

Students' Attitudes Towards Chemistry: On the Gender and Grades Perspective

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ABSTRACT

This descriptive research with a quantitative approach aims to describe the differences in students' attitudes toward chemistry based on gender and grade level. The participants were 186 senior high school students in Kalimantan Barat, Indonesia, selected by convenience sampling technique. The data collection tool used was the Likert-scale Attitudes Toward Chemistry Questionnaire by Salta that has been validated and proven reliable using *Pearson Correlation* and *Cronbach Alpha*. The questionnaire consisted of 23 items, including aspects of the importance of chemistry, difficulty of chemistry, the interest of chemistry, and usefulness of chemistry in the future career. *Mann Whitney* analysis was used to describe the effect of gender and grades on attitudes toward chemistry. The result showed that students had a neutral attitude toward chemistry. There are significant differences in attitudes towards chemistry between male and female students in all aspects. The differences in students' attitudes towards chemistry based on grades only exist in the aspect of the importance of chemistry. The teacher should motivate and enhance chemistry learning to increase students' positive attitudes toward chemistry. Further research is required to ensure the cause of the difference between male and female students' attitudes.

Keywords: Attitudes toward chemistry, Gender, Grades

1. INTRODUCTION

Chemistry is one of the subjects in the high school curriculum. Assessment in the chemistry curriculum focuses not only on the cognitive domain but also on the psychomotor and affective domains. One of the affective domains is attitude. Attitude is as important as academic achievement, so developing students' positive attitudes towards chemistry is necessary. Unfortunately, research has shown that chemistry is less attractive to students of all ages [1].

Attitudes are defined as emotional and mental entities that cause someone's action towards an object or subject [2]. Oluwatelure and Oloruntegbe [3] stated that attitude is a concept that arises from an effort to explain regularities in individual behavior. Its quality is measured from the results of evaluations made by a person. Attitudes, as part of the psychological, are expressed in specific behaviors with several likes or dislikes [4]. Attitudes towards chemistry involve students' tendency to respond to chemistry based on

the views and images they develop as a result of their experiences during learning [5]. In the classroom, teachers can assess students' attitudes by observing their behavior. Students who consistently finish their task and actively ask questions during chemistry lessons have a positive attitude in studying chemistry. Students' beliefs and attitudes can support or hinder learning [6].

Many factors can support students' attitudes in studying chemistry. Teachers' enthusiasm, the effectiveness of teaching, and the presentation of experiments can influence students' positive attitudes toward chemistry [7]. So, teacher attitudes toward the subject are essential to students' learning process. Other studies report that computer assisted-intervention (CAI) based learning (including web-based learning) positively increasing students' attitudes toward chemistry [8] [9] [10]. Students who studied chemistry using computer simulations have a higher motivation to study chemistry, in terms of desire and pleasure, and their capability to relate what

they learned to daily activities. Teaching methods using computers have several limitations, so the use of computers alone cannot directly affect attitudes. The use of computers needs to be integrated with other learning models to increase student attitudes effectively.

Adesoji [11] summarizes several factors related to students' attitude toward chemistry: teacher attitudes, teaching method, students' cognitive style, parents' influence, gender, age, career interest, and social view of chemistry. Hofstein [12] suggests that future chemistry teaching and learning developments should notice students' gender, motivation patterns, and learning styles. Each student has distinction preferences for other teaching techniques. Yunus [13] stated that doing chemical experiments in the laboratory made students show positive attitudes toward chemistry. Students' negative attitude is caused by the many and varied chemistry learning materials to be studied in a short time.

Many studies develop attitudes toward the chemistry scale. For example, Demircioğlu [14] set an attitude test item towards chemistry and divided them into two categories, liking chemistry lessons and career plans in chemistry. Liking chemistry deals with students' reactions to chemistry learning activities, while career plans deal with chemistry in students' goals. Tosun [15] suggests that attitudes towards chemistry consist of four subscales, such as learning chemistry in theory, liking work in chemistry laboratories, evaluative belief in chemistry lessons in schools, and behavioral tendencies to learn chemistry. To measure student attitudes towards chemistry, Eskandar [16] divides the components into two: interest in chemistry and self-confidence in learning chemistry. Meanwhile, Salta [17] developed an attitude test towards chemistry based on four concepts: difficulty in chemistry lessons, interest in chemistry lessons, the use of chemistry lessons for students' future careers, and the importance of chemistry for students' lives. Different opinions were expressed by Xu, Vullafane, and Lewis [4], who categorized attitudes into three components: the effective component, the cognitive component, and the behavioral component. The affective component is related to the emotional response that expresses students' level of liking or dislike towards chemistry lessons. The cognitive component is related to the evaluation, which consists of an individual's belief and knowledge of chemistry. The behavioral component relates to a person's behavioral tendency to act on chemistry.

The research related to attitudes towards chemistry has been carried out in many countries around the world. However, in Indonesia, especially in West Kalimantan region, it has never been done. This is the basic reason for conducting this study. This study also described how attitudes predict student behavior in the future towards school subjects and career trends. Attitude could predict future trends, especially if there is a direct interaction between attitudes and students. Behavior can be formed from attitude. For example, positive attitudes are disposed to show a pleasing reaction, and negative attitudes are disposed to show an unpleasing reaction. The primary purpose of this study is to describe attitudes toward chemistry of high school students. This study also describes the differences between gender and grade level.

To describe students' attitudes toward chemistry, this study has built up three research questions as follows:

RQ1: How students' attitudes toward chemistry learning in terms of four aspects?

RQ2: Do male and female students have difference in attitudes?

RQ3: Do 10th grader and 11th grader students have difference in attitudes?

2. METHOD

The research methodology used was a descriptive study with quantitative approach. Students' opinions through chemistry learning and chemistry career were collected using a questionnaire and reported descriptively. This research was conducted in 2020, and the data was collected in July of the same year.

2.1. Participants

This study's participant was 186 students that consist of 61 males and 125 females selected by convenience sampling. Convenience sampling is a nonprobability or nonrandom sampling technique in which the target population members meet the specific requirements, such as easily accessible, geographic proximity, willingness at certain times, or willingness to become participants. It also refers to research subjects from the population that are easily accessible to the researcher [18].

2.2. Data Collection Tool

The attitude questionnaire towards chemistry (ATC) consists of 23 items (13 positives and 10 negatives), representing four aspects related to

attitudes towards learning chemistry. The questionnaire uses a Likert-scale with 5 points arranged in the order of "strongly agree", "agree", "neither agree nor disagree", "disagree", and "strongly disagree". The questionnaire items appraised students' attitudes toward chemistry by the importance of chemistry course, the difficulty of chemistry course, interest in chemistry course, and the usefulness of chemistry on students' future career. The ATC questionnaire was adopted from Penn [19], which was

first developed by Salta and Tzougraki [14]. Some minor changes were made to the ATC questionnaire. For example, the statement "chemical symbols are like Chinese to me" was changed to "chemical symbols are hard for me to understand". The validity test using *Pearson Correlation* shows that all items were declared valid, while the reliability test using *cronbach alpha* results was 0.83, which is considered acceptable.

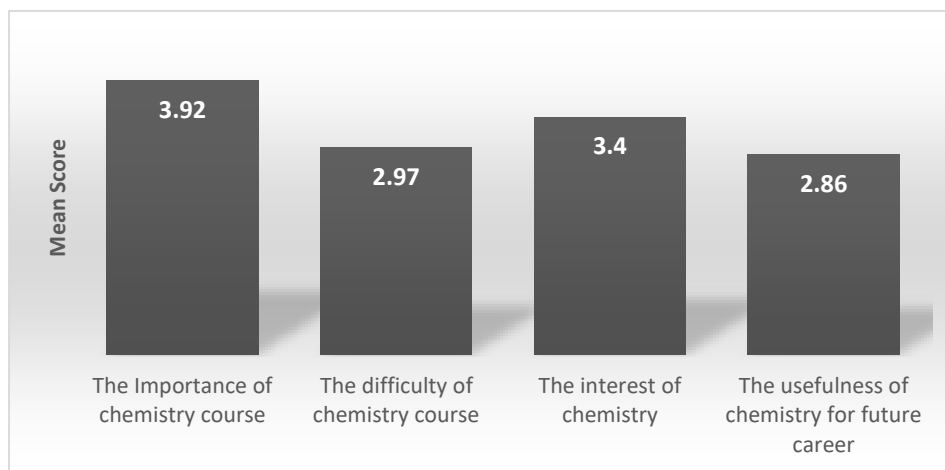


Figure 1 Mean score of students' attitudes toward chemistry

2.3. Data Analysis

For RQ1, the average score of students' attitudes towards chemistry in each aspect was calculated first, then interpreted in a negative, neutral, and positive attitude. For RQ2 and RQ3, the analysis used as inferential statistics. *Mann-Whitney* analysis was used to describe gender and grades level differences because the sampling technique was non-probability and included in non-parametric statistics.

3. RESULT AND DISCUSSION

Attitudes Toward Chemistry (ATC) questionnaire is the scale to assess students' attitudes toward chemistry. Figure 1 displays a summary of senior high school students' scores on four aspects of attitudes toward chemistry. The result showed that students assume chemistry lessons were not difficult and not easy to understand (neutral attitude). Their attitudes concerning the interest of chemistry lesson and usefulness for their future career is also neutral, but they realized that the chemistry lesson is essential in their life (positive attitude).

This finding was different from other studies. For example, Bennett [20] and Cheung [1] found that

students had a slightly positive attitude toward chemistry. The same finding was found in a study of Salta and Tzougraki [14], as stated that students had neutral attitudes toward chemistry. In detail, the result of our study shows that students in aspect "difficulty of chemistry course", and "interest of chemistry" were perceived neutral. Students recognize that chemistry is essential for their lives, but working in chemistry in the future is still a consideration. Students' interest in chemistry tends to be neutral. It may be because the chemical material presented is too theoretical during the learning process [21]. The neutral attitude in aspects difficulty, the interest of chemistry, and the usefulness of chemistry in future career could be caused by the curriculum in Indonesia that is fact-centred, not connecting the relationship between chemistry and real life. The pandemic situation forced chemistry learning to be carried out online without a hands-on practicum in the laboratory. Laboratory activities had a significant contribution to shaping and improving student attitudes toward chemistry [12].

3.1. Attitudes Toward Chemistry According to Gender

Table 1 provides the mean score and standard deviation for the four aspects according to students'

gender. *Mann-Whitney* was used to analyze differences in attitudes toward chemistry on a male and female student.

Based on table 1, the influence of categorical variable (gender) there were significantly different between males and females in importance, difficulty, interest, and usefulness of attitudes toward chemistry ($P = 0,004$; $P = 0,004$; $P = 0,009$; and $P = 0,022$ was less than 0,05). The mean score of female students is higher than male students, so it is possible to see that females had more positive attitudes than males. Several studies report that boys had a more positive attitude, while other studies have found more positive attitudes for girls. This study's result was relevant to Cheung [1] that girls had more like studying chemistry than did boys. These gender differences could be because students are included in the low-achieving group of students [22].

3.2. Attitudes Towards Chemistry According to Grades

Table 2 provides the mean score and standard deviation for the four aspects according to students' grades. *Mann-Whitney* was used to analyze differences in attitudes toward chemistry on 10th grade and 11th grade student.

From the findings of data review, it can be seen that $\text{Sig.} > 0.05$ which indicates that there was no significant difference in difficulty, interest, and usefulness aspects. In contrast, in the aspect of importance, there was a significant difference between class X and class XI students ($\text{Sig.} < 0.05$). The result shows that 10th graders in the "the importance of chemistry" aspect have a score lower than 11th graders. Nevertheless, the aspects difficulty of chemistry, interest of chemistry and usefulness of chemistry shows the opposite result. This study's finding cannot be directly compared with previous studies' conclusions since the number of researchers dealing only with grade level in importance, difficulty, interest, and usefulness of chemistry aspects of attitudes toward chemistry was sporadic. However, there are informative research relevant to the influence of grade level and gender, on the various dimensions of attitude toward chemistry. For example, Kubiak [21] reported that female students had more positive attitudes than male students in the dimension "relevance of chemistry", which similar to aspect "importance of chemistry" in our study. On the other hand, Can [23] found that the students' mean score fluctuated. The 9th graders had the highest mean score, then decreased in 10th grade, and increase again at 11th grade.

Table 1. Descriptive statistic of attitudes toward chemistry by gender

Aspects	Male (n = 61)		Female (n = 125)		U	P
	Mean Rank	Sum of Rank	Mean Rank	Sum of Rank		
The importance of chemistry	77.45	4724.5	101.33	12666.5	2833.5	0.004
The difficulty of chemistry course	77.14	4705.5	101.48	12685.5	2814.5	0.004
Interest in chemistry course	78.78	4805.5	100.68	12585.5	2914.5	0.009
Usefulness of chemistry for future career	80.71	99.74	4923.5	12467.5	3022.5	0.022

Table 2. Descriptive statistic of attitudes toward chemistry by grades

Aspects	10 th (n = 109)		11 th (n = 77)		U	P
	Mean Rank	Sum of Rank	Mean Rank	Sum of Rank		
The importance of chemistry	86.92	9474.5	98.19	7916.5	3479.5	0.046
The difficulty of chemistry course	98.19	10702.5	86.86	6688.5	3685.5	0.155
Interest in chemistry course	94.85	10339.0	91.58	7052.0	4049.0	0.683
Usefulness of chemistry for future career	96.79	10550.5	88.84	6840.5	3837.5	0.315

4. CONCLUSION

Based on this study's results, it can be concluded that students have a positive attitude towards chemistry in terms of the importance of chemistry, while in other aspects, tends to be neutral. Besides, there are significant differences in attitudes towards chemistry among male students and female students in all aspects, so it can be concluded that gender differences affect students' perceptions of chemistry. Furthermore, the differences in students' attitudes towards chemistry based on grade level only exist in the importance of chemistry, while there was no difference in other aspects. From this study's finding, the teacher should motivate and enhance chemistry learning to increase students' positive attitudes toward chemistry. For the distinction in attitudes in gender, further research is required to ensure the cause.

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