Students' attitudes toward chemistry based on their learning experiences

W P Surya*, and I S Arty

1Graduate School, Yogyakarta State University, Jl. Colombo No.1, Yogyakarta 55281, Indonesia
2Chemistry Department, Faculty of Mathematics and Natural Science, Yogyakarta State University, Jl. Colombo No.1, Yogyakarta 55281, Indonesia

*wisnupramanasurya@gmail.com

Abstract. Someone with special interest in a topic will easily participate in learning activities and easily adapt to the learning environment as needed. The purpose of this study is to analyze students' interest in chemistry based on student learning experiences in classroom. In this study, a questionnaire containing several statements about students' interests was distributed. The questionnaire was developed based on four categories, namely the level of student interest in chemistry, personal choice, teacher's role, and situational interest. The number of students who participated in this study was 61 students in high schools in Yogyakarta, Indonesia. Questionnaire data were analyzed quantitatively as means, standard deviations, and percentages, then categorized as low, medium, or high. Data shows that as many as 29.2% of students have high interest, 67.2% of students have moderate interest, and 3.3% of students have low interest. Female students are more interested in chemistry than male students. This research can be useful as additional information for teachers and other researchers to increase student interest because interest influences the learning process.

1. Introduction

Attitudes toward science and interests can play an important role among students who study science. Attitude is the sum total of a person's preference for certain types of objects. Broadly, attitude covers all aspects of personality development such as individual interests, motives, values, vocational judgments stemming from vocational pursuits and other phases of one's daily life [1]. An attitude mainly consists of three characteristics: feelings, cognition, and behavior. Attitude is a "like or dislike" feeling. People are committed to science when they understand more and want to take more science courses and keep reading about science [2]. The concept of interest seems appropriate in understanding the tendency of students or adults to engage in a particular theme or context or withdraw from them [3]. Interest is often described as an individual's relationship with an object and allows one to voluntarily engage in certain activities, and show intentional participation and satisfaction rather than laziness towards the object [4].

Interest is a key factor in the field of science education [3]. One of the goals of 21st century education is to reconstruct the interests of students in the fields of science, such as chemistry. This can be done by eliminating the factors that play a role in reducing students' interest in chemistry subjects [5]. Researcher revealed that interest is more than discipline and interest is the key to educational success [1]. Learning by using the 2013 curriculum has a role in increasing attention, learning activities, understanding and
interest of students towards the material being studied. If students are not interested in chemistry, they tend not to try to learn and understand the meaning of concepts taught to them. This shows that the most effective factor that contributes to students’ decisions to study chemistry is their interest in the subject [2].

Many studies have shown that students’ interests clearly do not receive the attention required in science lessons, attitudes toward learning, especially physics and chemistry and science itself, are negative. Science courses (except biology) are dropped at the upper secondary level, and student interest in science topics decreases from class to class [6]. People who are interested in learning new knowledge and skills will build on the knowledge they have already acquired, be independent and be alert about problems and topics. In addition, moderate prior knowledge, the potential to learn more and obtain new information combined will likely increase interest. The level of knowledge students possess or acquire does not specifically affect the enjoyment of their science [7].

Numerous studies have shown various factors responsible for the decline in students’ interest and attitudes towards science. These factors include personal characteristics, gender, class level, type of school, father’s occupation, age, socioeconomic status, pedagogical aspects, audio visual aids used by instructors, previous learning experiences, and career opportunities [5]. These factors can vary from one student to another. Students also develop negative attitudes towards certain aspects of integrated science, namely topics related to Chemistry and Physics. Many researchers under study have confirmed that students develop negative attitudes towards learning science. This may be due to the fact that the teacher cannot fulfill the aspirations or goals of students [1].

The PISA 2006 survey of science incorporated a unique approach to assessing student attitudes. The survey asked students about their attitudes towards science in a student questionnaire and evaluated students’ attitudes in three areas: interest in science, support for scientific enquiry, and responsibility towards resources and environments [8]. It is important to consider the level of interest that exists before students engage in learning [9]. Students who start classes with a higher initial level of interest may be more likely to adopt mastery goals because they want to learn more about the domains that interest them. In other words, initial interest might influence students to engage in learning, which then predicts future interests.

This study aims to analyze students’ interest in chemistry based on student learning experiences in classroom through students’ responses to considerations related to chemistry. Student actions can be interpreted as showing curiosity, and at some level showing a desire to acquire additional scientific knowledge. The research also illustrates the interests of students in several discussions discussing chemistry learning. Information about student interests will be used by other researchers or chemistry teachers to increase student interest because interest influences student learning processes.

2. Method

This research is a quantitative descriptive with ex post facto approach. This approach only reveals facts that occur without any manipulation of variables or creating certain conditions [10]. The sample in this study were 61 high school students in Yogyakarta. The population in this study were all high school and MA students in Yogyakarta. Samples are selected with convenient sampling technique to facilitate researchers. Questionnaires are used to collect closed responses from students. The questionnaire consisted of 30 statements, 19 of which were positive statements and 11 negative statements. The questionnaire consisted of two parts namely, instructions for filling out the questionnaire and statement. The questionnaire was made with a Likert scale, consisting of 4 scales. For positive statements (4-3-2-1) and for negative statements (1-2-3-4). The questionnaire was used based on four categories, namely existing level of interest in chemistry, personal choice, role of teachers [5], and situational interest [11]. The questionnaire was validated in content by experts and empirical validation for 120 students with a reliability of 0.72. Questionnaire data were analyzed quantitatively as means, standard deviations, and percentages, then categorized as low, medium, or high. Questionnaire data were processed in order to obtain scores and interest values from each student which were then analyzed using mean, standard deviation, percentage, and describing students’ interest in learning chemistry.
3. Result and Discussion

The results of data analysis showed that the average total score of students' interest in learning chemistry was 85 out of an ideal maximum score of 120. The categorization of students' interest in learning chemistry was 18 students (29.5%) who were in high interest in learning chemistry, 41 students (67.2%) were in medium interest in learning chemistry, and 2 students (3.3%) were in low interest in learning chemistry. Table 1 shows the distribution of students' interest in learning chemistry. Student interest in studying chemistry does not fully show extraordinary positive results, but there is still hope to be able to develop it through teaching methods and other factors that can influence it. Most students have an interest in learning chemistry in the medium category.

| Category | Frequency | Percentage | Cumulative Percent |
|----------|-----------|------------|--------------------|
| High     | 18        | 29.5       | 3.3                |
| Medium   | 41        | 67.2       | 70.5               |
| Low      | 2         | 3.3        | 100                |

Several previous studies have proven that students' interest in chemistry is still relatively low [1], [5], [12]. However, based on the results of data analysis, most of the students' interests are included in the medium category. Students' anxiety about learning chemistry makes them lose interest in chemistry. The main challenge in chemistry education is the gap between high demands that demand learning and low efforts made by students in part because of cognitive burdens. Chemistry contains abundant abstract concepts, which require significant commitment of time and effort from students. The contrast between low input and high demands results in unsatisfactory performance on the student's side and frustration on the instructor's side [6].

Table 2. Existing Level of Interest in Chemistry

| No. | Existing Level of Interest in Chemistry                                           | Mean (S.D) |
|-----|-----------------------------------------------------------------------------------|------------|
| 1   | I like my chemistry class                                                         | 2.89 (0.59) |
| 2   | I have many questions about chemistry in my mind.                                 | 2.66 (0.83) |
| 3   | The more I study chemistry, the more interesting it is to explore.                | 2.82 (0.74) |
| 4   | Chemistry has a very limited professional scope. *                                | 2.93 (0.65) |
| 5   | I feel bored when I have to study. *                                             | 2.69 (0.62) |
| 6   | I do things that are not related to chemistry during chemistry study. *           | 2.82 (0.67) |
| 7   | When I study, sometimes I am really attracted to chemistry.                       | 2.85 (0.75) |

*negative statement

Table 2 is a factor analysis of existing level of interest in chemistry which shows mediocre results, neither too high nor too low. The statement "Chemistry has a very limited professional scope" shows the highest results, it means students disagree with the statement. The statement "I have many questions about chemistry in my mind" shows the lowest results. Curiosity can help students to develop interest in learning chemistry and it is an assessment standard in measuring student interest [5], [8].
Table 3. Personal Choice

| No. | Personal Choice                                                                 | Mean (S.D) |
|-----|----------------------------------------------------------------------------------|------------|
| 1   | Chemistry is useful for solving everyday problems                                | 2.97 (0.66) |
| 2   | I try to answer questions raised by the teacher.                                 | 2.97 (0.55) |
| 3   | I only study chemistry if there are tests.*                                      | 2.36 (0.78) |
| 4   | Theories in chemistry cannot be changed or questioned.*                          | 3.15 (0.79) |

*negative statement

Students are interested in research related to the discipline of chemistry because they have a view that theories in chemistry can be changed or questioned. Personal choice factors as shown in Table 3 and individual decisions are very important in determining students' interest in chemistry. If students are interested in a subject, then they will achieve relatively higher success [13].

Table 4. Role of Teachers

| No. | Role of Teachers                                                                 | Mean (S.D) |
|-----|----------------------------------------------------------------------------------|------------|
| 1   | My chemistry teacher uses charts, models, and examples of everyday life to teach us. | 2.79 (0.76) |
| 2   | In chemistry class, my teacher is good at explaining chemistry matters.          | 3.05 (0.69) |
| 3   | My chemistry teacher paid as much attention to me as any other student.          | 2.80 (0.70) |
| 4   | My teacher also provides extra time to help us learn chemistry.                  | 2.17 (0.80) |
| 5   | The teacher conducts questions and answers during chemistry learning.            | 3.23 (0.50) |
| 6   | My teacher is passive during chemistry learning.*                                | 3.28 (0.58) |

*negative statement

The students revealed that their chemistry teacher was active during the chemistry learning process and their teacher was doing questions and answers during chemistry learning as shown in table 4. This is a positive result because the development of students' positive attitudes about chemistry as a school subject is one of the main responsibilities of every chemistry teacher. Student interest can increase when their chemistry teacher becomes a source in finding answers [4].

Table 5. Situational Interest

| No. | Situational Interest                                                                 | Mean (S.D) |
|-----|----------------------------------------------------------------------------------|------------|
| 1   | I am fascinated by chemistry                                                      | 2.57 (0.59) |
| 2   | I chose to appear because I am really interested in chemistry                     | 2.23 (0.62) |
| 3   | I am very happy to be able to study.                                              | 2.79 (0.66) |
| 4   | I am really looking forward to learning more about chemistry.                    | 2.75 (0.72) |
| No. | Situational Interest                                                                 | Mean (S.D) |
|-----|--------------------------------------------------------------------------------------|------------|
| 5   | I think chemistry is an important scientific discipline.                              | 2.98 (0.62) |
| 6   | I think chemistry is important for me to know.                                         | 3.07 (0.60) |
| 7   | I feel inferior to appear in class because I don't like chemistry.*                    | 2.74 (0.73) |

Situational interest in participating with the enjoyment or participation of students towards learning [11]. Based on Table 5, students feel that chemistry is an important science to have. In fact, when students don’t have too many questions about chemistry, they consider chemistry that are important and important to understand. However, not only are students’ assumptions positive, but they also need to try and be involved in learning chemistry.

The author includes one factor that influences student interest in chemistry, namely gender. Gender is also a factor that plays a role in students’ interest in learning [3]. Previous studies have shown that male students are more interested in chemistry than female students [14]. However, the contradictory results indicate that the maximum score of 120, obtained that male students (82.68) are not more interested in chemistry than female students (87.03). These contradictory findings are proven from various studies. Research has reported that there are no significant differences in boys and girls regarding the level of interest in chemistry [5].

Interest affects learning ability. Research shows a positive relationship between interest and various indicators of learning through its contribution to student connections with content, as well as maintaining that connection for sufficient time [15]. Individual interest and involvement in science is important in shaping teenager’s intention to continue learning about chemistry. Students tend to have formed a lasting interest in activities where they see themselves as competent [16]. Student interest in science is an important first step, but maintaining this interest is just as important [17].

Students’ interest can be increased because of the impact of contextual teaching and learning in chemistry by including real-world contexts so that learning becomes more beneficial for them [17]. This relates to the role of the teacher who is fully responsible for the impact of teaching and learning. This is also in line with the findings above where the teacher’s role is highest in the formation of students’ interest in chemistry. Gender-based preferences of several science subjects have been suggested as important factors affecting the choice of science in schools [15].

4. Conclusion

Based on the results and discussion, it can be concluded that the majority of students’ interest in chemistry is in the medium category. Female students are more interested in chemistry than male students. Factors that influence students’ interest in chemistry need to be considered especially the role of the teacher. The teacher’s role is very important in developing student interest through student-oriented learning and connecting concepts with real life. Students also need to develop interest through increasing curiosity, creating a classroom atmosphere, and having a high willingness to attend chemistry learning.

5. References

[1] Adodo S O and Gbore L O 2012 Prediction of attitude and interest of science students of different ability on their academic performance in basic science International Journal of psychology and Counselling 46 p.68-72.
[2] Hofstein A and Mamlok-Naaman R, 2011 High-school students’ attitudes toward and interest in learning chemistry Educ. Quim. 22, 2 p. 90–102.
[3] Krapp A and Prenzel M, 2011 Research on interest in science: Theories, methods, and findings Int. J. Sci. Educ. 33, 1 p. 27–50.
[4] Demirdogen B and Cakmakci G, 2014 Investigating students’ interest in chemistry through self-generated questions *Chem. Educ. Res. Pract.* 15, 2 p. 192–206.

[5] Akram T M Ijaz A and Ikram H, 2017 Exploring the factors responsible for declining students’ interest in chemistry *Int. J. Inf. Educ. Technol.* 7, 2 p. 88–94.

[6] Gräber W, 2011 German high school students’ interest in chemistry - A comparison between 1990 and 2008 *Educ. Quim.* 22, 2 p. 134–140.

[7] Salonen A Kärkkäinen S and Keinonen T, 2018 Career-related instruction promoting students’ career awareness and interest towards science learning *Chem. Educ. Res. Pract.* 19, 2 p. 474–483.

[8] Bybee R and McCrae B, 2011 Scientific literacy and student attitudes: Perspectives from PISA 2006 science *Int. J. Sci. Educ.* 33, 1 p. 7–26.

[9] Harackiewicz J M Durik A M Barron K E Linnenbrink-Garcia L and Tauer J M, 2008 The role of achievement goals in the development of interest: Reciprocal relations between achievement goals, interest, and performance *J. Educ. Psychol.* 100, 1 p. 105–122.

[10] Izzatin M and Widyawati E, Profile of basic teaching skills students of mathematics education at universitas borneo tarakan in the microteaching class 6th ICRIEMS Proceedings p. 1–8.

[11] Basso A Chiorri C Bracco F Carnasiali M M Alloisio M and Grotti M, 2018 Improving the interest of high-school students toward chemistry by crime scene investigation *Chem. Educ. Res. Pract.* 19, 2 p. 558–566.

[12] Gafoor K A and Vevaremmal S, 2014 Student interest in chemistry from upper primary to higher secondary schools in kerala January p. 65–71.

[13] Çiçek and İlhan N, 2017 Evaluating interest in acids-bases: Development of an acid-base interest scale (ABIS) and assessment of pre-service science teachers’ interest *Chem. Educ. Res. Pract.* 18, 4 p. 630–640.

[14] Baram-Tsabari A and Yarden A, 2005 Characterizing children’s spontaneous interests in science and technology *Int. J. Sci. Educ.* 27, 7 p. 803–826.

[15] Baram-Tsabari A and Yarden A, 2011 Quantifying the gender gap in science interests *Int. J. Sci. Math. Educ.* 9, 3 p. 523–550.

[16] Palmer T A Burke P F and Aubusson P, 2017 Why school students choose and reject science: a study of the factors that students consider when selecting subjects *Int. J. Sci. Educ.* 39, 6 p. 645–662.

[17] Cigdemoglu C and Geban O, 2015 Improving students’ chemical literacy level on thermochemical and thermodynamics concepts through context-based approach *Chem. Educ. Res. Pract.* 16, 2 p. 302–317.

**Acknowledgments**

The authors would like to say thanks to chemistry education students, lecturer, and all staff at Yogyakarta State University. We also specifically thank Irza Yuzulia, M.Pd for the advice and having time for the study.