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Evaluating the Effectiveness of Snakes and Ladders Media in Improving Algebra Learning Outcomes of Junior High School Students

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Abstract

Low algebra learning outcomes among junior high school students are often associated with the dominance of conventional lecture-based teaching methods that reduce student engagement and motivation during the learning process. Therefore, this study aims to evaluate the effectiveness of using snakes and ladders learning media to improve students' algebra learning outcomes and classroom activity. This research employed a mixed-methods approach with a one-group pretest–posttest design involving 29 purposively selected grade VII A students of STATE JUNIOR HIGH SCHOOLNegeri 6 Kota Sorong in the 2024/2025 academic year. Data were collected through lesson plans, pretest and posttest assessments, student activity observation sheets, and documentation. Data analysis included Kolmogorov–Smirnov normality tests, mastery percentage analysis, N-Gain calculation, and classical observation percentages using SPSS. The results indicated an increase in the average student score from 7.72 in the pretest to 43.34 in the posttest, with student activity reaching 68% categorized as active and an N-Gain score of 0.41 indicating moderate improvement. However, the classical mastery level only reached 21%, which was still below the minimum mastery criterion (KKM) of 71. In conclusion, the snakes and ladders learning media was effective in increasing students' motivation and participation in algebra learning, although further improvement is required to achieve optimal cognitive learning outcomes. Future studies are recommended to refine the instructional design, extend the implementation period, and involve larger samples to obtain stronger learning impacts. This study is limited by the use of a single-group design and a relatively small sample size, which may affect the generalizability of the findings.

Keywords: *Algebra Learning, Learning Media, Snakes And Ladders, Student Outcomes*

Abstract

Rendahnya hasil belajar aljabar pada siswa sekolah menengah pertama sering dikaitkan dengan dominasi metode pembelajaran ceramah yang bersifat konvensional sehingga mengurangi keterlibatan dan motivasi belajar siswa. Oleh karena itu, penelitian ini bertujuan untuk mengevaluasi efektivitas penggunaan media pembelajaran ular tangga dalam meningkatkan hasil belajar aljabar serta aktivitas belajar siswa. Penelitian ini menggunakan pendekatan mixed methods dengan desain one group pretest–posttest yang melibatkan 29 siswa kelas VII A STATE JUNIOR HIGH SCHOOLNegeri 6 Kota Sorong pada tahun ajaran 2024/2025 yang dipilih secara purposive. Pengumpulan data dilakukan melalui modul ajar, tes pretest dan posttest, lembar observasi aktivitas siswa, serta dokumentasi. Analisis data dilakukan menggunakan uji normalitas Kolmogorov–Smirnov, analisis persentase ketuntasan, perhitungan N-Gain, serta persentase

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observasi klasikal dengan bantuan SPSS. Hasil penelitian menunjukkan adanya peningkatan nilai rata-rata siswa dari 7,72 pada pretest menjadi 43,34 pada posttest, dengan tingkat aktivitas siswa mencapai 68% yang termasuk dalam kategori aktif serta nilai N-Gain sebesar 0,41 yang berada pada kategori sedang. Namun demikian, tingkat ketuntasan klasikal hanya mencapai 21% sehingga masih berada di bawah Kriteria Ketuntasan Minimal (KKM) sebesar 71. Dengan demikian, media pembelajaran ular tangga terbukti efektif dalam meningkatkan motivasi dan aktivitas belajar siswa, namun masih memerlukan penyempurnaan untuk mencapai hasil belajar kognitif yang optimal. Penelitian selanjutnya disarankan untuk menyempurnakan desain pembelajaran, memperpanjang durasi implementasi, serta melibatkan jumlah sampel yang lebih besar agar memperoleh dampak pembelajaran yang lebih kuat. Penelitian ini memiliki keterbatasan pada penggunaan desain satu kelompok dan jumlah sampel yang relatif terbatas sehingga dapat memengaruhi generalisasi temuan penelitian.

Kata Kunci: Aljabar, Hasil Belajar, Media Pembelajaran, Ular Tangga

INTRODUCTION

Learning mathematics, particularly algebra, is often considered challenging for junior high school students due to its logical and systematic nature, which requires a strong foundation in abstract thinking. Seventh-grade algebra serves as an essential basis for understanding more advanced mathematical concepts, and early misunderstandings in this topic can hinder students' overall mathematical learning progress (Isnaini et al., 2026; Jayanti et al., 2025; Prambudi & Yunianta, 2020; Sakiah et al., 2021). This phenomenon is widely observed in many schools, where students frequently demonstrate low interest in learning algebra because of its abstract characteristics (Syarah et al., 2023). In many classrooms, conventional lecture-based methods still dominate the teaching process, which often positions students as passive recipients of information rather than active participants in learning activities. Although such methods are considered efficient for delivering material, they may lead to boredom and reduce student engagement in the learning process (Cindy et al., 2025; Noza & Wandira, 2024; Yufita & Sihotang, 2020).

The main problem arises from the relatively low learning outcomes achieved by students in algebraic topics, which are often influenced by less interactive teaching methods. Observations conducted at State Junior High School 6 Sorong, Indonesia, showed that although students appeared attentive during lessons, many experienced difficulties when completing algebraic exercises. As a result, students' learning motivation gradually decreased, and their understanding of the material remained limited (Isfayani, 2023; Mea et al., 2024; Pramesti & Retnawati, 2019). This situation indicates that traditional learning approaches may not sufficiently support students in understanding abstract mathematical concepts, particularly algebra.

The lack of motivation in mathematics learning can significantly affect students' focus, persistence, and willingness to engage in problem-solving activities. When students experience repeated difficulties without adequate instructional support, their

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confidence in learning mathematics tends to decline. Consequently, learning becomes less meaningful and less effective (Isfayani, 2023; Syarah et al., 2023; Syamsiyah et al., 2023). To address this issue, teachers need to implement more engaging and interactive learning approaches that can stimulate students' curiosity and active participation in the learning process.

One alternative approach that can be used to enhance students' engagement is the use of interactive learning media. The integration of game-based learning media has been widely recognized as an effective strategy to increase students' participation and motivation in mathematics learning (Beno et al., 2022; Setyadi & Saefudin, 2019). Game-based media allow students to learn mathematical concepts through enjoyable activities, enabling them to interact with learning materials in a more dynamic and meaningful way. In particular, traditional games adapted for educational purposes can create a learning atmosphere that encourages collaboration, active participation, and problem-solving skills.

Despite various studies discussing the implementation of learning media in mathematics education, there remains a gap in empirical research examining the effectiveness of game-based learning media specifically designed for algebra learning at the junior high school level. Previous studies have generally focused on the development of interactive media or educational games in broader mathematics contexts without specifically analyzing their impact on algebra learning outcomes among seventh-grade students (Beno et al., 2022; Setyadi & Saefudin, 2019). Furthermore, several studies that developed snakes and ladders learning media were primarily conducted at the elementary school level and focused mainly on increasing learning motivation rather than evaluating improvements in algebraic understanding (Nurussofa & Astuti, 2023; Sibuea et al., 2025). Therefore, the novelty of this study lies in integrating the snakes and ladders game with structured algebra problems designed specifically for junior high school students, while also empirically evaluating its effectiveness in improving students' algebra learning outcomes within the context of mathematics education in Sorong.

In addition, educational research emphasizes the importance of appropriate research designs in evaluating the effectiveness of instructional innovations implemented in classrooms. Mixed methods approaches are considered suitable because they allow researchers to combine quantitative measurements of learning outcomes with qualitative observations of student engagement and learning activities (Creswell & Creswell, 2023; Emzir, 2022; Waruwu, 2023). By employing this approach, researchers can obtain a more comprehensive understanding of how learning media influence both cognitive achievement and behavioral participation during the learning process.

The significance of this research lies in its potential to provide alternative learning innovations that can enhance students' engagement and achievement in mathematics learning, particularly in algebra. Interactive learning media have been shown to positively influence students' participation and motivation when implemented

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effectively in classroom settings (Beno et al., 2022; Mea et al., 2024). Moreover, innovative instructional strategies are increasingly needed to address students' learning difficulties in abstract mathematical topics and to support more effective learning environments (Noza & Wandira, 2024; Pradilasari et al., 2019). Therefore, the findings of this study are expected to provide practical implications for teachers in designing more engaging mathematics learning activities and contribute to the development of research-based instructional strategies aimed at improving algebra learning outcomes among junior high school students. Therefore, this study aims to evaluate the effectiveness of using snakes and ladders learning media in algebra mathematics learning to improve the learning outcomes of seventh-grade students.

METHODS

Research Design

This study employed a mixed methods approach that integrates quantitative and qualitative elements to obtain a comprehensive understanding of the effectiveness of the snakes and ladders learning media in algebra instruction. The research used a pre-experimental method with a one-group pretest–posttest design, in which a single group of participants was given a pretest before the intervention, followed by treatment using the snakes and ladders learning media, and concluded with a posttest to measure changes in learning outcomes. This design is considered appropriate for examining the impact of a single instructional intervention without the use of a control group, while still allowing the integration of numerical data and observational findings in educational research (Sugiyono, 2023; Waruwu, 2023; Emzir, 2022).

Participants and Research Setting

The population of this study consisted of all seventh-grade students at State Junior High School 6 Sorong, Indonesia**,** during the even semester of the 2024/2025 academic year. A purposive sampling technique was applied to select 29 students from class VII A as the research sample. The sample was chosen based on accessibility and the relevance of the class to the initial research problem, namely the relatively low algebra learning outcomes observed during preliminary classroom observations. This sampling strategy aligns with the principles of non-probability sampling commonly applied in pre-experimental educational research (Creswell & Creswell, 2023; Sugiyono, 2023).

Research Instruments

Several instruments were used to collect data in this study. These included a teaching module or lesson plan designed according to the snakes and ladders learning model, pretest and posttest assessments to measure students' algebra learning outcomes, observation sheets to record student learning activities during the implementation of the learning media, and documentation of the teaching and learning process. The pretest and

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posttest focused on algebraic topics such as algebraic forms, arithmetic operations involving algebraic expressions, and factorization. Meanwhile, the observation sheets were used by observers to record students' participation and engagement during the learning activities.

Data Analysis Techniques

The collected data were analyzed using both descriptive and inferential statistical techniques. First, the Kolmogorov–Smirnov or Shapiro–Wilk normality test was conducted using SPSS to determine whether the data distribution met the assumption of normality. These analytical procedures were applied to ensure the validity and reliability of the research findings through systematic statistical analysis (Sudaryono, 2022; Priadana et al., 2024; Ritonga et al., 2025).

Research Procedure

The research procedure began with the administration of a pretest to measure students' initial understanding of algebraic concepts, including algebraic forms, algebraic operations, and factorization. After the pretest, the learning intervention was implemented through three learning sessions using a snakes and ladders game board measuring 2 × 2 meters. Students were divided into six groups, and each group participated in the learning activity collaboratively. During the learning sessions, the teacher provided instructions, motivation, and explanations of the game rules, where each square on the board contained algebra-related problems that students needed to solve. Students discussed the problems within their groups before advancing in the game. Throughout the learning process, three independent observers recorded student participation and classroom dynamics using observation sheets. The research concluded with the administration of a posttest and subsequent data analysis to evaluate the improvement in students' learning outcomes. The implementation of the procedure was conducted systematically to maintain data quality and ensure adherence to educational research ethics (Emzir, 2022; Waruwu, 2023).

RESULTS AND DISCUSSION

Results

This research was conducted in class VII A of State Junior High School 6 of Sorong City with 29 students as subjects. The research took place over four meetings during the even semester.

Implementation of learning using snakes and ladders media

The learning process began with a pretest to determine students' initial abilities in algebra. The pretest results showed that most students still had difficulty understanding algebraic concepts, particularly in algebraic forms, algebraic operations, and factoring. Subsequent learning activities were conducted in three meetings using the snakes and ladders learning media. At each meeting, the learning process began with a

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brief briefing, motivational giving, and a brief explanation of the material and rules of the snakes and ladders game. Students were then divided into six groups of 4–5 students. The snakes and ladders media used was printed in the form of a 2 × 2 meter banner and placed on the classroom floor so that students could play directly. Each game box contained algebra problems that had to be solved in groups. Students were required to discuss with their group members before answering the questions they received.

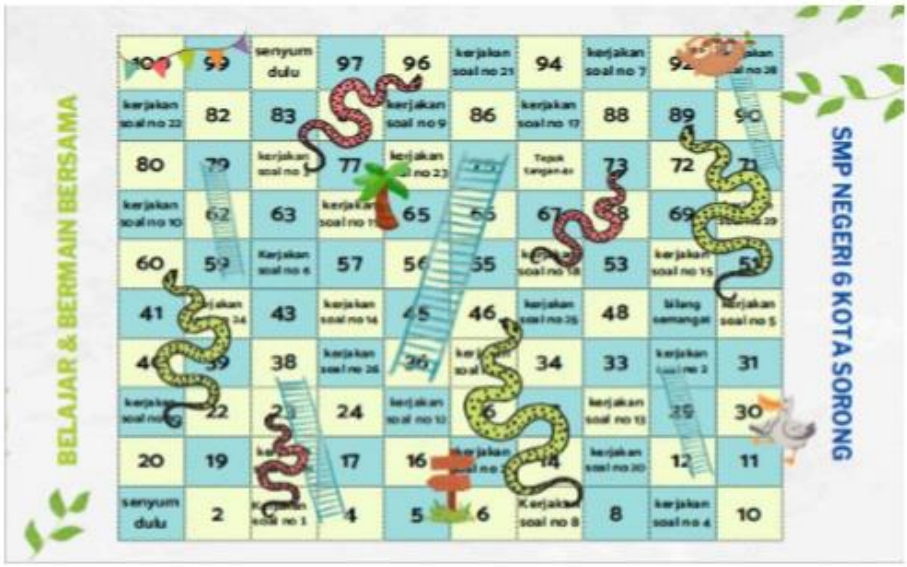

Figure 1. The snakes and ladders media

To support the observation process, the researcher was assisted by three observers. Each observer was tasked with observing two groups using a prepared observation sheet. Aspects observed included student activity, group cooperation, participation in answering questions, and student engagement during the learning process.

Student Activities and Activeness

Observations of student activity during the lesson showed that students were actively involved in the learning process. Students were enthusiastic about participating in games, discussing with group members, and participating in solving the algebra problems given. The percentage of student activity reached 68%, falling into the "high" category."Active". This shows that the snakes and ladders media is able to increase student involvement in the learning process.

Table 1. Percentage of Student Activity Observations

	Total			
Day	Student Learning Engagement	Concept Understanding	Problem Solving Skills	Group Cooperation
H-1	83	82	79	77
H-2	96	96	100	100
H-3	121	121	116	118

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Percentage	69%	69%	68%	68%
Average	68%			
Overall category	Active			

Based on the results of observations of student activities in Table 1, there was an increase in student activity during the three meetings based on indicators of engagement, conceptual understanding, problem-solving skills, and group collaboration. In the engagement indicator, the score increased from 83 (69%) on D-1 to 121 on D-3, indicating that students were increasingly active in learning. Conceptual understanding also increased from a score of 82 (69%) to 121, indicating that students' understanding of the material was improving. Problem-solving skills increased from 79 (68%) to 116, while group collaboration increased from 77 (68%) to 118. These results indicate that learning was effective and encouraged student activity and understanding.

Table 2. Student leactivity level

Category	Percentage Range	Number of Students	Percentage
Very active	$80\% \leq A \leq 100\%$	5 students	17%
Active	$60\% \leq A < 80\%$	13 students	45%
Quite Active	$40\% \leq A < 60\%$	9 students	31%
Less Active	$20\% \leq A < 40\%$	2 students	7%
Not active	$0\% \leq A < 20\%$	0 students	0%

Based on the table, it can be concluded that most students are in the categoryActive by 45% and Moderately Active by 31%, indicating that learning using the snakes and ladders media can increase student participation in the learning process. Furthermore, as many as 5 students (17%) are included in the Very Active category, indicating a very high level of engagement. Meanwhile, only 2 students (7%) are classified as Less Active, and there are no students in the Inactive category. Classically, the percentage of student activity reached 68% and is included in the Active category.

Student Learning Outcomes

Table 3. The average value of learning outcomes is calculated from the pretest and posttest values.

No	Category	Pretest	Posttest
1.	Number of Students	29	29
2	Lowest Value	0	0
3	The highest score	48	83
4	Total Value	224	1257
5	Average Value	7,724	43,344
6	Standard Deviation	10.23	24.47

Based on the number of students who took the pretest and posttest, there were 29 students. The lowest score on both tests was 0, which was due to students who did not

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take the posttest and thus received a score of zero. This absence could be influenced by health factors or certain permits and needs to be considered in the learning evaluation. Nevertheless, the highest score increased from 48 in the pretest to 83 in the posttest. The total student score also increased from 224 to 1257, along with an increase in the average score from 7.72 to 43.34. The standard deviation increased from 10.23 to 24.47, indicating a variation in student abilities. In general, student learning outcomes improved after the learning.

The analysis of the completeness of student learning outcomes was carried out based on the Minimum Completeness Criteria (KKM) applicable at State Junior High School 6 of Sorong City, especially in the subject of mathematics, namely 71, so the level of achievement of students' mathematical learning outcomes in a classical manner can be seen in the image below.

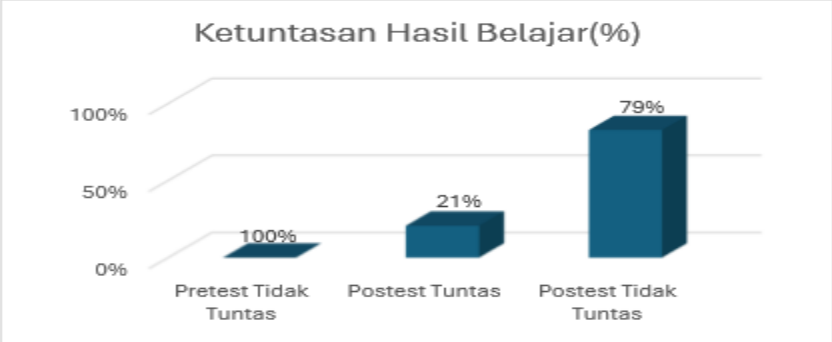

Figure 2. Students' Mathematical Learning Outcomes

Based on the Figure above, of the 29 students who participated in the learning, as many as 6 students (21%) have achieved learning completion, while 23 students (79%) have not met the Minimum Completion Criteria (KKM). This percentage indicates that the level of completion of student learning outcomes is still in the very low category (Pradilasari et al., 2019). However, there was an increase compared to the initial condition in the pretest, where no students achieved completion. After learning using the snakes and ladders media, the percentage of completion increased to 21%, which indicates a positive impact on student learning outcomes. However, these results do not meet the classical completion standards, so improvements in learning strategies and further guidance are needed so that students' understanding of the algebra material can increase optimally.

Knowledge Gain (N-Gain) is used to determine the extent of student achievement after receiving a specific treatment or learning process. The analysis data includes the sample class average, standard deviation, minimum score, and maximum score. This increase is also supported by the N-Gain results, which can be seen in the table.

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Table 4. Descriptive Analysis Results

Deskriptif Statistik Skor Pretest-Postest					
	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_score	29	-.03	.79	.4086	.22705
Ngain_persen	29	-3.09	79.38	40.8640	22.70514
Valid N (listwise)	29				

Based on the results of the descriptive analysis in Table 4, the minimum N-Gain score was 0.03 and the maximum value was 0.79. The average (mean) N-Gain score was 0.41 with a standard deviation of 0.23. Meanwhile, the minimum N-Gain percent value was recorded at -3.09 and the maximum value was 79.38, with an average value of 40.86 and a standard deviation of 22.71. Based on the average N-Gain value of 0.41, the increase in student learning outcomes quantitatively falls into the "Moderate" category.

Discussion

Based on the results of observations of the implementation of learning, it shows that the use of the snakes and ladders media in mathematics learning is running well, with an average implementation percentage of 74%, which is included in the "Good" category. Teachers are able to implement learning according to the plan, starting from explaining the use of the media, providing an introduction to the material, and guiding students throughout the learning process (Setyadi & Saefudin, 2019). The highest implementation aspect is found in the introductory activity of algebra material with a percentage of 95%, while the lowest aspects are student enthusiasm and the provision of feedback by the teacher, which each reached 60%. These results indicate that although the snakes and ladders media is effective in creating a pleasant learning atmosphere, efforts are still needed to improve student engagement, conceptual understanding, and the quality of interaction between teachers and students (Beno et al., 2022).

Based on the research results, the use of the snakes and ladders learning media demonstrated effectiveness in increasing student motivation and activity. The percentage of student learning motivation reached 75%, falling into the "High" category, while student activity at 68% fell into the "Active" category. This indicates that the snakes and ladders media is able to create an engaging and enjoyable learning environment and encourage active student engagement in the learning process.

However, the increase in motivation and activity has not yet had an optimal impact on student learning outcomes. The average posttest score only reached 43.34 and is still below the learning effectiveness limit (>65). Furthermore, the level of student learning completion is classified as "Very Low," as only 21% of students achieved the Minimum Completion Criteria (KKM), far from the classical completion standard of

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80%. Nevertheless, the average N-Gain score of 0.4086 is in the "Moderate" category, indicating an increase in student knowledge compared to the initial condition. Differences in students' initial abilities, limited learning time, and the lack of reflection sessions and material reinforcement are suspected to be factors that influence suboptimal learning outcomes, even though student motivation and activity have increased.

CONCLUSION

This study concluded that the use of snakes and ladders media in learning algebra mathematics for class VII A of State Junior High School 6 of Sorong City succeeded in increasing student activity up to 68% in the active category, with an increase in observation scores on indicators of involvement, conceptual understanding, problem solving, and group cooperation during three meetings. The average value of learning outcomes increased from 7.72 in the pretest to 43.34 in the posttest, supported by an average N-Gain value of 0.41 which is included in the moderate category, even though learning completeness only reached 21% or very low against the KKM 71. This main finding confirms the potential of snakes and ladders media as an interactive tool that creates a fun atmosphere, encourages group discussions, and motivates students towards abstract algebra material.

However, limitations of the study include the one-group pretest-posttest design without a control group, which makes it difficult to isolate the absolute effect of the media, as well as student absences that affected the lowest scores and high standard deviation variation (24.47), plus limited learning time and the lack of in-depth reflection sessions. For further research, it is recommended to use a quasi-experimental design with a comparison group, a larger sample size, and long-term measurements to test learning retention, as well as adapting digital media for flexibility. Practically, the implications of this study encourage mathematics teachers to adopt the snakes and ladders media as an innovative alternative to increase motivation, especially in schools with similar challenges, with adjustments to the questions according to students' ability levels to optimize completion.

REFERENCES

Beno, M., Sari, D., & Rahman, A. (2022). Implementation of interactive learning media to increase student participation in mathematics learning. Journal of Mathematics Education, 11(2), 145–154.

Cindy, S., Putri, J., Nuraziza, Q., & Lestari, PA (2025). Teacher strategies in increasing student learning motivation through interactive learning at STATE JUNIOR HIGH SCHOOLNegeri 6, Bengkulu City. Qalam Journal, 14(1), 21–26.

Creswell, J. W., & Creswell, J. D. (2023). Research design: Qualitative, quantitative, and mixed methods approaches (6th ed.). Sage Publications.

DOI: ...../JIES....

Emzir. (2022). Educational research methodology: Quantitative and qualitative. RajaGrafindo Persada.

Isfayani, E. (2023). Analysis of mathematics learning difficulties in algebraic forms for seventh-grade junior high school students. Malikussaleh Mathematics Education Journal, 3, 79–90.

Isnaini, RA, Rahmawati, R., Ramadani, NO, Martiza, S., Saputri, Z., & Efendi, D. (2026). Analysis of student learning activities in mathematics learning. Algebra: Journal of Educational, Mathematics and Earth Sciences, 2.

Jayanti, AD, Safitri, MC, Yeni, Y., & Kusno, K. (2025). Critical analysis of the thinking of Thorndike, Skinner, and Ausubel as a foundation for learning mathematics. Scientific Journal of Mathematics (JIMAT), 6, 681–699.

Mea, F., Tinggi, S., Kristen, A., Bangsa, A., Guru, K., Guru, I., & Dinamis, K. (2024). Teacher creativity and innovation in creating effective learning. Inculco Journal of Christian Education, 4(3), 252–275.

Noza, AP, & Wandira, RA (2024). The importance of learning methods in the learning process. Journal of Interdisciplinary Scientific Studies, 8(4), 158–164.

Nurussofa, R., & Astuti, HP (2023). Development of snakes and ladders game learning media to increase elementary school students' motivation to learn mathematics. SIGMA Journal of Learning and Mathematics (JPMS), 9(1), 22–28.

Pradilasari, L., Gani, A., & Khaldun, I. (2019). The influence of learning models on student learning outcomes in science material. Indonesian Journal of Science Education, 7(2), 75–83.

Prambudi, EY, & Yunianta, TNH (2020). Development of Bus Race Algebra media on algebra material. Jurnal Cendekia: Jurnal Pendidikan Matematika, 4(1), 8–22.

Pramesti, T., & Retnawati, H. (2019). Difficulties in learning algebra: An analysis of students' errors. Journal of Physics: Conference Series, 1320(1).https://doi.org/10.1088/1742-6596/1320/1/012061

Priadana, S., Rahmat, A., & Putri, D. (2024). Educational research methods and statistical data analysis. Alfabeta.

Ratnasari, A., & Jasiah, J. (2026). Development of mathematical snakes and ladders media on student learning activity in addition and subtraction. Journal of Mathematics Education and Learning, 5, 57–65.

Ritonga, A., Siregar, M., & Lubis, R. (2025). Statistical analysis of education using SPSS. Journal of Educational Research, 15(1), 45–55.

Sakiah, N.A., Effendi, S., & Nia, K. (2021). Analysis of the needs of PowerPoint-based interactive multimedia for algebra material in junior high school mathematics

DOI: ...../JIES....

learning. Journal of Mathematics Education and Teaching Research, 7(1), 39–48.https://doi.org/10.37058/jp3m.v7i1.2623

Setyadi, D., & Saefudin, A. (2019). The influence of using learning media on student learning activities. Journal of Mathematics Education, 13(2), 112–120.

Sibuea, MFL, Sembiring, MA, & Adinda, F. (2025). Development of an educational game of algebraic snakes and ladders as an alternative strategy for elementary school mathematics learning. Journal of Science and Social Research, 8, 3583–3588.

Sudaryono. (2022). Educational research methodology. Kencana.

Sugiyono. (2023). Quantitative, qualitative, and R&D research methods. Alfabeta.

Syamsiyah, SN, Kanora, DC, & Sofyan, H. (2023). Development of educational game tools snakes and ladders numeracy to improve students' mathematical abilities. Journal of Educational Technology and Learning (JTPP), 1(1), 266–271.

Syarah, F., Harahap, YN, & Putri, JH (2023). Students' difficulties in learning algebra material. Journal on Education, 5(4), 16067–16070.

Waruwu, M. (2023). Educational research approaches: Quantitative, qualitative, and mixed methods. Journal of Education, 12(1), 1–12.

Yufita, Y., & Sihotang, H. (2020). Transformational leadership and teacher empowerment in education transformation 4.0. Journal of Educational Dynamics, 13(2), 204–215.https://doi.org/10.33541/jdp.v13i2.1754