



Design of Interactive Learning Media Using Google Sites Assisted Inquiry Learning to Improve Critical Thinking Ability of Studets at SMAN 2 Painan

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ABSTRACT

The development of 21st-century technology demands more interactive and student-centered learning. However, preliminary studies at SMAN 2 Painan showed that students' critical thinking skills on heat were still low. This was due to the teacher-centered learning style, which resulted in students being less active, and the media used did not support exploration and discovery of concepts. To address these issues, this study developed an interactive, inquiry-based learning media supported by Google Sites. The development process followed the Dick and Carey model, with expert validation and practicality testing on 30 students and 3 Physics teachers. The validation results showed a Cohen's Kappa value of 0.96 (very valid), while the practicality test produced a value of 0.88 (very practical). These findings suggest that Google Sites can be an effective alternative to support inquiry-based learning and improve students' critical thinking skills. Consequently, this media can be used as an adaptive and accessible digital learning innovation. However, this study was limited to a small sample size, focused on only one topic, and did not examine the long-term impact of media use.

Keywords: Interactive Learning Media, Inquiry Learning, Google Sites, Critical Thinking, Heat.



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I. INTRODUCTION

The development of information and communication technology (ICT) in the 21st century has changed the way people access information, communicate, and learn [1]. This change brings various benefits, especially in the field of education, because technology can be a solution to problems that are difficult to solve with conventional methods [2]. The development of ICT also encourages students and teachers to adapt so that learning is more flexible and according to the needs of the times [3], [4]. Thus, technology no longer only plays a role as an additional tool, but has become an important part of the modern learning process.

21st-century skills including creativity, critical thinking, problem solving, communication, and collaboration (4C) need to be developed so that students are able to face global challenges [5]. In facing technological developments, teachers are required to utilize interesting media, prepare comprehensive learning, and manage the learning environment so that students can actively ask questions, question, and convey ideas [6], [7]. Teachers also play a role as facilitators who guide students to have critical and creative thinking skills according to the demands of the times [8]. Critical thinking skills include interpretation, analysis, evaluation, inference, explanation, and self-regulation [9]. These skills help students understand Physics concepts, analyze problems, and put forward arguments from various perspectives [10]. Thus, mastery of critical thinking skills needs to be facilitated through the application of appropriate learning models.

Physics is a relevant subject for developing these skills because it requires students to observe, test ideas, and draw conclusions based on evidence [13]. The importance of learning models that encourage active student learning is essential in learning physics. However, in reality, this ideal situation has not yet been fully realized. One way to develop students' critical thinking skills is by using the inquiry learning model. The inquiry model is a learning method that encourages students to actively think and analyze, while simultaneously seeking answers on their own without much teacher assistance. This way, students do not simply receive material passively, but are encouraged to discover and understand physics concepts independently [14]. Through inquiry learning, students are encouraged to be more active and independent in finding solutions to problems they face, thereby continuously honing their critical thinking processes. Thus, this model not only improves understanding of physics concepts but also equips students with thinking skills that are useful in facing real-world challenges.

Based on observations conducted at SMAN 2 Painan in grade XI phase F, it was found that the learning conditions in the field did not fully reflect the ideal conditions expected for developing critical thinking skills. A preliminary study was conducted using two approaches: analysis of student critical thinking test results and teacher and student questionnaires regarding the use of learning media. Initial findings from this study pointed to a key issue: students' low critical thinking skills, which hinders the optimal achievement of physics learning objectives. Therefore, further analysis of the current learning conditions is crucial.

The first concrete condition identified was the low level of students' critical thinking skills. This was identified through a written test instrument designed based on critical thinking indicators. The analysis of this test revealed an average critical thinking score of 33.6%, which is considered low. This finding indicates an urgent need to improve learning approaches, particularly in physics, to foster more effective and sustainable critical thinking skills to support overall educational success.

Table 1. Results of students' critical thinking ability test

Critical Thinking Indicators	Percentage	Category
Interpretation	38%	Low
Analysis	24%	Low
Evaluation	32%	Low
Inference	38%	Low
explanation	36%	Low

Based on the table, all critical thinking indicators are in the low category. The analysis indicator received the lowest score of 24%, indicating that students have difficulty identifying relationships between information and understanding the structure of the given problem. Other indicators, such as interpretation and inference, each scored at 38%, while evaluation and explanation also fell below the minimum expected standard. These findings indicate that students are not yet able to think systematically and logically when solving physics problems, particularly in the heat topic. This condition underpins the need to develop interactive learning media that can stimulate and effectively train critical thinking skills.

Furthermore, learning is still dominated by lecture methods with learning resources in the form of modules, worksheets, and conventional practice questions. Based on student questionnaires, the heat topic was considered difficult to understand because it did not encourage students to think critically and relate concepts to everyday life. These findings align with research by Suja (2023) [13], which showed that students' critical thinking skills across several indicators were still low, with an average of 59% (categorized as very poor).

To address these issues, interactive learning media are needed that can encourage students to think critically. The inquiry-based learning model can be a solution because it trains students to formulate problems, form hypotheses, collect and analyze data, and draw conclusions independently [14]. Digital media that supports the inquiry model have also been shown to increase student engagement and learning outcomes [15], [16], [17], [18]. One potential platform is Google Sites, as it supports the integration of various content such as videos, animations, documents, and presentations [15]. This platform also allows for easy access, independent learning, and the presentation of activities according to inquiry syntax [17].

Several previous studies have shown that inquiry-based interactive media can improve critical thinking skills and conceptual understanding [19], [20], [21], [22]. However, research specifically developing Google Sites-based media with the inquiry model in physics learning, particularly on heat, is still limited. Based on these conditions, this research was conducted with the aim of developing inquiry-based interactive learning media using Google Sites, as well as testing its validity and practicality in improving students' critical thinking skills at SMAN 2 Painan.

II. METHOD

This study uses the Dick & Carey development model [23], which emphasizes a systematic process in designing learning. This model was chosen because it is suitable for developing learning media that requires structured stages ranging from needs analysis to product evaluation, in contrast to other simpler models such as ADDIE. The selection of Dick & Carey was also based on its ability to consistently integrate learning objectives, instructional strategies, and assessments. The following is the procedure for the Dick & Carey model development stages.

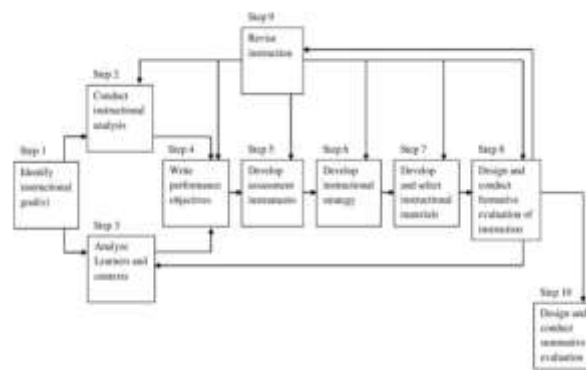


Fig. 1. Dick and Carey Model Research Design

This study used the Dick & Carey development model [23] because it is considered appropriate for developing interactive learning media that requires systematic stages starting from needs analysis to product evaluation. This model was chosen over other models, such as ADDIE, because it is more detailed in connecting learning objectives, strategies, and assessments consistently. The research procedure followed nine development steps. First, learning objectives were identified by reviewing learning outcomes in the curriculum for the topic of heat, so that measurable instructional objectives were obtained. Second, learning analysis was carried out by breaking down objectives into sub-competencies, compiling concept maps, and identifying conceptual difficulties frequently encountered by students. Third, analysis of student characteristics and context was conducted through a needs questionnaire and observations of 30 grade XI students and three Physics teachers at SMAN 2 Painan, taking into account age, learning experience, and access to technological devices.

Next, performance objectives are formulated in the form of measurable performance indicators and linked to critical thinking skills according to Facione [7]. In the next stage, assessment instruments are developed, including validation sheets for experts, evaluation questions, and practicality questionnaires for teachers and students. The validation instruments are prepared based on the Ministry of National Education guidelines (2010) [24] and adapted to critical thinking indicators. Validation is carried out by three expert Physics lecturers who assess aspects of material, visuals, learning design, integration of critical thinking skills, and suitability with the inquiry syntax. To ensure consistency of assessment, inter-rater reliability is analyzed using the Cohen's Kappa coefficient. The next stage is designing an instructional strategy by arranging a learning flow according to the inquiry syntax, starting from orientation, problem formulation, hypothesis creation, data collection, analysis, to drawing conclusions. This strategy is then translated into a storyboard and Google Sites navigation flow.

The development stage was carried out by compiling content in the form of text, images, videos, simulations, and digital worksheets integrated into Google Sites. The initial product (prototype) was then tested through formative evaluation. At this stage, experts provided assessments and comments using a validation sheet, while teachers and students completed a practicality questionnaire covering aspects of ease of use, attractiveness, efficiency, and usefulness. Data from the validation were analyzed using the Kappa formula to determine the level of agreement between assessors, while practicality data were analyzed descriptively quantitatively using a Likert scale. Based on these results, product revisions were carried out to obtain an interactive, inquiry-based learning media with Google Sites that was valid and practical for use in Physics learning.

Table 2. Likert Scale

Score	Category
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

(Source: Ref [25])

After the score is obtained, the score is processed using the Cohen's Kappa formula.

$$\text{Moment kappa (k)} = \frac{P_0 - P_e}{1 - P_e} \quad (1)$$

Information:

K = Kappa moment which shows the validity of the product

Po = The proportion realized, calculated by means of:

$$P_0 = \frac{\text{the number of scores given by the validator}}{\text{Maximum total score}} \quad (2)$$

P_e = The proportion that is not realized is calculated as follows:

$$P_e = \frac{\text{maximum score} - \text{the number of scores awarded by the validator}}{\text{maximum score}} \quad (3)$$

Validity categories based on Moment Kappa (k) are presented in the following table:

Table 3. Categories by Kappa Moment (k)

Interval	Category
0,81 - 1,00	Very Valid/Practical
0,61 - 0,80	High
0,41 - 0,60	Moderate
0,21 - 0,40	Low
0,01 - 0,20	Very Low
0,00	Invalid/Impractical

(Source: Ref [26])

III. RESULTS AND DISCUSSION

A. Result

The first stage was the validation of the interactive learning media. The results of the interactive learning media validation were collected from validation sheets evaluated by three experts, all physics lecturers from the Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang. The validation results from these three validators are illustrated in the graph below.

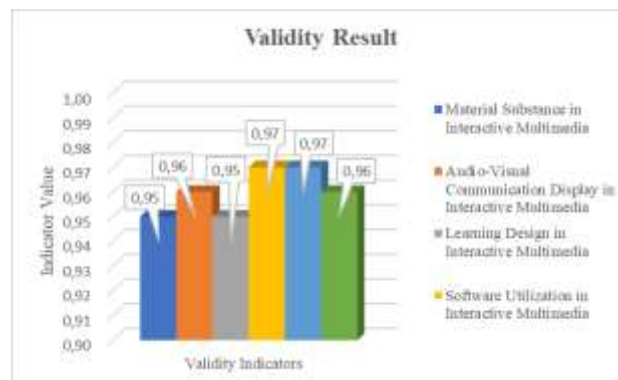


Fig. 2. Validity Result

From Figure 2 above, it can be seen that the validation results of the interactive inquiry-based learning media using Google Sites were carried out by three expert validators with assessment aspects including material suitability, visual appearance, learning design, software utilization, integration of critical thinking skills, and alignment with inquiry syntax. The analysis results show Cohen's Kappa values of the validation indicators are 0.95, 0.96, 0.95, 0.97, 0.97, and 0.96. The average validation score of the interactive learning media using inquiry learning assisted by Google Sites is 0.96, which places it in the "very valid" category. Thus, the interactive learning media is considered "very valid" for use based on the validation results. The visual appearance and integration of critical thinking aspects obtained the highest scores, while the software utilization aspect was relatively lower but remained in the very valid category. This indicates that the media has met academic eligibility standards, although the technological features can still be expanded to enrich interactivity.

The next stage was assessing the practicality of the interactive learning media. Practicality was tested through a questionnaire completed by 30 students and 3 teachers. The average score obtained was 0.88, categorized as very practical. Students considered the media easy to use, visually appealing, and supportive of independent exploration of concepts. Teachers emphasized the media's usefulness in saving time in delivering material and increasing student engagement through inquiry-based activities. Further analysis revealed differences in focus: students emphasized the experiential aspect of learning, while teachers valued the media's

function as a pedagogical tool. These differing perspectives complemented each other and strengthened the media's practicality. The results of this practicality assessment are represented in the graph below.

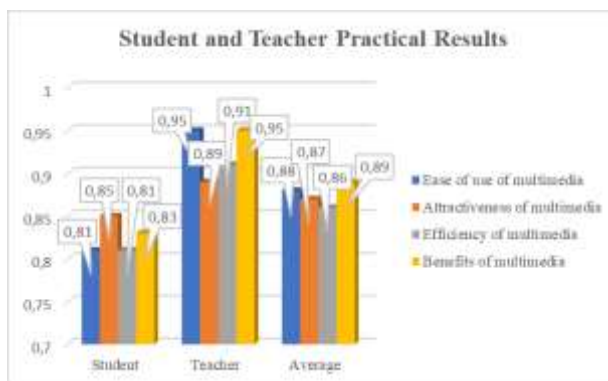


Fig. 3. Results of The Practicality of Teachers and Students

Figure 4 above shows that the teacher practicality indicator scores were 0.95, 0.89, 0.91, and 0.95, respectively, and the student practicality indicator scores were 0.81, 0.85, 0.81, and 0.83. The average practicality score for interactive learning media using Google Sites-assisted inquiry learning to improve students' critical thinking skills was 0.88, categorized as very practical. Therefore, the practicality score for interactive learning media using Google Sites-assisted inquiry learning falls into the "very practical" category.

The results of this study confirm that inquiry-based learning media using Google Sites is academically and practically feasible for use in Physics learning, particularly for heat. The high Kappa value demonstrates the intervalidator reliability of the assessment, while the positive responses from teachers and students confirm the media's potential as an effective learning tool. Another important finding is the media's dual function: supporting teachers as learning facilitators while providing interactive experiences that motivate students to develop critical thinking skills.

B. Discussion

Research at SMAN 2 Painan on 11th-grade students in phase F showed that critical thinking skills were still low. A needs analysis using teacher and student questionnaires revealed that the learning methods and media used did not fully support competency achievement. Digital transformation encourages the use of platforms such as Google Sites, which are adaptive, easily accessible, and capable of integrating multimedia and collaborative features [28]. Therefore, interactive learning media based on inquiry learning were developed, emphasizing exploration, observation, and concept discovery, with integrated content in the form of materials, worksheets, videos, quizzes, and assessments, thus supporting active student engagement while making it easier for teachers to manage learning.

Numerous studies have shown that inquiry-based media effectively improves critical thinking skills and conceptual understanding [30]. This model encourages students to ask questions, test ideas, and draw conclusions from in-depth learning experiences. Similarly, Al Mamun et al. [31] emphasized that content interaction in inquiry-based media can increase engagement and motivation, in line with the advantages of Google Sites as an adaptive online platform. Thus, teachers can utilize Google Sites to avoid monotonous methods and create more engaging and scientific learning [32].

During the development phase, researchers developed a validation instrument involving three experts, using indicators from the Ministry of National Education (2010a) [25], inquiry learning syntax, and critical thinking indicators [8]. Aspects assessed included material feasibility, visual appearance, learning design, software effectiveness, suitability of the inquiry model, and relevance to critical thinking development. Furthermore, a practicality questionnaire was developed, covering ease of use, attractiveness, efficiency, and usefulness, which was piloted on 30 students and three teachers. Validation ensured the appropriateness of the content and design, while the practicality test provided a picture of actual use and feedback for improvements.

The media was structured based on the structure of ICT-based teaching materials [28] adapted to the independent curriculum, with a home menu, instructions, learning outcomes, diagnostic, formative, and

summative assessments, materials, assignments, a glossary, a bibliography, and compilers. The content was enriched with images, videos, student worksheets (LKPD), and a virtual lab to motivate active student participation [33]. Based on Sugiyono's (2020) instrument [26], the validation results showed an average Kappa moment of 0.96 with a very valid category, while the practicality test produced a value of 0.88 with a very practical category. This proves that inquiry-based media through Google Sites is practical to use because it is easy to access, efficient, interesting, and useful for improving students' critical thinking skills.

IV. CONCLUSION

This research has produced an interactive, inquiry-based learning medium using Google Sites, which has proven highly valid with a Kappa value of 0.96 and highly practical with a Kappa value of 0.88. This medium facilitates the integration of materials, simulations, worksheets, videos, and assessments in one easily accessible platform, thus supporting the implementation of inquiry-based learning on heat. The novelty of this research lies in the development of Google Sites-based digital media specifically designed to train students' critical thinking skills through inquiry syntax, a technique previously rarely studied in the context of physics learning.

Consequently, this medium can be an alternative digital learning solution that is adaptive, simple, and relevant to the demands of 21st-century education. Teachers can utilize it to optimize inquiry-based learning, while schools can use it as a strategy to overcome limitations in laboratory facilities and face-to-face time. Thus, this research contributes to the development of innovative learning media that support 21st-century skills, particularly critical thinking.

However, this study has limitations. Participants included only one school with a relatively small sample size, and the research focus was limited to the topic of heat. Furthermore, this study did not assess the long-term impact of media use on students' critical thinking development. Therefore, future research is recommended to involve a more diverse sample, expand the study topic to other Physics materials, and evaluate the media's long-term effectiveness.

REFERENCES

- [1] F. Caena and C. Redecker, "Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu)," *Eur J Educ*, vol. 54, no. 3, pp. 356–369, Sep. 2019, doi: 10.1111/ejed.12345.
- [2] P. A. Maharani, E. Risdianto, and I. Setiawan, "Pengembangan Media Pembelajaran Interaktif Berbantuan Google Sites untuk Meningkatkan Hasil Belajar Siswa pada Materi Momentum dan Impuls," *Jurnal Penelitian Pembelajaran Fisika*, vol. 15, no. 1, pp. 31–42, Jan. 2024, doi: 10.26877/jp2f.v15i1.17458.
- [3] R. Lavi, M. Tal, and Y. J. Dori, "Perceptions of STEM alumni and students on developing 21st century skills through methods of teaching and learning," *Studies in Educational Evaluation*, vol. 70, p. 101002, Sep. 2021, doi: 10.1016/j.stueduc.2021.101002.
- [4] R. Septikasari, "Keterampilan 4C abad 21 dalam pembelajaran pendidikan dasar," *Tarbiyah Al-Awlad.*, vol. 8, no. 02, pp. 112–122, 2018.
- [5] Festiyed, "Perubahan Paradigma Proses Pembelajaran dalam Memberikan Layanan Profesional Berbasis Karakter," Jambi: Seminar Nasional MIPA dan PMIPA IAIN Sulthan Thaha Saifuddin Jambi, 2013, pp. 1–27.
- [6] M. N. Hudha, S. Aji, and A. Rismawati, "Pengembangan Modul Pembelajaran Fisika Berbasis Problem Based Learning untuk Meningkatkan Kemampuan Pemecahan Masalah Fisika," *SEJ (Science Education Journal)*, vol. 1, no. 1, pp. 36–51, May 2017, doi: 10.21070/sej.v1i1.830.
- [7] P. A. Facione, "Critical Thinking: What It Is and Why It Counts," 2015.
- [8] A. H. Talib and D. Amiroh, "Pengaruh Pendekatan Multi Representasi dengan Model Discovery Learning untuk Meningkatkan Penguasaan Konsep Kalor," *DIFRACTION*, vol. 4, no. 2, pp. 52–57, Feb. 2023, doi: 10.37058/diffraction.v4i2.6588.
- [9] C. Sahidu, "Pengembangan Program Pembelajaran Fisika (P3F)," Mataram: FKIP Universitas Mataram., 2018.
- [10] F. Festiyed, "Pengembangan Generic Life Skill Siswa Sekolah Menengah Pertama pada Pembelajaran Fisika," 2009.
- [11] Y. Hartawati, A. Harjono, and N. N. S. P. Verawati, "Kemampuan Berpikir Kritis Momentum Dan Impuls Ditinjau Dari Gaya Belajar Peserta Didik Dengan Model Learning Cycle 5E," *ORBITA: Jurnal Kajian, Inovasi dan Aplikasi Pendidikan Fisika*, vol. 6, no. 1, p. 181, May 2020, doi: 10.31764/orbita.v6i1.1515.
- [12] D. H. W. Sanjaya, *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*, 1st ed. Jakarta: Prenada media, 2006.

- [13] L. Suja and Sabani, "Analisis Keterampilan Berpikir Kritis Siswa Pada Materi Elastisitas dan Hukum Hooke di SMAS Dharmawangsa Medan," *Jurnal Edu Talenta*, vol. 2, no. 2, pp. 31–39, Dec. 2023, doi: 10.56129/jet.v2i2.47.
- [14] N. K. P. Pratama, E. P. Adi, and S. Ulfa, "PENGEMBANGAN MULTIMEDIA INTERAKTIF GEOGRAFI KELAS X MATERI TATA SURYA," *JKTP: Jurnal Kajian Teknologi Pendidikan*, vol. 4, no. 2, pp. 119–128, May 2021, doi: 10.17977/um038v4i22021p119.
- [15] Widya Mutiara Mukti, Yudhia Bella Puspita N, and Zanetti Dyah Anggraeni, "Media Pembelajaran Fisika Berbasis Web Menggunakan Google Sites Pada Materi Listrik Statis," *FKIP e-Proceeding*, vol. 5(1), pp. 51–59, 2020.
- [16] Evi Wijayanti, Fayeldi Trija, and Putri Pranyata Yuniar Ika, "Pengembangan Media Pembelajaran Matematika Berbasis Website Pada Materi Persamaan Garis Lurus Kelas VIII di SMP PGRI 01 Pakisaji Kabupaten Malang," *Emasains: Jurnal Edukasi Matematika dan Sains*, vol. 9(2), pp. 224–235, 2020.
- [17] N. Nurlatifah and J. Suprihatiningrum*, "Pengembangan Google Sites Berbasis Inkuiri Terbimbing pada Materi Asam Basa sebagai Media Belajar Mandiri Siswa SMA/MA Kelas XI," *Jurnal Pendidikan Sains Indonesia*, vol. 11, no. 1, pp. 67–83, Jan. 2023, doi: 10.24815/jpsi.v11i1.27391.
- [18] F. Yuniar, S. Sukarmin, and D. Wahyuningsih, "Pengembangan E-Modul Interaktif Berbasis Inkuiri Terbimbing pada Materi Fluida Statis Kelas XI SMA," *Jurnal Materi dan Pembelajaran Fisika*, vol. 11, no. 1, p. 48, May 2021, doi: 10.20961/jmpf.v11i1.47928.
- [19] W. Calesta, P. H. M. Lubis, and S. Sugiarti, "Pengembangan LKS Berbasis Inkuiri Terbimbing Berbantuan E-Learning Untuk Meningkatkan Pemahaman Konsep Pada Siswa kelas X SMA," *Jurnal Kumparan Fisika*, vol. 4, no. 1, pp. 51–60, May 2021, doi: 10.33369/jkf.4.1.51-60.
- [20] A. S. Putri and N. Aznam, "WEB MODUL IPA BERBASIS INKUIRI TERBIMBING UNTUK MENINGKATKAN THINKING SKILL," *EDUSAINS*, vol. 12, no. 1, pp. 47–53, Nov. 2020, doi: 10.15408/es.v12i1.11034.
- [21] A. Yunus, M. Danial, and M. Muharram, "Pengembangan E-Modul Berbasis Inkuiri Terbimbing untuk Meningkatkan Kemandirian Belajar dan Hasil Belajar Peserta Didik pada Materi Koloid," *Chemistry Education Review (CER)*, vol. 5, no. 2, p. 188, Apr. 2022, doi: 10.26858/cer.v5i2.32728.
- [22] I. Pratiwi, R. E. D, R. Silaban, and R. D. Suyanti, "Pengembangan Modul Berbasis Inkuiri Terbimbing Pada Materi Hukum Dasar Kimia Di Sekolah Menengah Atas," *Talenta Conference Series: Science and Technology (ST)*, vol. 2, no. 1, pp. 187–193, Jan. 2019, doi: 10.32734/st.v2i1.340.
- [23] W. Dick, L. Carey, and J. O. Carey, "The systematic design of instruction," 1985.
- [24] Depdiknas, "Jugnis Pengembangan Bahan Ajar" Direktorat Pembinaan Sekolah Menengah Atas, 2010.
- [25] P. D. Sugiyono, "Metode Penelitian Kuantitatif, Kualitatif, dan R&D . Alfabeta Bandung," 2013.
- [26] S. Boslaugh and P. A. Watters, "Statistics in a nutshell," 2008.
- [27] Depdiknas, *Panduan Pengembangan Bahan Ajar Berbasis TIK*. Jakarta: Direktorat Jendral Manajemen Pendidikan Dasar dan Menengah. Balitbang Depdiknas, 2010.
- [28] M. B. A. Najib, P. Setyosari, and Y. Soepriyanto, "Multimedia interaktif untuk belajar penjumlahan dan pengurangan pecahan," *Jurnal Kajian Teknologi Pendidikan*, vol. 1, no. 1, pp. 29–34, 2018.
- [29] Z. Arifin, S. Saputro, and A. Kamari, "The effect of inquiry-based learning on students' critical thinking skills in science education: A systematic review and meta-analysis," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 21, no. 3, p. em2592, 2025.
- [30] M. A. Al Mamun and G. Lawrie, "Student-content interactions: Exploring behavioural engagement with self-regulated inquiry-based online learning modules," *Smart learning environments*, vol. 10, no. 1, p. 1, 2023.
- [31] K. J. Aston, "“Why is this hard, to have critical thinking?” Exploring the factors affecting critical thinking with international higher education students," *Active Learning in Higher Education*, vol. 25, no. 3, pp. 537–550, 2024.
- [32] S. Wahyuni, A. Yani, D. Rosana, I. Wilujeng, and S. Nurohman, "Improving Students' Critical Thinking Skills Through The Use Of Pbl-Base Google Sites Learning Media And Review Students' Collaboration Skills," *Journal of Social Research*, vol. 3, no. 10, 2024.