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Research Trend on Newton's Law Misconceptions from Scopus Database using Bibliometric

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ABSTRACT

The purpose of this study is to present the development of research on the topic of student misconceptions of Newton's law. The database was obtained through the Scopus website for 10 periods (2015-2024). The data search resulted in 59 relevant research articles. The results showed that the development of misconception research on Newton's law has not been widely carried out, as shown by the average publication of 5.9 articles per year. The development of misconception research on Newton's law is most popular in 2020, where the COVID-19 pandemic forces learning to be done online, increasing the potential for misconceptions in learning. There are 6 clusters resulting from data visualization analysis. The country that produced the most articles about misconceptions in Newton's law came from Indonesia, with the affiliation that produced the most research articles on Newton's law misconceptions published in the most Scopus-indexed journals coming from the Indonesian Education University. The published articles are mostly journal articles and international conference proceedings. The visualization results using VOSviewer show that there are still many opportunities in the future for misconception research on Newton's law. Through this study, there is an overview for researchers to get research updates on student misconceptions research on Newton's law.

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1. INTRODUCTION

Physics can be considered a science that seeks to describe and explain the laws of nature and events in nature with descriptions according to human thinking (Soeharto & Csapó, 2021). Learning done by students is done by identifying physical events that occur in the surrounding nature to understand concepts (Solihat *et al.*, 2024). Because it is an observation of the surrounding nature, physics can be said to be physical knowledge that occurs due to the abstraction of the surrounding nature (Resbiantoro & Setiani, 2022; Guerra-Reyes *et al.*, 2024). This is evidence that physics learning is related to understanding the concept of events in the surrounding environment (Cowie *et al.*, 2021; Assem *et al.*, 2023).

Concept understanding is one of the important factors in physics learning (Danielson *et al.*, 2025). However, each student has different abilities in understanding physics concepts. Therefore, students are prone to experience errors in connecting physics concepts. Thus, the concepts they have will be different from the concepts formed by experts (Batlolona & Jamaludin, 2024; Maryani & Atmojo, 2024). This is because each student has a different way of building abstractions of physics concepts. If the concept built by the student is different from the concept of the experts, then the student can be said to experience misconceptions (Sari *et al.*, 2024). Misconception is a consistent pattern of thinking in a different situation or problem, but the pattern of thinking is wrong (Putri *et al.*, 2022). Misconceptions occur a lot in students, especially in students who have less analytical skills. This is because physics concepts are interrelated with each other. Thus, they require in-depth analytical skills (Archila *et al.*, 2024; Kotsis, 2024).

One of the techniques used in analyzing the level of student misconceptions is diagnostic tests. Diagnostic tests with a misconception approach can be done to measure the level of student misconceptions based on everyday experiences. Diagnostic tests that are usually conducted include Certainty Response Index (Adilah *et al.*, 2025; Ningroom *et al.*, 2025), 2-Tier Diagnostic Test, 3-Tier Diagnostic Test (Irfandi *et al.*, 2022; Azzahra & Kartikawati, 2023; Laeli, 2023), 4-Tier Diagnostic Test (Pujayanto, 2018; Kaniawati *et al.*, 2019; Fakhriyah & Masfuah, 2021), and 5-Tier Diagnostic Test (Ojo, 2024).

One of the physics materials that makes many students experience misconceptions is Newton's law (Rusilowati *et al.*, 2021; Suwasono *et al.*, 2023; Mustofa *et al.*, 2024). This is because force is a vector quantity that requires in-depth analysis in its discussion (de Faria *et al.*, 2025). The material about friction force, for example, many students think that the surface area affects the amount of friction force. Based on the formulation of Newton's law, the friction force only depends on the roughness of the contact area and the mass of the object. There are still many materials about Newton's law that still make students experience misconceptions (Abdilkadyr *et al.*, 2025; Kahaleh & Lopez, 2025; Suhandi *et al.*, 2025). Thus, many publications have discussed student misconceptions in Newton's law material. Therefore, in this study, the development of research on misconceptions in Newton's law is presented. Thus, future researchers can develop research on misconceptions in Newton's law.

The purpose of this study is to provide an overview of misconception research trends in Newton's law. The analysis used is the bibliometric method (Zafrullah & Ramadhani, 2024; Nandiyanto *et al.*, 2025; Rohimah, 2025). The bibliometric method was chosen because it can provide quantitative and qualitative data. Thus, future researchers can determine research gaps and novelty regarding misconceptions research on Newton's law in the future.

2. METHODS

2.1. Determine Keywords and Collect Data

This research uses a bibliometric approach (Nithideechaiwarachok & Chano, 2025). Data is taken from the Scopus database through the Scopus website. Scopus database was chosen because Scopus has complete data indexing, making it easier for researchers to conduct bibliometric analysis (Diaty *et al.*, 2025). The articles referenced are English-language articles. The source articles used were manuscripts published in journals, conference proceedings, and book chapters. The keywords used were “misconceptions” and “Newton's law”. These keywords were taken because there are still many cases of misconceptions experienced by students (Amiruddin *et al.*, 2025). Moreover, the physical analysis of Newton's law involves things experienced by students in their daily lives. If the theory built by the student is different from the opinion of experts, then the student can be said to have misconceptions. The steps of bibliometric analysis in this study are shown in **Figure 1**.

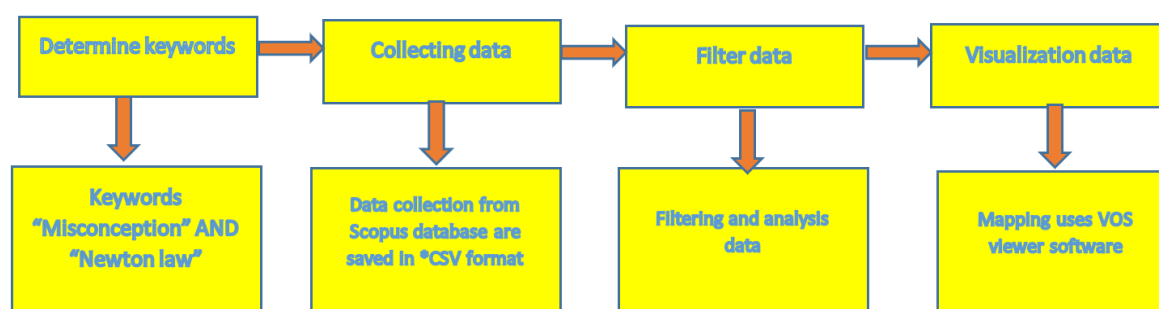


Figure 1. Schematic diagram of collecting data on research articles using bibliometric analysis.

2.2. Data Filtering

The data collected on the Scopus database is then filtered (Diaty *et al.*, 2025). The first filter is done based on the year, where the selected year range is the last 10 years, namely from 2015 to 2024. The number of articles originally collected was 85 documents. After filtering, 59 documents were analyzed. The data filter scheme is shown in **Figure 2**.

2.3. Data Visualization

Data visualization was done using VOSviewer software version 1.6.17. VOSviewer is able to produce analytical data in the form of data mapping with three categories, namely networking, overlay, and density (Imaniyati *et al.*, 2025; Wijaya, 2025). The type of analysis used is co-occurrence with the category of all keywords.

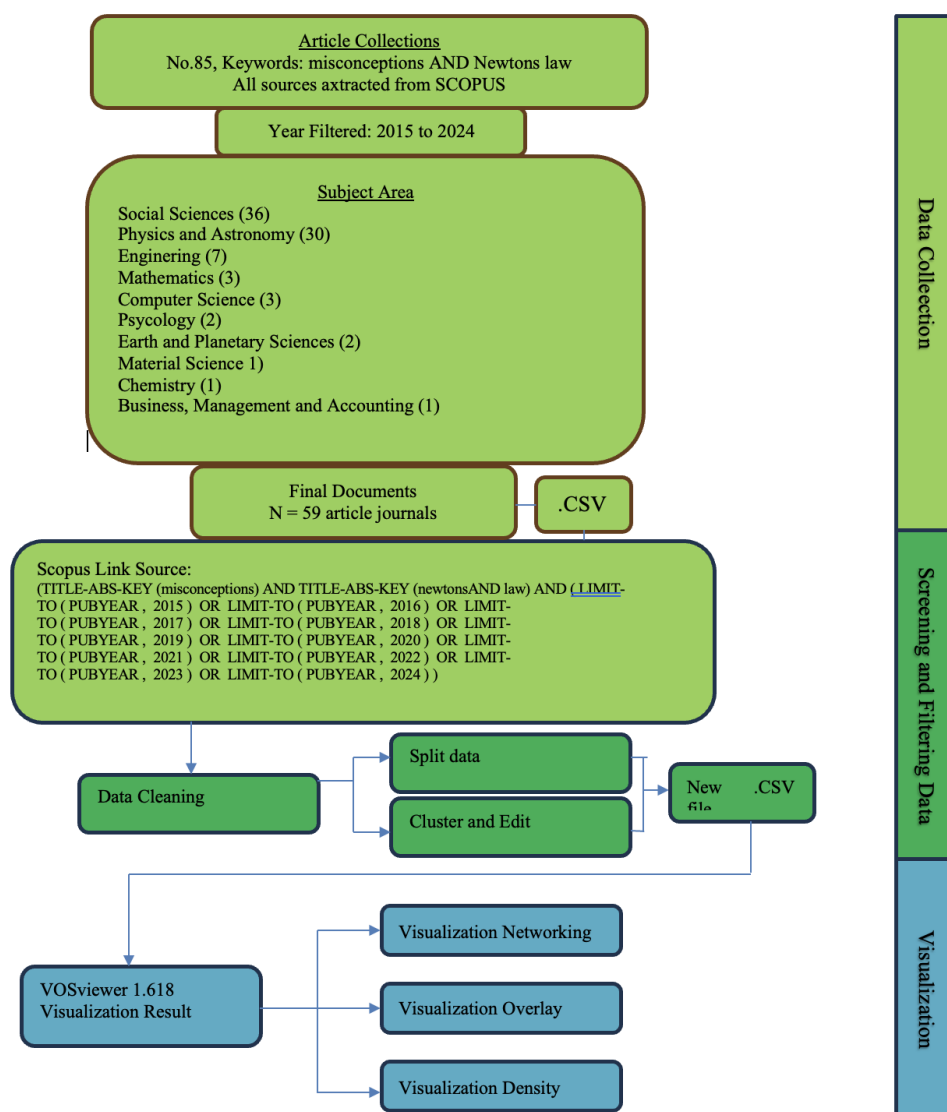


Figure 2. Data filtering process.

3. RESULTS AND DISCUSSION

3.1. Research Trend of Newton's Law Misconception

This study presents a literature review of articles on misconceptions in Newton's law for 10 periods, from 2015 to 2024. During this period, research on misconceptions in Newton's law experienced a fluctuating phase (see **Figure 3**).

The trend of research on misconceptions in Newton's law experienced significant fluctuations from 2015 to 2024. At the beginning of the period, the number of studies increased from around three studies in 2015 to seven studies in 2016. However, after that, there was a gradual decline until 2018, when the number of studies dropped to around three. In the following years, there was a significant spike, with the number of studies increasing dramatically and peaking in 2020 with more than ten studies. After reaching the highest point, the research trend again experienced a fairly sharp decline until it reached its lowest point in 2022, with only about two studies published. However, in the last two years, the number of studies has shown a gradual increase again, reaching around seven studies in 2024. These developments suggest that interest in misconception research on Newton's laws has fluctuated, with a peak of activity in 2020 and a recovery of the trend after a sharp decline in 2022.

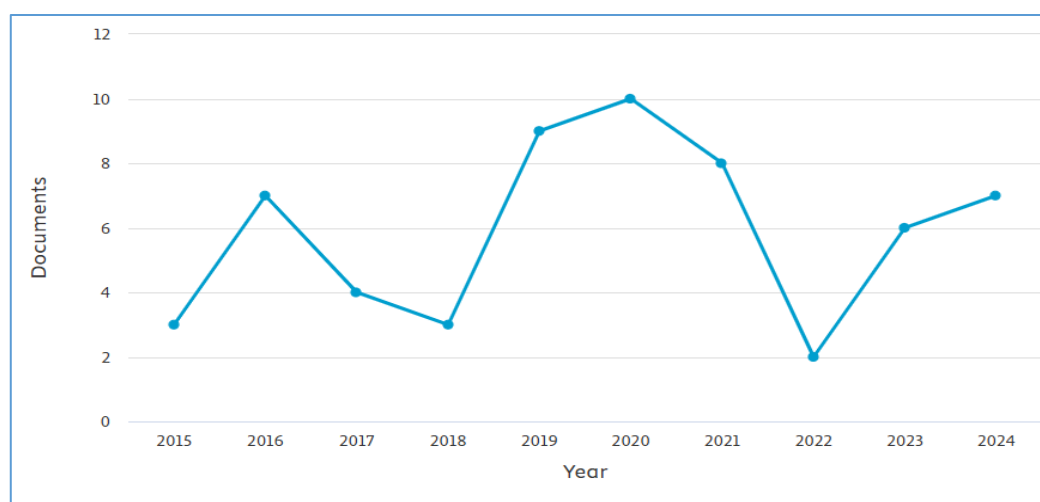


Figure 3. Research trends regarding misconceptions of Newton's law.

Figure 4 shows the number of studies that have been published by several researchers related to misconceptions in Newton's Laws. From **Figure 4**, it can be seen that Samsudin, A. is the researcher with the highest number of publications, reaching around 6 studies, which makes him the main contributor in this field. The next position is occupied by three researchers, namely Fratiwi, N.J., Kaniawati, I., and Suhendi, E., who each have a total of about 5 publications, which shows that they are also active in research related to misconceptions on Newton's Law. Furthermore, Suyana, I. is in the lower position with about 4 studies, which still shows a significant involvement in research in this area. Followed by Stewart, J., and Wells, J., who each have about 3 studies. Meanwhile, three other researchers, namely Coştu, B., Henderson, R., and Saniso, E., have a smaller number of publications, which is about 2 studies each. From this data, it can be concluded that Samsudin, A. has the largest contribution to research on misconceptions in Newton's Law compared to other researchers. Meanwhile, several other researchers also made considerable contributions, especially Fratiwi, N. J., Kaniawati, I., and Suhendi, E., whose number of publications is not much different. **Figure 4** provides a clear picture of the dominance of several researchers on this topic and shows who plays an active role in studies related to misconceptions in Newton's Laws.

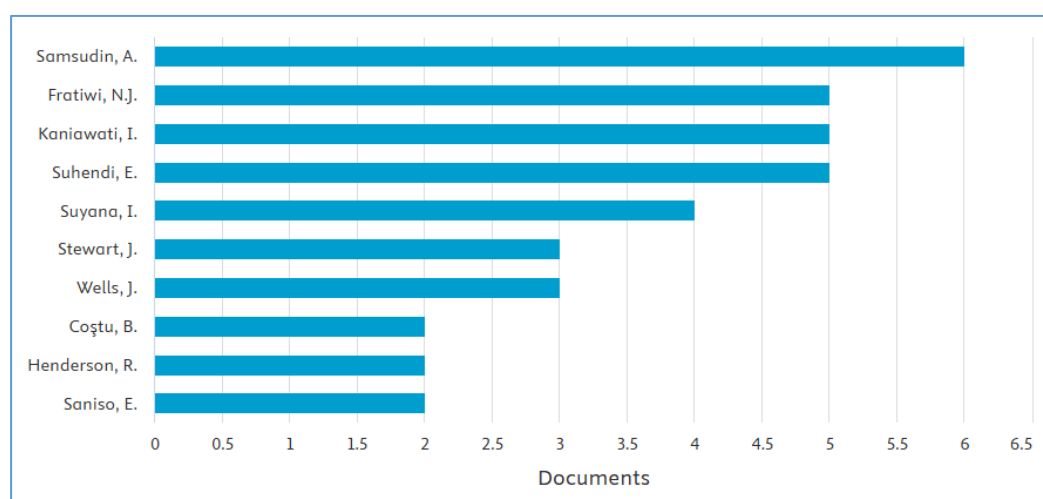


Figure 4. Researcher with the most documents on Newton's law misconceptions.

Figure 5 illustrates the number of studies that address misconceptions in Newton's law based on the country of origin. From **Figure 5**, it can be seen that Indonesia is the country with the highest number of studies, with a total of 25 studies. This shows that Indonesia has a very high attention to the study of misconceptions in Newton's law, possibly due to challenges in understanding physics concepts among students. In second place, the United States also shows a sizable number of studies, although it is still below Indonesia. This indicates that this topic is also a concern for researchers in the United States, although not as much as in Indonesia. Furthermore, countries such as Thailand, Turkey, China, Italy, and Mexico have relatively fewer studies than the top two countries, with a significant difference.

Countries such as Bosnia and Herzegovina, Croatia, and Greece are at the bottom of the list, with the least number of studies. This shows that studies on misconceptions in Newton's law in these countries are still limited compared to the other countries in the chart. Overall, it can be concluded from this chart that Indonesia is the main centre of research on misconceptions in Newton's laws, followed by the United States, while other countries have a much lower number of studies. This data could reflect the level of academic attention, educational curricula, or conceptual issues that are more prevalent in countries with a higher number of studies.

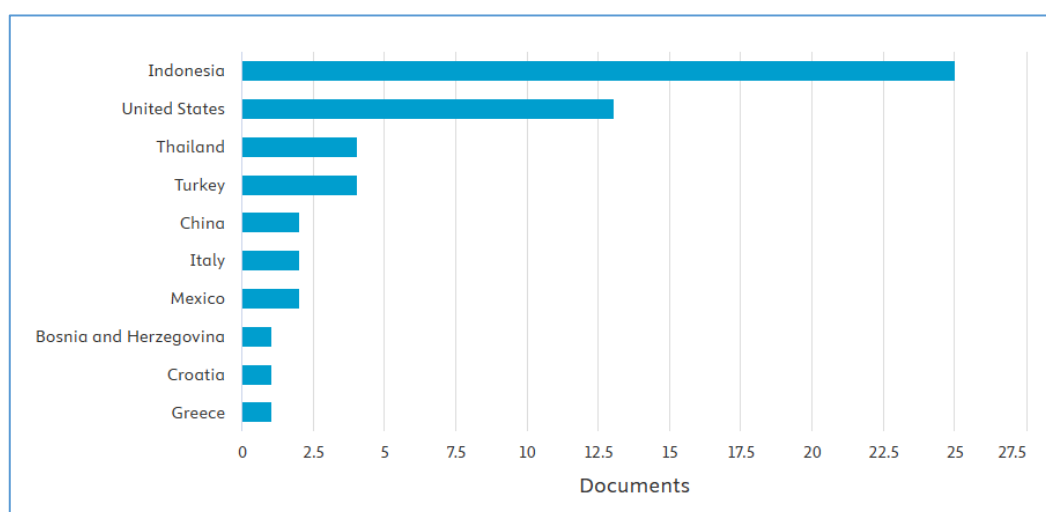


Figure 5. Countries with the most research on misconceptions in Newton's law.

Based on **Figure 6**, it can be seen that Universitas Pendidikan Indonesia is the institution with the highest number of studies related to misconceptions in Newton's law, with a total of 8 studies. This number is much higher than other universities, which only have 2 studies each. This shows that Universitas Pendidikan Indonesia has great attention to the issue of misconceptions in learning Newton's law, possibly through various research and scientific publications conducted by its academics and researchers. Meanwhile, several other universities also contributed to this research, although with fewer documents, including West Virginia University, University of Connecticut, Surabaya State University, South China Normal University, Yıldız Teknik Üniversitesi, Massachusetts Institute of Technology, Michigan State University, Sebelas Maret University, and Yogyakarta State University. Each of these universities has 2-3 studies that discuss similar topics. Although the number is not as large as Universitas Pendidikan Indonesia, the involvement of these institutions still shows that misconceptions of Newton's law are a global issue that attracts the attention of various researchers from various countries and academic institutions.

From the data presented, it can be concluded that Universitas Pendidikan Indonesia is the most active institution in conducting studies on misconceptions in Newton's law, both in

theoretical aspects and in its application in education. Meanwhile, other universities also participated in contributing, although in smaller numbers. This reflects that research on misconceptions in Newton's laws is one of the important fields of study in physics education that has received wide attention at the international level.

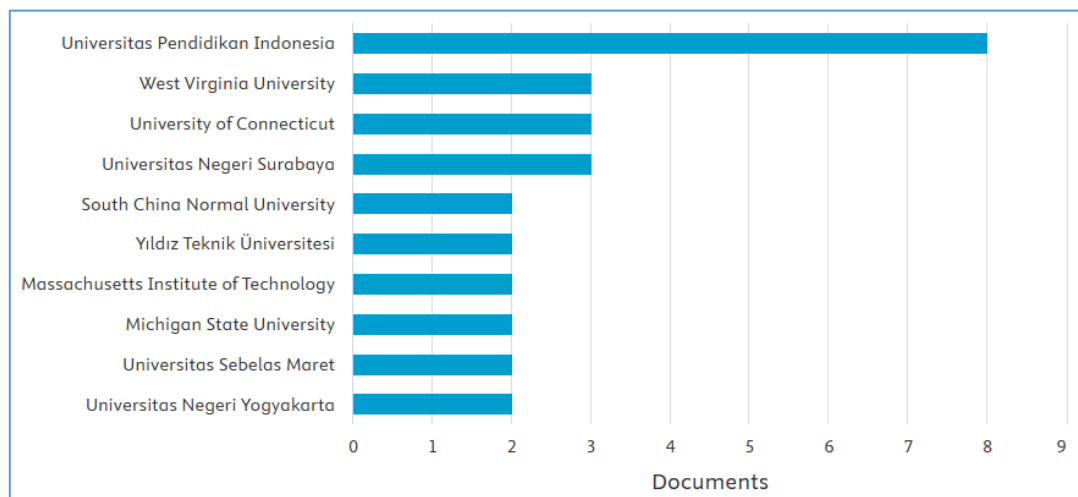


Figure 6. The researcher's affiliation with the highest research on misconceptions in Newton's law

Figure 7 shows the distribution of document types published in research on misconceptions in Newton's laws. This diagram shows that publications in the form of scientific articles (articles) dominate with a percentage of 55.9%, making it the most widely used type of research in presenting related research results. This shows that research on misconceptions in Newton's law is more often published in scientific journals that have a wide academic scope and can be accessed by many researchers and educational practitioners. In addition, publications in the form of conference papers have a fairly large percentage, namely 39.0%. This percentage shows that research on misconceptions about Newton's law is also often presented in academic forums such as seminars and scientific conferences. Conference papers are usually used to discuss preliminary findings or the latest developments in a field of research, which allows academics to get feedback before publishing their research in the form of journal articles. Meanwhile, publications in the form of book chapters accounted for only 3.4%, indicating that despite the importance of this topic, few studies are documented as part of larger academic books. The least common type of publication is in the form of a book, with a percentage of 1.7%. This small percentage indicates that research on misconceptions in Newton's laws is rarely published in the form of a stand-alone book. Overall, the distribution of document types in research on misconceptions in Newton's laws shows that scientific publications in the form of articles and conference papers are the main choice in disseminating research results. This indicates that discussions and theory development in this field continue to develop through more dynamic academic publications, such as journals and conference proceedings, compared to books or book chapters that tend to be more static. The Scopus-indexed journals that are the destination of misconceptions researchers on Newton's law are shown in **Table 1**.

Based on the data presented in **Table 1**, it is found that the publication most widely used as a reference source is *Journal of Physics: Conference Series*, with a percentage of 13%. This source is the most dominant compared to other publications. Furthermore, *Physical Review: Physics Education Research* occupies the second position with a percentage of 5%, followed by *AIP Conference Proceedings*, which has a contribution of 4%. Meanwhile, the *ASEE Annual*

Conference and Exposition Conference Proceedings and Challenges in Physics Education each contributed 2% of the total publications used. From this data, it can be concluded that Journal of Physics: Conference Series is the most frequently referenced source, showing its great influence in related research. The 10 articles with the highest number of citations are shown in **Table 2**.

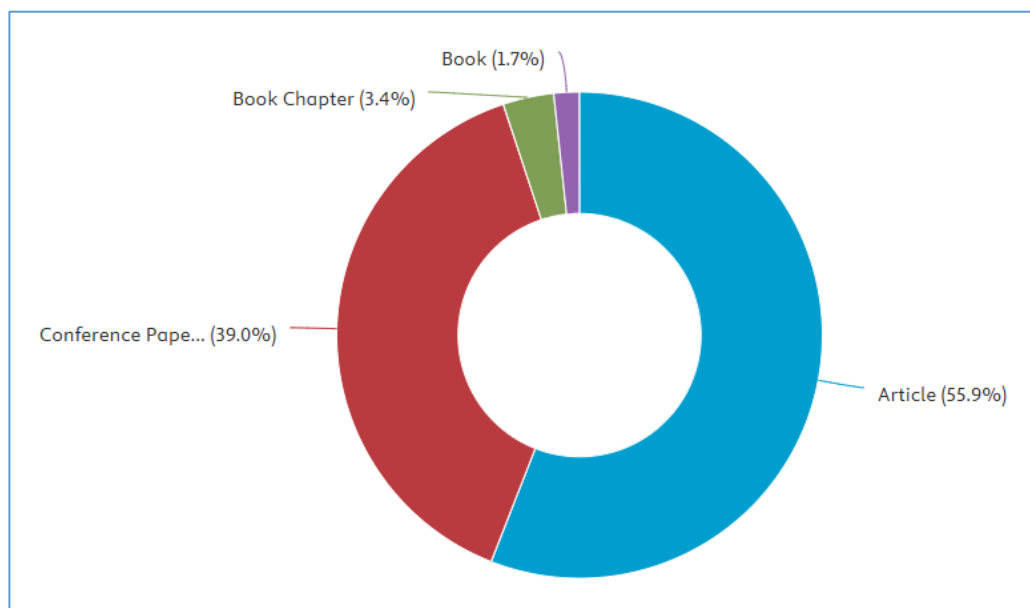


Figure 7. Types of documents published in research on misconceptions in Newton's law.

Table 1. Journal publication objective misconceptions on Newton's law

No	Journal	documents
1	Journal of Physics: Conference Series	13
2	Physical Review: Physics Education Research	5
3	AIP Conference Proceedings	4
4	ASEE Annual Conference and Exposition Conference Proceedings	2
5	Challenges In Physics Education	2

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

Title	Authors	Year	Journal identity	Cited by
Analyzing students' misconceptions about Newton's laws through the four-tier Newtonian test (FTNT)	Kaniawati et al. (2019)	2019	Journal of Turkish Science Education, 16(1), pp. 110–122	30
The transformation of the two-tier test into the four-tier test on Newton's laws concepts	Fratiwi et al. (2020)	2017	AIP Conference Proceedings, 1848, 050011	25
Drawing and using free body diagrams: Why it may be better not to decompose forces	Aviani et al. (2015)	2015	Physical Review Special Topics - Physics Education Research, 11(2), 020137	25

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

Title	Authors	Year	Journal identity	Cited by
Evaluating the cognitive consequences of playing Portal for a short duration	Adams <i>et al.</i> (2016)	2016	Journal of Educational Computing Research, 54(2), pp. 173–195	24
Knowledge integration in student learning of Newton's third law: Addressing the action-reaction language and the implied causality	Bao & Fritchman (2021)	2021	Physical Review Physics Education Research, 17(2), 020116	18
Developing memory on Newton's laws: For identifying students' mental models	Fratiwi <i>et al.</i> (2020)	2020	European Journal of Educational Research, 9(2), pp. 699–708	17
Alleviating students' misconceptions about Newton's first law through comparing PDEODE tasks and Poe tasks: Which is more effective?	Samsudin <i>et al.</i> (2017)	2017	Turkish Online Journal of Educational Technology, 2017(October Special Issue INTE), pp. 215–221	17
Pre-service science teachers' PCK: Inconsistency of pre-service teachers' predictions and student learning difficulties in Newton's third law	Zhou <i>et al.</i> (2016)	2016	Eurasia Journal of Mathematics, Science and Technology Education, 12(3), pp. 373–385	17
The effect of concept cartoon-embedded worksheets on grade 9 students' conceptual understanding of Newton's Laws of Motion	Atasoy & Ergin (2017)	2017	Research in Science and Technological Education, 35(1), pp. 58–73	16
Diagnostic Test with Four-Tier in Physics Learning: Case of Misconception in Newton's Law Material	Maharani <i>et al.</i> (2019)	2019	Journal of Physics: Conference Series, 1155(1), 012022	13

3.2. Mapping Data of Newton's Law Misconception Research using VOSviewer

Data visualization was carried out using VOSviewer software version 1.6.17. VOSviewer is able to produce analytical data in the form of data mapping with three categories, namely networking, overlay, and density (Farokhah *et al.*, 2024; Kongsanekham & Chano, 2024). The type of analysis used is co-occurrence with the category of all keywords. The data mapping based on networking, overlay, and keyword density is shown in **Figures 8, 9, and 10**, respectively.

Figure 8 shows the networking visualization of misconception research on Newton's law. In general, misconception research on Newton's law is divided into 6 clusters marked with red, blue, green, yellow, orange, and purple colors. Each cluster has its own network that connects one keyword to another.

Misconception research on Newton's law always boils down to the need to analyze student learning. Misconceptions are always related to concept understanding. Thus, it is necessary to develop learning methods to improve students' concept understanding. Some learning

models that are often used to remediate misconceptions in Newton's law are Cognitive Conflict-Based Learning (Mufit & Fauzan, 2023), Contextual Problem-Solving Learning (Diyana & Sutopo, 2024), Problem-based learning (Oktarisa et al., 2017; Sari & Ilyas, 2020; Suwasono et al., 2023), generative learning (Pardiyanto & Winarti, 2021; Mukramah et al., 2023), and project-based learning models (Gasana et al., 2024; Solviana et al., 2024).

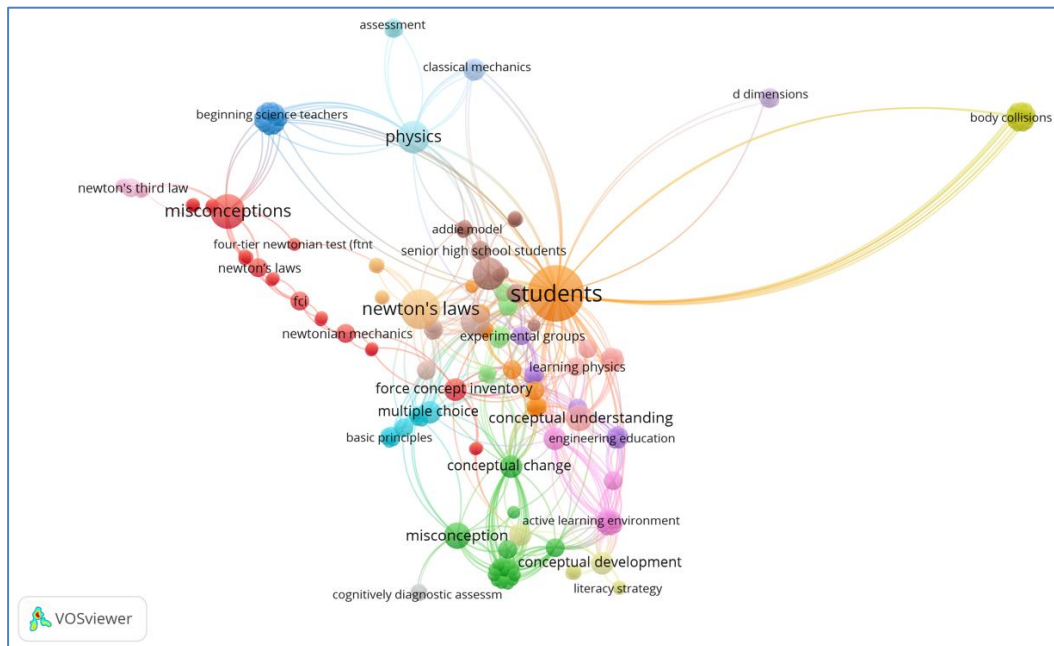


Figure 8. Networking visualization of Newton's law misconceptions research.

Figure 9 shows an overlay visualization of misconception research on Newton's law. The overlay visualization is needed to find out the latest research on Newton's law misconceptions. The solid green color indicates keywords that have been done for a long time, while the yellow keywords indicate that the research is still new (Admoko et al., 2024). Some of the recent keywords include force concept inventory, cognitively diagnostic assessment, and four-tier Newtonian test.

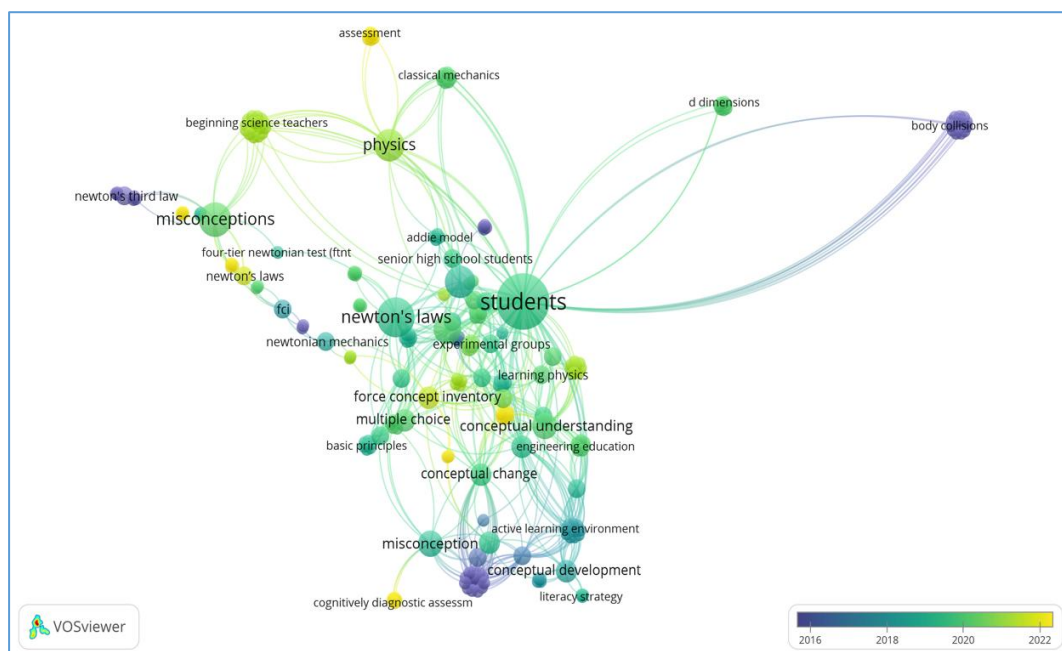


Figure 9. Overlay visualization of Newton's law misconceptions research.

Figure 10 shows the visualization of the density of Newton's law misconception research. The lighter the color, the more frequently the keyword appears in Newton's law misconceptions research (Ridwana *et al.*, 2024). Some keywords that often appear include students, Newton's law, physics, misconceptions, and conceptual understanding.

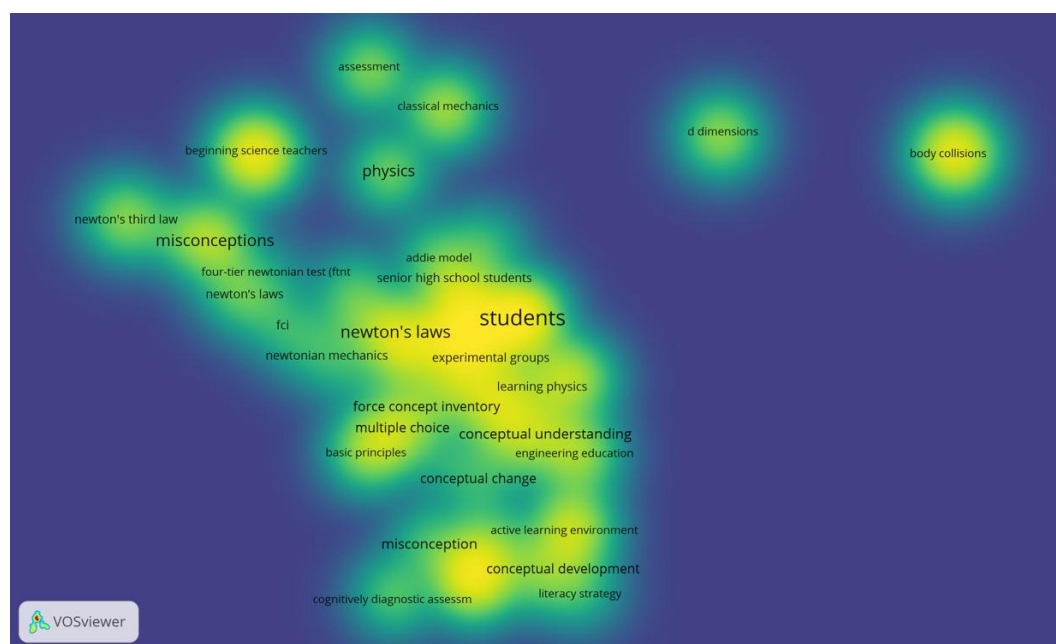


Figure 10. Density visualization of Newton's law misconceptions research.

4. CONCLUSION

This study successfully used bibliometric analysis to describe the development of research on misconceptions in Newton's laws. The database was obtained through the Scopus website for 10 periods (2015-2024). The data search resulted in 59 relevant research articles. The results of data analysis show that the development of misconception research on Newton's law has not been widely carried out, as shown by the average publication of 5.9 articles per year. The development of misconception research on Newton's law was most popular in 2020, where the COVID-19 pandemic forced learning to be done online, thus increasing the potential for misconceptions in learning. There are 6 clusters resulting from data visualization analysis. The country that produces the most articles about misconceptions in Newton's law comes from Indonesia, with the affiliation that produces the most research articles on Newton's law misconceptions published in the most Scopus-indexed journals coming from the Indonesian Education University. Published articles are mostly journal articles and international conference proceedings. The visualization results using VOSviewer show that there are still many future opportunities in misconception research on Newton's law.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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