JPPIPA (Jurnal Penelitian Pendidikan IPA)

Vol.9 No.2 2024

http://journal.unesa.ac.id/index.php/jppipa

ANALYSIS STUDENTS INTEREST IN AN INTEGRATIVE CONTEXT: A DESCRIPTIVE AND COMPARATIVE STUDY IN CHEMISTRY LEARNING

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Abstract

Understanding students' interest in learning chemistry is essential for educators to design effective teaching strategies and promote academic success. This study aims to investigates the learning interest in chemistry among students at different grade levels in SMAN 7 Kerinci, focusing on the integration of mathematics with chemistry lessons. Through descriptive and comparative analyses, we examine the factors influencing students' interest in chemistry and its integrative context with mathematics. Our findings reveal that students' interest in learning chemistry tends to decline as they progress through higher grade levels, with 11th grade students showing a higher interest compared to 12th grade students. Additionally, the integration of mathematics with chemistry poses challenges for students, impacting their interest levels. This study underscores the importance of innovative teaching approaches to enhance students' interest and engagement in chemistry education. Further research is needed to explore the underlying factors influencing students' interest in learning chemistry comprehensively. By understanding these factors, educators can develop targeted interventions to foster students' interest and passion for chemistry, ultimately promoting academic success and nurturing future scientists and innovators.

Keywords: Chemistry, Interest, Learning, Mathematics Integration

Article History: Received: February 26th, 2024. Revised: August 07th, 2024. Published: December 31th, 2024

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p-ISSN: 2527-7537
e-ISSN: 2549-2209

INTRODUCTION

Chemistry, a fundamental branch of natural science, delves into the intricate understanding of matter on micro and nano scales (Kind & Aston, 2022). However, despite its pivotal role, students often find chemistry challenging due to its focus on microscopic elements (Taber & García-Franco, 2010). Distinguishing between macroscopic and microscopic aspects further complicates the learning process (Treagust et al., 2011; Tümay, 2016), contributing to the perception of chemistry as a daunting subject.

Preliminary studies on students' preferences and perceived difficulty in science and mathematics reveals a concerning trend. Only a minority of students (26.96%) prioritize chemistry as their preferred subject, with many regarding it as the most challenging after mathematics. The incorporation of mathematical calculations in chemistry exacerbates this issue, deterring students' interest in the subject

The preliminary studies and observations in the field have been translated into reasons why students become less interested in further studying chemistry. In other words, various factors exert negative influences on students interest in the subject of Chemistry. It is not uncommon for chemistry to involve mathematical calculations (Kind & Aston, 2022). This condition will also have an impact on students' interest in learning Chemistry. The conditions outlined above lead to the conclusion that it is important to conduct an analysis of students' interest in learning Chemistry and, particularly, when Chemistry instruction involves mathematical forms.

Interest act as motivational variable (Renninger et al., 2015). It can be defined as a situation where students are motivated to participate in an activity and experience satisfaction. Interest is a combination of individual and situational interest (Lamb et al., 2012). Interest is not innate and does not develop spontaneously. Interest in learning is not something inherent and does not grow on its own in line with human development. Interest does not arise spontaneously but has a foundation in needs.

Interest grow based on internal situation or experience. Numerous studies have indicated that students are likely to achieve better academic performance if they have a high interest in the subjects they are studying (Komariyah dkk, 2018). Conversely, low interest in a subject can lead to poorer academic results.

Students will be more inclined to learn if they realize that learning is a way to achieve goals they consider important and if they see that their learning experiences will help them develop. It is highly likely that students will be interested in attending the lessons.

Interest represents a powerful inclination toward something. In other words, interest is specific to content or objects and involves a particular relationship between a person and the environment, sustained through interaction (Renninger et al., 2015). When connected to learning, particularly in chemistry, it can be concluded based on literature and preliminary studies that there are issues and a lack of interest among students in learning chemistry (or science in general). Furthermore, international studies shown that interest in science and technology among primary and secondary school students is low and seems to be decreasing (van Griethuijsen et al., 2015). This condition has persisted since an individual or student's elementary school years.

As children grow older, their interest in natural sciences experiences a significant decline (Potvin & Hasni, 2014). At the elementary school level, issues often arise related to the limited understanding of natural science subjects. Students encounter difficulties in science subjects because they are only engaged in activities such as listening, writing, or using textbooks without emphasizing creativity in conveying new ideas (Hartini & Faridah, 2022). A study states that students show high enthusiasm in the outdoor science learning process by utilizing the school environment (Anggraini & Efendi, 2023). The greater the students' interest in learning, the higher the achievement in science subjects that students attain, and vice versa (Awe & Benge, 2017).

At the Junior High School level, one of the common issues found in science learning is the low interest of students (Potvin & Hasni, 2014). Many students consider science to be one of the difficult subjects. Students academic achievements in science subjects are still below average when compared to their achievements in other subjects. Weak performance of students in science-related calculations is one of the causes of low interest in learning science (Adu-Gyamfi, 2013). As previously explained, Chemistry is a branch of natural science, especially in the realm of physical sciences alongside physics. Chemistry and physics have become separate subjects in school and involve more math than any other subject (D. H. Putri & Pranata, 2023). Another study also showed that among the science subjects (biology, chemistry, and physics), students consider chemistry to be the most difficult subject because it involves a lot of calculation (Yakina dkk, 2017).

In Indonesia, where chemistry is introduced separately at the high school level, students' interest in the subject varies (Akram et al., 2017). Despite its central role in understanding the world

around us, chemistry's presentation often fails to engage students (Alfarisi, 2018). Passive participation and minimal interaction during lessons reflect students' lack of interest (Anggorowati, 2020). However, a study reveals that the subject of chemistry is crucial to study because the science of chemistry plays a central role as the core of all knowledge. Additionally, understanding chemistry is vital because all elements around us are chemical elements (Kurniawan & Astuti, 2017).

The level of interest in learning among students is influenced by numerous factors. Various issues within learning activities or tasks can also diminish students' interest. According to a study, interest is a component of personality that correlates with students' motivation, self-regulation and academic achievement (Pranata et al., 2023). Encouraging interest in chemistry (or science) during the school period is crucial because students who are interested in science are more likely to pursue careers in the field (A. L. Putri et al., 2024).

Therefore, students' interest in learning is essential to be studied in more detail. Understanding the multifaceted nature of students' interest in learning chemistry is imperative for enhancing the quality of education. This study aims to explore students' interest in chemistry, particularly when mathematical concepts are involved, focusing on high school students. Additionally, it incorporates a comparative analysis across different grade levels to glean insights for improving the learning experience.

METHOD

This research employed descriptive and comparative methods and was conducted at SMAN 7 Kerinci during the second semester of the academic year 2023/2024. The target population comprised all students enrolled in science classes in 11^{th} and 12^{th} grades, totaling 270 students. A sample of 160 students was selected using purposive sampling.

Data on students' interest levels were gathered through a survey utilizing a standardized questionnaire. The instrument employed for data collection was adapted from the Science and Mathematics Integrated Questionnaire (SMIQ) utilized in previous studies (Béchard et al, 2021). The questionnaire was translated into Indonesian to ensure comprehension among the participants. It consists of 20 statements, including eight statements pertaining to Chemistry Interest, eight statements to Mathematics Interest, and four statements to Mathematics and Chemistry Interest. Additionally, an extra statement was included to mitigate response bias.

Each statement in the questionnaire presented respondents with four answer options. To evaluate students' responses, a Likert scale was utilized, with responses converted according to Table 1.

Table 1. Answer conversion

Answer Choices	Answer Scores	
	Positive	Negative
Strongly Agree	4	1
Agree	3	2
Disagree	2	3
Strongly Disagree	1	4

During the initial analysis, respondents who selected the "disagree" option for the trap statement were identified. Among them, 115 students were deemed to have read and carefully considered the questionnaire, while 45 students did not meet this criterion. Therefore, only responses from the 115 attentive students were included in data analysis

To depict students' interest in learning chemistry, the collected data will be analyzed using descriptive statistics. The resutls data on students' interest in learning chemistry will be categorized according to the classification in Table 2.

Table 2. Interest classification

Avarage Scores ($\bar{x}$)	Classification
$3 < \bar{x} \leq 4$	High
$2 < \bar{x} \leq 3$	Medium
$1 \leq \bar{x} \leq 2$	Low

Furthermore, a comparative test (Independent Samples t-test or Mann-Whitney U-Test at a significance level of 5%) will be employed to determine whether there is a difference in the interest of students in 11^{th} and 12^{th} grades towards Chemistry and its integrative context with Mathematics. If the analysis results yield a significance value less than or equal to 0.05, the conclusion drawn will be that there is a significant difference in the interest of students in 11^{th} and 12^{th} grades. Conversely, if the significance value is greater than 0.05, it will be concluded that there is no significant difference in the interest of students in 11^{th} and 12^{th} grades.

RESULTS and DISCUSSION

Descriptif Statistics

The results of the descriptive statistic test for students' interest in learning Chemistry and its

integrative context with Mathematics are summarized in Table 3.

Table 3. Result of descriptive statistic test

Students' Interest	Range	Min	Max	Mean	Standar Deviation	Variance	Skewness	
							Statistic	Std. Erorr
All Students	2.25	1.75	4.00	2.69	0.41	0.16	0.46	0.23
11th Grade	1.83	1.96	3.79	2.80	0.37	0.13	0.26	0.29
12th Grade	2.25	1.75	4.00	2.53	0.41	0.17	1.20	0.35

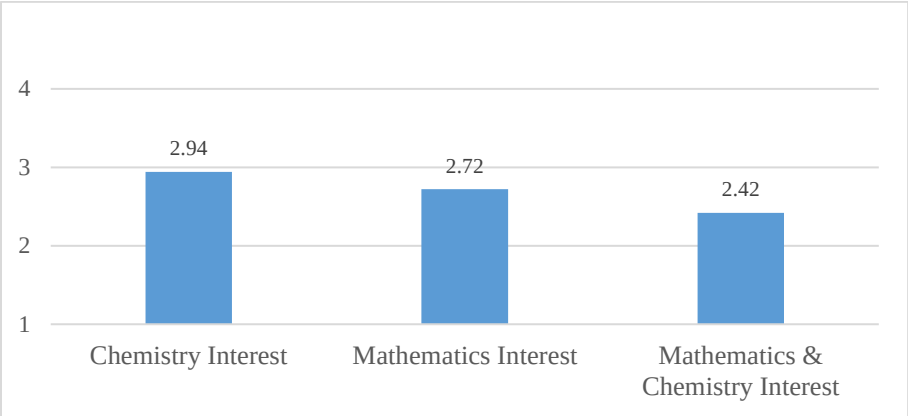

Figure 1. Average of student interest

The descriptive analysis provides insights into the overall interest in learning for all students and based on different grade levels (11th and 12th). On average, science students at SMAN 7 Kerinci exhibit a moderate interest in learning Chemistry and its integrative context with Mathematics, with a mean score of 2.69. Further details regarding interest indicators are illustrated in Figure 1, followed by discussion.

Among the three indicators of interest in learning Chemistry and its integrative context with Mathematics, Chemistry Interest yielded the highest average score, reaching 2.94. However, this score still falls within the moderate interest level. The highest-scoring statements in the instrument were related to students enjoying experimental activities in chemistry learning (3.27) and students expressing a willingness to continue learning chemistry (3.13). Both of these statements fall into the high-interest category, with percentages of 81.75% and 78.25%, respectively. Additionally, statement number 1 (2.95), which pertains to students looking forward to future chemistry learning activities, scored above the average.

However, others statements within the chemistry interest indicator received scores below the average. The statement with the lowest score related to the willingness to invest time in learning chemistry (2.60). Analysis of the response distribution revealed that 42.61% (49 out of 115 students) were unwilling to invest more time in learning Chemistry.

Observation and experimentation activities are classified as one of the activities involving motor aspects. Previous studies have revealed that these activities engage students and are favored among high school students (Cahyani & Pranata, 2023). Educators should consider enhancing Chemistry (including science in general) learning by increasing the frequency of experiments in the lesson plans. Another study also suggests including hands-on activities in nature and integrating technology (Cahyani & Pranata, 2023).

To address the students' low willingness to invest time in learning, science instruction must be carefully planned. Another studi suggest that learning should enable students to perceive science as a tool for inventing new things or developing new knowledge and skills. The more value they place on innovation orientation in their career choices, the higher their interest in science will be (Kang et al., 2019).

Interest in learning chemistry at the high school level appears to require improvement, as the majority of students prefer biology, considering it easier. Chemistry tends to be a subject that students avoid. Previous research on the same population regarding the preference

order of mathematics and science subjects indicated Biology as the most favored subject. Additional research findings on interest in learning chemistry among 11th grade science students revealed that 38% were categorized as having high interest, 51% as having moderate interest, and the remaining 11% as having low interest (Hemayanti dkk, 2020). Moreover, research on 10th-grade science students at MAN Semarang categorized their interest in learning chemistry as low, with 35% of students falling into this category (Sari & Maharani, 2019).

The lack of interest in studying chemistry among students can be attributed to various factors, including internal and external influences. Internal factors, such as awareness, emotions, and willingness, arise from within individuals, while external factors stem from the roles or involvement of others, such as family, friends, teachers, informal learning experiences, and the environment (Lamb et al., 2012). The lack of students' interest in studying chemistry is often caused by students perceiving that the chemistry material is irrelevant to their needs, abilities, and skills. As a result, they feel compelled to study it (Sanjiwani et al., 2018).

For the mathematics interest indicator, an average score of 2.72 was obtained, which is lower than the average score for chemistry interest. Mathematics interest is also categorized at a moderate level. Interestingly, no statements received a score higher than 3.00, indicating a lack of high interest. However, several statements scored above the average, including students' tendency to choose to learn Mathematics (2.94), interest in what they learn in Mathematics (2.83), and finding Mathematics learning not boring (2.79). However, these scores still fall within the moderate range, as no statement reached average value greater than 3.

Conversely, five statements received scores lower than the average score for the mathematics interest indicator. Statement number 14 had the lowest score (2.52), mirroring the lowest-scoring statement in chemistry interest, which pertains to the investment of time. Analysis of the response distribution revealed that 48.70% (56 out of 115 students) were unwilling to invest more time in learning Mathematics, a higher percentage compared to the interest in Chemistry.

Mathematics emerges as one of the less favored subjects not only at the elementary, junior high, and high school levels but also in higher education. This aversion is often attributed to the mathematical elements associated with calculations. Previous studies have revealed that mathematics learning using puzzles or challenges can be effective. Puzzle-based learning can enhance students' interest and motivation in various learning conditions, such as in-class learning and learning environments where students have diverse abilities (Pranata, 2023), as well as in activities preparing them for science competitions (Pranata, 2021).

In chemistry education, mathematical proficiency is crucial as students need to integrate chemical concepts with mathematical calculation skills, like in understanding chemical equilibria, electrolysis, acid–base chemistry and molecular structures (Kind & Aston, 2022). However, many students lack fundamental mathematical knowledge, making it challenging to grasp chemical concepts and utilize basic mathematical operations (Kurniawati dkk, 2017).

These findings underscore the importance of exploring the integration of mathematics into chemistry learning. Understanding how the application of mathematics impacts students' interest in chemistry learning can provide valuable insights into instructional strategies and curriculum design.

The data presented in Figure 1 confirm that interest tends to decrease when Chemistry involves integration with Mathematics or when chemistry learning requires extensive calculations. In line with previous research when Biology involves integration with Mathematics (Ulandari et al., 2024). Notably, the interest score for the mathematics and chemistry interest indicator is the lowest among all indicators, with a score of 2.42. This finding aligns with existing studies that highlight the interconnectedness of mathematical skills and chemistry learning outcomes. Indeed, students' mathematical ability significantly influences their success in learning chemistry (Vilia et al., 2017). However, literature suggests a scarcity of studies focusing on how mathematics is applied in the chemistry classroom (Ríordáin et al, 2016).

Within this indicator, the highest average score is only 2.62, indicating that students enjoy Chemistry learning involving mathematical calculations. However, this average score is still relatively low compared to statements regarding learning Chemistry and Mathematics separately. Furthermore, the lowest-scoring statement (2.21) pertains to learning activities involving both Chemistry and Mathematics.

From the analysis results, it can be concluded that students do not derive satisfaction when chemistry learning is integrated with mathematics, despite the inherent connections between certain chemistry concepts and mathematical principles, such as stoichiometry, reaction rates, and chemical equilibrium. Mathematical knowledge is often utilized to solve

chemistry problems, indicating the presence of mathematical elements in chemistry lessons.

A more detailed study was conducted through a comparative test between the learning interests of 11th grade and 12th grade students. Data distribution were assessed as assumptions for determining the appropriate statistical test (Independent Samples t-test or Mann-Whitney U-Test). Specifically, data were considered normally distributed when the skewness value fell between -1 and +1 (Morgan et al., 2004). Analysis results (Table 3) revealed that the data for the learning interests of 11th grade students met the criteria for normal distribution. However, the data for the learning interests of 12th grade students exhibited a skewness value greater than 1 (1.20), indicating the data distribution is not normal. Consequently, the comparison of learning interests for different grade levels was conducted using the Mann-Whitney U-Test (*Comparative Test I*).

Before proceeding to the comparative analysis, a more detailed descriptive analysis was conducted to gain insight into the overview of interest indicators for students from different grade levels. The results of the descriptive statistical analysis for each indicator are summarized in Table 4.

Table 4. Indicator of interest 11th and 12th grade students

Interest	N	Range	Min	Max	Mean	Std. Deviation	Variance	Skewness	
								Statistic	Std. Error
11th Grade									
Chemistry	70	1.75	2.13	3.88	3.00	0.14	0.14	-0.08	0.29
Mathematics	70	2.75	1.25	4.00	2.86	0.23	0.23	-0.41	0.29
Mathematics & Chemistry	70	2.50	1.50	4.00	2.55	0.25	0.25	0.17	0.29
12th Grade									
Chemistry	45	2.00	2.00	4.00	2.85	0.15	0.15	0.44	0.35
Mathematics	45	2.25	1.75	4.00	2.51	0.22	0.22	0.80	0.35
Mathematics & Chemistry	45	3.00	1.00	4.00	2.21	0.35	0.35	0.56	0.35

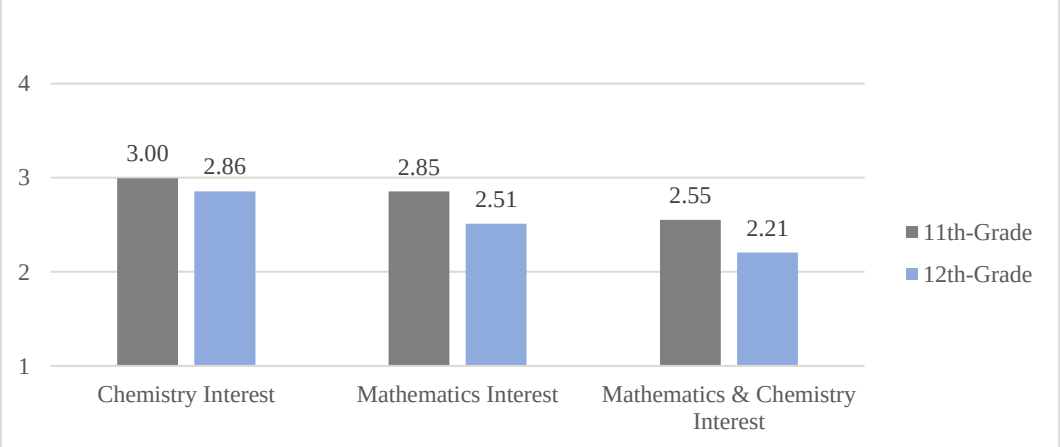

Figure 2. Average interest of 11th and 12th-grade students

Before moving to the comparative analysis, a more detailed descriptive analysis was conducted to understand the overview of interest indicators for students from different grade levels. The results of the descriptive statistical analysis for each indicator are visually represented in Figure 2.

Overall, from the three indicators presented in Figure 2, 11th-grade students tend to obtain higher scores compared to 12th-grade students. Although differences were found, they may not necessarily be significant. Further testing is required (Independent Samples t-test or Mann-Whitney U-Test). All groups of statistical data for each indicator and grade level were found to have

skewness within the range of -1 to +1, as indicated in Table 4. Thus, it can be concluded that all data groups are normally distributed(Morgan et al., 2004). Therefore, significant differences for each indicator can be tested using the Independent Samples t-test (*Comparative Test II*).

Comparative Test I: Mann Whitney U-Test

The Mann-Whitney U-Test was conducted to compare the learning interest in chemistry among students in different grade levels, namely, 11th and 12th grades in the science class. The test results are presented in Table 5 and 6.

Table 5. Test statistics

	Avarage Interest
Mann-Whitney U	856.500
Wilcoxon W	1892
Z	-4.121
Asymp. Sig. (2-tailed)	0.000

Table 5. Students' interest ranks

Students' Interest	**N**	**Mean Rank**	**Sum of Ranks**
11th Grade	70	68.26	4778.50
12th Grade	45	42.03	1891.50

Based on the "Test Statistics" output, the Asymp. Sig. (2-tailed) value is 0.000, which is less than 0.05. Therefore, it can be concluded that there is a significant difference in the learning interest in chemistry between 11th and 12th grades at SMAN 7 Kerinci. This significant difference suggests that the grade level influences students' interest in learning chemistry. The analysis results from Table 6 reveal that the mean rank of learning interest in chemistry for 11th Grade is higher than 12th Grade, with values of 67.21 and 43.68, respectively.

Additionally, referring to Table 3, it is observed that 11th grade science students (2.80) exhibit a higher interest in learning compared to 12th grade science students (2.53). This difference suggests a variation in students' interest levels across different grade levels. Interestingly, as students progress through the school grades, their interest in learning chemistry decreases. In other words, interest in learning chemistry (or science overall) declines as students grow older. This finding is also confirmed by a previous study (Potvin & Hasni, 2014). However, further analysis is needed to determine the significance of this difference.

Related studies conducted at the junior high school level, focusing on class levels, indicate variations in students' interest in science across different grades. For instance, students' interest in science in 7th Grade is superior, followed by 8th Grade, while 9th Grade obtains the lowest score (Putra et al., 2023). These findings suggest that students' interest in science at the junior high school level is also influenced by the grade level. The pattern remained consistent: as students progress through the school grades, their interest in learning decreases.

These results provide valuable insights into the factors influencing students' interest in learning chemistry and can serve as a basis for further research. Future studies could explore various factors that impact students' interest in learning chemistry in greater detail, potentially shedding light on effective strategies to enhance student engagement and interest in the subject.

Comparative Test II: T-Test

An Independent Samples t-test was conducted to compare the learning interest in chemistry among students with different grade levels for each indicator. The test results are presented in Table 7.

Table 7. *Independent samples t-test* for all indicator of interest

	Levene's test		**t-test for Equality of Means**						
	F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Contidence Interval of the Difference**	
								Lower	**Upper**
Chemistry Interest									
Ev assumed	0.00	0.95	1.98	113	0.050	0.14	0.07	0.0002	0.288
Ev not assumed			1.97	91.07	0.052	0.14	0.07	-0.002	0.290
Mathematics Interest									
Ev assumed	0.00	0.96	3.77	113	0.000	0.34	0.09	0.163	0.523
Ev not assumed			3.80	96.22	0.000	0.34	0.09	0.164	0.522
Mathematics & Chemistry Interest									

	Levene's test		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Contidence Interval of the Difference	
								Lower	Upper
Ev assumed	0.43	0.52	3.38	113	0.001	0.35	0.10	0.144	0.552
Ev not assumed			3.26	82.77	0.002	0.35	0.11	0.136	0.560

*Ev = Equal variances

The results of the Independent Samples t-test data show the average values for each indicator of learning interest in chemistry, namely Chemistry Interest, Mathematics Interest, and Mathematics & Chemistry Interest. From the significant values, it can be observed that thereare significant difference between 11th and 12th grades for all three indicators. Specifically, in the Mathematics Interest indicator, the weight of the values obtained between 11th and 12th grades is the same (0.000). In the Chemistry Interest indicator, there is a slight difference, with 11th grade having a value of 0.14 and 12th grade a value of 0.34. Similarly, the third indicator, Mathematics & Chemistry Interest, also shows a slight difference, 0.35 from 4 points scale.

The pattern remained consistent for all indicator: *as students progress through the school grades, their interest in learning decreases*. Based on the data analysis, it can be concluded that 11th grade tends to be more interested in learning chemistry, mathematis, and chemistry (integrated with mathematics). Ideally, at higher grade levels, students' interest in learning chemistry should increase, as this influences the academic performance of students who will complete their education at the high school level and prepare for further studies at the tertiary level.

CONCLUSIONS AND SUGGESTIONS

Conclusion

In conclusion, this study investigated the learning interest in chemistry among students at different grade levels in SMAN 7 Kerinci. Through descriptive and comparative analyses, we gained insights into the factors influencing students' interest in chemistry and its integration with mathematics.

The findings reveal that students' interest in learning chemistry tends to decline as they progress through higher grade levels. Specifically, 11th grade students exhibited a higher interest in learning chemistry compared to 12th grade students. The decline in interest also found form mathematics learning and chemistry learning (integrated with mathematics). This decline in interest may have significant implications for students' academic performance, as studies suggest a positive correlation between interest levels and academic achievement.

Furthermore, while the integration of mathematics with chemistry is essential for understanding complex concepts, our results indicate that students may find this integration challenging, leading to decreased interest in learning chemistry. This underscores the importance of innovative teaching strategies that effectively integrate mathematics into chemistry lessons while maintaining students' interest and engagement.

Sugesstion

Moreover, our study highlights the need for further research to explore the underlying factors influencing students' interest in learning chemistry. By understanding these factors more comprehensively, educators can develop targeted interventions to enhance students' interest and engagement in chemistry education.

Ultimately, fostering a strong interest in chemistry among students is crucial not only for academic success but also for nurturing future scientists and innovators. Therefore, it is imperative for educators to continuously strive to create dynamic and engaging learning environments that inspire curiosity and passion for chemistry among students.

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