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Implementation of Guided Discovery Learning Model Assisted by Google Sheets to Analyze Interest and Learning Outcomes of Class XI Students on Basic Law of Chemistry

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Abstract

Various studies have shown that applying the guided discovery learning model can increase students' interest in learning, which ultimately leads to better learning outcomes. This is especially important for difficult subjects or topics, such as basic chemistry laws. Based on observations at SMA Kristen YSKI, the researcher found indications of low student interest in chemistry. This study aims to analyze students' learning interest and learning outcomes as well as the relationship between the two. The research, using an explanatory sequential design, was conducted on Grade XI Fearless and Genuine students. Data on learning interest was collected through a psychometric scale questionnaire, while learning outcomes were measured through a test, followed by qualitative data collection through interviews. The data was then analyzed using descriptive statistics and correlation analysis between learning interest and learning outcomes. The results of the study provide data on students' interest in chemistry and their learning outcomes in basic chemistry laws, including distribution and central tendency analysis. Interestingly, some students with high learning interest scored low on the test, which was an unexpected result. Interviews were conducted with these students to understand the reasons behind this outcome. Some of the reasons mentioned included difficulty adjusting after the semester break, a tight schedule of tests and extracurricular activities, and a mismatch with the applied learning model, which led to less effective learning.

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INTRODUCTION

Education has become an integral part of life. The goal of education in Indonesia, as stated in Article 3 of Law No. 20 of 2003 on the National Education System, is to shape individuals who excel cognitively, socially, spiritually, and as responsible citizens. The utilization of ICT in education is one way to adapt learning to modern advancements while also enhancing 21st-century skills among students (Sumardi et al., 2020). One way to integrate ICT in education is by using Google Sheets. Google Sheets can support computer-supported collaborative learning (CSCL), particularly when used as a group-based e-LKPD (electronic student worksheet) tool. One of the key advantages of e-LKPD, especially when using Google Sheets, over traditional paper-based LKPD is that all group members can view and edit content simultaneously, fostering real-time collaboration (Andrew, 2019).

The constructivist theory states that learning is a process of building and expanding new knowledge based on existing knowledge. The best learning experience occurs when individuals actively construct their own understanding (Pritchard, 2009). One learning model that aligns with this theory is Guided Discovery Learning (GDL). According to Eggen & Kauchak (2016), the stages of this learning model include Introduction and Review, Open-ended Phase, Convergent Phase, Closure, and Application.

Guided Discovery Learning (GDL) helps students develop knowledge more effectively and has been shown to increase their interest in learning (Rahmawati et al., 2022; Sunendar, 2016). Interest is both a cognitive and affective state (Duchesne et al., 2022) and can be defined as a student's attraction to a subject or specific learning topic. Learning interest can be categorized into four dimensions: enjoyment, curiosity, attention, and student engagement (Slameto, 2003). A high level of learning interest enables students to better receive and process information, allowing them to expand their knowledge more effectively (Budiariawan, 2019). This, in turn, has a positive impact on learning outcomes. Learning outcomes refer to the skills or behavioral changes acquired by students after completing a learning process (Hamalik, 2003; Sudjana, 2009). Bloom classifies learning outcomes into three domains: cognitive, affective, and psychomotor (Woolfolk, 2020). Learning interest is particularly crucial for challenging subjects, such as basic chemistry laws, which are often difficult for students to understand (Hidayat et al., 2015; Laliyo et al., 2020).

Observations at SMA Kristen YSKI revealed several issues, which are explained as follows. Some students appeared less enthusiastic during learning sessions. This was supported by their responses to a questionnaire statement: "I feel bored when studying chemistry," where 47 out of 100 students agreed with the statement. Additionally, some students found chemistry less enjoyable, which affected their motivation to learn. This was reflected in their responses to the statement: "Chemistry is enjoyable because it balances memorization and formulas," where 41 out of 100 students disagreed with the statement. The researcher compared these findings with interest indicators according to Slameto (2003) and suspected that students' interest in learning chemistry was relatively low. This issue needs to be addressed because low learning interest can lead to ineffective learning, ultimately resulting in poor academic performance (Rozikin et al., 2018).

Based on the identified issues and observation results, the researcher believes that it is necessary to analyze students' learning interest and academic performance, particularly in basic chemistry laws, to determine the appropriate follow-up actions. To address this, the researcher has chosen the study titled "Implementation of the Guided Discovery Learning Model Assisted by Google Sheets to Analyze Learning Interest and Academic Performance of Grade XI Students on Basic Chemistry Laws." This study aims to analyze students' interest in chemistry, evaluate their learning outcomes in basic chemistry laws using the guided discovery learning model, and examine

the relationship between students' interest in chemistry and their academic performance in basic chemistry laws.

METHODS

The study was conducted at SMA Kristen YSKI, located at Jalan Sidodadi Timur No. 23, Semarang. This school was selected because it presented issues relevant to the research focus, specifically low student interest in learning, as identified in the preliminary observations. The population of this study consisted of all Grade XI students at SMA Kristen YSKI, while the sample was selected from Grade XI Fearless and XI Genuine. The convenience sampling method was used, considering that only these two classes were enrolled in chemistry lessons.

This study employed an explanatory sequential design, beginning with the collection of quantitative data, including students' learning outcomes in basic chemistry laws and their learning interest in chemistry. Based on the quantitative results, specific data points were selected for further analysis. The next step involved qualitative data collection through interviews, which served to support and further explain the quantitative findings. Qualitative data was particularly useful for interpreting unexpected results from the quantitative analysis (Creswell, 2015).

This study involved three variables. Two of them were quantitative variables, namely students' test scores on basic chemistry laws, assessed across three dimensions: knowledge, skills, and attitudes, and students' interest in learning chemistry. The third variable was qualitative, consisting of interview results with students. Data on students' knowledge and skills in basic chemistry laws were collected through written tests, while attitudinal learning outcomes and learning interest were measured using questionnaires.

The quantitative data was first analyzed descriptively using the SPSS statistical software. The data was then categorized into appropriate groups for further interpretation. To examine the relationship between the two quantitative variables, the Pearson correlation coefficient was calculated using SPSS to facilitate the computation. This correlation was further analyzed using qualitative data obtained from interviews. The interviews aimed to provide explanations for unexpected relationships between students' interest in learning chemistry and their learning outcomes in basic chemistry laws.

RESULT AND DISCUSSION

Descriptive Analysis of Basic Law of Chemistry Learning Outcomes Knowledge Dimension

The results of descriptive analysis on the basic law of chemistry test scores are shown in Table 1.

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Table 1. Descriptive analysis results on learning outcomes test score data

Mean	Std. Deviation	Minimum	Maximum	Skewness	Kurtosis
54,67	18,573	8	100	-0,129	0,341

The distribution of test scores obtained is presented in Figure 1.

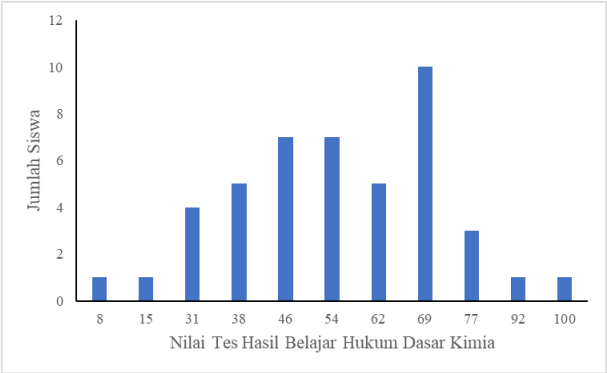

Figure 1. Distribution of basic law of chemistry learning test scores

The knowledge dimension learning outcomes were obtained from the basic laws of chemistry learning outcomes test. Descriptive statistics show that the average value of the basic laws of chemistry learning outcomes test is 54.67 (SD = 18.573). There is a very large range between the lowest test score and the highest test score. The skewness value shows that the asymmetry tends to the left which means that some students have very low scores compared to the average. There were only 5 out of 45 students (11%) who scored above the Criteria for Achievement of Learning Objectives (KKTP) set at 70.

Each question was then grouped based on the level of knowledge according to Bloom's taxonomy and the value of each student at each level of knowledge was calculated. The distribution of student learning outcomes at each level of knowledge according to Bloom's taxonomy is presented in Figure 2.

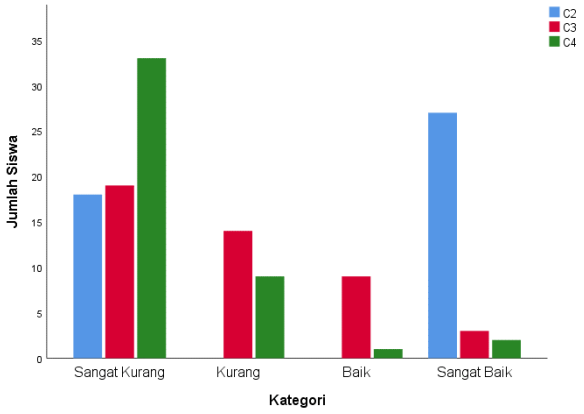

Figure 2. Learning outcomes based on Bloom's level of knowledge

It can be seen that only a few students (7%) obtained a minimum score of "Sufficient" at the C4 (analyzing) knowledge level. This is unfortunate because the guided discovery learning model applied

has not been able to train students' critical thinking skills as expected (Rahmawati et al., 2022). At the C3 (applying) knowledge level, 27% of students obtained a minimum score of "Fair". This is also still far from the expectation of completeness. The lowest level of knowledge contained in the test questions, namely C2 (understanding), has the best percentage of completeness among the other two levels of knowledge, which is 60%. Although the completeness at the C3 and C4 knowledge levels is still not as expected, the results of observations during learning show that these students who have not been completed still show enthusiasm in learning by trying to understand and occasionally asking the teacher or friends. Although the results have not been maximized, the process during learning has shown positive results.

Descriptive Analysis of Basic Law of Chemistry Learning Outcomes Attitude Dimension

The learning outcomes of the attitude dimension were obtained from the learning interest questionnaire given at the end of the lesson. Each questionnaire item indicator has been adjusted to the affective level of Bloom's taxonomy. The average results of the attitude dimension for each level are presented in Figure 3.

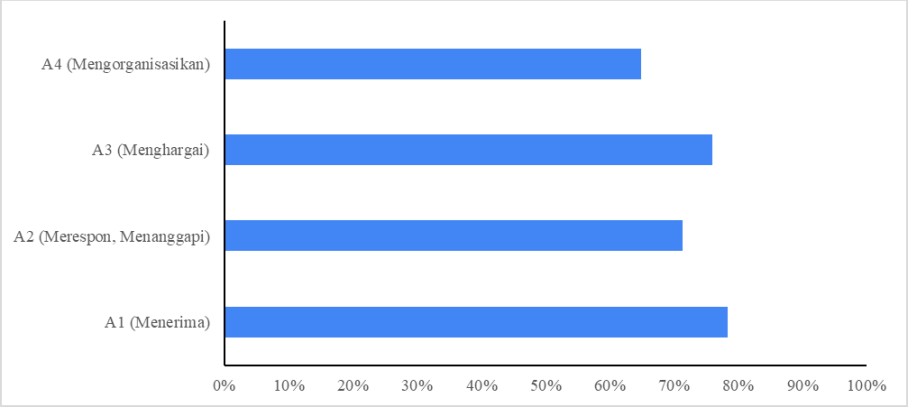

Figure 3. Average affective learning outcomes per level

The **Figure 3** shows that students tend to have a good attitude of acceptance and respect. This is reflected in the attitude of students who try to follow the learning well, such as paying attention during discussions and actively asking questions to friends and teachers. This student activeness is also one of the advantages of using the guided discovery learning model (Eggen & Kauchak, 2016).

Descriptive Analysis of Basic Law of Chemistry Learning Outcomes Skill Dimension

The learning outcomes of the skills dimension were obtained from the basic laws of chemistry learning outcomes test. The skills measured are critical thinking skills with indicators from Ennis (2018). Indicators of learning outcomes test questions that were originally only based on Bloom's level of knowledge were adjusted to Ennis' critical thinking skills indicators, then the scores of these questions became the basis for measuring the learning outcomes of the critical thinking skills dimension. There are two indicators of critical thinking skills measured, namely Basic Clarification (analyzing arguments:

identifying reasons or premises) in question items number 8 and 13 and Inference (deduction and assessing deduction: conditional logic) in question items number 10, 11, 14, and 15. The distribution of students' critical thinking skills is presented in Figure 4.

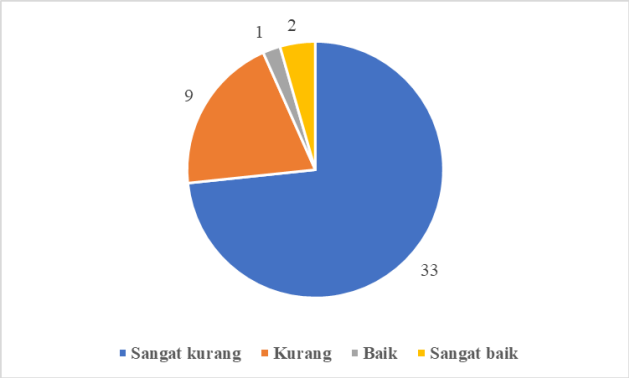

Figure 4. Distribution of critical thinking skills

Most students (73%) still have critical thinking skills in the "Very poor" category. Very few students had critical thinking skills in the category of at least "Fair" (7%). This shows that most students' skills in performing basic clarification, which includes analyzing arguments, and inference, which includes deduction and assessing deduction, are still very poor. This is unfortunate because the guided discovery learning model applied has not been able to train students' critical thinking skills as expected (Rahmawati et al., 2022).

Descriptive Analysis of Interest in Learning Chemistry

The results of descriptive analysis on chemistry learning interest data are shown in Table 2.

Table 2. The results of descriptive analysis on data on student interest in learning class XI Fearless

Mean	Std. Deviation	Minimum	Maximum	Skewness	Kurtosis
96,13	14,204	71	131	0,138	-0,461

The average chemistry learning interest score is 96.13 (SD = 14.204). If converted into percentage form, the average interest in learning is 73% which is included in the "High" interest category. Students with the lowest interest are in the "Medium" category and students with the highest interest are in the "Very High" category. From observations during learning, the behavior of students with the highest and lowest interest does reflect their learning interest score. Students with the lowest interest often do not pay attention and instead do or open things other than learning. In contrast, students with the highest interest are very active in asking questions and discussing and often help friends who are struggling. The SD value is not too large, indicating moderate variation in students' learning interest scores. The skewness value shows the asymmetry of the distribution tends to the right, which means that some students have a high interest that pulls the distribution to the right. The highest average interest lies in the indicator "Students' attitude towards the assigned tasks" (81%) and not far below in the indicator "Communication between teachers and students" (80%). On average, students tend to have a high interest in learning chemistry as

reflected in the way they do their assignments wholeheartedly. In addition, some students feel that teachers pay attention to each student fairly, provide extra time to help students who are struggling, and actively communicate two-way with students during learning. For example, students xi_f_9 and xi_g_2 are very active in asking the teacher (researcher) to confirm their findings. In the indicator "Student activeness during chemistry learning at school", an average percentage of 78% was obtained. This shows that most students actively answer the teacher's questions and discuss with friends and with the teacher. Some students who tend to be less active in general learning, such as students with code xi_f_2, xi_f_13, and xi_g_6, become active in asking questions and discussing the learning of basic laws of chemistry with guided discovery learning model. This is in accordance with one of the expected outcomes of the application of guided discovery learning, namely high student motivation and activeness (Janssen et al., 2014). Research shows that high learning outcomes tend to be achieved by students who are active in learning (Schnitzler et al., 2021). In other questionnaire indicators, various percentages were obtained but most were in the "High" category. This is also in accordance with the results of studies showing that the guided discovery learning model can lead to high interest in learning (Rahmawati et al., 2022).

Analisis Korelasi antara Hasil Belajar Hukum Dasar Kimia Dimensi Pengetahuan dengan Minat Belajar Kimia

Correlation analysis was conducted between the test scores of the basic laws of chemistry learning outcomes and the chemistry learning interest score to determine the trend of the relationship between the two. The correlation between the test scores of basic laws of chemistry learning outcomes and students' chemistry learning interest scores are presented in Table 3.

Table 3. Pearson correlation between learning outcome test scores and interest in learning

		Chemistry Study Interest Questionnaire Score
Basic Law of Chemistry Learning Outcome Test Score	***Pearson Correlation***	0,031
	***Sig.* (2 *tailed*)**	0,838
	N	45

The basic laws of chemistry learning test scores and chemistry learning interest scores show a very weak and statistically insignificant positive relationship, r (45) = 0.031, p> 0.05. An increase in learning outcomes test scores is followed by an increase in learning interest scores, and vice versa, although the strength of this relationship is classified as very weak. It cannot be concluded that there is a significant relationship between learning outcomes of basic laws of chemistry and interest in learning chemistry.

Relationship between Basic Law of Chemistry Learning Outcomes and Interest in Learning Chemistry

Table 4 shows the test scores of the basic laws of chemistry learning outcomes, the category of basic laws of chemistry learning outcomes, the score of the interest in learning chemistry questionnaire in percentage form, and the category of students' interest in learning chemistry.

Table 4. Interest in learning chemistry and basic laws of chemistry learning test scores

Student Code	Questionnaire Score	Learning Outcome Test Score	Interest Category	Learning Outcome Category
xi_f_1	103	38	High	Very Low
xi_f_2	94	46	High	Very Low
xi_f_3	119	8	Very High	Very Low
xi_f_4	101	62	High	Low
xi_f_5	117	54	Very High	Very Low
xi_f_6	98	38	High	Very Low
xi_f_7	105	31	High	Very Low
xi_f_8	76	46	Moderate	Very Low
xi_f_9	112	54	Very High	Very Low
xi_f_10	95	77	High	Fair
xi_f_11	118	15	Very High	Very Low
xi_f_12	85	69	High	Low
xi_f_13	79	31	Moderate	Very Low
xi_f_14	107	46	Very High	Very Low
xi_f_15	97	62	High	Low
xi_f_16	88	38	High	Very Low
xi_g_1	131	69	Very High	Low
xi_g_2	116	69	Very High	Low
xi_g_3	71	31	Moderate	Very Low
xi_g_4	81	54	High	Very Low
xi_g_5	100	69	High	Low
xi_g_6	110	54	Very High	Very Low
xi_g_7	88	62	High	Low
xi_g_8	79	54	Moderate	Very Low
xi_g_9	82	62	High	Low
xi_g_10	106	69	Very High	Low
xi_g_11	94	92	High	Excellent
xi_g_12	108	46	Very High	Very Low
xi_g_13	107	69	Very High	Low
xi_g_14	97	31	High	Very Low
xi_g_15	106	46	Very High	Very Low
xi_g_16	84	46	High	Very Low
xi_g_17	108	100	Very High	Excellent
xi_g_18	110	77	Very High	Fair
xi_g_19	71	38	Moderate	Very Low
xi_g_20	73	69	Moderate	Low
xi_g_21	93	54	High	Very Low
xi_g_22	92	69	High	Low
xi_g_23	86	62	High	Low
xi_g_24	95	69	High	Low
xi_g_25	95	38	High	Very Low
xi_g_26	97	69	High	Low
xi_g_27	90	77	High	Fair
xi_g_28	86	46	High	Very Low
xi_g_29	76	54	Moderate	Very Low

From Table 4, it can be seen that some students have learning outcomes that are inversely proportional to their learning interests. Various studies have shown that high learning interest tends to be followed by high learning outcomes; there is a positive relationship between learning interest and learning outcomes (Suryana et al., 2022). Interviews with some of these students were conducted to find out the reasons behind this unexpected relationship. Some students who showed the expected relationship were also interviewed for comparison. Table 5 is a summary of the interview results of each selected student.

Table 5. Summary of the results of interviews with several students

Students Code	Summary of Interview Results
xi_f_1	• Has his own learning interest in science, especially physics and chemistry • Teachers also influence his interest in learning • Sometimes bored or lazy but still trying to overcome it • Before the test, xi_f_1 students were busy preparing for the competition so that learning for the test was not optimal
xi_f_11	• The material studied is interesting • Liked the application of concepts (calculating) • Before the test, Student xi_f_11 was still adapting after the semester break so that learning was not optimal
xi_f_14	• Favors application of concepts over theory • Teachers influence his interest in learning • Lazy to study and play too many games so that learning is not maximized
xi_f_12	• Loves physics, chemistry, and math that is more calculation than theory • Strives for good chemistry grades for scholarships • Teachers do not influence his learning interest
xi_g_4	• Have a high interest in learning chemistry • Interest decreased slightly because it was difficult to understand the topic of the basic laws of chemistry with the guided discovery learning model → he reinforcement phase was not maximized → test scores are not maximized
xi_g_16	• Interest in learning chemistry only because of teacher influence • Prefer physics and math which are more calculating • Busyness outside of class hours (extracurricular 2x a week and math tutoring 2x a week) so that learning for chemistry tests is not optimal
xi_g_25	• Has a high interest in learning chemistry • Interest decreased slightly because it was difficult to understand the topic of basic laws of chemistry with the guided discovery learning model → prefer conventional models • Test scores are less than optimal because they have not fully understood the material
xi_g_28	• High interest in learning science, especially physics and chemistry • Prefer conventional models • Difficulty with the guided discovery learning model so that it has not fully understood even though it has been given reinforcement →test scores are not optimal
xi_g_1	• Have a high interest in learning in the field of science, especially chemistry • Likes calculation materials such as math, physics, and chemistry • Sometimes less careful when doing tests so that the value is not maximized even though it meets the KKTP
xi_g_18	• Have a high interest in chemistry • Want to study chemical engineering so that they try to study physics and chemistry more vigorously • High curiosity so that it fits with the guided discovery learning model

CONCLUSION

The average interest in learning chemistry is 96.13 (75%). The interest indicator with the highest score is "Students' attitude towards the assigned task" (81%). The interest indicator with the lowest score is "Awareness of learning chemistry independently" (47%). The lowest chemistry learning interest lies in the "Moderate" category while the highest chemistry learning interest lies in the "Very high" category. The average knowledge dimension learning outcome is 54.67 with the highest and lowest scores being 8 and 100 respectively. There were only 5 students who scored above the KKTP while the remaining 40 students scored below the KKTP. The highest attitude dimension learning outcome with a score of 78%

was at the A1 level (accept) and was most closely followed by the A3 level (appreciate) with a score of 76%. The measured skill dimension learning outcome is critical thinking skills with 33 out of 45 students still in the "Very Poor" category. High learning interest is not always accompanied by high learning outcomes. The results of interviews with several students show that there are various factors that cause low learning outcomes even though they admit that they really have a high interest in learning chemistry.

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