

GLOBAL RESEARCH TRENDS ON MISCONCEPTIONS IN MOTION (2005-2024): A BIBLIOMETRIC LITERATURE REVIEW

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Abstract: Misconceptions arise when students' understanding of concepts differs from scientific consensus. In physics education, misconceptions are common, especially in motion concepts. This study aims to map research trends on misconceptions in motion, serving as a reference for future studies. Data was collected from the Scopus database over 20 years (2005-2024), yielding 353 relevant articles. The analysis reveals a significant increase in publications, peaking in 2020. The United States produced the most research on misconceptions in motion, with the majority published in Scopus-indexed journals. Padang State University contributed the most publications. Metadata analysis highlights thematic relationships between conceptual change, physics education, and student learning, with a focus on technology use and active learning approaches to address misconceptions. This study provides insights into the increasing interest in misconceptions in motion concepts and suggests future research directions to improve physics education. By mapping these trends, the study offers a foundation for developing more effective teaching strategies and interventions to mitigate misconceptions and enhance students' conceptual understanding.

Keywords: *Misconceptions, Motion, Research Trend, Systematic Literature Review*

INTRODUCTION

Physics education involves the process by which students connect natural phenomena with the concepts they learn. The primary goal of physics education is to master these concepts, which are inherently linked to understanding the natural world (Andoy & Rebuera, 2024; Ruhana et al., 2023). Physics, as a field of study, is categorized as physical knowledge derived from the abstraction of natural events (Ko'o et al., 2022; Shofiyah et al., 2024). This highlights the central role of conceptual mastery in physics learning, which serves as a foundation for understanding the natural world (Hidayat et al., 2023; Soeharto & Csapó, 2021; Waraga et al., 2023).

However, each student possesses varying abilities to relate physics concepts to real-world phenomena, leading to differences in the quality and accuracy of their understanding. These differences are particularly evident when students fail to correctly link the physics concepts they learn with scientifically accepted principles, leading to the development of misconceptions. A misconception is defined as a consistent but erroneous pattern of thinking that is applied across different situations, despite being incorrect (Aldazharova et al., 2024; Foisy et al., 2015). Misconceptions arise because students construct abstract representations of physics concepts in ways that can diverge from expert scientific understanding. This process of conceptual construction is referred to as "conception" (Putra et al., 2023; Wen et al., 2024).

The alignment—or lack thereof—between students' conceptions and established scientific concepts is a crucial issue in physics education. When students' conceptions deviate from scientific concepts, misconceptions inevitably emerge. These misconceptions are particularly common among students who possess lower analytical abilities (Didik et al., 2020). Moreover, misconceptions often arise when students attempt to synthesize multiple interrelated concepts that require deep conceptual understanding (Soeharto & Csapó, 2022). Thus, the understanding of concepts is recognized as a critical factor in the learning process of physics (Suhandi et al., 2025). Physics education should aim not only to encourage rote memorization but also to foster an understanding of the practical applications and benefits of physics in everyday life (Orazov et al., 2025).

Several studies have documented the prevalence of misconceptions in various physics domains, including kinematics (Admoko & Suliyannah, 2023; Sharifi et al., 2025; Syuhendri, 2021), Newton's laws (Putri et al., 2024; Suhandi et al., 2025; Suwasono et al., 2024), static fluids (Busyairi & Zuhdi, 2024; Saputra et al., 2024), wave mechanics (Batlolona & Jamaludin, 2024), electricity (Didik et al., 2020; Didik & Aulia, 2019), magnetism (Koudelkova & Dvorak, 2015; Ramachandran et al., 2025), work and energy (Arifuddin et al., 2024), temperature and heat (Maryam et al., 2024; Souisa et al., 2024; Stefanou et al., 2024), and gas kinetic theory (Nurulwati et al., 2024; Orazov et al., 2025). Despite the extensive documentation of misconceptions, there is a lack of focused research specifically addressing misconceptions in motion kinematics—a core topic in physics education.

Kinematics, as a fundamental component of physics, is introduced to students at various educational levels, ranging from junior high school to university. Yet, misconceptions in this area persist, even among students who have been exposed to the topic for several years. This ongoing issue underscores the need for a deeper, more systematic investigation into the nature and causes of misconceptions in motion kinematics. Previous research has identified misconceptions within this domain (Yang et al., 2024; Dwi Sundari et al., 2023; Mustofa et al., 2024), but these studies have often been isolated and lack a comprehensive analysis of the root causes and effective remediation strategies.

Therefore, the current study aims to bridge this gap by conducting a bibliometric mapping of research on misconceptions in motion kinematics. The purpose of this mapping is to provide a comprehensive overview of the current state of research, identify trends, and highlight gaps in the literature. This bibliometric analysis, assisted by VOSviewer, is a crucial tool for obtaining systematic and quantitative data to map the existing research landscape and inform future research directions (Hamidah et al., 2020; Husaeni & Nandiyanto, 2022).

The need for a focused bibliometric analysis of misconceptions in motion kinematics is underscored by the prevalence of such misconceptions and the lack of an organized research synthesis. Bibliometric analysis offers a rigorous, data-driven approach to mapping the trends, patterns, and gaps in the literature, allowing researchers to identify key areas that require further investigation. This approach provides systematic insights into the factors contributing to misconceptions, their impact on student learning, and potential methods for addressing these misconceptions through targeted educational strategies. The study of misconceptions in motion kinematics is crucial for improving the quality of physics education. By mapping the existing research, this study aims to provide a foundation for developing more effective teaching methods and intervention strategies that can mitigate misconceptions, leading to enhanced conceptual understanding and better learning outcomes for students.

RESEARCH METHODS

Collecting Data

The data for this study was extracted from the Scopus database (<https://www.scopus.com>, accessed on April 9, 2025), a highly regarded and extensive bibliometric resource. Scopus is considered one of the largest and most reliable databases globally, ensuring comprehensive coverage across various research fields. This makes the data highly representative of trends in the broader academic community. The Figure 1 illustrates the systematic process used to collect, filter, and analyze data for a bibliometric study on misconceptions in motion physics, sourced from the Scopus database. The selection criteria for manuscripts were focused on articles, conference papers, reviews, book chapters, and conference reviews, as these types of documents are essential for tracking the evolution of research topics over time. Only manuscripts published in English were included, as English is the predominant language in global academic publishing, ensuring the relevance and accessibility of the data to an international audience.

For the bibliometric analysis, the keywords "misconceptions" AND "motion" were used to search the Scopus database for relevant publications from 2005 to 2024, spanning a period of 20 years. This timeframe allowed for a comprehensive exploration of the research trends and shifts in misconceptions related to motion concepts. A total of 353 articles were selected, distributed across several academic disciplines: social sciences (136 articles), physics and astronomy (125 articles), engineering (57 articles), medicine (43 articles), computer science (43 articles), mathematics (36 articles), psychology (23 articles), and arts and humanities (16 articles).

The data collection process involved querying Scopus with specific filters for publication years (2005-2024) and document types (excluding non-article formats and conference reviews). Once the relevant articles were identified, they were exported into a CSV file for further processing. Initially, Scopus-provided visualizations were utilized to assess the overarching trends and patterns within the dataset. These visualizations offered an overview of the research landscape, helping to identify prominent research themes before delving into a more detailed analysis.

Following the initial data collection and visualization steps, the dataset underwent a cleaning process. This involved segmenting and editing the data for consistency. The final analysis was conducted using VOSviewer 1.6.19, a tool for creating visual maps based on bibliometric data. This software generated three types of visual outputs: visualization overlay, visualization density, and the final visualization result. These visualizations were instrumental in further analyzing academic trends and the progression of research on misconceptions related to motion physics, offering a clearer view of research developments over the past two decades.

By using these rigorous selection criteria and methodologies, the data for this study provides a robust and comprehensive overview of the trends in misconception research on motion concepts. The combination of Scopus' initial visualizations and VOSviewer's advanced capabilities enabled an in-depth analysis of the research landscape, ensuring that the findings are both systematic and relevant to the objectives of this study.

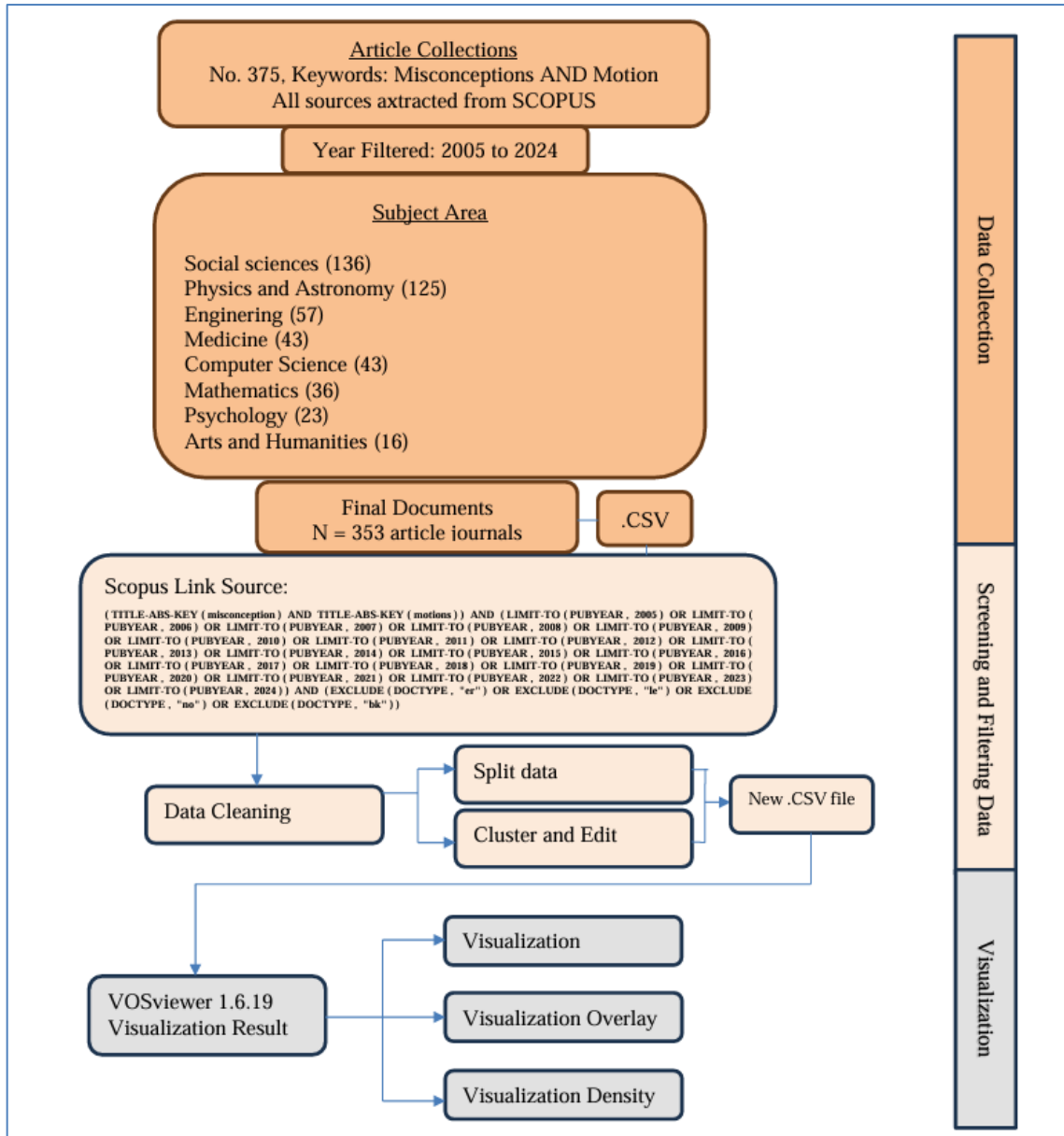


Figure 1. Schematic diagram of research using bibliometric

Visualization using Scopus Data Base and VOSviewer

Visualization of bibliometric data used consists of researchers, journals, countries, affiliations and research data mapping using the Scopus Data Base VOSviewer application (Donthu et al., 2021; Meiliyadi et al., 2025; Yanti et al., 2024). VOSviewer is a software package designed for the purpose of creating visualizations. The output of visualization using VOSviewer allows visualization of three different types of maps, namely networking visualization, overlay visualization, and density visualization (Nandiyanto et al., 2024; Noviyanti et al., 2024; Yanti et al., 2024). In this research, the VOSviewer application used is the latest version (Version 1.6.19), which was released on January 23, 2023. Schematic diagram of research using bibliometric shown in Figure 1.

Based on a keyword search on the Scopus database, 375 documents related to misconceptions in motion material were obtained. The documents were then filtered to fit the research criteria so that 353 documents in .CSV format were obtained. The 353 documents

were then analyzed using VOSviewer software to map the misconception research trends in motion material.

RESULTS AND DISCUSSION

Research Trend on Misconception in motion based on scopus database

Bibliometric research requires a database as a source of data. In this study, the database used is the Scopus database. The Scopus database was chosen because it has a complete and detailed data source so that it can be used in bibliometric research. Manuscripts used can be in the form of articles, conference papers, reviews, book chapters and conference reviews. Based on the results of the analysis, 353 documents were obtained in the form of articles, conference papers, reviews, book chapters and conference reviews. The types of documents obtained in the Scopus database regarding misconception research on motion material are shown in Figure 2.

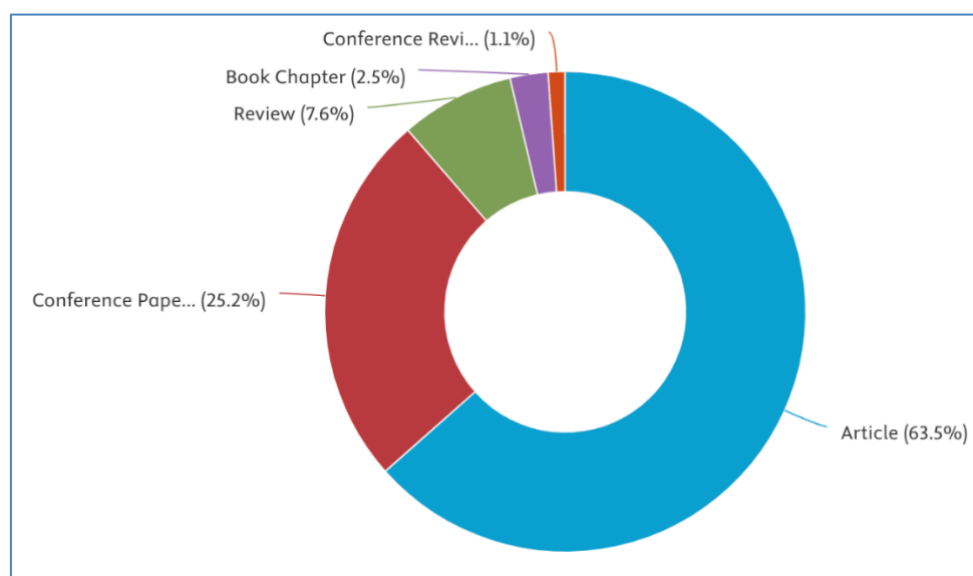


Figure 2. Types of documents published on the scopus database regarding misconceptions on motion material

Based on the results of data searches from the Scopus database, scientific publications that discuss the topic of misconceptions in motion material are scattered in various types of documents. The most dominating document type is journal articles (articles) with a percentage of 63.5%. This shows that most of the research on misconceptions of motion concepts is published in scientific journals that have gone through a peer-reviewed process, thus indicating that this topic has received serious attention among academics. The second most common type of publication was conference papers, which accounted for 25.2%, indicating that scientific forums such as seminars and conferences are also an important forum for conveying preliminary research results related to misconceptions in this material. In addition, publications in the form of reviews accounted for 7.6% of all documents, indicating an effort to synthesize and evaluate various previous research results in the same field.

Meanwhile, documents in the form of book chapters have a contribution of 2.5%, which indicates that the topic of misconceptions in motion material has also become part of the discussion in the wider scientific literature. The document type with the least amount is conference review, which only covers 1.1% of the total publications. Overall, this data reflects that the issue of misconceptions in motion has received significant attention in the academic

world, with various forms of publications that serve as a means of disseminating research results and theory development in the field of science education, especially physics.

Table 1. Journals that publish many articles about misconceptions in motion material

No	Journal	documents
1	Jurnal of Physics: Conference Series	27
2	AIP Conference proceedings	14
3	Physics Education	12
4	Physical Review: Physis Education Research	10
5	ASEE Annual Conference And Exposition Conference Proceedings	6
6	Physics Teacher	6
7	European Journal of Physics	5
8	New Physics Sae Mulli	5

Based on Table 1, it can be seen that the topic of misconceptions in motion material is one of the main focuses in physics education research, as evidenced by the number of publications spread across various reputable scientific journals. The journal that contains the most publications related to this topic is Journal of Physics: Conference Series with 27 documents. This shows that international physics conferences are an active forum in discussing and finding solutions to students' misconceptions related to Newton's law. In the second position, AIP Conference Proceedings contributed 14 documents, indicating the high interest of researchers to publish experimental and innovative studies that are often presented in scientific forums. Furthermore, Physics Education and Physical Review: Physics Education Research contain 12 and 10 documents respectively. Both are known as journals that focus on teaching strategies and pedagogical approaches, so the articles in them discuss how to identify, analyze, and overcome misconceptions systematically.

Meanwhile, ASEE Annual Conference and Exposition Conference Proceedings and Physics Teacher each contributed 6 documents. Both contribute to the development of practical teaching, particularly in the context of technical education and direct classroom teaching. On the other hand, European Journal of Physics and New Physics: Sae Mulli have 5 related documents each. Both journals emphasize cross-cultural and conceptual approaches, as well as the use of technology in physics education. Overall, this distribution of publications shows that misconceptions in Newton's laws are an issue that is consistently researched by the international physics education community, both from a conceptual, practical, and experimental perspective.

Figure 3 shows the trend of research published on the Scopus database regarding misconceptions in motion material each year. Based on the data obtained from the Scopus database, the trend of research publications that discuss the topic of misconceptions in motion material from 2005 to 2024 shows a fluctuating pattern but tends to increase overall. At the beginning of the period, from 2005 to 2008, the number of documents published was still relatively low, with a range between 6 to 12 documents per year. However, starting in 2009 there was an increase in the number of publications, which reached 13 documents, and continued to increase until it reached 17 documents in 2011. Fluctuations still occurred during the period 2012 to 2015, but a more consistent trend began to be seen since 2016. In this period, the number of publications showed a tendency to increase significantly, especially starting in 2018 which recorded 22 documents and jumped to 30 documents in 2019.

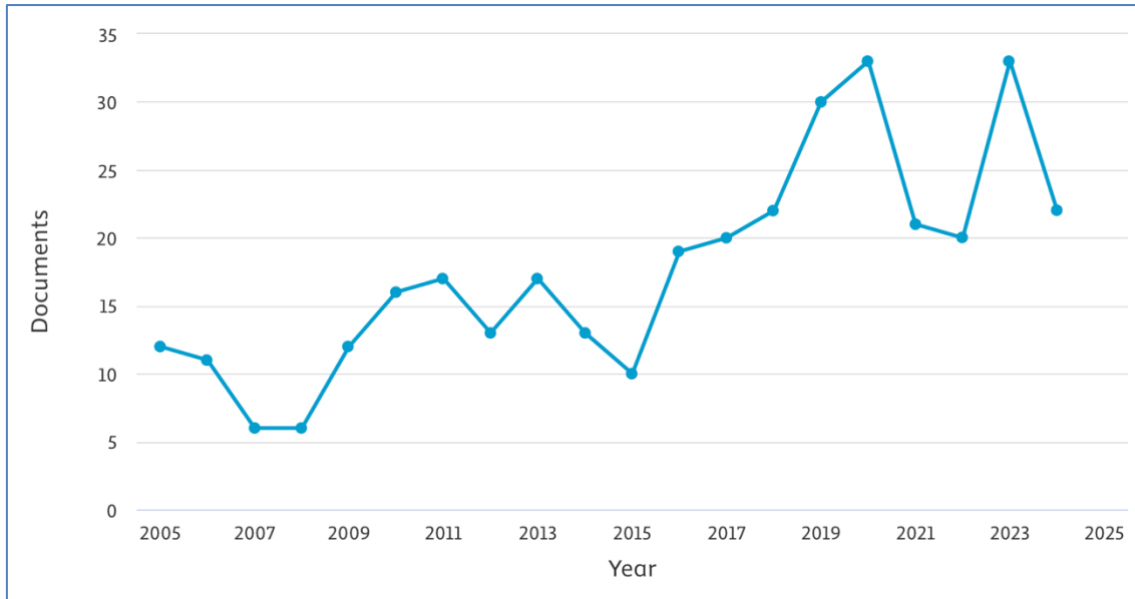


Figure 3 Trends in research published on the Scopus database regarding misconceptions in motion material each year

The peak number of publications occurred in 2020 and 2023, which recorded 34 documents each. This indicates that the interest and attention to the issue of misconceptions in motion material has increased, especially in the last decade. Although there was a decrease in 2021 and 2022, the number of publications remained at a relatively high level compared to the early years, which were 21 and 20 documents respectively. In 2024, the number of publications was recorded at 22 documents. Overall, this data shows a positive upward trend in research publications on misconceptions in motion, reflecting the high relevance and urgency of this topic in the study of physics education and the development of science learning.

Based on Figure 4, it can be seen that the researcher with the highest number of publications indexed in the Scopus database regarding misconceptions in motion material is Mufit, F., with a total of 5 scientific documents. This number shows that Mufit, F. is the most productive contributor in this study compared to the other researchers shown. Below Mufit, there are eight other researchers who have 3 documents each on similar topics, namely Bao, L., Hirashima, T., Horiguchi, T., Natsiavas, S., Paraskevopoulos, E., Vidak, A., Wattanakasiwich, P., and Xiao, Y.. Although the number of their publications is not as many as Mufit's, their contributions are still significant in enriching the literature on misconceptions of motion concepts. Meanwhile, the researcher with the least number of publications on the list is Ananta, S., who has 2 documents. Overall, this graph provides an overview of who are the researchers who are active in the field of misconception research on motion material, as well as showing that Mufit, F. plays an important role and can be the main reference in similar studies.

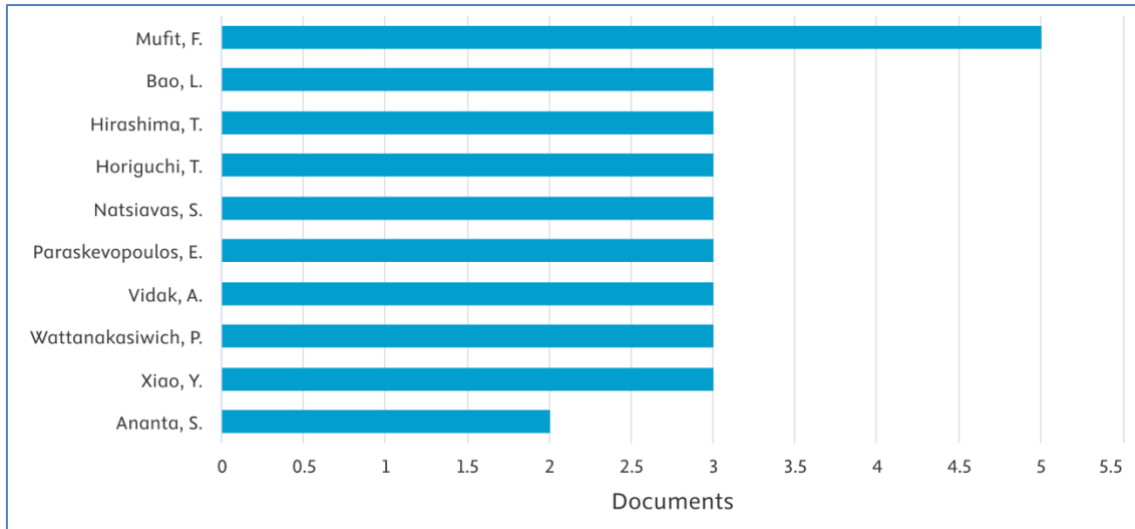


Figure 4. Researchers with the highest number of studies published on the Scopus database regarding misconceptions on motion material

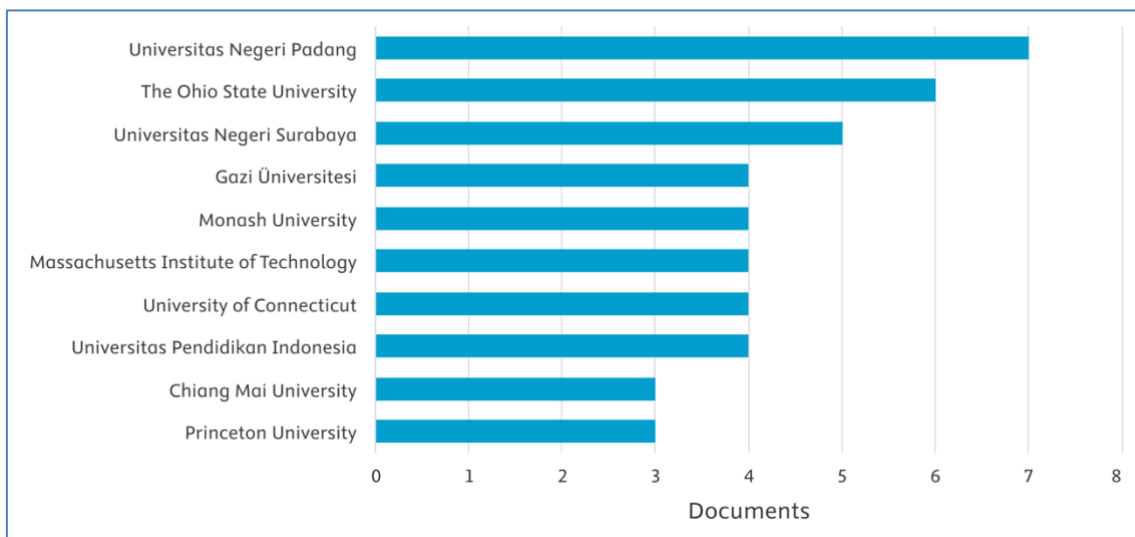


Figure 5. Researcher affiliation with the highest number of studies published on the Scopus database regarding misconceptions on motion material

Figure 5 shows the affiliation of researchers with the highest number of studies published on the Scopus database on misconceptions in motion material. Based on publication data obtained from the Scopus database, it is known that there are several higher education institutions that consistently contribute to research on misconceptions in motion materials. The institution with the highest number of publications is Padang State University, with a total of 7 published documents. This number places Universitas Negeri Padang as the institution with the most significant contribution to this study, especially in the national context. Furthermore, The Ohio State University occupies the second position with a total of 6 publications, showing high attention from higher education institutions in the United States to conceptual issues in physics learning. Surabaya State University with 5 documents. Five other institutions also made major contributions, each with 4 documents, namely Gazi Üniversitesi, and Monash University, Massachusetts Institute of Technology, University of Connecticut, and University

of Education Indonesia. In addition, there were two other institutions that produced 3 documents each, namely Chiang Mai University and Princeton University. Overall, this data shows that the issue of misconceptions in motion is one of the areas that has received extensive attention globally, both from institutions in developed and developing countries.

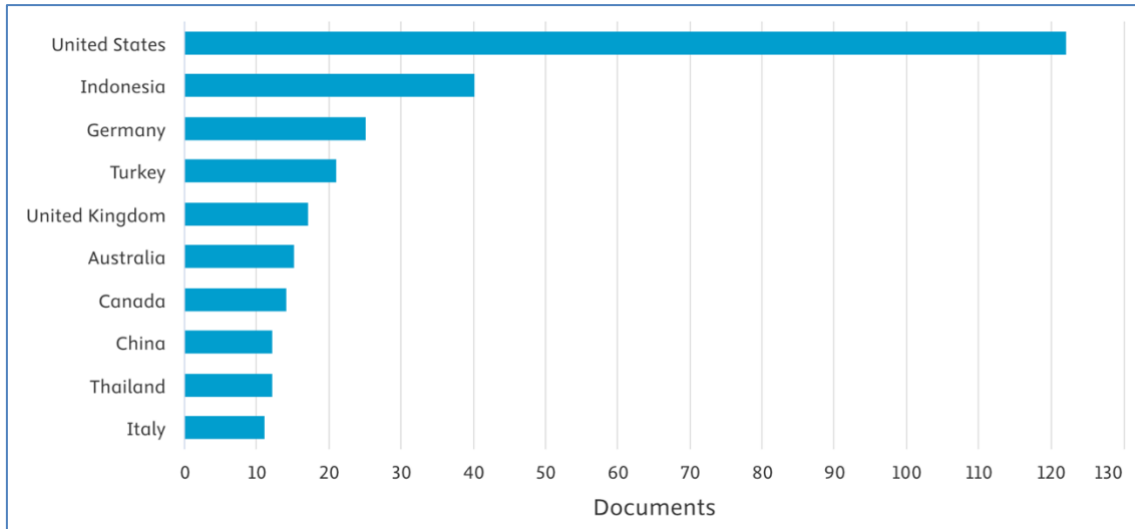


Figure 6. Country of origin of researchers with the highest number of studies published on the Scopus database on misconceptions in motion material

Figure 6 shows the country of origin of the researchers with the highest number of studies published on the Scopus database on misconceptions in motion. It appears that the distribution of publications on misconceptions in motion shows varied contributions from a number of countries in the world. The country with the highest number of publications is the United States, with a total of more than 120 documents. This dominance reflects the active role of researchers from the United States in studying and developing pedagogical approaches to overcome misconceptions in physics, especially on the topic of motion. The second position is occupied by Indonesia, which contributed around 40 documents. This makes Indonesia the only developing country to compete significantly in the number of publications on this topic. The large contribution from Indonesia shows the high attention of academics and education practitioners to the problem of misconceptions in science learning at the national level. Other countries that also show considerable contributions include Germany with more than 25 documents, followed by Turkey, the UK and Australia, each in the range of 15 to 20 documents. Furthermore, there are Canada, China, Thailand and Italy, which each recorded more than 10 documents.

In general, this data shows that the issue of misconceptions in motion is a global concern, with contributions coming from various continents. Developed countries tend to dominate in terms of the number of publications, but developing countries such as Indonesia and Thailand also show significant development. The 10 most cited articles on misconception research on motion are shown in table 2.

Table 2. 10 articles with the highest number of citations in Newton's law misconception research

No	Title	Authors	Year	Journal identity	Cited by
1	Saying the wrong thing: Improving learning with multimedia by including misconceptions	Muller et al.,	2008	<i>Journal of Computer Assisted Learning</i> , Volume 24, Issue 2, Pages 144 - 155	106
2	Misconceptions of Turkish pre-service teachers about force and motion	Bayraktar, S.	2009	<i>International Journal of Science and Mathematics Education</i> , Volume 7, Issue 2, Pages 273 - 291	66
3	Using tracker as a pedagogical tool for understanding projectile motion	Wee et al.,	2012	<i>Physics Education</i> , Volume 47, Issue 4, Pages 448 - 455	57
4	Student misconceptions about force and acceleration in physics and engineering mechanics education	Liu & Fang	2016	<i>International Journal of Engineering Education</i> , Volume 32, Issue 1, Pages 19 - 29	54
5	Remedying science student teachers' misconceptions of force and motion using worksheets based on constructivist learning theory	Atasoy et al.,	2011	<i>Energy Education Science and Technology Part B: Social and Educational Studies</i> , Volume 3, Issue 4, Pages 653 - 668	50
6	Video-game training and naïve reasoning about object motion	Masson et al.,	2011	<i>Applied Cognitive Psychology</i> , Volume 25, Issue 1, Pages 166 - 173	41
7	Investigating primary and secondary student's learning of physics concepts in Taiwan	Chang et al.,	2007	<i>International Journal of Science Education</i> , Volume 29, Issue 4, Pages 465 - 482	40

No	Title	Authors	Year	Journal identity	Cited by
8	Teaching towards knowledge integration in learning force and motion	Ying et al.,	2019	<i>International Journal of Science Education</i> , Volume 41, Issue 16, Pages 2271 - 2295	31
9	Conceptual change and misconceptions in engineering education: Curriculum, measurement, and theory-focused approaches	Streveler et al.,	2015	<i>Cambridge Handbook of Engineering Education Research</i> , Pages 83 - 102	31
10	Exploring the structure of misconceptions in the force and motion conceptual evaluation with modified module analysis	Wells et al.,	2020	<i>Physical Review Physics Education Research</i> , 16(1), 010121	26

Mapping Research Trend on Misconception in Motion Using VOSviewer

The output of visualization using VOSviewer allows visualization of three different types of maps, namely networking visualization, overlay visualization, and density visualization (Nugraha & Rochman, 2024). In this research, the VOSviewer application used is the latest version (Version 1.6.19). The networking visualization, overlay visualization and density visualization of the analysis results using VOSviewer software are shown in Figure 7, Figure 8 and Figure 9, respectively.

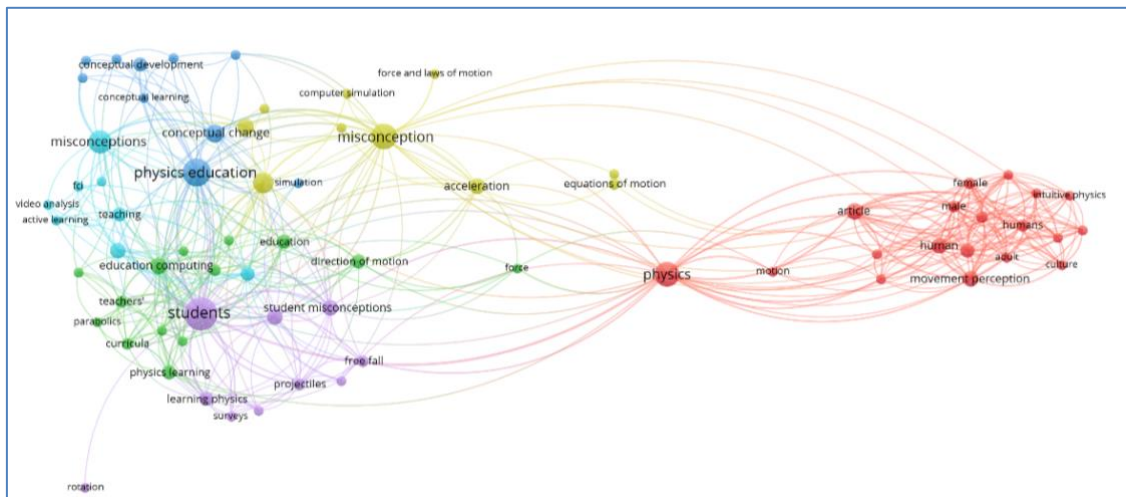


Figure 7. Networking visualization of research on misconceptions on motion material

Figure 7 shows the networking visualization of research on misconceptions in motion. It can be seen that the networking visualization of publications on misconceptions in motion generated through VOSviewer shows thematic links between terms that are often used together in the literature. In this network map, keywords are grouped into five different clusters based on color, reflecting the diverse focus of the study. The blue cluster dominates topics around

conceptual change and physics learning strategies, with keywords such as conceptual change, physics education, teaching, and video analysis, signifying pedagogical approaches to address student misconceptions. The green cluster focuses on the use of simulation and experimental approaches in understanding motion concepts such as acceleration, equations of motion, and computer simulation, indicating the important role of technology in learning. Meanwhile, the purple cluster focuses on learner characteristics and physics learning contexts, with keywords such as students, learning physics, and teachers, describing survey-based research and empirical studies. The red cluster emphasizes interdisciplinary aspects that connect physics with human perception, such as movement perception, posture, and human body, indicating the involvement of physiological and psychological studies. The yellow cluster serves as the main link between the other clusters, with basic keywords such as misconception, physics, and force, representing the core concepts that are the focus of all research. Overall, the results of this visualization illustrate that the issue of misconceptions in motion material is viewed from various perspectives, ranging from pedagogics, educational technology, to cognitive science, thus forming a complex and interconnected research network.

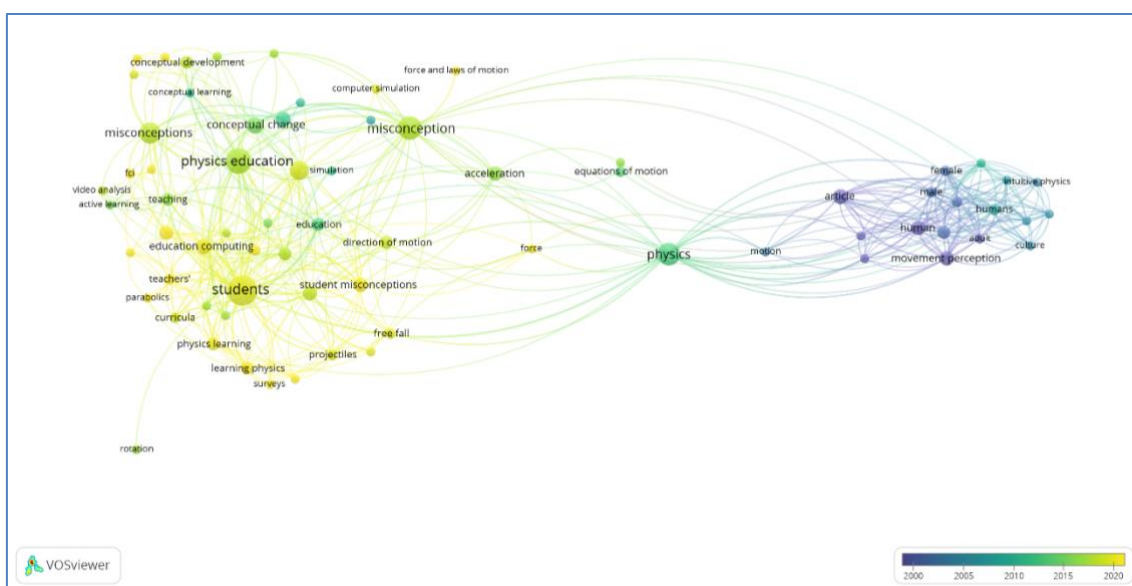


Figure 8. Overlay visualization of research on misconceptions on motion material

Figure 8 shows a keyword-based overlay visualization of research on misconceptions in motion generated through VOSviewer software. The overlay visualization shows a chronological and thematic overview of publication trends based on the year of keyword occurrence. The color of the keyword network represents the time period of dominance of the topic, starting from dark purple for keywords that appear a lot before 2010, light blue for around 2010-2015, to bright yellow for keywords that dominate after 2020. On the right side of the graph, marked by purple to blue, keywords such as movement perception, human, article, posture, and biomechanics physics appear, indicating that early studies focused more on aspects of motion perception and the relationship between physics and the study of humans in a physiological and biological context. Over time, the focus of research began to shift towards physics education and learning. This is reflected in the dominance of green to yellow on the left side of the visualization. Keywords such as physics education, misconception, students, conceptual change, education computing, and video analysis become more prominent in publications after 2015 to 2023. This shows that during this period, researchers' attention began

to focus on pedagogical approaches, the use of technology in learning, and efforts to improve students' conceptual understanding of motion materials. In addition, some very recent keywords, shown in bright yellow, include active learning, curricula, learning physics, and student misconceptions. This indicates that in recent years, active learning approaches and curriculum integration have become key strategies in addressing misconceptions of motion concepts among students.

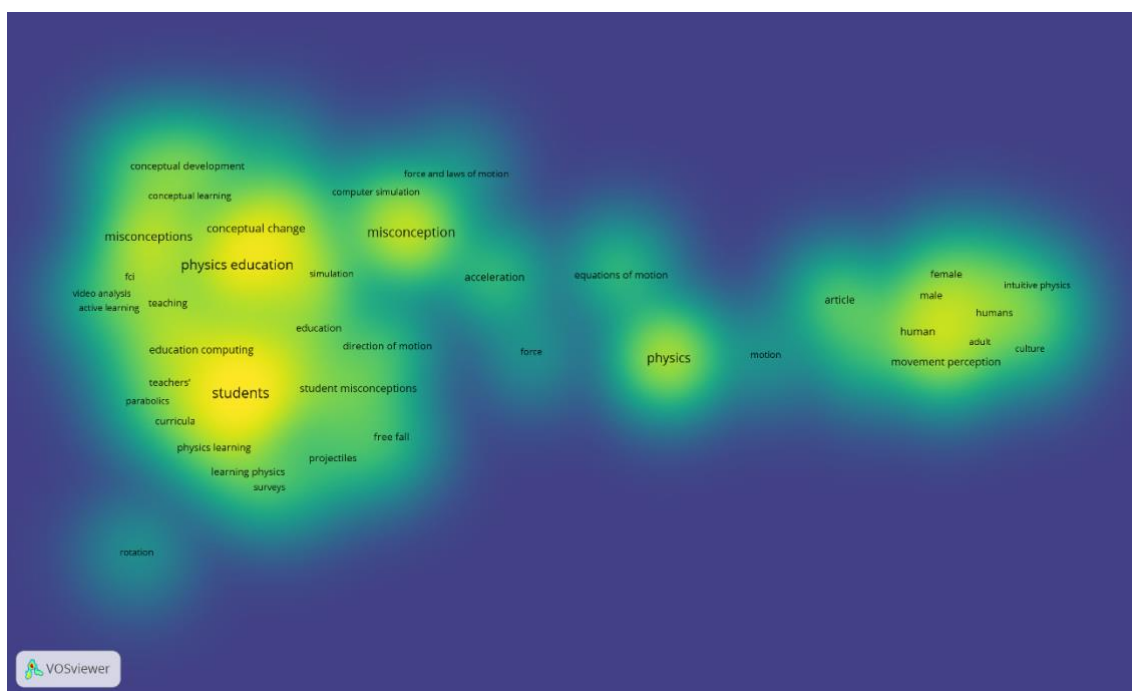


Figure 9. Density visualization of research on misconceptions on motion material

Figure 9 shows a visualization of the density describing the research on misconceptions in motion featuring various keywords grouped by colour intensity. It can be seen that in the yellow area, which indicates high concentration, there are important terms such as misconceptions, physics education, students, and physics. These terms reflect the main focus of the research, which is students' understanding of physics concepts, particularly in the context of movement. Around the green coloured area, which has medium intensity, we find words such as conceptual change, computing education, teacher conceptions, learning physics. This shows the connection between changes in understanding, the use of technology in education, and teachers' views on existing misconceptions. Meanwhile, the blue area showing low intensity includes terms such as simulation, motion, human, culture, and article. These terms indicate supporting aspects that may contribute to misconceptions, such as simulation in learning, human factors, and cultural contexts that influence student understanding. Overall, this visualization provides a comprehensive overview of relevant themes in motion misconception research.

Discussion and Scientific Implication

The results of this study reveal a clear pattern in the evolution of research on misconceptions in motion. The dominance of journal articles, particularly those published in peer-reviewed journals, underscores the academic rigor applied to this topic. The increasing publication trend since 2016, particularly in 2020 and 2023, signals a growing recognition of the importance of addressing misconceptions in physics education, particularly in motion concepts.

The thematic trends reflected in the VOSviewer visualizations reveal significant research clusters in conceptual change, physics education, simulation, and interdisciplinary connections between physics and human perception. The yellow cluster, which includes key terms such as misconception, physics, and force, represents the core concepts that dominate this area of research. The blue and green clusters indicate a shift towards more practical, pedagogical approaches to teaching motion concepts and the integration of technology, such as video analysis and simulations, to enhance student understanding.

Furthermore, the overlay visualization highlights the transition from earlier studies focused on human perception and biomechanics to a more recent emphasis on active learning, curriculum integration, and efforts to correct misconceptions. This shift indicates the increasing recognition of active learning strategies as crucial in addressing misconceptions in motion concepts (Admoko & Suliyannah, 2023; Andoy & Rebuera, 2024).

Despite the progress, the research gaps in this area are evident. Although significant contributions have been made in understanding misconceptions in motion, more work is needed to explore the cognitive and psychological mechanisms that underlie these misconceptions (Arifuddin et al, 2024). Additionally, the integration of new educational technologies, such as virtual simulations, presents a promising area for future research. There is also a need to examine the impact of different educational systems globally to identify best practices in teaching motion concepts and mitigating misconceptions (Hidayat & Widiasih, 2023).

This study has significant implications for both the academic and educational communities. By providing a comprehensive overview of the research landscape on misconceptions in motion, it offers valuable insights into the trends, gaps, and future directions in this field (Dwi et al, 2023). The growing focus on pedagogical approaches and the integration of technology in addressing misconceptions suggests that future research should explore the effectiveness of different teaching methods, including the use of simulations, active learning, and flipped classrooms, in improving students' understanding of motion concepts (Meiliyadi et al, 2025).

Moreover, the global contributions to this research indicate that misconceptions in motion are a universal issue, and efforts to address them should be informed by a diverse range of educational contexts and approaches. The findings emphasize the importance of continued collaboration between researchers, educators, and institutions to develop more effective strategies for overcoming misconceptions and enhancing the quality of physics education worldwide (Noviayanti et al, 2024; Orazov et al, 2025). While substantial progress has been made in understanding and addressing misconceptions in motion, this study highlights several areas where further research is needed. The integration of new technologies, the exploration of global educational practices, and a deeper understanding of cognitive mechanisms all represent promising avenues for future work that can further enhance the quality of physics education and improve students' conceptual understanding.

CONCLUSION

This study successfully applied bibliometric analysis to map the evolution of research on misconceptions in motion materials, using data sourced from the Scopus database over a 20-year period (2005–2024), which resulted in 353 relevant articles. The findings reveal a notable increase in research output, particularly in 2020, with the United States leading in terms of publication volume. The majority of the research was published in Scopus-indexed journals, with Padang State University emerging as a key institution contributing to this body of work.

The upward trend in research publications underscores the growing academic interest in addressing misconceptions in motion materials, which are critical for enhancing conceptual understanding in physics education. The implications of this bibliometric analysis suggest the need for further investigation into the cognitive and psychological mechanisms that contribute to these misconceptions, as well as the exploration of innovative educational strategies, such as virtual simulations, to mitigate them. Additionally, future research should aim to compare educational systems globally to identify best practices for addressing misconceptions and explore the potential of emerging technologies in education. By broadening the scope to include diverse international perspectives, future studies can enrich the global discourse on misconceptions in motion, ultimately contributing to more effective physics teaching and learning worldwide.

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REFERENCES

- Admoko, S., & Suliyanah. (2023). Could Physics Teachers Also Have Misconceptions on Basic Kinematics? *Journal of Physics: Conference Series*, 2623, 012025. <https://doi.org/10.1088/1742-6596/2623/1/012025>
- Aldazharova, S., Issayeva, G., Maxutov, S., & Balta, N. (2024). Assessing AI's problem solving in physics: Analyzing reasoning, false positives and negatives through the force concept inventory. *Contemporary Educational Technology*, 16(4), ep538. <https://doi.org/10.30935/cedtech/15592>
- Andoy, E. J. B., & Rebuera, A. J. G. (2024). Boosting Physics Engagement in The Philippine Countryside: The Impact of Digital Modules on Understanding of Projectile Motion. *2024 International Conference on TVET Excellence and Development*, 206304. <https://doi.org/10.1109/ICTeD62334.2024.10844622>
- Arifuddin, M., Muis, A., Mahtari, S., & Suyidno, S. (2024). Misconception analysis of high school students with certainty of response index on work and energy materials. *AIP Conference Proceeding*, 3058, 020017. <https://doi.org/10.1063/5.0201466>
- Batlolona, ohn R., & Jamaludin, J. (2024). Students' misconceptions on the concept of sound: a case study about Marinyo, Tanimbar Islands. *Journal of Education and Learning*, 18(3), 681–689. <https://doi.org/10.11591/edulearn.v18i3.21135>
- Busyairi, A., & Zuhdi, M. (2024). Profile of Student Misconceptions on Static Fluids: A Meta-Analysis Study. *Kappa Journal*, 8(3), 476–484. <https://doi.org/10.29408/kpj.v8i3.28433>
- Didik, L. A., & Aulia, F. (2019). Analisa Tingkat Pemahaman dan Miskonsepsi pada Materi Listrik Statis Mahasiswa Tadris Fisika Menggunakan Metode 3-Tier Multiple Choices Diagnostic. *Phenomenon*, 9(1), 99–112. <https://doi.org/http://dx.doi.org/10.21580/phen.2019.9.1.2905>
- Didik, L. A., Wahyudi, M., & Kafrawi, M. (2020). Identifikasi Miskonsepsi dan Tingkat Pemahaman Mahasiswa Tadris Fisika pada Materi Listrik Dinamis Menggunakan 3-Tier Diagnostic Test. *Journal of Natural Science and Integration*, 3(2), 128–137. <https://doi.org/10.24014/jnsi.v3i2.9911>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>

- Dwi Sundari, P., Azhar, A., & Rahmatina Rahim, F. (2023). Identification of kinematics understanding of physics students at the university in coastal area. *BIO Web of Conferences*, 79, 05008. <https://doi.org/10.1051/bioconf/20237905008>
- Foisy, L.-M. B., Potvin, P., Riopel, M., & Masson, S. (2015). Is inhibition involved in overcoming a common physics misconception in mechanics? *Trends in Neuroscience and Education*, 4(1–2), 26–36. <https://doi.org/10.1016/j.tine.2015.03.001>
- Hamidah, I., Sriyono, S., & Hudha, M. N. (2020). A bibliometric analysis of covid-19 research using vosviewer. *International Journal of Science and Technology*, 5(2), 209–216. <https://doi.org/10.17509/ijost.v5i2.24522>
- Hidayat, Hidayat, O. S., & Widiasih. (2023). Development of Google Sites-Based Learning Resources to Improve Mastery of Concepts and Process Skills in Electrical Circuit Materials. *Jurnal Penelitian Pendidikan IPA*, 9(6), 4624–4231. <https://doi.org/10.29303/jppipa.v9i6.3612>
- Husaeni, D. F. Al, & Nandiyanto, A. B. D. (2022). Bibliometric Using Vosviewer with Publish or Perish (using Google Scholar data): From Step-by-step Processing for Users to the Practical Examples in the Analysis of Digital Learning Articles in Pre and Post Covid-19 Pandemic. *ASEAN Journal of Science and Engineering*, 2(1), 19–46. <https://doi.org/10.17509/xxxxt.vxix>
- Ko'o, E., Meiliyadi, L. A. D., & Bahtiar. (2022). Pengembangan lembar kerja siswa (LKS) berbasis multiple intelligences pada materi kalor kelas VII MTS Miftahul Ishlah. *Relativitas: Jurnal Riset Inovasi Pembelajaran Fisika*, 5(1), 1–18. <https://doi.org/10.29103/relativitas.v5i1.6979>
- Koudelkova, V., & Dvorak, L. (2015). High school students' misconceptions in electricity and magnetism and some experiments that can help students to reduce them. *IL NUOVO CIMENTO*, 38(C), 101. <https://doi.org/10.1393/ncc/i2015-15101-7>
- Maryam, S., Arif, K., Putri, A. N., Oktavia, R., Nellisma, & Angraini, D. (2024). Analysis Misconceptions Middle School Students in Padang Barat on Temperature, Heat and Expansion Material Use Instrument Four Tier Test. *Jurnal Penelitian Pendidikan IPA*, 10(10), 8227–8237. <https://doi.org/10.29303/jppipa.v10i10.7628>
- Meiliyadi, L. A. D., Arizona, K., Wahyudi, M., & Damayanti, I. (2025). Research Trend on Newton's Law Misconceptions from Scopus Database using Bibliometric. *Indonesian Journal of Educational Research and Technology*, 5(3), 275–290. <https://doi.org/10.17509/ijert.v5i3.88015>
- Mustofa, H. A., Sandanadas, E., Mohtar, L. E., & Faresta, R. A. (2024). Identifying Student Prior-Knowledge and Conceptual Changes Profile on Newton Law Using by using POE (Predict, Observe, and Explain) as Probing Understanding Strategy. *Journal of Science and Mathematics Letters*, 12(1), 80–91. <https://doi.org/10.37134/jsml.vol12.1.10.2024>
- Nandiyanto, A. B. D., Fiandini, M., & Husaeni, D. N. Al. (2024). Research Trends from The Scopus Database Using Keyword Water Hyacinth and Ecosystem: A Bibliometric Literature Review. *ASEAN Journal of Science and Engineering*, 4(1), 33–48. <https://doi.org/10.17509/ajse.v4i1.60149>
- Noviyanti, A. R., Adzkie, Q. A. A., Novella, I., Kurnia, I., Suryana, S., Bin, A. M., & Irwansyah, F. S. (2024). Hydroxyapatite as Delivery and Carrier Material: Systematic Literature Review with Bibliometric Analysis. *ASEAN Journal of Science and Engineering*, 4(2), 191–206. <https://doi.org/10.17509/ajse.v4i2.70223>
- Nugraha, A. K., & Rochman, C. (2024). Mapping Research Trends In Teaching And Learning Trajectories In Science Learning. *Phenomenon: Jurnal Pendidikan MIPA*, 15(1), 63–84. <https://doi.org/10.21580/phen.2024.14.1.21216>
- Nurulwati, Halim, A., Mailizar, Syukri, M., & Saputri, M. (2024). Identification of Students'

- Misconceptions to the Kinetic Gas Theory in Physics. *Jurnal Penelitian Pendidikan IPA*, 10(6), 3113–3117. <https://doi.org/10.29303/jppipa.v10i6.8018>
- Orazov, B., Issayeva, G., Maxutov, S., Kozhabekova, E., & Balta, N. (2025). Exploring university students' misconceptions of the kinetic molecular theory of gases: A study from Kazakhstan. *Eurasia Journal of Mathematics, Science and Technology Education*, 21(2), em2587. <https://doi.org/10.29333/ejmste/15957>
- Putra, M. D., Ernest, I. Z., Rokhma, M. A. N., & Rilo Pangastuti, Insih Wilujeng, S. R. (2023). Analysis of Students' Critical Thinking Ability Through Science E-Module Learning Based Google Sites. *Jurnal Penelitian Pendidikan IPA*, 9(64658–4665). <https://doi.org/10.29303/jppipa.v9i6.2793>
- Putri, V. A., Sundari, P. D., Mufit, F., & Dewi, W. S. (2024). Analysis of Students' Physics Conceptual Understanding using Five-Tier Multiple Choice Questions: the Newton's Law of Motion Context. *Jurnal Penelitian Pendidikan IPA*, 10(5), 2275–2285. <https://doi.org/10.29303/jppipa.v10i5.5847>
- Ramachandran, B., Jyothy, S. N., Smith, M. D., & Velankar, Y. P. (2025). Examining conceptual understanding of electricity and magnetism in the post-pandemic era. *Physics Education*, 60, 035009. <https://doi.org/10.1088/1361-6552/adbc3a>
- Ruhana, B. A., Meiliyadi, L. A. D., & Zaini, M. (2023). Pengaruh model discovery learning terhadap keterampilan berpikir kritis siswa pada materi suhu dan kalor. *Relativitas: Jurnal Riset Inovasi Pembelajaran Fisika*, 6(1), 1–10. <https://doi.org/10.29103/relativitas.v6i1.10375>
- Saputra, O., Hermanto, I. M., Safitri, A. I., Putra, H. T., Nadzirin, A., & Lusiyanti, D. (2024). Development of 4-Tier Diagnostic Fluid Static Test (4T-DFST) to identify profile students' conception. *Journal of Physics: Conference Series*, 2900, 012003. <https://doi.org/10.1088/1742-6596/2900/1/012003>
- Sharifi, F., Ahmadi, F., Meshkat, M., & Talkhabi, M. (2025). Investigating the effect of teaching kinematics concepts using thought experiments on students' academic progress and learning strategies. *Physics Education*, 60(3), 035018. <https://doi.org/10.1088/1361-6552/adbdal>
- Shofiyah, N., Suprpto, N., Prahani, B. K., Jatmiko, B., Anggraeni, D. M., & Nisa', K. (2024). Exploring undergraduate students' scientific reasoning in the force and motion concept. *Cogent Education*, 11(1), 2365579. <https://doi.org/10.1080/2331186X.2024.2365579>
- Soeharto, S., & Csapó, B. (2021). Evaluating item difficulty patterns for assessing student misconceptions in science across physics, chemistry, and biology concepts. *Heliyon*, 7(11), e08352. <https://doi.org/10.1016/j.heliyon.2021.e08352>
- Soeharto, S., & Csapó, B. (2022). Exploring Indonesian student misconceptions in science concepts. *Heliyon*, 8(9), e10720. <https://doi.org/10.1016/j.heliyon.2022.e10720>
- Souisa, C. A., Batlolona, J. R., & Malawau, S. (2024). Student Misconceptions about Heat Transfer Mechanisms: An Island Ethnophysics Study. *KnE Social Sciences*, 8, 162–179. <https://doi.org/10.18502/kss.v9i31.17567>
- Stefanou, M., Stylos, G., Georgopoulos, K., & Kotsis, K. T. (2024). Primary Preservice Teachers' Misconceptions and Reasoning of Thermal Concepts in Everyday Contexts. *International Journal of Learning in Higher Education*, 31(1), p127. <https://doi.org/10.18848/2327-7955/CGP/v31i01/127-157>
- Suhandi, A., Samsudin, A., Fratiwi, Janeusse, N., Nurdini, N., Feranie, S., Purwanto, M., Linuwih, G., Suharto, & Coştu, B. (2025). Altering misconceptions: how e-rebuttal texts on Newton's laws reconstructs students' mental models. *Frontiers Education*, 10, 1472385. <https://doi.org/10.3389/educ.2025.1472385>
- Suwasono, P., Munthe, H., & Saniso, E. (2024). Minimize student misconceptions about

- Newton's third law with unstructured problems in modeling instruction. *AIP Conference Proceeding*, 3106, 060006. <https://doi.org/10.1063/5.0215283>
- Syuhendri, S. (2021). Effect of conceptual change texts on physics education students' conceptual understanding in kinematics. *Journal of Physics ...*, 1876, 012090. <https://doi.org/10.1088/1742-6596/1876/1/012090>
- Waraga, S. S., Abdjul, T., & Odja, A. H. (2023). Development of Google Sites-Assisted Learning Devices on Vibrations and Waves Material. *Jurnal Penelitian Pendidikan IPA*, 9(8), 6101–6110.
- Wen, Y., Lin, J., Ming, Y., Zhang, J., Wu, X., Bao, L., Yu, K., & Xiao, Y. (2024). Role of inhibition in overcoming interferences of misconception under similar feature saliency: An eye-tracking study of the projectile motion problem. *Physical Review Physics Education Research*, 20(2), 020121. <https://doi.org/10.1103/PhysRevPhysEducRes.20.020121>
- Yang, L., Huang, L., Wu, X., Xiong, J., Bao, L., & Xiao, Y. (2024). Assessment of preservice physics teachers' knowledge of student understanding of force and motion. *Physical Review Physics Education Research*, 20(1), 010148. <https://doi.org/10.1103/PhysRevPhysEducRes.20.010148>
- Yanti, R., Elquthb, J. N., Rachmadewi, I. P., & Qurtubi, Q. (2024). Bibliometric study of association rule-market basket analysis. *International Journal of Advances in Applied Sciences*, 13(2), 282–290. <https://doi.org/10.11591/ijaas.v13.i2.pp282-290>