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Analysis of Student Motivation and Learning Outcomes Using Kahoot Assisted PjBL and IBL on Hydrocarbons

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Abstract: *Low student motivation and learning outcomes regarding the topic of hydrocarbons stem from a lack of instructional variety and minimal use of interactive media. This study aimed to analyze differences in student motivation and learning outcomes between the PjBL and IBL models both supported by kahoot and to examine the relationship between motivation and learning outcomes in both models. A quantitative method with a quasi-experimental design was employed. The sample consisted of 68 Grade XI students from MAN 1 Medan, selected via purposive sampling and divided into two experimental classes. Data were collected using motivation questionnaires and learning outcome tests administered before and after instruction. Data analysis involved the Shapiro-Wilk test, Levene's test, the Independent Samples t-test, and Pearson Product Moment correlation at α = 0,05. The results revealed significant differences in motivation between the PjBL and IBL classes (p = 0,025; effect size d = 0,56) and in learning outcomes (p < 0,001; effect size d = 0,97). Positive and significant relationships were found between motivation and learning outcomes in both the PjBL class (r = 0,371; p = 0,031) and the IBL class (r = 0,345; p = 0,045) during kahoot assisted hydrocarbon instruction.*

Keywords: *Project based learning; inquiry based learning; kahoot; learning motivation; learning outcomes*

INTRODUCTION

Education plays an important role in developing human resources. In chemistry learning, students often struggle to grasp abstract concepts, particularly regarding hydrocarbons a topic that encompasses molecular structures, carbon chains, and compound nomenclature. The complexity of this subject matter leads to low student motivation and poor learning outcomes (Ardhani & Kristin, 2023). Apart from that, 21st century learning requires 4C skills, namely critical thinking, creativity, collaboration, communication, so active and collaborative learning is needed. However, some students are still passive, not confident, and have difficulty understanding the concept of hydrocarbons (Ujud et al., 2023). Student learning mastery in chemistry remains low; for instance, Batubara et al. (2024) reported a mastery rate of 48,5%, while instruction tends to be dominated by conventional methods. (Batubara et al., 2022).

Interviews with chemistry teachers at MAN 1 Medan revealed that while cooperative learning and problem based

learning models are used for the hydrocarbons unit, their implementation has been inconsistent. The instructional media employed are limited to PowerPoint presentations and educational videos, failing to optimally foster student engagement. Observations indicated that approximately 70% of students did not meet the established mastery threshold (KKTP) of 77. Furthermore, students tended to be passive, lacked the confidence to ask questions, and rarely participated in discussions. These conditions highlight the need for a more interactive, student centered approach that utilizes learning models capable of boosting motivation and improving learning outcomes.

One learning model considesred capable of enhancing student engagement is Project Based Learning. This model fosters creativity, collaboration, and conceptual understanding through project based activities (Fajariyanti et al., 2022). Fidela et al (2024), It is stated that this learning model is capable of engaging students and helping them grasp learning concepts. Through project based, students are trained to collaborate and solve problems, thereby boosting motivation and improving learning outcomes (Fidela et al., 2024). In addition, PjBL encompasses cognitive, affective, and behavioral learning outcomes, as well as the quality of the project products produced by students (Guo et al., 2020). Furthermore, Bayani et al (2024), demonstrated that the PjBL model can enhance motivation and chemistry learning outcomes, with a value of 0,69 and a instructional effectiveness of 83% (Bayani et al., 2024).

The IBL model can also help learners discover concepts independently through the processes of inquiry and problem solving (Gunawan et al., 2025). IBL places emphasis on discovering knowledge through observation and problem solving, thereby supporting scientific thinking and conceptual understanding (Manihuruk et al., 2025). The inquiry approach also cultivates scientific thinking processes, ranging from formulating questions and conducting investigations to drawing conclusions (Afiyah & Zulkarnaen, 2025). This approach is considered highly suitable for chemistry learning because it is capable of fostering students' science process skills (Sutiani & Fayadah, 2021).

The implementation of both models can be supported by interactive learning tools such as kahoot. Kahoot is a gamification based, interactive quiz platform that can boost student engagement in chemistry lessons through a point system, leaderboards, and a learning atmosphere that is both competitive and fun (Iman et al., 2021; Karmina & Dewi, 2025). Furthermore, the use of kahoot can transform learning into a student centered process, thereby significantly increasing learning motivation (Pitriani et al., 2024). Hasanah & Suciani (2025), demonstrate that the use of kahoot increased students' learning motivation from an average of 40% to 72%, thereby encouraging active student participation in the learning process (Hasanah & Suciani, 2025). An inquiry model supported by kahoot can improve student learning outcomes (Harianja et al., 2025).

PjBL emphasizes product creation through collaborative projects, whereas IBL focuses on the inquiry process to develop students' analytical and scientific thinking skills. Both approaches hold great potential for application to the subject of hydrocarbons; however, research combining or comparing the two within this specific topic remains limited (Kencana & Rifa'i, 2022). Learning motivation is a psychological factor that drives, stemming from both internal impulses such as the desire for personal growth and external factors, such as the surrounding environment (Panggabean et al., 2022). Low learning motivation can result in students being less active in asking questions, seeking information, and developing knowledge through the process of inquiry (Marliani, 2021). This condition can also hinder the

connection between prior knowledge and new information, resulting in a conceptual understanding that lacks depth and is easily forgotten (Irawan et al., 2023).

Based on the foregoing, this study was conducted to analyze differences in student motivation and learning outcomes between the implementation of the PjBL and IBL learning models both supported by kahoot media regarding the topic of hydrocarbons, as well as to analyze the relationship motivation and learning outcomes in each experimental class.

LITERATURE REVIEW

Project Based Learning Model

Project Based Learning is an instructional approach in which students acquire knowledge through the completion of a structured project (Purba et al., 2023). The PjBL syntax consists of six stages: (1) essential question, (2) project planning, (3) schedule creation, (4) project completion with teacher monitoring, (5) project presentation, and (6) project evaluation (Zahra & Yasin, 2024). PjBL offers advantages in fostering student engagement, enhancing problem solving skills, and cultivating responsibility and independent learning among students (Sinaga & Sagala, 2021). However, this model also has drawbacks, it is time consuming, not all teachers are prepared to abandon conventional teaching methods, it demands a high level of teacher readiness, and there are resource limitations (Purwanti & Yuliastuti, 2023).

Inquiry Based Learning Model

Inquiry Based Learning is a learning model that the process of inquiry to gain understanding through structured, critical, logical, and analytical activities (Karmila et al., 2020). The IBL process consists of six stages: orientation, problem formulation, hypothesis formulation, data collection, hypothesis testing, and conclusion drawing (Depin et al., 2024). The inquiry process can foster higher order thinking skills, independence, critical thinking, and conceptual understanding, as well as student motivation and engagement (Panggabean et al., 2024). This model enables students to be more active during learning, which can boost learning motivation (Siregar, 2024). The process is comprehensively useful for stimulating critical thinking skills and integrating concrete experience with theoretical knowledge (Dezola et al., 2023). IBL offers advantages in enhancing critical thinking skills, conceptual understanding, and independence. However, the model also has drawbacks: it requires more time and effective teacher guidance, and it can lead to difficulties or confusion for students if the inquiry process is not well directed (Handrini et al., 2025).

Kahoot

Kahoot is an internet based learning tool that offers interactive quizzes through features such as games, quizzes, discussions, and surveys. Its use can foster learning innovation and student engagement in the use of technology (Inayah et al., 2021). The process of using kahoot involves creating a quiz, setting time limits and scoring, adding images or answer choices, and then sharing the access code with students. Once the quiz is completed, kahoot displays the students' results and scores (Bunyamin et al., 2020).

Motivation to Learn

Learning motivation is the drive that compels a person to engage in a learning activity (Tristiana & Rusnilawati, 2024). Effective motivation can encourage students to be more active and diligent, and to strive to understand the material, thereby supporting their learning achievements (Purba et al., 2022). Learning motivation encompasses both intrinsic and extrinsic factors. Intrinsic motivation relates to interest, curiosity, and personal satisfaction in learning, whereas extrinsic motivation is influenced by external factors such as rewards, support, and a conducive learning environment (Widad et al., 2022). In this study, student motivation was assessed using six indicators: desire and aspiration for success, learning drive and need, future hopes and goals, appreciation of learning, engagement in learning activities,

and a conducive learning environment (Syachtiyani & Trisnawati, 2021).

Learning outcomes

Learning outcomes represent the level of student achievement following the learning process, in accordance with established educational objectives (Mahmudi et al., 2022). Learning outcomes indicate the extent to which educational objectives have been achieved, encompassing knowledge, understanding, and the ability to apply the material that has been learned (Ricardo & Meilani, 2017). Learning outcomes are influenced by 2 factors: factors internal and external (Panggabean et al., 2023).

METHODS

Research Location

This research was conducted at MAN 1 Medan, located at Jalan Williem Iskandar No. 7B, Medan Tembung District, North Sumatra Province.

Population and Sample

Research Population

The population comprised 360 Grade XI students in the 2025/2026 academic year, distributed across 12 classes at MAN 1 Medan.

Research Sample

The sample was selected using a purposive sampling technique, taking into account the comparability of class characteristics based on academic information provided by the school, the same teacher, class availability for the study, and the alignment of the lesson schedule with the research implementation. Two classes were selected: Class XI-10 Science B-4 (34 students) as Experimental Class I using PjBL, and Class XI-3 Science A-1 (34 students) as Experimental Class II using IBL. Thus, the total sample comprised 68 students.

Desain Penelitian

This study is a quantitative, quasi-experimental approach with a two-group pretest-posttest design. This design was selected because the study involved pre-existing classes, meaning the researcher did not randomly assign individuals to the research groups. The research design is shown in Table 1.

Table 1. Two Group Pretest-Posttest Research Design

Class	Initial Test *(Pretest)*	Treatment	Final Test *(Posttest)*
Experiment I (PjBL)	P_1	X_1	P_2
Experimen II (IBL)	P_1	X_2	P_2

Research Variables

The independent variables were the PjBL and IBL learning models, while learning outcomes constituted the dependent variable. Control variables include the subject matter, textbooks, teachers, instructional time, and the test and non test instruments employed. Additionally, learning motivation was measured, and its relationship with student learning outcomes was analyzed using the pearson product moment correlation test.

Data collection technique

Data collection in this study utilized a test instrument comprising 40 items. Following validity testing, 24 items were deemed valid; subsequently, 20 items were selected for use in the study based on considerations of difficulty level and discrimination power. The reliability of the test instrument fell into the very high category, with a coefficient of 0,8689. The non test instrument, a learning motivation questionnaire, consists of 25 statements using a 1-5 Likert scale covering the following indicators: (1) desire for success; (2) learning needs; (3) aspirations and goals; (4) appreciation in learning; (5) engaging activities; and (6) a conducive learning environment. The questionnaire instrument underwent expert validation. Data collection involved administering a pretest and an initial motivation questionnaire prior to the intervention. The instructional intervention spanned three sessions, totaling 240 minutes

(6 x 40 minutes). Following the instruction, students completed a posttest and a final motivation questionnaire.

Kahoot was used as a tool for evaluation and learning reinforcement in both classes. It was employed at the end of the lesson to assess students' understanding of the hydrocarbon material through interactively presented questions. Thus, kahoot was utilized consistently across both the PjBL and IBL classes, ensuring that the primary difference in treatment lay in the specific learning models applied.

Data Analysis

Normality Test

Normality tests are used to determine whether data are normally distributed. In this study, the Shapiro-Wilk test was employed using SPSS 26.0 at a significance level of 5% (0,05). Data are considered normally distributed if the significance value (sig) is greater than α (0,05); conversely, if the significance value is less than α (0,05), the data are not normally distributed. Normality tests were conducted on the initial and final motivation data, as well as the pretest and posttest data.

Homogeneity Test

A homogeneity test is used to determine the level of data homogeneity. In this study, Levene's test is employed at a significance level of 5% (0,05). Data are considered homogeneous if the significance value (sig) is greater than α (0,05); conversely, if the significance value is less than α (0,05), the data are considered non-homogeneous. The homogeneity test is conducted on the initial and final motivation data, as well as the pretest and posttest data.

Hypothesis Testing

The data analysis method used for hypothesis testing was the Independent Sample T-Test at a 5% significance level. This analysis compares student motivation and learning outcomes between the two instructional classes based on their post-test results. The relationship between learning motivation and learning outcomes was subsequently examined using Pearson's correlation at the 5% significance level.

RESULT AND DISCUSSION

Learning Motivation Data

Student learning motivation was assessed by administering initial and final motivation questionnaires to the students. Data regarding the initial and final motivation results for Experimental I and II are presented in Table 2.

Table 2. Data on Learning Motivation Results for Experimental Classes I (PjBL) and II (IBL)

Class	Average Initial Motivation	Average Final Motivation
Experiment I (PjBL)	71,24	100,85
Experiment II (IBL)	69,56	95,59

Regarding the learning motivation data, the average initial motivation for Experimental Class I (taught using the PjBL model) was 71,24, while the final motivation was 100,85. Meanwhile, the average initial motivation for Experimental Class II (using the IBL model) was 69,56, and the final motivation was 95,59. Students in the PjBL class achieved higher average motivation scores compared to students in the IBL class.

Learning Outcome Data

Student learning outcomes were assessed by administering pretests and posttests. The pretest and posttest data for Experimental Class I and Experimental Class II are presented in Table 3.

Table 3. Learning Outcome Data for Experimental Classes I (PjBL) and II (IBL)

Class	Pretest Average	Posttest Average
Experiment I (PjBL)	34,41	82,50
Experiment II (IBL)	33,53	74,85

Based on the research findings, the average learning outcome scores for Experimental Class I taught using the PjBL model were 34,41 for the pretest and 82,50 for

the posttest. Meanwhile, the average scores for Experimental Class II taught using the IBL model were 33,53 for the pretest and 74,85 for the posttest. Higher average learning outcomes were also achieved in the PjBL class compared to the IBL class.

Analysis of Research Data

To ensure the research data is suitable for parametric testing, tests for normality and homogeneity, as well as hypothesis testing, were conducted. Data analysis was performed using SPSS 26.

Normality Test

The Shapiro-Wilk results showed significance values above 0.05 for the initial and final motivation data and for the pretest and posttest learning-outcome data in both classes. These results indicate that the datasets met the normality assumption required for the subsequent parametric analyses.The results of the normality test are presented in Table 4.

Table 4. Shapiro-Wilk Normality Test Results for Experimental Classes I (PjBL) and II (IBL)

Class	Data	Shapiro-Wilk Sig.	α	Description
Experiment I (PjBL)	Initial Motivation	0,191	0,05	Normally Distributed
	Final Motivation	0,112	0,05	Normally Distributed
	Pretest	0,064	0,05	Normally Distributed
	Posttest	0,074	0,05	Normally Distributed
Experiment II (IBL)	Initial Motivation	0,258	0,05	Normally Distributed
	Final Motivation	0,214	0,05	Normally Distributed
	Pretest	0,170	0,05	Normally Distributed
	Posttest	0,137	0,05	Normally Distributed

Homogeneity Test

Levene's test produced significance values of 0,483 for initial motivation, 0,653 for final motivation, 0,680 for the pretest, and 0,166 for the posttest. Because all values exceeded 0,05, the datasets were considered homogeneous, indicating comparable variance between the two experimental classes. The results of the homogeneity test are presented in Table 5.

Data	Levene Test Statistic Sig.	α	Description
Initial Motivation	0,483	0,05	Homogeneous
Final Motivation	0,653	0,05	Homogeneous
Learning Outcome Pre-test	0,680	0,05	Homogeneous
Learning Outcome Post-test	0,166	0,05	Homogeneous

Tabel 5. Hasil Uji Homogenitas Levene's test Kelas Eksperimen I (PjBL) dan II (IBL)

Hypothesis Testing

Once it is known that the data is normally distributed and homogeneous, a hypothesis test can be conducted. The hypothesis test is carried out using an Independent sample t-test at a significance level of α (0,05). If the results obtained are sig. < α (0,05) then H_a is accepted and H_0 is rejected, and vice versa, if the results sig. > α (0,05) Therefore, H_a is rejected and H_0 is accepted. Hypothesis testing was also carried out using the Pearson Correlation test at a significance level of α (0,05). If the results obtained sig. < α (0,05) then H_a is accepted and H_0 is rejected, and vice versa, if the results sig. > α (0,05) Therefore, H_a is rejected and H_0 is accepted.

Differences in Learning Motivation between PjBL and IBL Models

whether the two kahoot-assisted learning models produced different levels of student motivation. The PjBL class obtained a

mean final motivation score of 100,85, while the IBL class obtained 95,59. The significance value was 0,025, which is below 0,05. Therefore, the analysis indicates a statistically significant difference in final learning motivation between the two experimental classes.

Table 6. Results of Hypothesis Testing on the Difference in Learning Motivation between Experimental Class I (PjBL) and Class II (IBL)

Class	Pearson Correlation	Sig. (2-tailed)	Description
Experiment I (PjBL)	0,371	0,031	Ha accepted
Experiment II (IBL)	0,345	0,045	Ha accepted

Differences in Learning Outcomes between PjBL and IBL Models

The second hypothesis addressed differences in learning outcomes between the kahoot-assisted PjBL and IBL classes. The PjBL class recorded a mean posttest score of 82,50, compared with 74,85 in the IBL class. The significance value was 0,001, below the 0,05 criterion, indicating a statistically significant difference in learning outcomes between the two groups. The statistical findings are summarized in Table 7.

Table 7. Results of Hypothesis Testing on the Difference in Learning Outcomes between Experimental Class I (PjBL) and Class II (IBL)

Data	Class	Mean	Std. Deviation	Sig. (2-tailed	α	Description
Learning outcomes	Experiment I (PjBL)	82,50	6,990	0,001	0,05	Ha accepted
	Experiment II (IBL)	74,85	8,746	0,001	0,05	Ha accepted

The Relationship Between Motivation and Learning Outcomes in PjBL and IBL Models

The third hypothesis examined the association between learning motivation and learning outcomes in each experimental class. In the PjBL class, the Pearson correlation coefficient was 0,371 with p = 0,031. In the IBL class, the coefficient was 0,345 with p = 0,045. Both p-values are below 0,05, indicating statistically significant positive relationships between motivation and learning outcomes in the respective classes.

Table 8. Hypothesis Test Results Regarding the Relationship between Learning Motivation and Learning Outcomes in Experimental Classes I (PjBL) and II (IBL)

Data	Class	Mean	Std. Deviation	Sig. (2-tailed	α	Description
Learning Motivation	Experiment I (PjBL)	100,85	9,212	0,025	0,05	Ha accepted
	Experiment II (IBL)	95,59	9,711	0,025	0,05	Ha accepted

The correlation analysis results for Experimental Class I showed a significance value of 0,031 < α (0,05), leading to the acceptance of H_a. Similarly, experimental Class II showed a correlation with a significance value of 0,045 < α (0,05), meaning H_a was accepted and H_0 was rejected. It can be concluded that there is a significant correlation between learning motivation and learning outcomes when using the Project Based Learning and Inquiry Based Learning models.

Discussion

The analysis showed a difference in final learning motivation between the two classes. The PjBL class obtained a mean score of 100,85, whereas the IBL class obtained 95,59, with p = 0,025. In the context of this study, the higher motivation score in the PjBL class may be related to the characteristics of project activities, which require students to work directly on tasks, collaborate, and present products. These activities can provide concrete learning experiences and opportunities for active participation. The result is consistent with Indriyati et al. (2024), who reported that PjBL implementation increased student learning motivation from 68,95% to 76,97% (Indriyati et al., 2024).

The mean posttest score was 82,50 in the PjBL class and 74.85 in the IBL class, with p = 0,001. This result indicates a statistically significant difference in learning outcomes between the two groups. The finding is consistent with Septiantoko and Muhsinatun (2019), who reported differences in learning outcomes between PjBL and Inquiry based learning (Septiantoko &

Muhsinatun, 2019), and with research by Mardiana et al. (2024), which found that PjBL could produce higher learning outcomes than IBL (Mardiana et al., 2024).

Regarding the third hypothesis, a significant relationship was found between learning motivation and learning outcomes in both classes. In the PjBL class, a significance value of 0,031 and a correlation coefficient of 0,371 were obtained, whereas in the IBL class, the significance value was 0,045 with a correlation coefficient of 0,345. The correlation coefficients in both classes indicate a relationship of low strength. This means that students with higher learning motivation tend to achieve better learning outcomes; however, this relationship does not indicate that motivation directly causes an improvement in learning outcomes. The results indicate that for both classes, the sig. < α (0,05), therefore H_a is accepted and H_0 is rejected. Furthermore, other studies indicate that the PjBL model has a significant influence on students' motivation and learning outcomes. The research results show a significance value of 0,039. The results indicate that the value, the sig. < α (0,05), therefore H_a is accepted and H_0 is rejected. This means that the PjBL model is related to both learning motivation and learning outcomes (Dyah & Suryanti, 2023).

Based on the research findings, it can be concluded that the kahoot assisted PjBL experimental class demonstrated higher average levels of motivation and learning outcomes compared to the kahoot assisted IBL class in the context of learning about hydrocarbons. This can be attributed to project activities, discussions, presentations, and problem solving tasks that provided students with opportunities for active and collaborative engagement. Meanwhile, IBL emphasizes the processes of inquiry and hypothesis testing. Furthermore, there is a positive and significant relationship between motivation and learning outcomes in both the PjBL (r = 0,371; p = 0,031) and IBL (r = 0,345; p = 0,045) classes, although the strength of the relationship is low. These findings align with Prihatin et al. (2024), who stated that the improvement in the PjBL class was greater than in the IBL class, in terms of both student engagement and learning outcomes (Prihatin et al., 2024). Projec Based Learning (PjBL) is highly suitable for chemistry instruction because it helps students understand abstract concepts in a more concrete way (Panggabean et al., 2024).

These findings indicate that the learning models implemented in the two classes resulted in significant differences in student learning outcomes. Learning models that link course material to students' activities and learning experiences such as project based activitie can foster student engagement and active participation in the learning process. In this study, the PjBL class demonstrated higher average learning outcomes compared to the IBL class.

In addition to statistical significance, the magnitude of the difference between classes was analyzed using Cohen's d. The differences in learning motivation between the PjBL and IBL groups yielded Cohen's d values of approximately 0,56 for motivation and 0,97 for learning outcomes. These values indicate that the difference between the PjBL and IBL classes represents an effect size worthy of consideration; consequently, the interpretation of the research findings is based not only on statistical significance but also on the magnitude of the difference observed between the classes.

CONCLUSION

The study identified a statistically significant difference in learning motivation between the PjBL and Kahoot-assisted IBL classes on hydrocarbon material (p = 0,025). The PjBL class also obtained a higher mean posttest score (82,50) than the IBL class (74,85), with the difference being statistically significant (p = 0,001). A significant positive relationship was found between learning motivation and learning outcomes in both groups. The Pearson correlation coefficient was 0,371 (p = 0,031)

in the PjBL class and 0,345 (p = 0,045) in the IBL class.

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