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# Differences in Junior High School Students' Motivation to Learn Science in Guided Inquiry and Conventional Learning: Analysis Based on the ARCS Model

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**ABSTRACT**

The purpose of this study is to determine whether there are differences in the motivation for learning science between students that are taught using the guided inquiry method and students that are taught using the conventional method, particularly in the subject of Substances and Their Changes. Learning motivation was observed using the ARCS framework, which examines four aspects: Attention, Relevance, Confidence, and Satisfaction. A total of 24 students were placed in the experimental group that applied guided inquiry learning, while the other 24 students were placed in the control group that was taught using conventional methods. The results show that the experimental group's motivation to learn was significantly higher than the learning group's. All aspects of ARCS also showed significant differences. The aspect of satisfaction showed the greatest improvement, followed by confidence, relevance, and attention. It can be concluded that the application of guided inquiry has been proven to increase motivation in learning science, especially in fostering student satisfaction and confidence.



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## 1. Introduction

Science studies at the junior high school level hold an important position in the development of scientific understanding and reasoning skills among students. However, many research projects show that enthusiasm for learning science among Indonesian students remains a challenge that requires serious attention (Gomez,


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2025). Learning motivation is an element that influences success in learning. Motivation acts as an internal drive that encourages students to actively participate in the learning process and maintain resilience when facing challenges in understanding (Ishida & Sekiyama, 2024). In the context of science learning, motivation not only affects the intensity of student engagement, but also the quality of scientific thinking processes and learning outcomes (Kubsch *et al.*, 2021). Students with high learning motivation show greater dedication in completing complex challenges, improve their analytical skills, and gain a deeper understanding of concepts (Valenzuela *et al.*, 2024). Therefore, building and maintaining motivation to learn is important in the process of effective science learning. Although learning motivation plays a crucial role, low motivation to learn science remains a serious and unresolved challenge. The results of the Programme for International Student Assessment (PISA) 2022 show that Indonesia's literacy score is 383, ranking 67th out of 81 countries and below the OECD average of 485 points (OECD, 2023). The low results indicate fundamental problems in science education in Indonesia. Teaching that is dominated by a teacher-centred approach, with methods that focus on transferring information and memorising concepts without direct student involvement, has an impact on low intrinsic motivation among students (Dah et al., 2024). This situation resulted in students losing interest in investigating phenomena in depth, lacking confidence in completing tasks, and feeling dissatisfied with the learning process.

To conduct an analysis of all factors related to learning motivation ARCS model: *Attention, Relevance, Confidence, Satisfaction*) designed by John Keller in 1987 offers a structured theoretical framework that has been proven through research. The ARCS model consists of four main interconnected elements: (1) Attention focuses on how to increase and maintain student's focus through perceptual stimulation, questions, and activity variation; (2) Relevance is related to how students see the relationship between the material and their own needs, goals, and experiences; (3) *Confidence* relates to student's belief that they can achieve success through their efforts; (4) *Satisfaction* reflects the satisfaction students feel from the learning process, both intrinsic (internal) and extrinsic (external) (Keller, 1987). The ARCS model has been proven effective in identifying and improving various aspects of learning motivation in science education (Li & Keller, 2018). This model has been successfully applied in various learning contexts in Indonesia, including online learning and educational technology. Mirzaei *et al.* (2024), making it highly relevant for use in analysing motivation in science education in Indonesia.

Guided inquiry learning is a method that has the potential to address the issue of low motivation in science learning among students. Guided inquiry makes students active individuals who are involved in the scientific research process with regular guidance from teachers, providing opportunities for students to build conceptual understanding through direct experience (Setiawan *et al.*, 2023). This model combines the phases of scientific inquiry, including problem identification, hypothesis development, research planning, information gathering and analysis, and conclusion drawing, into structured learning activities that still provide opportunities for students to think independently (Faizin *et al.*, 2024). Recent research in Indonesia shows that guided inquiry learning models are effective in improving critical thinking skills. (Drastisianti *et al.*, 2024), improving pupils' scientific literacy (Faizin *et al*., 2024), and science process skills of secondary school students (Karlina *et al*., 2024).

In the context of the ARCS model, guided inquiry has characteristics that are in line with the four components of motivation: the orientation phase, with contextual phenomena arousing attention, investigation of authentic problems increases relevance, gradual guidance builds confidence, and achievement through self-discovery in investigation produces satisfaction (Januarti & Muliyadi, 2024). However, research specifically exploring how guided inquiry deeply influences the four components of ARCS in the subject of Matter and Its Changes at the junior high school level is still very limited, creating a research gap that needs to be filled. Previous studies have shown the effectiveness of guided inquiry learning in improving various aspects of science learning in Indonesia. Research Hafitria & Efwinda (2024), shows that STEM project-based learning effectively improves junior high school students' learning outcomes and science process skills on the topic of global warming. Drastisianti *et al*. (2024) also found demonstrating that guided inquiry with media stimulation pHet successfully increases the capacity for critical analysis and comprehension of the reaction rate concept.

Research Faizin *et al*. (2024) confirming that guided inquiry can improve the science literacy skills of secondary school students. However, a systematic review by Muchson *et al*. (2024) An analysis of 287 science education research articles in Indonesia from 2000 to 2020 revealed that the majority of studies still focus on cognitive aspects such as critical thinking and learning outcomes, while research exploring the impact on affective aspects, particularly learning motivation, remains very limited. Studi Januarti & Muliyadi, (2024) which discusses learning innovation by tending to measure learning motivation in general without analysing the specific components that form motivation. This gap indicates the need for research that explores in depth how guided inquiry can influence learning motivation according to ARCS components in the context of science learning in junior high school. Matter and its changes is one of the basic competencies in the Grade VII junior high school science curriculum, which has unique characteristics for guided inquiry implementation. Based on an analysis of the independent curriculum by Sari *et al*. (2022), Matter and its changes involve basic ideas such as the characteristics of matter, physical and chemical changes, and ways of separating mixtures, which may seem abstract but have real-world applications in pupils' everyday activities.

The Merdeka Curriculum, which has been implemented since 2021, highlights the importance of developing science skills through investigative activities such as observing, asking questions, making predictions, designing, conducting investigations analysing information, and presenting results Sari *et al*. (2022) which is in line with the characteristics of guided inquiry learning. The topic of Substances and Their Changes is well-suited to inquiry-based learning because it provides opportunities for pupils to conduct hands-on experiments with familiar phenomena, such as mixing substances, dissolving, changing form, and basic reactions in the context of everyday life (Rahmayumita *et al*., 2024). Learning that integrates authentic phenomena into this material has the potential to increase the relevance of learning for students, which can increase student motivation to learn. Tyas *et al*. (2024). However, the reality in schools is still dominated by lecture-style teaching and teacher demonstrations, resulting in minimal opportunities for students to explore independently (Yusnidar *et al*., 2024). As a result, the potential for developing student motivation is not being optimally utilised.

Based on a review of the literature, there are several research gaps that have been filled. Although there has been a lot of research on the effectiveness of guided inquiry in Indonesia, there has been little research that specifically analyzes its impact on learning motivation (Muchson *et al.*, 2024). Most studies still focus on cognitive aspects such as learning outcomes, conceptual understanding, and thinking skills. In-depth research on affective aspects, particularly motivation, has not received adequate attention. Existing research on motivation tends to measure motivation as a single construct without analyzing the specific components that constitute it (Januarti & Muliyadi, 2024). Understanding each indicator's *attention, relevance, confidence, satisfaction* separately is crucial for creating effective learning interventions. There is still very little material that examines learning motivation through guided inquiry models, even though this topic has characteristics that support inquiry-based learning (Rahmayumita *et al.*, 2024). In the context of implementing an independent curriculum that emphasizes the importance of inquiry-based learning and focuses on students (Sari *et al.*, 2022), empirical research on how methods impact student motivation is important. Therefore, this study is expected to contribute theoretically to deepening the study of the relationship between guided inquiry learning and learning motivation based on ARCS indicators, as well as offering practical contributions to science teachers in designing learning that not only improves cognitive aspects but also increases student learning motivation through the four ARCS elements. Based on the identified background, this study aims to analyze the differences in learning motivation among students who participate in conventional learning on the subject of substances and their changes in the seventh grade of junior high school, as reviewed from Keller's ARCS indicators.

## 2. Method

This study used a quasi-experimental design with a posttest-only control group design. Two complete classes of seventh-grade students were selected as the experimental group, which received guided inquiry learning, and the control group, which received conventional learning. Learning motivation was measured once at the end of the learning process using an ARCS-based questionnaire. The study was conducted at a private secondary school in Surabaya, Indonesia, in November 2025. The research subjects included all Year 7 students studying the topic of Substances and Their Changes. Purposive sampling was used to select two classes based on academic equivalence and teacher readiness to implement guided inquiry learning. The sample consisted of 48 students: Class VII-A served as the experimental group (n=24) and Class VII-B as the control group (n=24). Analysis of the previous semester's report card scores demonstrating that there is no significant difference between the two groups ($p > 0.05$) that indicates the existence of academic equivalence. None of the students in the sample had special needs or physical limitations that could affect their participation in learning activities at the beginning of the school year.

Student learning motivation was measured using a questionnaire adapted from the Course Interest Survey (CIS) developed by Keller (2010) and validated in the context of science learning in Indonesia. The motivation instrument was designed based on the ARCS model, which measures four indicators of learning motivation, namely *Attention*, *Relevance*, *Confidence*, and *Satisfaction*. The questionnaire consisted of 20 statements divided equally to measure the four indicators, with each indicator measured by five statements. To avoid biased responses, each dimension included a mixture of positive and negative statements.

**Table 1.** Structure of Learning Motivation Questionnaire Based on ARCS Model

| Indicator | Item Number | | Total Item |
|---|---|---|---|
| | Positive (+) | Negative (-) | |
| *Attentin* | 1, 2, 5 | 3, 4 | 5 |
| *Relevance* | 6, 9, 10 | 7, 8 | 5 |
| *Convidence* | 11, 15 | 12, 13, 14 | 5 |
| *Satisfaction* | 17, 18, 19 | 16, 20 | 5 |

Students' responses to each statement were assessed using a 4-point Likert scale. For positive statements, The assessment was carried out as follows: Strongly Agree (SS) received a score of four, Agree (S) received a score of three, Disagree (TS) received a score of two, and Strongly Disagree (STS) received a score of one.. Conversely, for negative statements, the values were reversed, namely: VS=1, S=2, DS=3, and VS=4. Thus, the range of scores that each student could achieve was between 20 (lowest score) and 80 (highest score). Learning in the experimental group was designed to follow the guided inquiry stages. This model consists of six main phases according to Ramadhana & Muchlis (2022) In the first phase, teachers provide students with an overview and motivation, as well as learning objectives. Activities carried out by students in this phase include listening to the teacher's explanations and giving their opinions. In phase 2, teachers guide students in formulating problems that are relevant to phenomena or issues. In phase 3, students are asked to formulate tentative answers to explain a problem. Teachers in this phase train critical thinking skills in the components of inference and interpretation. In phase 4, students collect data by conducting experiments. The purpose of these experiments is for students to be able to clearly prove their tentative answers, have direct learning experiences, and solve problems using scientific methods.

Learning in the control group was conducted using a more teacher-centred conventional approach. Learning began with a lecture in which the teacher explained concepts related to matter and its changes. The explanation was accompanied by examples from everyday life. After the teacher's lecture, there was a question-and-answer session led by the teacher. In this session, the teacher asked questions to the students to gauge their understanding, and the students were allowed to ask questions. The teacher also conducted several simple demonstrations to show examples of physical and chemical changes, such as melting ice and burning paper. Although there were interactive activities in this conventional learning, student involvement was still limited when compared to the experimental group. Students played more of a role as recipients of information than as discoverers. At the end of the second meeting, after the learning series had taken place, a learning motivation questionnaire was distributed to students in both classes. The questionnaire was completed individually within 10 minutes. The researcher provided a brief explanation on how to complete the questionnaire and ensured that all students understood each statement. The questionnaire data was then processed and statistically analysed.

The data obtained from the learning motivation questionnaire were analysed using two approaches, namely descriptive analysis and inferential analysis. The entire data analysis process was carried out using SPSS software version 24. Descriptive analysis aims to provide an overview of the learning motivation profile of students in each group. Several statistics are calculated, including the mean, median, standard deviation, highest score and lowest score for each aspect of ARCS as well as the total learning motivation score. Furthermore, to provide a more meaningful interpretation, motivation levels were categorised based on the percentage of the score obtained against the maximum score. The categorisation criteria used were adapted from the assessment guidelines Arikunto (2013),

**Table 2.** Percentage of Student Learning Motivation Categories

| Percentage | Category |
|---|---|
| 81% - 100% | Very high |
| 61% - 80% | High |
| 41% - 60% | Medium |
| 21% - 40% | Low |
| 0% - 20% | Very low |

This categorisation will help in understanding the distribution of learning motivation levels and provide a clear picture of the motivation profiles between the two groups. Inferential analysis was conducted to test the research hypothesis, namely to determine whether the difference in learning motivation between the experimental group and the control group was statistically significant. Before testing the hypothesis, the necessary statistical assumptions were tested. A normality test was conducted to examine whether the learning motivation data from both groups was normally distributed. Given that the sample size of each group was less than 50 (n=24), the most appropriate test was the Shapiro-Wilk test. The decision criterion was that the data were regarded as normally distributed if the obtained significance value (p-value) was higher than 0.05.

A homogeneity test was carried out to ascertain whether or not the variance in learning motivation data from both groups was homogeneous.. The test used was Levene's test. Similar to the normality test, if the significance value obtained was greater than 0.05, it could be concluded that the variance of both groups was homogeneous. The appropriate hypothesis test depends on the results of the prerequisite tests. If both assumptions of normality and homogeneity are met, then the hypothesis test performed is a parametric test, namely the independent sample t-test. However, if one or both assumptions are not met, then the test performed is non-parametric as an alternative, namely the Mann-Whitney U test.

Hypothesis testing was conducted not only on the total learning motivation score, but also on the scores for each ARCS aspect separately. This was done to identify which aspects of learning motivation differed between the two groups, thereby providing a more detailed understanding of the impact of guided inquiry learning on specific aspects of student learning motivation. In addition to the significance test, the effect size was also calculated using Cohen's d to measure the practical magnitude of the differences found. Cohen's d is calculated using the formula: $d = (M_1 - M_2) / Sd\text{pooled}$, with $SD\text{pooled} = \sqrt{[(SD_1^2 + SD_2^2) / 2]}$. Interpretation of Cohen's d values follows the guidelines (Cohen, 1988) : $d < 0.2$ indicates a small effect; $0.2 \leq d < 0.8$ indicates a moderate effect; and $d \geq 0.8$ indicates a large effect.

## 3. Results and Discussion

### Results

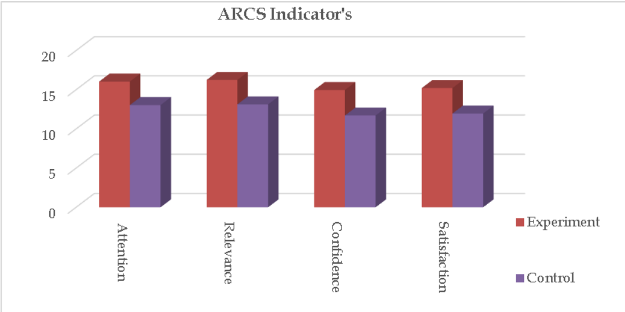
Table 2 presents a comparison of the two groups' total learning motivation levels. the group that received guided inquiry treatment was 62.46. Meanwhile, the group that used conventional learning obtained an average of 49.83. There was a difference of 12.63 points between the two averages, indicating that the learning motivation of students in the experimental group was statistically superior.

**Table 3.** Descriptive Statistics of Total Learning Motivation

| Group Class | N | Mean | Std. Dev | Mean |
|---|---|---|---|---|
| Experiment | 24 | 62.46 | 4.727 | .965 |
| Control | 24 | 49.83 | 6.438 | 1.314 |

Based on the analysis results, the experimental group obtained higher average scores in every aspect of ARCS. Among the four aspects, Relevance recorded the highest average score (M=16.25). This was followed in order by Attention with a score of 16.04, Satisfaction with a score of 15.21, and Confidence with a score of 14.96.

**Figure 1.** Motivation Questionnaire Results Based on Indicators




Based on the Shapiro-Wilk test, it can be concluded that the learning motivation data for both research groups met the normality assumption ($p > 0.05$). A complete summary of the normality test for each ARCS dimension and total score significance value the results obtained are 0.644 and 0.813, which means that the data is normally distributed. The variation of learning motivation data between the experimental and control groups is homogeneous, with a significance value ($p > 0.05$), according to testing using Levene's test. Analysis using an independent sample t-test revealed that there was a statistically significant difference in overall learning motivation between the two groups (t=7.744; p=0.000). The magnitude of the effect of the treatment, measured by Cohen's d, reached 2.237. This figure falls into the category of a very large effect size, so it can be concluded that the application of guided inquiry has a real and substantial effect on student learning motivation. Based on further testing of each aspect of the ARCS model, it can be concluded that there are significant differences between the two groups in all four components.

### Discussion

The results of the study show a significant difference in science learning motivation between students involved in guided inquiry-based learning and students in traditional learning environments (t=7.744, p=0.000, d=2.237). This difference is not only statistically relevant but also practically substantial, as emphasized by the very high effect size (Cohen's d=2.237). These findings are in line with recent analyses showing that well-organized guided inquiry-based learning results in improved cognitive and emotional learning outcomes compared to purely didactic or unguided methods (Jong et al., 2023). In the next section, we will discuss in depth how guided inquiry-based learning affects each element of the ARCS motivation model and the reasons behind its superior effectiveness compared to conventional teaching.

In the experimental group, the *attention* component showed a higher average value (R = 16.04) compared to the control group (R = 13.04), with a difference of 3.00 points (t = 5.142, p = 0.000). This proves that the guided inquiry learning method is successful in attracting and maintaining students' interest. According to the ARCS framework (Keller, 2010)Interest can be increased through three main tactics, namely sensory stimulation (stimulation through the senses), questioning stimulation (stimulation through investigation), and diversity (variation in activities). The guided inquiry learning method in this study combines these three tactics through the presentation of real events at the initial stage, investigative questions at the conceptualization stage, and different practical activities at the investigation stage. Conversely, conventional learning, which mostly involves lectures and demonstrations by teachers, tends to rely on extrinsic attention based on the teacher's presentation skills, without actively involving students in the learning process (Dah *et al*., 2024). A study by Dah *et al*. (2024) shows that inquiry-based learning, including open and guided inquiry, positively affects student motivation by involving them in a discovery process that triggers their natural curiosity. However, more recent research by Meulenbroeks et al. (2023) shows that guided inquiry learning should not only support the investigation process itself but also tasks such as operating equipment, so that students' attention remains focused on the research process and is not distracted by technical difficulties.

The relevance component showed a significant difference between the experimental group (M = 16.25) and the control group (M = 13.13), with a difference of 3.12 points (t = 5.396, p = 0.000). In fact, the relevance component received the highest score in the experimental group, indicating that guided inquiry-based learning is very effective in conveying to students the relevance of learning materials to everyday life. According to Keller (2010) relevance can be enhanced through goal orientation (connection to goals), motivational alignment (alignment with learning motives), and familiarity (use of familiar contexts). The guided inquiry-based learning approach used in this study focuses on authentic phenomena related to changes in matter that are closely related to students' daily experiences, such as cooking, baking, and changes in form. This context-based approach is in line with the findings. Photo (2025), which shows that effective inquiry-based learning begins with engaging students with familiar problems or phenomena and then helping them develop a more abstract understanding of the concepts involved. By directly investigating phenomena they experience every day, students not only understand the concepts of physical and chemical change theoretically but also experience the practical relevance of this knowledge. These findings are supported by Geraldine & Simmie (2024) which emphasizes the importance of authentic problems in inquiry-based learning. They argue that involving students in exploring problems that are personally or socially relevant leads to a deeper understanding of why science learning is important. In contrast, conventional learning, which teaches concepts deductively, starting with abstract definitions and then providing examples, tends to make it difficult for students to see the connection to real life. Although the control group teachers also provided contextual examples, the connection was not as strong as in inquiry-based learning, because teachers gave one-way instructions without the opportunity for students to explore on their own (Dah et al., 2024).

In terms of *confidence*, the experimental group had an average score of 14.96 points, while the control group had an average score of 11.71 points, a very significant difference (t=5.600, p=0.000, a difference of 3.25 points). These results indicate that guided inquiry-based learning effectively develops students' confidence in their ability to succeed in science learning. According to the self-efficacy theory Bandura, (1997) Self-confidence is built through four main sources: mastery experience (experience of success), vicarious experience (observation of others), social persuasion (social support), and physiological states (physiological and emotional conditions). It should be noted that although the experimental group had the lowest mean self-confidence score of the four ARCS components (M=14.96), the score was still much higher than all components in the control group. This means that fostering self-confidence in science learning requires a more focused approach than just reminders and ordinary connections. However, in this specific situation, guided inquiry learning is still more beneficial than conventional teaching methods.

The aspect of *satisfaction* showed the most significant comparison between the four ARCS elements, recording the highest t-value (t = 7.677, p = 0.000) and an average gap equivalent to the aspect of self-confidence (3.25 points). The group that underwent the experiment scored 15.21, while the control group only scored 11.96. This very high t-value indicates that excitement is the most effective motivational factor in different teaching methods. Keller (2010) That feeling of joy comes from the natural impact that is the result of proper learning, positive effects in the form of good benefits, and honest treatment, namely fairness and consistency. These results use Self-Determination Theory (SDT), which strongly emphasizes the crucial importance of freedom of action, self-efficacy, and a sense of ownership in generating intrinsic motivation and enjoyment in learning. Chiu, (2021) explains that when these three basic psychological needs are met, it will show how active students are in learning, where freedom gives control over the learning process, fosters a sense of being able to complete work, and encourages collaboration in groups and interaction with supportive teachers.

The experimental group derived great satisfaction from the process of discovering knowledge for themselves (intrinsic satisfaction), rather than simply accepting what the teacher told them. When the students successfully proved or disproved their hypotheses through experimentation, the sense of accomplishment they experienced was far more meaningful than when they simply listened to the teacher's explanations. A study by Aidoo et al. (2024) on motivation and learning strategies in digital inquiry learning found that student satisfaction with inquiry learning (*satisfaction*) was much higher when they participated in activities that explained ideas and applied scientific knowledge in a meaningful context, compared to simply conducting experiments without deep reflection. In this study, the discussion and presentation stages provided opportunities for students to express their understanding and receive recognition from teachers and peers, thereby reinforcing positive outcomes.

Conversely, conventional learning offers limited satisfaction because students lack self-confidence. They passively absorb information, and their satisfaction is more extrinsic through (good test results) than intrinsic. Research by Photo, (2025) shows that learning that does not offer students opportunities for self-discovery tends to lead to limited engagement and short-term satisfaction that is not sustainable. Overall, the research findings indicate that guided inquiry learning has a significant positive impact on all components of ARCS motivation. *Satisfaction* (t=7.677) > *Confidence* (t=5.600) > *Relevance* (t=5.396) > *Attention* (t=5.142) are the top impacts. This pattern provides important insights, such as the effectiveness of inquiry in determining students attention, satisfaction, and confidence. This shows that guided inquiry learning not only makes learning more effective, but it is also important in providing learning experiences that encourage self-improvement and intrinsic motivation. Recent research shows that guided inquiry learning, which involves learning with teacher guidance to find out and discover answers on one's own, is more effective than learning without any guidance or learning that involves too much lecturing. According to (Jong et al., 2023) dan Strat et al. (2024)), guided inquiry that emphasizes the use of evidence, examples, and logical reasoning helps students understand concepts better and makes them more motivated to learn.

Research by Lotter & Ramnarain (2025) shows that guided inquiry can still be effective even when conducted in schools with limited resources, as long as the tasks, learning materials, and guidance from teachers are well prepared. These findings indicate that this learning model can be realistically applied in schools in Indonesia, which often face limitations in facilities and teaching materials. According to research Meulenbroeks et al (2024) also discovered an important mechanism, namely that appropriate teacher support is needed not only in the process of thinking and inquiry, but also in practical matters, such as how to use learning tools or materials. This support has been shown to increase students' intrinsic motivation to learn, as it helps them avoid unnecessary frustration and maintain focus on the main learning objectives.

Utami *et al*, (2024) Through a systematic review of argumentative investigations, they show that the argumentative discussion phase plays an important role in improving scientific literacy. In this phase, students' claims, evidence, and reasoning are made more open, allowing them to jointly question and critique them. They found that comparing alternative representations and defending scientific positions through argumentation not only deepens conceptual understanding but also fosters confidence and satisfaction in learning. Both aspects of *confidence* and *satisfaction*are components of ARCS with the largest effect sizes in this study. These findings confirm that the discussion and presentation phases of inquiry-based learning not only complement each other, but are fundamental components that significantly contribute to increasing learning motivation, particularly through students experiences of participating in scientific communities of practice.

This study certainly has several limitations. One of them is the use of a posttest-only design without measuring initial motivation. This condition makes it impossible for researchers to conclude with certainty that guided inquiry-based learning actually increases learning motivation causally. A more accurate conclusion is that there are differences in motivation profiles between groups after the learning process takes place. Although the analysis shows that the initial academic abilities of the two groups are relatively equal based on their previous semester report card scores, this does not guarantee that their initial learning motivation levels are also the same. Therefore, further research is recommended to use a *pretest-posttest* design so that changes in motivation can be tracked more accurately and continuously over time. Although the ARCS questionnaire has undergone a rigorous validation process, future research will obtain a richer picture if student motivation data is sourced from more than just questionnaires. The use of data triangulation, such as observations of student engagement during learning, in-depth interviews, and analysis of learning outcomes such as investigation reports, can help provide a more comprehensive and in-depth understanding of the dynamics of student learning motivation. This study was conducted in schools with a relatively small sample size (n=48).

## 4. Conclusions

Based on the findings of the study and the above-mentioned discussion, it can be said that students who engage in guided enquiry learning and students who engage in traditional learning on the topic of substances and their changes have very different motivations for learning science. These results confirm that guided inquiry learning contributes substantially to the development of learning motivation among seventh-grade junior high school students. At the component level, the greatest differences occurred in the Satisfaction (d=2.217) and Confidence (d=1.617) components, indicating that guided inquiry learning is very effective in building students intrinsic learning satisfaction and confidence in conducting scientific investigations. The Relevance (d=1.555) and Attention (d=1.485) also showed a very large effect size, confirming that contextual phenomenon-based learning successfully made students feel the relevance of the material to their daily lives and maintained their active involvement in the learning process. The findings of this study provide strong empirical evidence that guided inquiry learning, with a structure consisting of orientation, conceptualization, investigation, conclusion, and discussion, can accommodate pupils core psychological requirements for autonomy, competence, and relatedness as conceptualized in.

The practical implication of this study is that science teachers need to integrate guided inquiry learning more systematically into their teaching practices, especially for materials that have concrete manifestations in everyday life, such as Substances and Their Changes. The implementation of guided inquiry does not require very complex resources, but it does require a paradigm shift from teacher-centered to student-centered, where teachers act as facilitators who provide strategic guidance rather than as the sole source of knowledge. Schools need to provide support by allocating sufficient time for investigative activities, providing adequate laboratory facilities, and developing teachers' professional skills in designing and implementing inquiry-based learning. Learning assessment also needs to be aligned with the objectives of inquiry, not only measuring content mastery but also scientific process skills and affective dispositions such as learning motivation.

First, the posttest-only design limits the ability to claim causal changes in motivation, even though academic equivalence analysis showed no significant differences in the initial conditions of the two groups. Investigating the relationship between motivation and cognitive learning outcomes will provide a more comprehensive understanding of the causal mechanisms by which guided inquiry enhances learning. Second, in-depth qualitative analysis through interviews and observations will enrich our understanding of students' subjective experiences in inquiry learning and identify specific elements that contribute most to the development of motivation. Third, comparative research between various levels of scaffolding in inquiry (from highly structured to minimal guidance) can provide insight into the optimal orchestration for student populations with different characteristics. Overall, this study contributes to the Indonesian science education literature by showing that guided inquiry learning is not only effective for cognitive development but also for affective aspects, particularly learning motivation. With a large effect size on all ARCS components, these findings strengthen the argument for transforming science learning practices from transmissive to investigative.

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## 6. References

Aidoo, B., Chebure, A., Gyampoh, A. O., & Tsyawo, J. (2024). Assessing Student Teachers ′ Motivation and Learning Strategies in Digital Inquiry-Based Learning. *Education Sciences*, *14*, 1–13. https://doi.org/https://doi.org/10.3390/educsci14111233

Arikunto, S. (2013). *Prosedur Peneliti* (Jakarta).

Bandura, A. (1997). *Self-Efficacy : The Exercise of Control*. Oxford University Pres.

Chiu, T. K. F. (2021). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education ISSN:* https://doi.org/10.1080/15391523.2021.1891998

Cohen, J. (1988). *Statistical Power Analysis for the Behavior Sciences (2nd Edition)*. Lawrence Erlbaum Associates.

Dah, N. M., Noor, M. S. A. M., Kamarudin, M. Z., & Azziz, S. S. S. A. (2024). The impacts of open inquiry on students ′ learning in science : A systematic literature review. *Educational Research Review*, *43*. https://doi.org/10.1016/j.edurev.2024.100601

Drastisianti, A., Dewi, A. K., & Alighiri, D. (2024). International Journal of Pedagogy and Teacher Education Effectiveness of Guided Inquiry Learning With PhET Simulation to Improve Students ′ Critical Thinking Ability and Understanding of Reaction Rate Concepts. *International Journal of Pedagogy and Teacher Education*, *8*(2), 235–252. https://doi.org/. https://doi.org/10.20961/ijpte.v8i2.93924

Faizin, A., Susantini, E., & Raharjo. (2024). Application of A Guided Inquiry Learning Model to Improve Students' Scientific Literacy Skills. *IJORER : International Journal of Recent Educational Research*, *5*(2), 490–503. https://doi.org/https://doi.org/10.46245/ijorer.v5i2.573 ABSTRACT

Geraldine, D. V. V., & Simmie, M. (2024). Assessing Scientific Inquiry : A Systematic Literature Review of Tasks , Tools and Techniques. *International Journal of Science and Mathematics Education*, *23*(4), 871–906. https://doi.org/10.1007/s10763-024-10498-8

Gomez, M. J. (2025). The Impact of Inquiry-Based Learning in Science Education : A Systematic Review of Student Engagement and Achievement. *Journal of Education, Learning, and Management (JELM)*, *2*(2), 353–363. https://doi.org/https://doi. org/10.69739/jelm.v2i2.1143

Hafitria, M. L., & Efwinda, S. (2024). Enhancing Students ' Learning Outcomes and Science Process Skills through STEM Project-Based Learning on Global Warming Topics. *JPPPF (Jurnal Penelitian Dan Pengembangan Pendidikan Fisika)*, *10*(1), 147–160. https://doi.org/http://doi.org/10.21009/1

Ishida, A., & Sekiyama, T. (2024). Variables influencing students ' learning motivation : critical literature review. *Frontiers in Education*. https://doi.org/10.3389/feduc.2024.1445011

Januarti, I. M., & Muliyadi, L. (2024). Development of Ethnoscience-Based Student Worksheet Using the Guided Inquiry Learning Model to Increase Students ' Learning Motivation and Scientific Literacy : A Review. *International Journal of Science Education and Science*, *1*(1), 13–18.

Jong, T. De, Lazonder, A. W., Chinn, C. A., Fischer, F., Gobert, J., Hmelo-silver, C. E., Koedinger, K. R., Krajcik, J. S., Kyza, E. A., Linn, M. C., Pedaste, M., Scheiter, K., & Zacharia, Z. C. (2023). Let ' s talk evidence – The case for combining inquiry-based and direct instruction. *Educational Research Review*, *39*(May), 100536. https://doi.org/10.1016/j.edurev.2023.100536

Karlina, Syahria, & Wulandari, B. A. (2024). Guided Inquiry : Science Learning Techniques in Improving Elementary School Students ' Process Skills and Concept Mastery. *Asian Journal of Education and Social Studies*, *50*(11), 118–126.

Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instraction Development*, *10*, 2–10. https://doi.org/https://doi.org/10.1007/BF02905780

Keller, J. M. (2010). *Motivational Design for Learning and Performance: The ARCS Model Approach*. Springer. https://doi.org/10.1007/978-1-4419-1250-3

Kubsch, M., Nordine, J., Fortus, D., & Krajcik, J. (2021). The interplay between students ' motivational profiles and science learning. *Journal of Research in Science Teaching*, *60*(1), 3–25. https://doi.org/10.1002/tea.21789

Li, K., & Keller, J. M. (2018). Use of the ARCS model in education : A literature review. *Computers & Education Journal*, *122*(March), 54–62. https://doi.org/10.1016/j.compedu.2018.03.019

Lotter, L., & Ramnarain, U. (2025). An Exploratory Study on the Use of a Flipped Classroom Model for Supporting Inquiry-based Learning in Natural Sciences Classrooms An Exploratory Study on the Use of a Flipped Classroom Model for Supporting Inquiry-based Learning in Natural. *African Journal of Research in Mathematics, Science and Technology Education*, *29*(1), 99–112. https://doi.org/10.1080/18117295.2024.2428554

Meulenbroeks, R., Rijn, R. Van, & Reijerkerk, M. (2024). Fostering Secondary School Science Students ′ Intrinsic Motivation by Inquiry - based Learning. *Research in Science Education*, *54*(3), 339–358. https://doi.org/10.1007/s11165-023-10139-0

Mirzaei, A., Rad, H. S., & Rahimi, E. (2024). Integrating ARCS motivational model and flipped teaching in L2 classrooms : a case of EFL expository writing. *Computer Assisted Language Learning*, *37*(5–6), 1136–1165. https://doi.org/10.1080/09588221.2022.2068614

Muchson, M., Cobern, W. W., & Saefi, M. (2024). The science education research trends ( SERT ) in Indonesian secondary schools : a systematic review and bibliometrics study. *Cogent Education*, *11*(1). https://doi.org/10.1080/2331186X.2024.2308407

OECD. (2023). PISA 2022 Results : Factsheets Indonesia. *OECD*, *1*.

Photo, P. (2025). Teaching Experiences Connected To The Implementation Of Inquiry - Based Practical Work In Primary Science Classrooms. *Research in Science Education*, 1493–1516. https://doi.org/10.1007/s11165-025-10235-3

Rahmayumita, R., Zulfarina, & Fakhruddin. (2024). Science Learning : An Analysis Related to Student Learning Activities in Junior High Schools. *Journal of Science Education Research*, *8*(2), 92–99. https://doi.org/https://doi.org/10.21831/jser.v8i2.65379

Ramadhana, R., & Muchlis, M. (2022). Penerapan Model Pembelajaran Inkuiri Terbimbing Untuk Meningkatkan Keterampilan Berpikir Kritis Pada Materi Asam Basa. *Chemistry Education Practice*, *5*(2), 133–141. https://doi.org/10.29303/cep.v5i2.3379

Sari, G. M. A., Antika, V. Y., Wisutama, R. A., Syiami, L. N., Sulaeman, N. F., Nuryadin, A., & Subagiyo, L. (2022). New Indonesian Science Curriculum for Junior High School : A Content Analysis to Support STEM SDGs. *JURNAL LITERASI PENDIDIKAN FISIKA*, *3*(2), 176–182. https://doi.org/https://doi.org/10.30872/jlpf.v3i2.1555

Setiawan, F. R. A., Supardi, Z. A. I., & Jatmiko, B. (2023). Profile of Guided Inquiry in Science Learning in Junior High Schools. *IJORER : International Journal of Recent Educational Research*, *4*(3), 343–354. https://doi.org/https://doi.org/10.46245/ijorer.v4i3.294

Strat, T. T. S., Henriksen, E. K., & Jegstad, K. M. (2024). Studies in Science Education Inquiry-based science education in science teacher education : a systematic review. *Studies in Science Education*, *60*(2), 191–250. https://doi.org/10.1080/03057267.2023.2207148

Tyas, R. A., Hastuti, P. W., & Rahayu, D. P. (2024). MAPPING INDONESIA ′ S INDIGENOUS SCIENCE AS A SCIENCE LEARNING CONTEXT IN JUNIOR HIGH SCHOOL : A NEW PARADIGM. *E-Journal of Cultural Studies*, *17*(4), 54–71. https://doi.org/https://doi.org/10.24843/cs.2024.v17.i04.p05

Utami, L., Festiyed, F., Yerimadesi, Y., & Arsih, F. (2024). Argument Driven Inquiry in Science Education : A Systematic Literature Review. *International Conference on Education and Innovation*, *1*(1), 52–62.

Valenzuela, J., Miranda-Ossandon, J. C., Muñoz Andrea, P. M., & Del Valle Juan-Gabriel, V.-S. (2024). Learning-oriented motivation : Examining the impact of teaching practices with motivational potential. *Plos One*, 1–12. https://doi.org/10.1371/journal.pone.0297877

Yusnidar, Fuldiaratman, & Chaw, E. P. (2024). A Study Of Mixed-Method: Science Process Skills, Interests And Learning Outcomes Of Natural Science In Junior High School. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *8*(1), 76–89. https://doi.org/10.22437/jiituj.v8i1.31977