly in cluster, from various schools of Bandung, Indonesia.

The attitude questionnaire was adopted and selected from Student Questionnaire used in Programme for International Student Assessment (PISA) 2006. The questions were translated into Indonesian language and validated by an expert. The questionnaire consisted of 23 items and classified into four dimensions (e.g: enjoyment, self-confident, value and motivation) according to the previous research [17]. Data collected by questionnaire, which in ordinal scale, were transformed into interval scale using Method of Successive Interval (MSI). The application of MSI to analyze the questionnaire data in this study is a new method. In an ordinal scale, the responses can be ranked but the distance between responses is not measurable. Thus, we can not assume whether the difference between responses is large or not. Meanwhile, the difference between responses in interval data can be calculated [22]. The interval data could be further analyzed to calculate the means, standard deviations, and inferential statistics using Statistical Package for Social Science (SPSS).

4. Result and Discussion
4.1. Demographic characteristic
Table 1 shows the demographic profile of the students who participated in this study according to gender. The participants of this study were 77 students, consisted of 40 female and 37 male students.

| Gender | N  | %  |
|--------|----|----|
| Female | 40 | 48.1 |
| Male   | 37 | 51.9 |
| Total  | 77 | 100 |

4.2. Attitude towards science
The questionnaire was analyzed by calculating mean scores of each dimension (enjoyment, self-confident, value and motivation) and categorized the mean scores as low, medium and high, based on
criteria [23]. Table 2 shows the criteria used to categorize these dimensions whereas Table 3 shows the mean scores of each dimension.

**Table 2. Level of dimensions**

| Mean scores | Level   |
|-------------|---------|
| 1.00 - 2.33 | Low     |
| 2.34 - 3.66 | Medium  |
| 3.67 - 5.00 | High    |

**Table 3. Descriptive statistics for the questionnaire**

| Dimension                        | Mean  | Std.Deviation | Level   |
|----------------------------------|-------|---------------|---------|
| Enjoyment                        | 3.1921| 0.93239       | Medium  |
| Self-Confidence                  | 3.5335| 0.89686       | Medium  |
| Value                            | 3.0481| 0.99738       | Medium  |
| Motivation                       | 2.8426| 1.06593       | Medium  |
| Overall Positive Attitude towards Science | 3.1613| 1.00465       | Medium  |

Based on Table 3, the overall students’ positive attitudes towards science were at medium level. The “Self-confidence” dimension had the highest mean value, indicating that most of students believed their performance in science was good. By contrast, the “Motivation” had the lowest mean value, which was slightly different from “Enjoyment” and “Value” dimensions. The possible reason for this finding is because most of students were confident with their performance in science, they have not high motivation to explore more information about science. This statement in accordance with the result of previous study which reported that when students have high self-confidence, their level of motivation increase [24]. Further explanation about each item in four dimensions displayed respectively in the following tables.

**Table 4. Descriptive statistics for “Enjoyment” dimension**

| Item                                      | Mean   | Std. Deviation |
|-------------------------------------------|--------|----------------|
| I generally have fun when I am learning science topics | 3.5756 | 0.85890        |
| I like reading about science              | 2.9510 | 0.83394        |
| I am happy doing science-related problems | 2.5348 | 0.86779        |
| I enjoy acquiring new knowledge in science| 3.5756 | 0.82963        |
| I am interested in learning about science | 3.3232 | 0.84028        |

Descriptive statistics for items relating to the “Enjoyment” are shown in Table 4. The mean score of the statement “I generally have fun when I am learning natural science topics” was high (M=3.5756), which indicates that most of students enjoyed learning about science. Meanwhile, the statement “I am happy doing science-related problems” had the lowest score (M= 2.5348).
Table 5. Descriptive statistics for “Self-confidence” dimension

| Item                                                                 | Mean   | Std. Deviation |
|----------------------------------------------------------------------|--------|----------------|
| I could explain why earthquakes occur more frequently in some areas  | 3.5756 | 0.87989        |
| than in others                                                       |        |                |
| I could describe the role of antibiotics                           | 3.5755 | 0.90356        |
| I could identify the science question associated with the disposal of garbage | 3.5752 | 0.86626        |
| I can predict how changes to an environment will affect the survival of certain species | 3.5754 | 0.89899        |
| I could interpret the scientific information provided on the labelling of food items | 3.3234 | 0.92347        |
| I could identify the better of two explanations for the formation of acid rain | 3.5756 | 0.90739        |

Table 5 shows the descriptive statistics for items relating to the “Self-Confidence” dimension. Information in the table indicated that some students believed that they have good performance in science, including explaining, describing, identifying, predicting, interpreting, and evaluating. This result confirms the previous statements about their excellent performance in science.

Table 6. Descriptive statistics for “Value” dimension

| Item                                                                 | Mean   | Std. Deviation |
|----------------------------------------------------------------------|--------|----------------|
| Advances in science and technology usually improve people’s living conditions | 3.3233 | 0.86981        |
| Science is important for helping us to understand the natural world | 2.0080 | 0.78864        |
| Some concepts in science help me see how I relate to other people. | 2.5795 | 0.88229        |
| Advances in science and technology usually help improve the economy | 2.9510 | 0.86847        |
| Science is valuable to society                                       | 3.5756 | 0.81316        |
| I find that science helps me to understand the things around me      | 3.3234 | 0.84370        |
| Advances in science and technology usually bring social benefits     | 3.5756 | 0.84392        |

Table 6 shows the descriptive statistics for items relating to the “Value” dimension. Based on the information in the table, some students agreed that science is important for their life. Learning about science will help them to understand the natural world and advances in science and technology will improve people’s living conditions.
Table 7. Descriptive statistics for “Motivation” dimension

| Item                                                                 | Mean  | Std. Deviation |
|---------------------------------------------------------------------|-------|----------------|
| I plan to borrow or buy books on science topics                      | 2.6276| 0.92038        |
| I am willing to visit web sites about science topics                 | 2.9510| 0.93762        |
| I would like to read science magazines or science articles in newspaper | 3.1651| 0.92508        |
| I plan to attend a science club or science society                   | 1.8939| 0.91023        |
| I will use science in many ways when I am an adult                   | 3.5752| 0.84289        |

Table 7 shows the descriptive statistics for items relating to the “Motivation”. Overall mean score of each item showed that students’ motivation to explore the information about natural science was quite low, in line with the previous statement. This result implies that students prefer to learn about science in class rather than search the information from other sources, such as website, book, magazine, and article.

Overall students’ responses on four dimensions of attitude towards science showed that the Indonesian students tend to be passive in science learning. They were not interested to explore more information about science outside the classroom as well as to solve science-related problems. These negative views should to be changed by giving a positive learning experience and giving motivation about the importance of science for their future.

4.3. Attitude towards Science based on Gender

In order to find significance difference between gender and attitude towards science, normality test should be applied. According to the result of normality test using Sapiro-Wilk, both data (overall female and male scores) were not normally distributed (p = .000, α = .05). Therefore, nonparametric test (Mann-Whitney U test) was chosen. Table 8 shows the result of Mann-Whitney U test.

| Mean | Std.Deviation | U    | p-value |
|------|---------------|------|---------|
| Female | Male | Female | Male |       |
| Overall Attitude towards Science | 3.1764 | 3.1710 | 1.02369 | 0.96544 | 390.400 | 0.922 |

Based on the Table 8, there was no statistically significant difference in attitude towards science between female (M = 3.1764, SD = 1.02369) and male students (M = 3.1710, SD = 0.96544), where U = 390.400, p = .922, α = .05. This result was supported by the previous studies [14],[16],[25]. This result also suggests that the opportunities for Indonesian female and male students who may choose science-related field as their future career are the same.

5. Conclusion and Recommendation
The study results showed that students’ positive attitude towards science was at medium level, suggesting that there are still possible room for improvement. In addition, there was no significant
difference between male and female students in attitude towards science. It is recommended for the teacher to improve the students’ attitude towards science, moreover in motivation. In addition, the teacher should not be gender biased when teaching science subject.

Acknowledgments

Authors thank to Forum Komunikasi Mahasiswa Sekolah Pascasarjana Universitas Pendidikan Indonesia for supporting this study. D. Sofiani and A.S.Maulida also thank to Indonesia Endowment Fund for Education Scholarship (LPDP), Republic of Indonesia for financing their Master Scholarship.

References

[1] Hofstein A and Mamlok-naaman R 2011 High-School Students’ Attitudes toward and Interest in Learning Chemistry 2290–102
[2] Kumari S N and Saraladevi K 2014 Gender Differences in Attitude towards Science Teaching and Learning Styles among Adolescents Int. J. Sci. Res. 3 50–8
[3] Kemendidkubud 2017 Model Silabus Mata Pelajaran Sekolah Menengah Pertama/Madrasah Tsanawiyah (SMP/MTs) (Jakarta: Kemendidkubud)
[4] Wan Z H and Lee J C K 2017 Hong Kong secondary school students’ attitudes towards science: a study of structural models and gender differences Int. J. Sci. Educ. 0 1–21
[5] Markle B R and Banion T O 2014 Assessing Affective Factors to Improve Retention and Completion (Arizona: League)
[6] Paramitha S T 2017 Influence of Joyful Learning on Elementary School Students’ Attitudes Toward Science Proc. Int. Conf. on Mathematics, Science, and Computer Science Education (Bristol: IOP Publishing)
[7] Hussaini I 2013 Attitudes of Secondary School Students Towards Biology in Birnin Kebbi Metropolis, Kebbi State, Nigeria 2 596–600
[8] Simpson R D and Steve Oliver J 1990 A summary of major influences on attitude toward and achievement in science among adolescent students Sci. Educ. 74 1–18
[9] Kpolovie J P, Joe A I O T 2014 Academic Achievement Prediction: Role of Interest in Learning and Attitude towards School Int. J. Humanit. Soc. Sci. Educ. 1 73–100
[10] Bang E and Baker D R 2013 Gender Differences in Korean High School Students’ Science Achievements and Attitudes towards Science in Three Different School Settings Mevlana Int. J. Educ. 3 16
[11] Miller P H, Slawinski Blessing J and Schwartz S 2006 Gender Differences in High-school Students’ Views about Science Int. J. Sci. Educ. 28 363–81
[12] Weinburgh M 1995 Gender differences in student attitudes toward science: A meta-analysis of the literature from 1970 to 1991 J. Res. Sci. Teach. 32 387–98
[13] Banu D P 1986 Secondary school students’ attitudes towards science Res. Sci. Technol. Educ. 4 195–202
[14] Ogawa M and Shimode S 2004 Three distinctive groups among Japanese students in terms of their school science preference: from preliminary analysis of Japanese data of an international J. Sci. Educ. Japan 28 1–11
[15] Stiggins R J 1994 Student-Centered Classroom Assessment (New York: Macmillan College Publishing Company)
[16] Ayodele M O, And and Olatunbosun S M 2015 Gender Differences in Students’ Attitude towards Basic Science in Junior Secondary School Int. J. Contemp. Appl. Sci. 2 114–20
[17] Martha Tapia and George E. Marsh II 2004 An Instrument to Measure Mathematics Attitudes Acad. Exch. Q. 8
[18] Aldridge J M, Fraser B J and Huang T-C I 1999 Investigating classroom environments in Taiwan and Australia with multiple research methods J. Educ. Res. 93 48–62
[19] Wahyudi and Treagust D F 2004 Learning Environment and Students’ Outcomes In Science Classess In Indonesian Lower Secondary Schools J. Sci. Math. Educ. South East Asia 27 139–65
[20] Hacieminoglu E and Education E S 2011 Middle School Students’ Attitude toward Science in
Constructivist Curriculum Environment *Proc. Int. Conf. on New Trends in Education and Their Implications* (Turkey)

[21] Debacker T K, Nelson R M and Nelson R M 2010 Motivation to Learn Science: Differences Related to Gender, Class Type, and Ability J.Educ. Res 245-254

[22] Scales L and Sullivan G M 2013 Analyzing and Interpreting Data From Likert-Type Scales J Grad Med Educ. 541-542

[23] Mohamed L and Waheed H 2011 Secondary Students’ Attitude towards Mathematics in a Selected School of Maldives *Int. J. Humanit. Soc. Sci.* 1 277–81

[24] Ara A S, Journal D T and Science A S 2013 The reasons of lack of motivation from the students ’ and teachers ’ voices *J. Acad. Soc. Sci.* 1 35–45

[25] Olasehinde K J and Olatoye R A 2014 Scientific Attitude, Attitude to Science and Science Achievement of Senior Secondary School Students in Katsina State, Nigeria *J. Educ. Soc. Res.* 4 445–52