Wahana Pendidikan Fisika (2026) 11 (1): 123-132
https://doi.org/10.17509/wapfi.111.15
2406-9205 (Print) | 2477-4820 (Online)
ORIGINAL RESEARCH

Scientific approach using a cooperative model of Newton's law material to improve students' cognitive abilities

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Received: 17 November 2025 · Accepted: 15 March 2026 · Published Online: 27 April 2026

Abstract

This study aims to determine the improvement of students' cognitive abilities in Newton's Law material taught by applying a scientific approach with a cooperative learning model. This type of research is pre-experimental with a one-group pretest-posttest design, involving 21 students of class X SMA Kristen Tual as the research sample. Data were collected through test instruments (15 items of multiple-choice questions for pretest and posttest) and non-test instruments (Student Worksheets/LKPD). The results showed that in the initial ability (pretest), 100% of students were in the failing qualification with scores below the minimum mastery criteria (< 70). After the treatment, the average score of students' learning process through LKPD reached 85.90 in the good qualification. The final test (posttest) results showed a significant improvement with an average score of 74.41, where 52.4% of students achieved good to excellent qualifications. Based on the Normalized Gain (N-Gain) test, the average score was 0.45, which is in the moderate qualification. Thus, it can be concluded that the application of a scientific approach using a cooperative model can significantly improve students' cognitive abilities in Newton's law material for class X of SMA Kristen Tual.

Keywords: Scientific Approach · Cooperative Model · Cognitive Ability · Newton's Law

INTRODUCTION

Education in Indonesia is a key pillar that supports, directs, and measures a nation's progress in various aspects of life. As a strategic instrument for enhancing the nation's intellectual development, a quality, adaptive and solution-oriented education system is an absolute prerequisite for a country to be highly competitive and remain abreast of the dynamics of global development in the modern era. Currently, the world of education in Indonesia is undergoing a massive transition phase, as the government continues to strive to transform the education system structurally and conceptually. One concrete step taken is through the implementation of the Independent Curriculum. This new curriculum policy demands a radical shift in the learning paradigm, whereby graduation competency standards and the quality of student learning processes are gradually improved to be on par with educational achievements in developed countries (Puskomda, 2018). The essence of this transformation is no longer simply the passive accumulation of cognitive knowledge transfer, but rather how to shape the character of lifelong learners who possess independent thinking and the ability to solve real-life problems.

In the context of science learning, particularly in Physics, the primary challenge educators often face is how to fundamentally shift students' mindsets, from mechanical and procedural to

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How to Cite: Tidore, H.H., Rachman, G. & Limba, A. (2026). Scientific approach using a cooperative model of Newton's law material to improve students' cognitive abilities. *Wahana Pendidikan Fisika, 11*(1), 123-132. https://doi.org/10.17509/wapfi.111.15

analytical and contextual. Physics is often perceived by most students as one of the most intimidating subjects, filled with complex mathematical formulas and disconnected from the realities of everyday life. As a result, students' learning orientation tends to be trapped in the activity of memorizing formulas solely for the sake of achieving exam scores, without understanding the physical meaning of the concepts being studied. This paradox certainly contradicts the ideal nature of physics learning, which should be directed at developing analytical, logical, and critical thinking skills in analyzing natural phenomena (Majid, 2017). The science learning process must be able to guide students not only to receive final information, but also to train them to become accustomed to formulating problems, proposing hypotheses, analyzing data, and drawing conclusions objectively.

To address this paradigm gap, the government, through its pedagogical regulations, has mandated the implementation of a scientific approach as the primary driving force in classroom learning (Permendikbud, 2019). Through the characteristics of a scientific approach structured in five main stages: observing, questioning, experimenting, associating, and communicating, students are positioned as active subjects (student-centered learning) who construct their own knowledge independently based on empirical experience. The activity of observing physical phenomena at the beginning of learning serves to spark curiosity, which is then manifested through the skill of asking questions about cause-and-effect relationships. The process of investigation through experiments or data collection provides space for students to interact directly with physical objects, while the process of reasoning trains associative thinking to link observational results with conceptual theory. Finally, the activity of communicating trains students to systematically construct scientific arguments and justify them before the academic public.

However, the reality on the ground shows that the independent implementation of the scientific approach often encounters technical and substantive obstacles if not combined with an appropriate and adaptive learning model. When the scientific approach is applied in a conventional, individualistic classroom format, students' cognitive load in constructing new concepts is often too heavy, triggering frustration and boredom. Therefore, collaborative synergy with socially oriented learning models is needed, one of which is considered highly relevant is cooperative learning. Cooperative learning refers to a collaborative small-group learning method whose members are heterogeneous, consisting of varying academic abilities (high, medium, low), gender, and different social background characteristics (Sari & Kristin et al., 2020; Fitriyanti, 2023). The integration of the scientific approach into a cooperative structure creates a safe cognitive transition space for students, where they can exchange ideas and confirm conceptual understanding before moving on to the scientific generalization stage.

Through this cooperative learning model, students are not only required to succeed individually, but are also encouraged and facilitated to actively collaborate with each other to achieve their group's shared goals (Sembiring, 2023). This model has a dual positive impact: on the one hand, it optimizes academic achievement through group discussions, and on the other hand, it trains emotional intelligence and social skills in establishing positive interpersonal relationships, both within and outside the school environment. According to Rahmatrizal and Julia (2018), the fundamental characteristics of effective cooperative learning encompass three main dimensions: promotive face-to-face interaction, individual accountability where each member is responsible for their contributions, and the creation of a solid group structure that

https://doi.org/10.17509/wapfi.111.15

makes all members feel they share a common purpose and destiny. This "life and death" metaphor in an academic context is crucial for fostering empathy, where highly capable students have a moral responsibility to help construct understanding for their groupmates experiencing learning difficulties (peer tutoring).

The urgency of this combination of approaches and models becomes even more crucial when faced with the characteristics of physics itself. Physics is a science that was born, grew, and developed from a series of observations and experiments on various physical phenomena of the universe. One of the most fundamental, crucial foundational materials that underpins the development of classical mechanics, yet is often considered abstract and confusing by students, is the material on Newton's Laws of Motion (which includes Newton's First, Second, and Third Laws). These three basic laws specifically discuss the dynamic interaction between the motion of objects and the forces that influence them. The spectrum of this material is actually very broad and close to students' daily lives, ranging from micro mechanical phenomena that can be observed with the naked eye, such as the event of maintaining position when pushing a table or the jolt of the body when a vehicle brakes suddenly, to macro cosmological phenomena that cannot be directly observed by the naked eye, such as the phenomenon of gravitational force, the revolution of planets around the sun, and the orbital path of artificial satellites (Chan et al. 2015). The nature of material that bridges the concrete and the abstract is what demands mature conceptual visualization in its learning.

However, this ideal situation is in stark contrast to the objective reality found in schools in urban and suburban areas. Based on initial observations and in-depth interviews conducted by researchers with teachers and students in grade X of Tual Christian High School, strong indications were found that students' cognitive abilities and mastery of physics concepts in Newton's Laws are still very low and have not yet reached the established minimum completion criteria (KKM). The root causes of this problem stem from two main aspects: limited student active involvement in constructing knowledge and the continued dominance of the conventional one-way lecture method by teachers. Physics learning in these classes still proceeds monotonously, with the teacher acting as the sole source of conceptual truth (teacher-centered), writing formulas on the board, providing numerical examples, and immediately providing rote exercises without encouraging students to understand the physical essence behind the formulas. As a result, students become passive, quickly bored, lack motivation, and fail to connect the concepts of Newton's Laws with the mechanical phenomena they encounter every day.

This passive condition, if allowed to continue, will not only reduce students' academic achievement cumulatively, but will also kill the potential for critical thinking and analytical skills that are essential for students to compete at a higher level. This problem requires immediate, tactical, and measurable solutions to improve learning tools and models. Based on the empirical and theoretical background described, this study was designed as a pedagogical intervention effort to solve the problem of the low quality of physics learning in the area. Therefore, this study aims specifically to examine, analyze, and describe the effectiveness of the application of a scientific approach integrated with a cooperative learning model in improving the cognitive abilities of grade X students of SMA Kristen Tual, especially in the material Newton's Laws of Motion. The results of this study are expected to provide theoretical contributions to the development of physics learning strategies and become a practical reference for educators in designing meaningful, active, and enjoyable science learning in the classroom.

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METHOD

This research is a quantitative experimental research with a Pre-Experimental Model design in the form of a One-Group Pretest-Posttest Design. The research population, which also served as the sample (saturated sampling), was all 21 students of class X of SMA Kristen Tual.

Data collection was conducted using two types of instruments: test and non-test instruments. The test instrument consisted of a pretest and a posttest consisting of 15 validated multiple-choice questions to measure students' cognitive abilities in Newton's Laws. The non-test instrument, a Student Worksheet (LKPD), was used to measure students' conceptual mastery during the group learning process.

The collected data was analyzed using quantitative descriptive statistics to determine the percentage of completion and average achievement scores. Students' competency mastery levels were converted based on the classification standards in Table 1.

Table 1. Level of Competency Mastery

Score Interval	Criteria
91 – 100	Very Good
81 – 90	Good
71 – 80	Fair
≤ 70	Poor/Failed

To measure the extent of improvement in students' cognitive abilities before and after treatment, a Normalized Gain (N-Gain) test was conducted with the N-Gain value acquisition criteria interpreted based on the classification in Table 2 (Hake, 1999).

Table 2. N-Gain Value Categories

Interval	Criteria
$g \geq 0{,}7$	High
$0{,}3 \leq g \leq 0{,}7$	Moderate
$g < 0{,}3$	Low

RESULT AND DISCUSSION

Student Initial Abilities

Before implementing the scientific approach and cooperative learning model in the classroom, the researcher administered a pretest to all students. This initial assessment was strategically important for assessing students' initial conceptual understanding and cognitive readiness for the material to be taught. The detailed results of the cognitive domain pretest are presented in the form of a frequency distribution table in Table 3.

Table 3. Frequency Distribution of Initial Test

Interval	Freq.	Percentage (%)	Criteria
91-100	-	-	Very Good
81-90	-	-	Good
71-80	-	-	Fair
≤70	21	100	Poor/Failed

Based on the statistical data presented in Table 3, an objective picture is obtained that all 21 students of class X of SMA Kristen Tual (100%) are cumulatively in the Fail qualification. This empirical reality is indicated by the individual student scores which are all below 70, which

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is the Minimum Completion Criteria (KKM) standard set by the school for the Physics subject. This real condition provides a very strong indication that both personally and collectively, the students have not had an adequate and comprehensive conceptual mastery of Newton's Laws material before the intervention of academic actions from the researcher. This pattern of low mastery is commonly found in conventional classroom models, where Newton's First, Second, and Third Laws material is often considered as mere memorization of mathematical formulas, not as a logical representation of the phenomena of force and motion that occur in the students' environment.

From a cognitive psychology perspective, students' failure in this initial phase aligns with the theoretical foundation proposed by Aryani (2017), who asserts that low student achievement or learning outcomes at the beginning of a teaching session generally stem from the fact that students have not yet received or constructed the material schemata in a coherent and structured manner. Before treatment is given, the cognitive structure or information stored in students' long-term memory regarding the relationship between force, mass, and acceleration is still in the form of separate, random concepts, and often even colored by inherent misconceptions (preconceptions). Without systematic stimuli such as the observing and questioning stages in the scientific approach, students will experience difficulty in linking new knowledge with their previous knowledge. Therefore, the pretest results that are in the failing qualification become a crucial argument for researchers in designing and justifying the urgency of implementing a collaborative learning strategy based on a scientific approach assisted by LKPD to reconstruct students' conceptual understanding to be more complete and in-depth.

Concept Mastery During the Learning Process

The learning intervention process in this study was implemented in a structured manner over three meetings, employing a scientific approach supported by Student Worksheets (LKPD) within a cooperative learning model. Based on the results of periodically recorded process assessments, a consistent and positive trend of increasing cognitive performance and concept mastery was found from one meeting to the next.

In the first meeting, the average score for students' cognitive development was recorded at 83.97, placing the group's achievement at the Good level. The initial steps in this meeting focused on providing contextual stimulation in the form of everyday mechanical phenomena, namely pushing a table in a classroom. This problem-oriented approach was deliberately designed to elicit students' schemata and intuitive understanding of Newton's First Law, specifically the principle of inertia, which states that an object will tend to remain at rest unless acted upon by a resultant external force. Following this stimulation phase, students were directed to conduct simple, independent practicums in small, heterogeneous groups. This empirical investigation aimed to test, prove, and confirm the initial hypotheses they had formulated with their group mates in the Student Worksheet (LKPD). Although social interactions at the beginning of this first meeting were somewhat awkward due to the transition from conventional methods, students' enthusiasm in observing the physical phenomena provided a strong foundation for a smooth learning process.

Entering the second meeting, students' cognitive performance experienced positive escalation, with the average process score increasing to 85.89, which remained at the Good level. The dynamics of cognitive achievement improvement during this phase were explicitly

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influenced by pedagogical adaptation, as students began to demonstrate familiarity and fluency in following each stage of the scientific approach syntax, from observing to communicating discussion results. Furthermore, students' time management in group discussions of conceptual problems in the worksheet demonstrated significantly greater efficiency compared to the previous meeting. The smooth flow of learning during this second meeting was also inseparable from the implications of the educators' thorough learning scenario planning, which included accurate time allocation and the availability of supporting experimental media. This aligns with Sambella (2024) argument, which asserts that collaborative learning plans that emphasize alignment between teacher instructions and active student responses are crucial for effective knowledge transfer in the classroom.

The peak of this trend in concept mastery during the intervention process occurred at the third meeting, where students' average cognitive ability achieved the highest score of 87.84, representing a "Good" qualification. In the final stage of this process assessment, students' scientific thinking independence had been optimally developed. Students appeared to be very accustomed and skilled in identifying and formulating physics problems presented in the worksheet, extracting key variables, and conducting in-depth and critical analysis of experimental data with their group mates without the need for detailed direction from the teacher. The teacher's role in this third meeting had shifted completely to that of a pure facilitator and mediator who oversaw the progress of peer tutoring in heterogeneous groups. Cumulatively, if drawn a straight line across the entire series of teaching and learning activities, the average cognitive ability of students during the learning process of the three meetings reached 85.90 with a Good qualification. This high and stable process achievement result provides a strong indication that the combination of a scientific approach and a cooperative model is able to create an effective cognitive transition space in boosting students' understanding of Newton's Laws.

Student Final Abilities

After the entire series of learning interventions using a scientific approach integrated into the cooperative model were completed, the researchers administered a final test or posttest. This final testing step was specifically designed as a summative evaluation instrument to measure the level of success of the treatment and the extent of the shift in cognitive performance achieved by students after constructing a conceptual understanding of Newton's Laws material collaboratively. The data from the measurement results of the final abilities of the students' cognitive domains are presented in detail in Table 4.

Table 4. Frequency Distribution of Final Test

Interval	Freq.	Percentage (%)	Criteria
91-100	1	4,8	Very Good
81-90	10	47,6	Good
71-80	10	47,6	Fair
≤ 70	-		Poor/Failed

The data presented in Table 4 empirically demonstrates a very positive and significant shift and transformation in students' cognitive performance when compared to the initial ability data (pretest). Based on the accumulated final scores, the overall average posttest score reached 74.41, placing students in the general classification range from Fair to Good. This data representation is reinforced by the highest individual score achieved by students, achieving a perfect score of 100, qualifying for Very Good (4.8%), and the lowest score achieved by students, which increased to 73.33, qualifying for Fair (47.6%). The most significant crucial fact from these posttest results is the disappearance of failure retention in the classroom, with no students (0%) categorizing as failing or receiving scores below the Minimum Completion Criteria (≤ 70).

The success of this cognitive transition demonstrates that the combination of a scientific approach, supported by student worksheets (LKPD) and a cooperative model, can facilitate students' conceptual reconstruction very effectively. Through the learning experiences received throughout the intervention, students no longer merely memorize the mathematical scheme of Newton's Laws passively, but are able to construct information into their knowledge structure in a deep and meaningful way through the group experiment stage (Sanjaya, 2016). The absence of students in the failing category provides theoretical confirmation that this social-oriented learning model is able to provide an equitable learning space, where the heterogeneous group discussion process successfully activates peer tutoring that helps boost the understanding of low-ability students. These satisfactory posttest results not only reflect a mature mastery of the material, but also indicate the growth of students' intrinsic motivation and self-confidence in solving analytical physics problems after being accustomed to learning through an active and contextual approach.

Improving Mastery of Physics Topic

To objectively observe the level of significance, effectiveness, and consistency of the improvement in students' cognitive abilities from the pre-treatment phase (pretest) to the post-treatment phase (post test), researchers conducted advanced data analysis using the Normalized Gain (N-Gain) test. The use of the N-Gain test is crucial in educational experimental research because it can eliminate bias factors caused by differences in students' initial scores, thus purely measuring the effectiveness of the academic intervention provided. The results of the calculation of the acquisition index or the accumulated distribution of students' N-Gain scores are visually and in detail summarized in Table 5.

Table 5. Distribution of N-Gain Test Results

Interval	Freq.	Percentage (%)	Criteria
$g \geq 0,7$	2	9,5	High
$0,3 \leq g \leq 0,7$	15	71,5	Moderate
$g \leq 0,3$	4	19	Low

Based on the statistical data presented in Table 5, empirical findings indicate that the average N-Gain index achieved by the entire study sample was 0.45. This value theoretically places the effectiveness of improving cognitive abilities and conceptual mastery of tenth-grade students at Tual Christian High School in the Medium category for Newton's Laws. A more in-depth analysis of this data distribution reveals that the majority of the total sample population, 15 students (71.5%), experienced a moderate or moderate increase in cognitive performance. On the other hand, two students (9.5%) achieved a significant increase exceeding the 0.7 gain index, while the remaining four students (19.0%) remained stuck in the low-improvement category.

https://doi.org/10.17509/wapfi.111.15

The comprehensive data analysis above illustrates that students' mastery of physics concepts significantly accelerated after the classroom learning process was intervened with a scientific approach within a cooperative learning model. The predominance of students in the moderate to high improvement category indicates that the combination of student worksheets (LKPD) and scientific syntax successfully stimulated targeted cognitive reconstruction. This is in line with what was conveyed by Zakwandi et al. (2020), who stated that the improvement in the quality of mastery of physical material occurred because in the cooperative learning space, students were encouraged to more actively observe force phenomena, analyze the relationship between mass and acceleration variables, and ask each other questions in groups, so that they were able to draw conceptual conclusions very well. Achieving a gain index at a moderate level proves that this socially oriented learning strategy does not merely provide a momentary impact, but is able to be an effective pedagogical solution in improving the quality of students' scientific understanding gradually and consistently.

Discussion

The success of improving students' cognitive abilities is significantly influenced by the integration of the scientific approach and the cooperative learning model. The scientific approach trains students to conduct empirical investigations, starting with observing force phenomena, asking questions, collecting data through Newton's Laws lab work, associating the relationship between mass and acceleration, and communicating these findings in class (Permendikbud, 2019). These activities directly reduce mechanical learning based on formula memorization and transform it into meaningful conceptual understanding. This aligns with Daryanto (2023), who asserted that the scientific approach can improve higher-order thinking skills and train students to solve problems systematically.

Furthermore, the cooperative model complements this approach from a socio-cognitive perspective. The formation of heterogeneous groups provides space for peer tutoring. Students with high academic abilities help construct the understanding of their peers at medium or low levels through student worksheet discussions. According to Azizah (2025), recognizing the heterogeneity of student abilities (high, medium, and low) helps teachers differentiate treatment and facilitate equitable learning needs. This dynamic group learning experience helps students construct new information more solidly into their cognitive structures (Sanjaya, 2016). This increased mastery of the material occurs because throughout the lesson, students are required to actively observe, analyze, and draw conclusions (Zakwandi et al., 2020).

Although the improvement is moderate, there are several challenges in the field, such as limited student prior knowledge and differences in the speed of material absorption among individuals. Therefore, the teacher's role as a facilitator in controlling the discussion within each group is crucial to the effectiveness of learning (Arbiyan et al., 2024).

CONCLUSION

Based on the overall results of the research and data analysis regarding the application of the scientific approach with a cooperative model on Newton's Law material in class X of SMA Kristen Tual, it can be concluded that this intervention significantly succeeded in improving students' cognitive abilities. The initial conditions showed that all students were in the failing qualification because none of them managed to achieve the KKM score. However, during the

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learning process, students' cognitive performance measured through filling out LKPD in groups showed very good results with the accumulative average score reaching its peak in the third meeting. The success of this process was positively correlated with students' final test results which experienced a significant increase to reach sufficient and good qualifications with no more students in the failing qualifications. The efficiency of improving cognitive abilities was also strengthened by the average value of the N-Gain index which placed the effectiveness of this model in the medium category, which means this model is effective in bridging students' conceptual understanding gradually.

REFERENCES

Anggareni, N. W., Ristiati, N. P., & Widiyanti, N. L. P. M. (2013). Implementasi strategi pembelajaran inkuiri terhadap kemampuan berpikir kritis dan pemahaman konsep IPA siswa SMP. *Jurnal Pendidikan dan Pembelajaran IPA Indonesia*, *3*(1).

Arbiyan, A. Y., Mustaji, M., & Suhari, S. (2024). Pengaruh Model Problem Based Blended Learning dan Gaya Kognitif terhadap Hasil Belajar Fisika Siswa Madrasah Aliyah. *Jurnal Pendidikan: Riset dan Konseptual*, *8*(1), 91-105.

Aryani, W., & Mansur, M. (2017). Pengaruh penggunaan alat peraga mistar hitung terhadap hasil belajar siswa pokok bahasan penjumlahan dan pengurangan bilangan bulat. *Primary: Jurnal Keilmuan dan Kependidikan Dasar*, *9*(1), 55-78.

Azizah, L., & Alnashr, M. S. (2022). Pengembangan bahan ajar tematik berbasis kearifan lokal guna meningkatkan hasil belajar kognitif siswa. *Dawuh Guru: Jurnal Pendidikan MI/SD*, *2*(1), 1-12.

Chan, N. N., Walker, C., & Gleaves, A. (2015). An exploration of students' lived experiences of using smartphones in diverse learning contexts using a hermeneutic phenomenological approach. *Computers & Education*, *82*, 96-106.

Daryanto. (2023). *Pendekatan Saintifik dalam Pembelajaran Kurikulum Terpadu*. Yogyakarta: Gava Media.

Fitriyanti, N., Zevika, M., & Zakwandi, R. (2023). Implementation of online think pairs share (otps) model to improve student learning outcome. *Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*, *11*(2), 232-239.

Hake, R. (1999). *Analyzing Change Gain Scores* Woodland Hills Dept. of Physics. Indiana University

Majid, A. (2017). *Strategi Pembelajaran*. Jakarta: PT Rineka Cipta.

Permendikbud. (2019). *Peraturan Menteri Pendidikan dan Kebudayaan Nomor 22 Tahun 2019 tentang Standar Proses Pendidikan Dasar dan Menengah*. Jakarta: Kementerian Pendidikan dan Kebudayaan.

Puskomda. (2018). *Pendidikan di Indonesia dan Standarisasi Kelulusan*. Surabaya: Pusat Kota Jenderal Pendidikan Indonesia.

Ramafrizal, Y., & Julia, T. (2018). Kajian Model Pembelajaran Kooperatif Tipe STAD (Student Teams Achievement Division) Dalam Upaya Meningkatkan Efektifitas Proses Belajar Mengajar Akuntansi. *Oikos: Jurnal Kajian Pendidikan Ekonomi dan Ilmu Ekonomi*, *2*(2), 133-145.

Sambella, M. (2024). Peran Strategis Pembelajaran Kolaboratif dan Budaya Kerja dalam Mendorong Kinerja Guru: Kajian Literatur. *JTPPm (Jurnal Teknologi Pendidikan Dan Pembelajaran): Edutech and Intructional Research Journal*, *11*(2).

Sanjaya, W. (2016). *Media Komunikasi Pembelajaran*. Jakarta: Kencana.

Sari, B. T. W., & Kristin, F. (2020). Efektivitas penggunaan model problem based learning dan model group investigation terhadap kemampuan kerjasama siswa sekolah dasar. *Jurnal Basicedu*, *4*(2), 257-267.

Sembiring, F. M. (2023). Peran pembelajaran kooperatif terhadap prestasi akademik dan pengembangan keterampilan sosial. *EDUCARE: Jurnal Pendidikan dan Kesehatan*, *1*(1), 36-40.

https://doi.org/10.17509/wapfi.111.15

Zakwandi, R., Yuningsih, E. K., & Setya, W. (2020). Implementasi pembelajaran berbasis praktikum pada konsep taraf intensitas bunyi untuk meningkatkan penguasaan konsep Peserta Didik. *Jurnal Penelitian Pembelajaran Fisika*, *11*(1), 75-82.

https://doi.org/10.17509/wapfi.111.15