Inovasi Kurikulum

Strengthening critical thinking through joyful learning implementation using the semantic wave approach

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ABSTRACT

Along with the rapid advancement of technology, critical thinking skills have become essential competencies for students. However, in education, many learning methods remain conventional and do not yet optimally support the development of students' critical thinking skills. Implementing joyful learning in combination with the semantic wave approach, it is expected that students will gain a learning experience that is more enjoyable, meaningful, and systematically structured. The purpose of this study is to analyze the effectiveness of applying joyful learning with the semantic wave approach in enhancing students' critical thinking abilities. This research utilizes the Classroom Action Research (CAR) method, consisting of three cycles designed to evaluate the implementation of joyful learning based on the semantic wave approach. The results indicate a significant increase in pretest and posttest scores, with an average improvement, accompanied by a reduction in students' learning achievement gaps. Furthermore, findings from the pre-cycle stage revealed low levels of motivation, engagement, and analytical skills among students in understanding the material. Through the implementation of the joyful learning model based on the semantic wave approach, there was a proven increase in students' active participation, gradual conceptual understanding, and overall learning outcomes.

ABSTRAK

Seiring dengan pesatnya kemajuan teknologi, keterampilan berpikir kritis menjadi salah satu kompetensi penting yang perlu dimiliki oleh peserta didik. Meskipun demikian, realitas di dunia pendidikan menunjukan bahwa metode pembelajaran masih banyak yang bersifat konvensional dan belum optimal dalam mendukung pengembangan keterampilan berpikir kritis murid. Penerapan joyful learning yang dipadukan dengan pendekatan semantic wave, diharapkan dapat menyebabkan murid memperoleh pengalaman belajar yang lebih menyenangkan, bermakna, dan terstruktur secara sistematis. Tujuan penelitian ini untuk menganalisis efektivitas penerapan joyful learning dengan pendekatan semantic wave dalam meningkatkan kemampuan berpikir kritis murid. Penelitian ini menggunakan metode Penelitian Tindakan Kelas (PTK) yang terdiri dari tiga siklus, yang dirancang untuk mengevaluasi implementasi joyful learning berbasis semantic wave. Hasil penelitian ini menunjukan nilai pretest dan posttest meningkat signifikan, dengan rata-rata nilai meningkat, disertai kesenjangan hasil belajar murid semakin kecil. Selain itu, temuan pada tahap pre-cycle menunjukkan rendahnya motivasi, keterlibatan, dan kemampuan analisis murid dalam memahami materi. Melalui implementasi model joyful learning berbasis semantic wave yang dilakukan, terbukti terjadi peningkatan partisipasi aktif murid, pemahaman konsep secara bertahap, serta hasil evaluasi belajar.

Kata Kunci: *berpikir kritis; joyful learning; pembelajaran abad ke-21; semantic waves*

INTRODUCTION

In the era of globalization and rapid technological development, critical thinking skills have become essential competencies in 21st-century learning. (Milala *et al*., 2024). This ability is essential for students to analyze, evaluate, and develop solutions to real-world problems. (Lo *et al*., 2023). However, the reality in educational settings shows that the learning methods implemented in schools are still conventional and do not encourage students to think critically and deeply. Learning that focuses on memorization and minimal interaction often results in low student motivation and engagement in the learning process. This presents a challenge for teachers in creating learning models that can foster active and meaningful critical thinking skills. (Correia *et al*., 2023). One of the main challenges in conventional learning is the lack of strategies to help students understand the material more deeply and relate it to everyday contexts. (Dzattadini *et al*., 2025; Ritter & Standl, 2023).

Many students have difficulty analyzing concepts because the learning methods used are not interactive enough and do not facilitate more complex thinking exploration. (Dlamini & Dewa, 2022). Therefore, innovations in learning are needed that are not only engaging but also able to increase students' active involvement in critical thinking and problem-solving processes. *Joyful learning* seeks to reduce academic pressure, which often makes students feel stressed and lose interest in learning, by introducing elements of fun into learning. (Masayu *et al*., 2025). Some common methods used in joyful learning include gamification, where game elements such as quizzes, puzzles, and project-based challenges are used to increase interactivity; experiential learning, which invites students to explore concepts through simulations and real-life experiments; collaboration-based learning, where students work in small groups to discuss and solve problems together; and multimodal learning, utilizing various digital media, such as video, animation, and interactive applications. (Mubarok *et al*., 2024).

The *semantic wave* approach can be applied in the joyful learning process to create a learning experience that is both enjoyable and profound. (Zhao & Zheng, 2024). *Semantic Wave helps students understand material gradually, connecting abstract concepts with concrete examples from everyday life and then returning to higher levels of abstraction to build conceptual understanding. Furthermore, the integration of joyful learning and the semantic wave approach in student study guides can help students develop critical thinking skills gradually and systematically. Students are encouraged to understand concepts from simpler perspectives before moving on to more complex concepts, so they are better prepared to analyze and apply these concepts in various situations.* (Msusa, 2019). This approach can be an innovative solution in 21st-century learning, where students are required to not only memorize information but also be able to process, evaluate, and apply their knowledge critically in real life. (Feriyanto & Anjariyah 2024).

Previous findings suggest that the application of semantic waves has a positive impact on improving algorithmic skills in computer education, thereby facilitating the development of algorithmic reasoning. (Ritter & Standl, 2024). Other findings suggest that the formation of multimodal semantic waves in the classroom strengthens the movement from concrete to conceptual understanding when guided by explicit teaching strategies. (Zhao & Zheng, 2024). Different from previous findings that only examined the semantic wave and joyful learning separately, this study examines the integration of joyful learning and the semantic wave for critical thinking skills. Based on this research and the previously described problems, this study aims to examine in greater depth the strengthening of critical thinking skills through the implementation of joyful learning using the semantic wave method in informatics for grade 10 at the Sekolah Menengah Atas (SMA) level. This study is expected to provide a comprehensive overview of both the process and results of the implementation of the applied learning strategy.

LITERATURE REVIEW

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Joyful Learning in Learning

Joyful learning is an approach that emphasizes the importance of a fun, participatory, and enthusiastic learning environment. The goal is to increase students' emotional engagement and motivation throughout the learning process. (Nafi'ah & Faruq, 2025). Within this framework, positive emotions are seen as a crucial factor in supporting academic success. Students who learn in a pleasant environment tend to understand and remember the material more easily because they are not under pressure. (Sya'ro & Dewi, 2022). *Joyful learning is designed to create a learning experience that is fun, interactive, and motivates students to be more actively involved in the learning process.* (Permana *et al*., 2022; Yasid, 2025). This approach is based on the principle that a positive learning environment can enhance students' understanding, facilitate concept exploration, and help them develop critical thinking skills more effectively. (Ghifari *et al*., 2022).

Joyful learning can be implemented through various strategies, such as the use of educational games, project-based learning, creative group work, and the use of interactive media like videos, animations, and simulations. This approach makes students active participants in the learning process. They not only receive information but also actively construct knowledge through interaction and experience. (Masayu *et al*., 2025). Implementing the *joyful learning* method can improve student learning outcomes and motivation, especially in subjects that tend to be considered difficult. This approach contributes to the development of social skills such as collaboration, communication, and empathy. When students feel happy, they are more open to expressing their opinions and working together with their peers. (Mubarok *et al*., 2024).

Semantic Wave Approach in Learning

In learning practice, the unpacking process occurs when teachers simplify abstract concepts into something more concrete and easier for students to understand. Conversely, the repacking process occurs when students are guided to restructure their understanding at a more abstract and complex level. This movement of meaning is called "semantic waves," which is an indicator that learning is dynamic and in-depth. The semantic wave approach is a pedagogical concept derived from *Legitimation Code Theory* (LCT) and is used to analyze knowledge practices in education. Semantic waves are a pedagogical strategy that allows students to gradually understand a concept, starting from a simple and concrete understanding to a more complex and abstract analysis. (Fathimah *et al.,* 2025; Tang *et al.,* 2024). This model explains how meaning in the learning process can be expanded or condensed through movement between concrete and abstract understanding. Using this approach can increase the connection between the concepts taught and students' real-life experiences. (Hipkiss & Windsor, 2023).

This helps students not only in understanding procedures, but also in linking learning activities with the underlying theoretical principles, so that students' understanding is not fragmented, but rather systematic and reflective. (Zhao & Zheng, 2024). The two main components of the semantic wave are: 1) Semantic Gravity (SG), which describes the extent to which a concept is connected to a real context; and 2) Semantic Density (SD), which indicates the level of complexity of a concept. (Correia *et al*., 2023). SG refers to the initial stage of learning, where the material is explained in a simpler form and is relevant to students' daily experiences so that it is easier to understand (Correia *et al*., 2023). Then, in the transition stage, concepts begin to be expanded by connecting them to deeper theories. In the final stage, SD is applied to increase the complexity of the material, encourage students to conduct in-depth analysis, and connect learned concepts to broader contexts.

Critical Thinking as a 21st Century Skill

Critical thinking is a cognitive competency that enables a person to evaluate information logically, solve problems rationally, and make decisions based on evidence. (Chashechnikova *et al*., 2025). In the context of education, these skills are included in the four core competencies of the 21st century, known as the 4Cs, consisting of Critical Thinking, Creativity, Collaboration, and Communication. Critical thinking is not only limited to the ability to refute or question, but also includes the skills of constructing strong arguments, reflecting on ideas, and evaluating diverse viewpoints. In learning activities, students who have critical thinking skills can connect previous knowledge with new information, analyze data, and develop appropriate solutions to a problem. Unfortunately, the traditional learning system, oriented towards memorization, still dominates in many schools. This makes it difficult for students to develop critical thinking skills optimally. (Ummah & Azmi 2020). Therefore, it is necessary to implement learning strategies that encourage exploration, problem-solving, and active engagement. *Joyful learning* and the semantic wave can be effective alternatives for creating an open and interactive thinking space for students. (Mutiara *et al*., 2024).

METHODS

This study uses the Classroom Action Research (CAR) method with the Kemmis and Taggart model, consisting of three cycles, designed to evaluate the implementation of semantic wave-based joyful learning in student learning guides to improve critical thinking skills. Data collection in this study was carried out using a mixed method approach, namely, combining qualitative and quantitative data so that the results obtained are more comprehensive, valid, and in-depth. Qualitative data were collected through observations of student activities during learning, reflection notes, documentation, and short interviews to determine student involvement and responses to the implementation of semantic wave-based joyful learning. Meanwhile, quantitative data were obtained through critical thinking skills tests in the form of pretests and posttests in each cycle to measure student improvement, as well as questionnaires or assessment rubrics that support the analysis of learning outcomes. In this study, 36 grade X SMA students of Kartika became the research subjects, with the role of teachers as learning facilitators, students as active participants in understanding and applying concepts gradually, and observers who recorded the implementation of learning and the development of student understanding.

Figure 1. Research Flow
Source: Author Documentation 2025

Based on Figure 1, it is clear that in the pre-cycle stage, or initial cycle, the research began by analyzing the initial learning conditions to understand the extent to which conventional approaches affected student engagement and understanding. This stage included direct classroom observations to record student participation in discussions, their problem-solving abilities, and understanding of the material without the innovative approach. Furthermore, diagnostic assessments, such as open-ended questions and pretests, were conducted to obtain quantitative and qualitative insights into students' basic understanding. An initial survey was also used to determine students' perceptions, interests, and preferences for the semantic wave-based joyful learning method, thereby identifying the model's motivational potential. The results of this initial analysis then served as the basis for designing more appropriate learning strategies in subsequent cycles. In Cycle 1, learning focused on strengthening SG, namely, transforming abstract concepts into more concrete and contextual concepts for easier understanding. Teachers implemented various joyful learning strategies such as gamification, interactive media, material visualization, group discussions, and real-life experience-based assignments. Student engagement was monitored through an assessment rubric, and students were asked to reflect on themselves through critical thinking self-assessments.

If difficulties in understanding are encountered, the learning strategy will be adjusted in the next cycle to be more effective. Entering Cycle 2, learning is directed at moving students from concrete to deeper conceptual understanding. They begin training in academic language, working on case studies, simulations, and problem-solving tasks that require the ability to connect concepts to complex situations. Teachers facilitate open-ended questions to encourage reflection and critical thinking, while student

understanding is evaluated through interviews, analytical tasks, and critical thinking rubrics. If there are still difficulties in connecting concepts systematically, teachers implement scaffolding strategies for reinforcement. In Cycle 3, the focus is directed at improving SD, namely, students' ability to reconnect concrete concepts to broader theories in an abstract and academic way. Students are challenged to complete problem-based projects, discuss using logical arguments, and reflect on the application of concepts in various contexts. Success is measured by comparing pretest and posttest scores and an analysis-evaluation-synthesis rubric. After all cycles are completed, a posttest is conducted, and data analysis is carried out using mixed methods, combining statistical analysis (mean, standard deviation, normality test) with thematic analysis from observations, interviews, and self-assessments. If there is a significant increase in critical thinking skills, the model is deemed effective; if not, reflection is needed to improve the implementation strategy to make it more optimal.
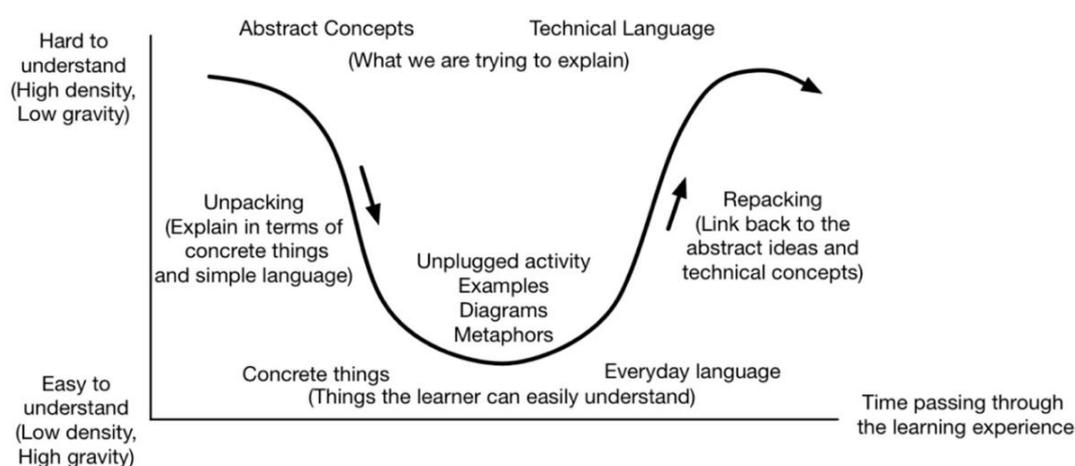
Correlation of Semantic Wave with PTK Research Method

Figure 2. Correlation of Semantic Wave with the Classroom Action Research Method
Source: Author's Documentation 2025

Figure 2 shows the relationship between the semantic wave framework and the stages in Classroom Action Research (CAR) applied in this study. At the Abstract Concepts (High Density, Low Gravity) stage, which is connected to the Pre-Cycle (initial observation), students generally do not yet understand the concept in depth. (Auniillah *et al*., 2025). The main focus is to analyze students' initial understanding by assessing their understanding of the material through a conventional approach before implementing the semantic wave-based joyful learning model. Therefore, a pretest and initial survey were conducted to obtain data on students' level of understanding of the basic concepts to be developed. The results of this stage serve as the basis for designing learning strategies in the next cycle. Next, the Unpacking stage (Concrete Things & Simple Language) is represented by Cycle 1, where abstract concepts are explained using simple language and concrete examples to make them easier for students to understand. Teachers utilize analogies, diagrams, and exploratory activities, such as unplugged activities, to strengthen students' basic understanding.

This process is complemented by the use of interactive media, group discussions, and a hands-on, experiential approach. Once students grasp the basic concepts, they move on to the Everyday Language (Things the Learner Can Easily Understand) stage in Cycle 2, where students begin to connect concrete concepts to more complex theories. The learning process at this stage is supported by discussions, case studies, problem-solving, collaborative strategies, and digital technology to increase student engagement. Then, in Repacking (Link Back to Abstract & Technical Concepts), reflected in Cycle 3, students are

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expected to be able to reconnect concrete concepts to more complex abstract concepts. Teachers implement project-based learning and problem-solving challenges to test the application of concepts, while students are encouraged to conduct presentations, reflections, and argument-based discussions to deepen their understanding. Finally, the Technical Language (Abstract Understanding) stage is realized through data analysis, namely comparing pretest and posttest results to assess improvements in students' critical thinking skills. If students are able to systematically connect simple concepts to abstract ones, then the semantic wave-based learning strategy is declared successful and effective.

RESULTS AND DISCUSSION

Pre-Cycle Stage (Abstract Concepts-High Density, Low Gravity)

In the pre-cycle stage, it was found that the learning process was still conventional, with abstract concepts delivered without contextual bridges. Based on observations, students appeared passive, lacked enthusiasm, and had difficulty understanding the concepts presented. This indicates that learning with high SD and low SG did not provide adequate epistemic access for students. Pretest data supported these findings, where some students were unable to interpret concepts in depth and still had difficulty connecting theory to real phenomena. This condition provides an important basis for designing more meaningful learning interventions through a semantic wave-based joyful learning approach.

Descriptive Statistical Analysis of Pretest and Posttest

Table 1. Descriptive Statistical Analysis of Pretest and Posttest Scores

	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Mean Std. Error	Std. Deviation
Pretest	36	50	100	81.31	1.897	11.384
Posttest	36	63	100	89.89	1.477l	8.860
Total	36	120	200	171.19	3.130	18.783
Valid N	36					

Source: Research 2025

Table 1 shows that all students fully participated in both stages of the evaluation. This is demonstrated by the Valid N (listwise) value of 36, indicating no missing data. The analyzed data were complete and representative to illustrate learning outcomes before and after the intervention. The pretest scores showed that the minimum student score was 50 and the maximum reached 100. Meanwhile, in the posttest, the minimum score increased to 63, with the maximum score remaining at 100. This indicates an increase in the basic level of material mastery, especially for students who previously scored low. The increase in the minimum score from 50 to 63 indicates that the learning intervention had a positive impact on students who previously had a weaker understanding.

The pretest results showed an average score of 81.31. After implementing the semantic wave-based joyful learning strategy, students' average score increased to 89.89, an average increase of 8.58 points. This increase indicates that, in general, the learning intervention significantly improved students' critical thinking skills. The standard error of the mean, a measure of the accuracy of the average estimate, decreased from 1.897 in the pretest to 1.477 in the posttest. This decrease in the standard error indicates that the average posttest score estimate is more stable and has a higher level of confidence. This suggests that score increases are more consistent across students.

The standard deviation for the pretest was recorded at 11.384, while for the posttest it dropped to 8.860. This decrease in the standard deviation reflects a smaller variation in scores between students after the intervention. In other words, student learning outcomes became more evenly distributed, not confined to a specific group of students. The minimum total score was 120, and the maximum reached 200, with an average score of 171.19 and a standard deviation of 18.783. Although this total score was not the primary focus of the analysis, this information is still useful in assessing the accumulation of student achievement throughout the learning process. These statistical data illustrate that the semantic wave-based joyful learning approach can create an effective and enjoyable learning experience for students. This not only resulted in an increase in average scores but also reduced the performance gap between students. This learning model allows students to gradually grasp concepts, moving from the concrete to the abstract, ultimately improving their critical thinking skills.

Cycle 1 - Unpacking (Concrete Things and Simple Language)

Figure 3. Student Worksheet 1
Source: Author's Documentation 2025

In cycle 1, learning was conducted using a Culturally Responsive Teaching (CRT) approach that focused on the practice of creating a simple network connection (straight cable) using a UTP cable and RJ-45 connector, as shown in Figure 3. The teacher used simple language, concrete analogies, and practical activities (unplugged simulation) so that students could understand network concepts contextually. This approach helped students ground abstract concepts in real-world experiences, as in SG theory. In general, students showed increased activity during the practical activities. However, in the initial stages of the theoretical explanation using learning videos, some students still appeared less enthusiastic. Nevertheless, the hands-on practical activities succeeded in increasing student engagement and strengthening their basic understanding of computer network concepts.

Cycle 2 - *Everyday Language (Things the Learner Can Easily Understand)*

Figure 4. Student Worksheet 2
Source: Author's Documentation 2025

In Cycle 2, the CRT approach was continued, this time focusing on creating cross-cable connections, as shown in Figure 4. Continuing from the previous cycle, students appeared more confident and enthusiastic. They were able to connect previous practical experiences with the new concepts being taught. At this stage, the teacher facilitated collaborative discussions using everyday language, making it easier for students to understand technical terminology, which was then gradually formalized into academic language. This process reflects the point of lowest semantic gravity, where students begin to build bridges to more complex conceptual understanding. Observations showed that students were better able to connect concrete experiences with theoretical concepts of computer networks, in line with findings in the LCT literature on semantic climbing. (Hipkiss & Windsor, 2022; Zhao & Zheng, 2024).

Cycle 3 - *Repacking (Link Back to Abstract and Technical Concepts)*

Figure 5. Student Worksheet 3
Source: Author's Documentation 2025

In cycle 3, the focus of learning was on the topic of Intellectual Property Rights (IPR) using a Problem-Based Learning (PBL) approach. Students were then asked to complete worksheets containing case study questions (see **Figure 5**). This strategy was chosen because IPR material is contextual and requires critical thinking skills. Students were given real-life cases related to copyright infringement in the digital era, then asked to analyze and design solutions collaboratively. Through this activity, students practiced repackaging, namely, restructuring the understanding they had acquired into a more abstract and complex conceptual structure. Students were able to construct evidence-based arguments and generalize concepts, thus demonstrating SD improvement. The PBL strategy has proven effective in improving students' Higher Order Thinking Skills (HOTS) and raising awareness of the importance of digital ethics.

Data analysis

Table 2. Analisis Data dan Peningkatan *Technical Language* Murid

Analysis Aspects	Observed indicators	Quantitative and Qualitative Data	Findings	Interpretation of Technical Language Enhancements
Learning Outcomes (Test Scores)	Average pretest and posttest scores	*Pretest = 81.31* *Posttest = 89.89* *Improvement = +8.58 points*	There was a significant increase in average learning outcomes after implementing *the joyful learning × semantic wave approach.*	The improved scores indicate that students are better able to understand technical concepts conceptually and in a structured manner.

Analysis Aspects	Observed indicators	Quantitative and Qualitative Data	Findings	Interpretation of Technical Language Enhancements
Distribution of Scores (Score Variation)	Standard Deviation and Standard *Error*	*Pretest* SD = 11,384 *Posttest* SD = 8,860	Score variation across students decreased, indicating more equitable improvement.	Mastery of technical language improved not only among high-achieving students but also across the entire student group.
Learning Activities (Observation)	Activity and participation in discussions and practical exercises	Increased activity from 65% to 92% (classroom observation)	Students are more active in asking questions and explaining concepts using technical terms.	Students are beginning to use terms such as *UTP cable, cross connection, data transmission,* and *network topology* correctly.
Use of Technical Language (Interviews and Worksheets)	Accuracy of technical terms and academic sentence structure	78% of students used technical terms correctly (Cycle 3) compared to 45% (Pre-Cycle)	There has been a significant increase in the use of academic and technical language.	Students can explain the concept of computer networks and intellectual property rights using formal and coherent language structures.
Critical Thinking and Argumentation Skills	Ability to explain logical reasons in projects/discussions	The average argumentative ability score increased from 3.2 to 4.5 (scale 1-5)	Students can link theory with practice and provide technical justification.	This increase indicates a semantic climb from concrete understanding to abstraction and generalization of concepts.
Reflection and Metacognitive Awareness	Student self-assessment and reflection results	85% of students stated they were more confident using technical terms and understanding concepts.	Students can identify errors, correct them, and re-explain concepts correctly.	Reflection shows that students have reached the technical language level with high-level thinking skills (HOTS).

Source: Research 2025

Based on the data analysis presented in Table 2, it can be concluded that the implementation of semantic wave-based joyful learning has a significant positive impact on improving students' technical language. Quantitatively, the average pretest score of 81.31 increased to 89.89 in the posttest, indicating an increase of 8.58 points after the intervention. This increase indicates that students not only improved their conceptual understanding but also mastered technical terminology related to computer networks and Intellectual Property Rights (IPR). Furthermore, the decrease in the standard deviation from 11.384 to 8.860 indicates that student learning outcomes have become more equitable, with a narrowing gap in individual abilities. This indicates that the learning approach used is able to reach all groups of students inclusively. Observations showed that student engagement increased from 65% in the pre-cycle to 92% in the third cycle, indicating increased involvement and active participation in the learning process. Students began to demonstrate the courage to ask questions, discuss, and use technical terms such as straight cable, cross connection, data transmission, and network topology more appropriately.

Data from interviews and worksheet analysis also supported these findings, with 78% of students able to use technical terms correctly in the third cycle, up from 45% in the pre-cycle. This indicates that students have progressed from everyday language to technical language with higher semantic density. Improvements were seen in students' critical thinking and argumentative skills, with the average argumentative ability score increasing from 3.2 to 4.5 (on a scale of 1-5). Students demonstrated improved

ability to provide logical explanations, link theory to practice, and construct evidence-based arguments. This demonstrates the occurrence of a semantic climb, the movement from concrete understanding to conceptual abstraction. Student reflections also indicated that 85% of students felt more confident in using technical terms and understanding the concepts taught. They were able to re-explain concepts using more formal and structured academic language, indicating achievement at the technical language level.

Discussion

Correlation of Semantic Wave with PTK Research Method

In the pre-cycle stage, learning conditions were still conventional, where teachers presented material in the form of abstract concepts, resulting in students having difficulty understanding the meaning of phenomena described by concepts with high SD and low SG. According to Maton (2020) in "Semantic waves: Context, complexity and academic discourse", when material is delivered without a contextual bridge, students' epistemic access is limited, so understanding does not develop optimally. The findings of the pretest and initial survey of this study are consistent with studies showing that delivering material that is too abstract has an impact on low student engagement.(Asvat, 2022; Zhao & Zheng, 2024). Therefore, an initial diagnosis through a pretest is important to design an unpacking strategy that lowers the elementary level into a more concrete form before learning continues. (Hipkiss & Windsor, 2022).

Next, in Cycle 1, an unpacking strategy was implemented using simple language, concrete objects, analogies, and unplugged activities or simulations. This approach theoretically aligns with the principle of increasing SG, enabling students to connect abstract concepts with real-world experiences. (Asvat, 2022). Previous research results show that when teachers facilitate the movement from concepts to concrete examples (high SG), student engagement and understanding increase significantly. (Hipkiss & Windsor, 2022). The integration of joyful learning elements such as gamification, collaborative activities, and the use of visual media also adds an affective dimension that strengthens students' intrinsic motivation, making the unpacking process more effective. (Feriyanto & Anjariyah, 2024). Pedagogically, the role of the teacher transforms from a conveyor of information to a facilitator of meaning-making, in line with reflective practices in Classroom Action Research. (Semathong, 2023; Siregar & Zuhriyah, 2024).

In Cycle 2, after students become familiar with concrete representations, learning focuses on the use of everyday language through collaborative activities, case studies, and discussions. This stage lays the foundation for formalizing academic terminology and strengthening the transition to more complex conceptual understanding. Literacy research on LCT indicates that the lowest point on the curve (lowest SG) is a critical moment for building the bridge to higher elementary levels. Students need scaffolding to generalize concrete experiences into conceptual representations. (Hipkiss & Windsor, 2022; Zhao & Zheng, 2024). Students' increased ability to relate concrete experiences to abstract concepts indicates the presence of semantic climb, consistent with empirical evidence that case studies and structured discussions accelerate this semantic transition. (Chinaka, 2021). The use of digital tools also strengthens this learning process through multimodal representations that facilitate the transfer of understanding. (Suseno & Ritonga, 2025; Zhao & Zheng, 2024).

Then, in Cycle 3, the learning process focuses on repackaging, namely, the restructuring of previously analyzed meanings into a more compact conceptual structure. This process reflects semantic climb, which is measured not only by improving academic scores but also by students' ability to explain, argue, and apply concepts in new contexts. Project-based approaches such as Project-Based Learning (PjBL) and Problem-Based Learning (PBL) applied at this stage provide space for students to generalize and abstract. This aligns with the concept of repackaging in LCT literature, which is important for epistemic access. (Bowdler *et al.*, 2024; Zhao & Zheng, 2024). Recent studies have shown that authentic tasks such as mini-

projects can stimulate evidence-based argumentation that reflects both SD gains and strengthening higher-order thinking skills. (Karim, 2025; Rusznyak, 2022).

The next stage is data analysis, where the comparison between the pretest and posttest, along with qualitative evidence such as observations, interviews, and self-assessments, shows that students not only experienced improved scores but also demonstrated improved use of technical terms, logical argument structures, and metacognitive reflection. This indicates that learning has reached the technical language level. (Hipkiss & Windsor, 2023). Researchers emphasize the importance of combining quantitative evidence, such as N-gain and effect size, with qualitative evidence to ensure that score increases reflect improvements in the quality of understanding, not just test performance. (Bowdler *et al*., 2024; Zhao & Zheng, 2024). The combination of an iterative CAR approach and a *semantic wave* strategy allows for a more comprehensive and epistemically valid evaluation of learning. The integration of *joyful learning* with the *semantic wave* has a dual impact, strengthening both students' cognitive and affective aspects.

Cognitively, this approach enhances knowledge transfer and conceptual understanding; affectively, it increases students' motivation, curiosity, and perception of self-competence. (Anggoro, 2022; Sulisworo, 2025). Research shows that positive emotions and active engagement not only strengthen memory and attention but also open up space for flexibility of thinking between concrete and abstract representations. (Feriyanto & Anjariyah, 2024). Therefore, a learning design that combines affective and cognitive aspects can create sustainable and inclusive learning. Furthermore, formative evaluation plays a crucial role in supporting each semantic wave transition. Formative assessments, such as open-ended questions, reflection, and immediate feedback, serve as safeguards in determining the balance between SG and SD in each learning cycle. (Bowdler *et al*., 2024; Zhao & Zheng, 2024). Triangulation of data through observation, interviews, and self-assessment also strengthens the validity of the results, as it demonstrates consistency across sources of evidence. (Semathong, 2023; Putri *et al*., 2023).

Research Obstacles and Limitations

Although the research results show positive results, several obstacles and limitations remain, such as time constraints, digital infrastructure readiness, and differences in student adaptation speeds. This was also found in similar studies. (Anggoro *et al*., 2022). The practical implications of these findings are the need for ongoing teacher training in designing semantic waves, adequate time allocation for the semantic climb process, and the development of varied learning media. (Bowdler, 2024; Hipkiss & Windsor, 2022). From a policy perspective, the results of this study support the integration of joyful learning × semantic wave as a 21st-century learning model that can be widely implemented with adjustments to school contexts. However, time, resources, and student characteristics remain challenges in implementing innovative learning. Therefore, further research is needed to address these obstacles with adaptive strategies such as increasing teacher capacity and providing adequate digital infrastructure.

CONCLUSION

Findings from the pre-cycle stage indicated low student motivation, engagement, and analytical skills in understanding the material. The implementation of the semantic wave-based joyful learning model, conducted over three cycles, demonstrated an increase in active student participation, gradual conceptual understanding, and learning evaluation results. Each cycle showed improvements, ranging from the introduction of practical activities to the use of interactive digital media, to the PBL approach that encourages students to think logically and independently. Pretest and posttest results also showed significant improvements, accompanied by a decrease in standard deviation, indicating a narrowing gap in student learning outcomes. Furthermore, the Pearson correlation analysis showed a strong and

significant relationship between students' initial and final scores, reinforcing the effectiveness of the implemented model. Joyful learning and semantic wave-based learning not only positively impact learning outcomes but also the learning process itself, making it more enjoyable, meaningful, and adaptive to the needs of 21st-century students. Further research is recommended to develop the semantic wave-based joyful learning model in the context of other subjects, particularly science and mathematics, which are characterized by abstract and complex characteristics. Furthermore, further research can explore the integration of artificial intelligence (AI)-based learning technology and learning analytics to monitor the development of students' critical thinking skills in real time. Further studies can also expand the research subjects to different school levels (middle school or college) to test the consistency of the model's effectiveness, as well as examine its impact on soft skills aspects such as collaboration, communication, and student creativity.

AUTHOR'S NOTE

The author declares that there is no conflict of interest regarding the publication of this article. The author confirms that the data and content of the article are free from plagiarism.

REFERENCES

Anggoro, S., Widodo, A., Thoe, N. K., & Cyril, N. (2022). Promoting nature of science understanding for elementary school through joyful learning strategy. *Journal of Pedagogy and Education Science, 1*(2), 63-76.

Asvat, Z. J. (2022). Semantic waves and their affordances for teaching scaffolding to pre-service teachers. *Reading and Writing, 13*(1), 1-10.

Auniillah, F. H. T., Kamaludin, A., & Rahmawan, S. (2025). Development of a Powtoon animation video on hydrocarbon material based on joyful learning to increase the learning interest of high school students. *Jurnal Pendidikan Matematika dan IPA, 16*(2), 381-399.

Bowdler, S., Nielsen, W., Meedya, S., Matthews, A., & Salamonson, Y. (2024). Legitimation Code Theory's role in shaping nursing education: An integrative review. *Nurse Education Today, 140*(1), 1-10.

Chashechnikova, O., Odintsova, O., Hordiienko, I., Danylchuk, O., & Popova, L. (2024). Innovative technologies for the development of critical thinking in students. *Revista Amazonia Investiga*, *13*(81), 197-213.

Chinaka, T. W. (2021). Introducing the second law of thermodynamics using legitimation code theory among first-year chemistry students. *Cypriot Journal of Educational Sciences, 16*(3), 981-994.

Correia, P. R. M., Kinchin, I. M., & Conceição, A. N. (2023). Using concept maps to surf semantic waves in the pursuit of powerful knowledge structures. *Knowledge Management and E-Learning*, *15*(3), 381-391.

Dlamini, R., & Dewa, A. (2022). Unplugged teaching: Deepening information technology learning. *Open Journal of Social Sciences*, *10*(4), 476-486.

Dzattadini, A., Amelia, D., Anggina, L., & Putra, M. R. E. (2025). Improving student competence through innovation of Islamic boarding school-based learning strategic. *Curricula: Journal of Curriculum Development, 4*(1), 215-228.

Fathimah, N. S., Ariani, A. S., & Junaeti, E. (2025). Pengenalan strategi pembelajaran semantic wave bagi mahasiswa calon guru Informatika. *Income: Indonesian Journal of Community Service and Engagement, 4*(2), 105-118.

Feriyanto, F., & Anjariyah, D. (2024). Deep learning approach through meaningful, mindful, and joyful learning: A library research. *Electronic Journal of Education Social Economics and Technology, 5*(2), 208-212.

Ghifari, Y., Amanda, D. A., & Hadiapurwa, A. (2022). Analysis effectiveness of online learning during the COVID-19 pandemic. *Curricula: Journal of Curriculum Development, 1*(2), 115-128.

Hipkiss, A. M., & Windsor, S. (2023). Surfing semantic waves: Using semantic profiling to focus on knowledge in practicum lessons. *Action in Teacher Education, 45*(1), 68-85.

Lo, Y. Y., Lin, A. M. Y., & Liu, Y. (2023). Exploring content and language co-construction in CLIL with semantic waves. *International Journal of Bilingual Education and Bilingualism*, *26*(3), 289-310.

Masayu, A. L., Adhantoro, M. S., Purnomo, E., & Kurniaji, G. T. (2025). Implementation of deep learning in education: Towards mindful, meaningful, and joyful learning experiences. *Journal of Deep Learning, 1*(1), 47-56.

Milala, K. N. B., Harahap, F., & Hasruddin, H. (2024). Developing STEM-based LKPD to improve student's critical thinking abilities. *Inovasi Kurikulum, 21*(4), 2243-2262.

Msusa, N. (2019). Semantic waves: Writer performance ranges on the National Benchmark Tests (NBT) academic literacy test. *Alternation: Interdisciplinary Journal for the Study of the Arts and Humanities in Southern Africa, 26*(2), 201-221.

Mubarok, Y., Herdiawan, R. D., & Nurhidayat, E. (2024). Mindful, meaningful, and joyful approaches: challenges and potential solutions as perceived by EFL teacher at primary school level. *Papanda Journal of English Education, 3*(2), 61-72.

Mutiara, E., Suyanto, S., B, N. K. L., Laksita, G. D., & Zamzami, Z. (2024). Improving critical thinking skills using problem based learning: Systematic literature review. *Jurnal Penelitian Pendidikan IPA*, *10*(12), 988-995.

Nafi'ah, J., & Faruq, D. J. (2025). Conceptualizing deep learning approach in primary education: Integrating mindful, meaningful, and joyful. *Journal of Educational Research and Practice, 3*(2), 225-237.

Permana, R. S. G., Roni, M., Rahmawati, W., & Susanto, S. (2022). Building joyful learning to enhance students' motivation in studying English. *Attractive: Innovative Education Journal, 4*(2), 138-143.

Putri, N. L. S., Susanti, R. H., & Purnama, M. D. (2023). Improvement of elementary science learning outcomes using guided experimentation method. *Journal of Environment and Sustainability Education, 1*(2), 72-79.

Ritter, F., & Standl, B. (2023). Promoting student competencies in informatics education by combining semantic waves and algorithmic thinking. *Informatics in Education*, *22*(1), 141-160.

Semathong, S. (2023). Participatory action research to develop the teachers on classroom action research: Kemmis & McTaggart model in practice. *Shanlax International Journal of Education, 11*(3), 29-36.

Siregar, U. H., & Zuhriyah, A. (2024). The use of audiovisual in improving student learning outcomes in Islamic education subjects at SD Negeri 0104 Sibuhuan. *Indonesian Journal of Education and Social Humanities, 1*(3), 71-78.

Sulisworo, D. (2025). Feasibility analysis of joyful learning implementation through higher-order thinking skills. *Buletin Edukasi Indonesia (BEI), 4*(1), 20-29.

Suseno, S., & Ritonga, S. (2025). Desain media pembelajaran dalam Pendidikan Agama Islam (PAI). *Jurnal Manajemen Pendidikan, 10*(2), 562-577.

Sya'ro, A. Z. & Dewi, E. P. (2022). Effect on educational content creators on student motivation and learning outcomes in the pandemic COVID-19. *Curricula: Journal of Curriculum Development, 1*(1), 73-86.

Tang, J., Chen, S., & Bakhir, N. M. (2024). Blended teaching mode innovation of film and television creative course based on semantic wave theory. *Education and Information Technologies, 29*(3), 3681-3698.

Ummah, S. K., & Azmi, R. D. (2020). Pelatihan pengembangan perangkat pembelajaran berbasis teknologi informatika dengan bercirikan joyful learning. *Publikasi Pendidikan, 10*(2), 93-99.

Yasid, A. (2025). Deep learning based on joyful learning in increasing learning motivation. *Semantik: Jurnal Riset Ilmu Pendidikan, Bahasa dan Budaya, 3*(1), 41-47.

Zhao, Q., & Zheng, Z. (2024). Knowledge-building in classroom: A multimodal semantic wave model. *Sage Open, 14*(2), 1-12.