

Analysis Of the Validity of the Circular Quest: Detective Orbit Board Game as a Learning Medium for the Topic

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ABSTRACT

Teaching Uniform Circular Motion requires instructional media that can visualize abstract concepts and promote student engagement. This study assessed the validity of the Circular Quest: Detective Orbit board game based on expert evaluations of its content, pedagogical quality, functionality, and visual design. The study was part of research and development using the ADDIE model and focused on the Development phase. Six validators, comprising three subject matter experts and three media experts, evaluated the board game using validation sheets. The data were analyzed using Aiken's V, with $V \geq 0.89$ indicating validity. The results showed coefficients of 0.93 for content completeness, 0.92 for curriculum alignment and pedagogical suitability, 0.94 for content suitability, and 0.97 for media suitability and functionality. Visual design obtained a coefficient of 0.80 and did not meet the validity criterion. Overall, the board game achieved an Aiken's V coefficient of 0.91 and was classified as valid. These findings indicate that Circular Quest: Detective Orbit meets the overall expert-validation criterion as an instructional medium for Uniform Circular Motion. However, the revised visual design requires revalidation before implementation. Further research should examine the board game's practicality and effectiveness through classroom testing.

Keywords: Aiken's V; uniform circular motion; board game; instructional media validity

INTRODUCTION

Physics is one of the subjects that plays a crucial role in developing students logical, analytical, and systematic thinking skills (Maiyena & Imamora, 2020). However, technological advancements and changes in student characteristics demand innovation in the learning process so that physics material can be understood more effectively (Simamora 2021). Despite its important role in education, physics is still often perceived by some students as a difficult, abstract, and boring subject (Mehora, 2026; Khusniah et al., 2022). This situation leads to low student interest and engagement during the learning process. One of the physics topics often considered difficult is Uniform Circular Motion (UCM). This topic covers concepts such as period, frequency, angular velocity, linear velocity, and centripetal acceleration, which require visualization skills and a solid understanding of the relationships between these concepts. Although circular motion is a common phenomenon in daily life, the underlying physical concepts are often difficult for students to grasp because they are abstract (Noviansyah et al., 2024).

The results of preliminary observations conducted on 36 students from four 10th-grade classes (XA, XC, XE, and XJ) at Kupang State High School 1 during the Field Experience Program (PPL), supported by interviews with supervising teachers, indicate that the physics learning process still faces various challenges. Most students tend to be passive during learning



activities, are not very engaged in group discussions, and show low enthusiasm for learning. The supervising teachers noted that classroom instruction is still dominated by the lecture method, as implementing student-centered learning is difficult due to students' limited prior understanding of physics concepts. This situation also contributes to conventional worksheet-based learning activities being dominated by only a few specific students, resulting in uneven group participation particularly in the topic of Uniform Circular Motion, which requires in-depth conceptual visualization. This situation indicates the need for learning media capable of enhancing students' active participation and creating a more engaging learning experience (Akyuna, Wahyuni, & Mintasih, 2026). One alternative that can be used to address these issues is game-based learning media. This finding aligns with the research by Sakti & Kartiani (2023), which shows that the use of conventional methods and modules as learning media can lead to low student interest and poor learning outcomes. Game-based media are considered capable of creating a more enjoyable learning atmosphere, increasing learning motivation, and encouraging social interaction among students during the learning process (Rosyada 2025). Furthermore, combining elements of games and education can provide a more interactive learning experience, so that students do not merely passively receive information but are also actively engaged in the learning process (Putri et al. 2024).

Based on these needs, a learning medium in the form of the board game Circular Quest: Detective Orbit was developed for the topic of Uniform Circular Motion. Board games are learning media with unique characteristics. According to Mike Scovian in Erlitasari (2016), a board game is a medium in which game components are placed, moved, or manipulated on a board surface designed according to a specific set of rules. This medium combines strategic elements and typically has clear learning objectives to be achieved. Furthermore, according to Gibbs & Smith in (Soesilo et al. 2025), a board game is a game medium that can be either physical or digital, generally involving components such as a board, cards, dice, and tokens in the gameplay process. This medium integrates elements of gameplay, group discussion, and problem-solving through various game components such as concept cards, exploration cards, and mission cards. In addition to featuring a space adventure theme, this game also incorporates an investigative concept, allowing students to take on the role of scientific detectives who solve various challenges based on the concept of Uniform Circular Motion.

Various previous studies have shown that board games have the potential as a learning medium capable of enhancing students' motivation to learn, active participation, and learning outcomes. The study Sakti & Kartiani (2023) indicates that the use of board games has a positive impact on students' learning outcomes compared to conventional learning. Rosyada (2025) also reports that board games combined with the Problem-Based Learning model can improve students' learning outcomes. Furthermore, Ningtyas (2023) states that board games can foster students' creativity and critical thinking skills through interactive learning activities. Regarding the topic of Uniform Circular Motion, Noviansyah (2024) developed a Portable Board-assisted learning approach and found that the use of this instructional medium has a positive impact on students' learning outcomes.

Nevertheless, most of these studies have focused more on the influence of board game use on learning outcomes and motivation, while research that specifically develops board games for the Uniform Circular Motion topic and assesses the media's suitability through expert validation remains relatively limited. In fact, the validation process is a crucial step to ensure that the developed media meets the criteria for content, pedagogical, media, and visual suitability before being implemented in the classroom.

The advantage of board games over other types of media lies in their mechanism of use, which requires direct interaction with the medium. This is what keeps board games relevant even as many other games emerge. Board games as learning media align with Edgar Dale's Cone of Experience, which explains that optimal learning outcomes are achieved through direct, concrete experiences (Sari, 2019). Before being used in instruction, the developed media must undergo a validation process to ensure the appropriateness of the content, the media's presentation, and the quality of the final product.

The novelty of this study lies in the development of a learning medium in the form of the board game Circular Quest: Detective Orbit, which is specifically designed to facilitate learning about Uniform Circular Motion using the Discovery Learning model. Unlike board games in previous studies which were generally applied to other subjects and were more oriented toward measuring learning outcomes the educational media developed in this study integrates concept cards, mission cards, exploration cards, scientific investigation mechanisms, and the context of the phenomenon of Uniform Circular Motion into a single educational game. Furthermore, this study focuses on analyzing the media's feasibility based on expert validation as an initial step before the media is implemented with students. The media's feasibility level was analyzed using Aiken's V validity coefficient based on the assessments of six expert validators comprising three subject matter experts and three media experts as a form of feasibility testing that has not been widely conducted in previous developments of Uniform Circular Motion board games. Therefore, this study aims to analyze the validity level of the Circular Quest: Detective Orbit board game as a physics learning medium for the topic of uniform circular motion based on expert validators' assessments.

METHODS

This study uses the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). However, this article specifically focuses only on the Development stage namely, the process of validating instructional media through expert judgment to determine the product's suitability before it is implemented with students. Therefore, this article does not discuss the implementation or evaluation stages of the media in the learning process. The ADDIE model is a more structured and comprehensive research and development model, making it suitable for various forms of product development (Syahid et al. 2024). However, this article focuses solely on the Development stage specifically, the process of validating instructional media conducted before the product is implemented with students (Hidayat & Nizar, 2021). The product being validated is the board game Circular Quest: Detective Orbit, which covers the topic of Uniform Circular Motion for 10th-grade high school students, with a total of six validators. Research data were obtained through evaluations by the six validators, consisting of subject matter experts and media experts. The instrument used was a validation sheet designed based on aspects of instructional media feasibility.

The aspects evaluated included content completeness, curriculum alignment and pedagogical suitability, content suitability, media suitability and functionality, and visual design. Each indicator was rated using a 1-4 Likert scale, where a score of 1 indicated the very unsuitable category and a score of 4 indicated the very suitable category. An even-numbered scale (1-4) was chosen to avoid the tendency of validators to select neutral responses (central tendency bias), ensuring that the ratings provided were more definitive and accurately reflected the actual assessment of the product's quality (Aiken 1985).

Table 1. Validity Criteria Index Validated by Aiken's 6 Validators

Aiken's V Scale	Category
$V \geq 0,89$	Valid
$V < 0,89$	Invalid

The validation data were analyzed using Aiken's V validity coefficient to determine the level of agreement among validators regarding the quality of the developed product. The resulting coefficient values were then interpreted based on the validity criteria used in this study. After the data were converted, they were analyzed to determine the level of validity based on the categories presented in the table below. A product is considered valid if it achieves an Aiken's V score of ≥ 0.89 . Conversely, an Aiken's V score < 0.89 indicates that the product is invalid, suggesting that it still requires revision before it can be used in the learning process.

RESULTS AND DISCUSSION

Product validation was conducted by six validators consisting of subject matter experts and instructional media experts. The validation process aimed to determine the suitability of the Circular Quest: Detective Orbit board game before its implementation in the learning process. The validation of the Circular Quest: Detective Orbit board game was carried out by six validators comprising subject matter experts and instructional media experts. The assessment covered five aspects: content completeness, curriculum alignment and pedagogical suitability, content suitability, media suitability and functionality, and visual design. The validation results were analyzed using Aiken's V coefficient to determine the level of media suitability for each indicator. The validation data were then analyzed using Aiken's V validity coefficient.

Table 2. Content Completeness Aspect

No.	Indicator	Average V Score	Category
1.	The material covers all concepts of Uniform Circular Motion: period, frequency, linear velocity, and angular velocity.	0.94	Valid
2.	The formulas for Uniform Circular Motion are presented accurately and completely	1.00	Valid
3.	Examples of the application of uniform circular motion in everyday life are relevant and easy to understand.	0.89	Valid
4.	The difficulty level of the questions is appropriate for 10th-grade students.	0.89	Valid
Average		0.93	Valid

Based on Table 1, the aspect of material completeness obtained an average Aiken's V score of 0.93, falling into the valid category. The highest score was obtained for the indicator of accurate and complete presentation of the formula for Uniform Circular Motion, with a score of 1.00, while the indicators of the relevance of examples applying the concept to daily life and the appropriateness of the difficulty level of the questions each obtained a score of 0.89. These results indicate that the presented material covers the main concepts of Uniform Circular Motion, such as period, frequency, linear velocity, and angular velocity, and has been adapted to the characteristics of 10th-grade high school students.

These validation results indicate that the content in the board game Circular Quest: Detective Orbit meets the criteria for content completeness and is therefore capable of supporting the achievement of learning objectives. The presentation of comprehensive content is a key factor in the development of instructional media because it helps students build a holistic understanding of concepts before applying them to problem-solving. This finding aligns with the work by [Maiyena dan Imamora \(2020\)](#), who state that content comprehensiveness is a primary indicator of instructional media quality because it influences students' conceptual understanding. Furthermore, the results of this study are also supported by [Utami et al. \(2024\)](#), which explains that instruments and media that achieve a high Aiken's V validity score indicate that the developed content aligns with learning objectives and is suitable for use. Evidence from science education likewise shows that game-based learning is most productive when scientific content is represented through coherent tasks and explicit learning goals ([Li & Tsai, 2013](#)). Board-game design can also organize complex scientific concepts into manipulable rules, representations, and challenges, which supports the content structure used in the present medium ([Chiarello & Castellano, 2016](#)).

Based on Table 3, the aspects of curriculum alignment and pedagogical appropriateness received an average Aiken's V score of 0.92, falling into the valid category. The indicator of content alignment with learning outcomes received the highest score of 1.00, while the indicator of cognitive level alignment of test items received a score of 0.83, making it the indicator with the lowest score in this aspect. These results indicate that, in general, the content aligns with the established learning outcomes and learning objectives; however, further refinement of the question design is needed to better align with the distribution of cognitive levels based on Bloom's Taxonomy.

Table 3. Curriculum Alignment and Pedagogical Suitability

No.	Indicator	Average V Score	Category
1.	The material aligns with the established Learning Outcomes (LO).	1.00	Valid
2.	The material aligns with the Learning Objectives stated in the Lesson Plan	0.94	Valid
3.	The questions require students to achieve the appropriate cognitive levels (C1–C4).	0.83	Invalid
4.	The material supports the development of the Graduate Student Profile (critical thinking, collaboration, and others).	0.94	Valid
5.	The material is presented systematically (from basic concepts to applications).	0.89	Valid
6.	The variety of question types (concepts, calculations, analysis, applications) promotes a deeper understanding.	0.89	Valid
7.	The difficulty level of the questions varies in a balanced proportion.	0.94	Valid
Average		0.92	Valid

These results indicate that the instructional media met pedagogical criteria because the content was organized systematically, supported the development of students' thinking skills, and aligned with the current curriculum. The validators' feedback regarding cognitive level classification was subsequently addressed by mapping the questions according to levels C1 through C4 to better align with the learning objectives. This finding aligns with the [Hidayat dan Nizar \(2021\)](#), which states that the development phase in the ADDIE model aims to refine the product based on expert validation results so that the resulting instructional media meets learning needs. Thus, the revisions made to the pedagogical aspects are expected to improve the quality of the instructional media before it is used in the learning process. This refinement is consistent with the principle that game mechanics, feedback, and learning objectives must form a coherent instructional system rather than operate as separate features ([Plass et al., 2015](#)).

Table 4. Content Feasibility Aspects

No.	Indicator	Average V Score	Category
1.	The board game fully incorporates the concept of Uniform Circular Motion in accordance with the learning objectives.	1.00	Valid
2.	The questions and challenges in the game are clear and appropriate for the students' abilities.	0.89	Valid
3.	The game's content encourages students to think critically and apply the concept of uniform circular motion.	0.89	Valid
4.	The material and challenges are relevant to everyday life phenomena.	1.00	Valid
5.	Media can help students understand concepts interactively.	0.94	Valid
Average		0.94	Valid

Based on Table 4, the content validity aspect received an average Aiken's V score of 0.94, falling into the valid category. The highest scores were obtained for the indicators that the board game fully covers the concept of Uniform Circular Motion in accordance with the learning objectives and that the material is relevant to everyday life phenomena, each of which received a score of 1.00. Meanwhile, the indicators regarding the clarity of questions and challenges in the game, as well as the medium's ability to encourage students to think critically, received a score of

0.89, while the indicator regarding the medium's ability to help students understand concepts interactively received a score of 0.94.

These results indicate that the content of the developed educational media aligns with the learning objectives and effectively connects the concept of Uniform Circular Motion to phenomena encountered in daily life. Presenting the material in the form of a game also provides students with opportunities for active interaction through discussion, problem-solving, and decision-making throughout the game. These findings align with the study by [Ningtyas \(2023\)](#), which states that board games can foster creativity and encourage students' active engagement in learning. Additionally, the study by [Putri et al. \(2024\)](#) explains that game-based learning media can increase enthusiasm for learning because students do not merely receive information passively but are directly involved in the learning process. A multidisciplinary review further shows that board gameplay can create learning spaces that support teamwork, creativity, and complex thinking through structured interaction ([Bayeck, 2020](#)). A recent systematic review of board games in science education likewise reports benefits for knowledge acquisition, engagement, and collaboration, while noting the need for stronger evidence on long-term effects and specific game mechanisms ([Othman et al., 2025](#)).

Table 5. Media Feasibility and Functionality Aspects

No.	Indicator	Average V Score	Category
1.	The board game design is engaging and supports learning motivation.	1.00	Valid
2.	The layout of the board, cards, and instructions is easy to understand and use.	0.89	Valid
3.	The materials are safe and practical to use.	1.00	Valid
4.	Game-based interactions facilitate student collaboration and participation.	1.00	Valid
5.	The media is appropriate for the students' characteristics (grade level, age, ability)	0.94	Valid
Average		0.97	Valid

Based on Table 5, the aspects of media suitability and functionality received an average Aiken's V score of 0.97, classified as valid, making them the aspects with the highest scores compared to the others. Three indicators received a score of 1.00: an engaging board game design that supports learning motivation; the safety and practicality of the media's use; and the game's ability to facilitate student collaboration and participation. Meanwhile, the indicators for the layout of the board, cards, and instructions received a score of 0.89, while the indicator for the media's suitability for student characteristics received a score of 0.94.

These results indicate that the developed media possess a good level of practicality and functionality, making them easy to use in the learning process. The game design, which involves group activities, is also capable of fostering interaction among students during the learning process. This finding aligns with the study by [Sakti & Kartiani \(2023\)](#), which states that the use of board games can increase student engagement because learning takes place in a more active and enjoyable manner. The results of this study are also supported by ([Rosyada 2025](#)), which explains that board-game-based learning media can create an interactive learning atmosphere while increasing students' motivation to learn. Evidence from physics and astronomy instruction also suggests that carefully designed board games can engage students by combining disciplinary content with discussion, shared decision-making, and problem-solving activities ([Cardinot & Fairfield, 2019](#)).

Based on Table 6, the visual design aspect received an average Aiken's V score of 0.80, placing it in the invalid category. The lowest score was obtained for the typography readability indicator at 0.67, followed by the illustration relevance indicator at 0.78, and the color combination and image quality indicators, each scoring 0.83. Meanwhile, the card layout indicator received a score of 0.89, falling into the valid category. These results indicate that although the learning media met the criteria for content and functionality, the visual presentation still requires some refinements to make it more engaging and user-friendly for students.

Table 6. Visual Design Aspects

No.	Indicator	Average V Score	Category
1.	Attractive and consistent colors and color combinations	0.83	Invalid
2.	Typography or fonts are easy to read at all sizes.	0.67	Invalid
3.	The card layout is balanced and not confusing.	0.89	Valid
4.	The illustrations or diagrams are relevant and enhance understanding.	0.78	Invalid
5.	Image quality is clear and free of blurring or defects.	0.83	Invalid
Average		0.80	Invalid

Feedback from the validators indicated that visual quality is one of the factors influencing students' comfort in using the learning media. Therefore, the researcher made revisions, including improving the color combination for greater contrast, enhancing the readability of the font, refining the illustrations and image quality, and optimizing the layout of several game components. These improvements were made to ensure that the media is not only appropriate in terms of content but also has a visual presentation capable of optimally supporting the learning process. This aligns with Ningtyas's (2023), which states that an attractive visual design can increase students' attention and motivation to learn when using game-based media.

Table 7. Results of Product Revisions Based on Validators' Suggestions

Aspect	Validator Findings or Suggestions	Revisions Made
Completeness of Content	The GMB material does not yet cover all important concepts because it does not include the subtopic of centripetal acceleration.	Add material and questions related to centripetal acceleration to the concept cards and mission cards so that the scope of the GMB material becomes more comprehensive.
Curriculum and Pedagogical Alignment	Learning objectives need to be formulated to be more specific and measurable.	Revise the learning objectives to make them clearer, more operational, and in line with the established learning outcomes.
	There is currently no classification of question cognitive levels based on Bloom's Taxonomy.	Develop a question mapping based on cognitive levels C1 (recall), C2 (understanding), C3 (application), and C4 (analysis).
	The game flow is quite long, so attention must be paid to managing learning time.	Re-evaluate the time allocation for each game activity to ensure it aligns with the available learning time.
Materials and Functionality	There is currently no information on the duration of each game activity.	Add estimated times to the exploration cards, concept cards, and mission cards to help manage time during the learning session.
	The card components may get scattered during use.	Add storage compartments or other alternatives to keep the cards organized.
	Game pieces are unstable during use.	Replace the game pieces with sturdier materials so they don't easily fall over during play.
Visual Design	The text color on the game board lacks contrast, which affects readability.	Change the font color to a lighter shade with higher contrast so it is easier for students to read.
	The illustrations and visual quality of the media still need improvement.	Improve the illustrations, layout, and image quality to make them clearer, more engaging, and more supportive of student understanding.

These results indicate that although the content and functionality of the media have been rated as good, improvements are still needed in the visual aspects to make the media more engaging, easier to read, and more user-friendly for students. This evaluation framework aligns with research on the development of learning media that incorporates didactic, constructional, technical, content, and learning aspects in expert validity testing (Ningtyas & Pradikto, 2025).

Based on expert validation results, the Circular Quest: Detective Orbit board game received an average Aiken's V score of 0.91, falling into the valid category. These results indicate that the developed media meets the feasibility criteria in terms of content completeness, curricular and pedagogical appropriateness, content suitability, as well as media and functionality. It should be emphasized that this overall valid rating was achieved even though one of the main aspects visual design did not yet meet the validity criteria (0.80). Thus, the educational media is deemed generally suitable, but its use in instruction still requires the completion of visual design revisions first. The validators provided several recommendations for refining the product before its implementation phase. The first improvement was made regarding the completeness of the material by adding a subtopic on centripetal acceleration to ensure a more comprehensive coverage of the topic Uniform Circular Motion. Regarding curriculum and pedagogical alignment, the validators suggested that learning objectives be formulated in a more specific and measurable manner. Additionally, questions were classified according to cognitive levels C1 through C4 to demonstrate their alignment with the targeted learning indicators. Validators also provided feedback regarding game time management. Given that the game flow consists of several interconnected activities, the researchers added time estimates to each card and game activity so that the learning process could proceed according to the time allocated in the classroom.

Regarding media and visual design, several revisions were made to improve the readability and practicality of the materials. The text color on the game board was changed to a higher contrast to make it easier for students to read. Additionally, to keep the card components neat and prevent them from getting scattered, a belly band is used to hold them together and identify the card category, so that the game components are more organized and easier for students to use during the learning process. The game pieces were also replaced with a more stable material to prevent them from falling over easily during use. Improvements were also made to the quality of the illustrations and visual presentation to make the learning materials more engaging and supportive of the learning process. All of these revisions were carried out in response to feedback from the validators so that the Circular Quest: Detective Orbit learning resource would have improved material quality, visual presentation, and usability. Consequently, this resource has been deemed valid and suitable for use as a physics learning resource on the topic of Uniform Circular Motion following the refinements made in accordance with the validators' suggestions, and it is ready to be implemented in the learning process. The emphasis on stable components, clear organization, and practical classroom use is consistent with Dziob (2020), who demonstrated how a physical board game can be structured as a learning and assessment activity in physics classes.



Figure 1. Before revision



Figure 2. After revision

Theoretically, the results of this study contribute to the development of research on game-based learning media in physics education, particularly regarding the topic of Uniform Circular Motion. The validation results indicate that the developed media has met the criteria for content completeness, curricular and pedagogical appropriateness, content suitability, and media functionality based on expert evaluations. These findings reinforce that the validation process is a crucial stage in research and development to ensure the quality of the media before it is implemented with students. At a broader level, a meta-analysis of game-based STEM education reported positive effects on learning achievement and emphasized the importance of game mechanisms, learner characteristics, and implementation conditions (Wang et al., 2022). Because the present study was limited to expert validation, this prior evidence provides a rationale for subsequent implementation and does not constitute proof that the current product has already improved student achievement.

In practical terms, the results of this study indicate that the Circular Quest: Detective Orbit board game can serve as an interactive learning medium for physics teachers to present the topic of Uniform Circular Motion in a more engaging and interactive manner. Furthermore, the validation results obtained can serve as a reference for other researchers and educational media developers in designing game-based learning media that consider content, pedagogical aspects, functionality, and visual design before being applied in learning activities.

CONCLUSION

This study aimed to analyze the feasibility of the board game Circular Quest: Detective Orbit as a physics learning medium for the topic of Uniform Circular Motion through expert validation. The results of the analysis using Aiken's V validity index showed that the developed medium achieved an overall validity score of 0.91, falling into the valid category. The content completeness aspect received a score of 0.93; the curriculum and pedagogical suitability aspect received a score of 0.92; the content suitability aspect received a score of 0.94; and the media and functionality aspect received a score of 0.97. Meanwhile, the visual design aspect received a score of 0.80, indicating that some improvements are needed before the medium can be used in instruction.

Based on the validators' feedback, revisions were made by adding material on centripetal acceleration, clarifying the learning objectives, classifying questions according to cognitive levels C1-C4, adding time allocations for game activities, improving visual readability, and refining the physical components of the educational media. After the revisions, the board game Circular Quest: Detective Orbit was deemed suitable for use as a physics learning medium for the topic of Uniform

Circular Motion. These findings indicate that integrating board game concepts into physics instruction has the potential to serve as an engaging, interactive, and appropriate alternative medium for high school students. This study has limitations because it focused its analysis solely on the expert validation stage and thus did not examine the practicality or effectiveness of the medium when used in the learning process. Therefore, future research is recommended to conduct implementation and evaluation phases to test the practicality, effectiveness, and impact of using the Circular Quest: Detective Orbit board game on students' learning outcomes, learning motivation, and thinking skills.

REFERENCES

- Aiken, L. R. (1985). "Three Coefficients for Analyzing the Reliability and Validity of Ratings. Educational and Psychological Measurement." *Original Work Published* 45(1):131–42. doi:<https://doi.org/10.1177/0013164485451012>.
- Akyuna, Reyza Qurrota, Ana Dwi Wahyuni, dan Diyah Mintasih. (2026). "Peran Media Pembelajaran Interaktif Dalam Meningkatkan Partisipasi Peserta Didik." *Jurnal Hukum, Pendidikan & Sosial Keagamaan* 5(1):121–32.
- Bayeck, Rebecca Yvonne. (2020). "Examining Board Gameplay and Learning: A Multidisciplinary Review of Recent Research." *Simulation & Gaming* 51(4):411–31. doi:10.1177/1046878119901286.
- Cardinot, Adriana, and Jessamyn A. Fairfield. (2019). "Game-Based Learning to Engage Students with Physics and Astronomy Using a Board Game." *International Journal of Game-Based Learning* 9(1):42–57. doi:10.4018/IJGBL.2019010104.
- Chiarello, Fabio, and Maria Grazia Castellano. (2016). "Board Games and Board Game Design as Learning Tools for Complex Scientific Concepts: Some Experiences." *International Journal of Game-Based Learning* 6(2):1–14. doi:10.4018/IJGBL.2016040101.
- Dziob, Daniel. (2020). "Board Game in Physics Classes A Proposal for a New Method of Student Assessment." *Research in Science Education* 50(3):845–62. doi:10.1007/s11165-018-9714-y.
- Erlitasari, Nova Dwi. (2016). "Pengembangan Media Board Game Garis Bilangan Materi Bilangan Bulat Pada Mata Pelajaran Matematika Kelas IV SDN Ngampelsari Candi Sidoarjo."
- Hidayat, Fitria, dan Muhamad Nizar. (2021). "Model Addie (Analysis, Design, Development, Implementation and Evaluation) Dalam Pembelajaran Pendidikan Agama Islam." *Jurnal Inovasi Pendidikan Agama Islam (JIPAI)* 1(1):28–38. doi:10.15575/jipai.v1i1.11042.
- Khusniah, Zahrotul, Yulia Linguistika, dan Erif Ahdhianto. (2022). "Analisis Peningkatan Minat Belajar Siswa Dengan Menggunakan Model Game-Based Learning Pada Pembelajaran Matematika Materi Pecahan Kelas V SDN PW 01." *Primary: Jurnal Pendidikan Guru Sekolah Dasar* 11(2):613. doi:10.33578/jpfkip.v11i2.8808.
- Li, Ming-Chaun, and Chin-Chung Tsai. (2013). "Game-Based Learning in Science Education: A Review of Relevant Research." *Journal of Science Education and Technology* 22(6):877–98. doi:10.1007/s10956-013-9436-x.
- Maiyena, Sri, dan Marjoni Imamora. (2020). "Pengembangan Modul Elektronik Fisika Berbasis Konstruktivisme untuk Kelas X SMA." *Journal of Teaching and Learning Physics* 5(1):01–18. doi:10.15575/jotalp.v5i1.5739.
- Mehora, S. (2026). Analisis Minat Belajar Siswa Terhadap Mata Pelajaran Fisika di SMA. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, 11(04), 246-256.
- Ningtyas, Septiana Ika. (2023). "Penggunaan Board Game Sebagai Media Pembelajaran untuk Melatih Berpikir Kreatif Siswa." *Research and Development Journal of Education* 9(2):871–80.

- Ningtyas, S. Z., & Pradikto, S. (2025). Pengaruh Metode Pembelajaran Konvensional Dan Game Terhadap Pembelajaran KWU Dalam Meningkatkan Minat Belajar SMAN 4 Pasuruan. *Jurnal Kajian Dan Penelitian Umum*, 3(1), 115-124.
- Noviansyah, Muhammad Iqbal, Syukran Mursyid, dan Judyanto Sirait. (2024). "Pengaruh Pembelajaran Gerak Melingkar Beraturan Berbantuan Alat Peraga Portable Board Terhadap Hasil Belajar Siswa."
- Othman, Mohd Kamal, Rahimah Mat, and Kah Ching Sim. (2025). "A Systematic Review of Paper-Based and Digital Board Games for Collaborative Science Learning." *Review of Education* 13(3):e70107. doi:10.1002/rev3.70107.
- Plass, Jan L., Bruce D. Homer, and Charles K. Kinzer. (2015). "Foundations of Game-Based Learning." *Educational Psychologist* 50(4):258–83. doi:10.1080/00461520.2015.1122533.
- Putri, Tanaya Eka, Assyifa Fitria Nuraini, Tatang Herman, dan Aan Hasanah. (2024). "Media Pembelajaran Berbasis Game Untuk Meningkatkan Antusias Belajar Siswa Kelas IX Di Salah Satu SMP Negeri Cimahi." *PHI: Jurnal Pendidikan Matematika* 8(1):49–54. doi:10.33087/phi.v8i1.329.
- Rosyada, Balqis Putri. (2025). "Efektivitas Model Problem Based Learning Berbantuan Board Game Ular Tangga untuk Meningkatkan Hasil Belajar Peserta Didik." *Jurnal Pembelajaran dan Pengajaran Pendidikan Dasar* 8(1):40–48. doi:doi: <http://dx.doi.org/10.33369/>.
- Sakti, Hadi Gunawan, dan Baiq Sarlita Kartiani. (2023). "Efektivitas Penggunaan Media Board Game Terhadap Peningkatan Hasil Belajar Siswa." *Jurnal Visionary: Penelitian dan Pengembangan dibidang Administrasi Pendidikan* 11(1):116. doi:10.33394/vis.v11i1.7791.
- Sari, Pusvyta. (2019). "Analisis Terhadap Kerucut Pengalaman Edgar Dale Dan Keragaman Gaya Belajar Untuk Memilih Media Yang Tepat Dalam Pembelajaran." *Mudir: Jurnal Manajemen Pendidikan* 1(1):42–57.
- Simamora, Rini. (2021). "Penggunaan Teknologi Sebagai Inovasi Media Pada Pembelajaran Fisika Di Era Persaingan Industri Untuk Mendukung Program Kampus Mengajar." *Prosiding Webinar Nasional Pendidikan Dan Sains Kimia*.
- Soesilo, T. D., Windrawanto, Y., Kristin, F., Jeslyn, A., & Nurhidayat, A. (2025). Penerapan Model Problem Based Learning dan Penggunaan Board Game Career Racing Dalam Peningkatan Kematangan Karier Peserta Didik: Penerapan Model Problem Based Learning dan Penggunaan Board Game Career Racing Dalam Peningkatan Kematangan Karier Peserta Didik. *Scholaria: Jurnal Pendidikan dan Kebudayaan*, 15(1), 93-100.
- Syahid, I. M., & Istiqomah, N. A. (2024). Model ADDIE dan ASSURE Dalam Pengembangan Media Pembelajaran. *Journal of International Multidisciplinary Research*, 2(5), 31-45.
- Utami, Lisa, Festiyed, Dian Purnama Ilahi, Arista Ratih, Elvi Yenti, dan Lazulva. (2024). "Analisis Indeks Aiken Untuk Mengetahui Validitas Isi Instrumen Scientific Habbits of Mind." *Journal of Research and Education Chemistry* 6(1):59. doi:10.25299/jrec.2024.vol6(1).17430.
- Wang, Liang-Hui, Bing Chen, Gwo-Jen Hwang, Jue-Qi Guan, and Yun-Qing Wang. (2022). "Effects of Digital Game-Based STEM Education on Students' Learning Achievement: A Meta-Analysis." *International Journal of STEM Education* 9:26. doi:10.1186/s40594-022-00344-0.