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BIBLIOMETRIC ANALYSIS: TREND ANALYSIS OF MISCONCEPTIONS IN SOLVING HOTS QUESTIONS BASED ON THE NEWMAN PROCEDURE

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ABSTRACT
Misconceptions are understandings that deviate from concepts accepted by experts, which can hinder students' learning process**.** The aim of this research is to analyze trends in scientific publications related to misconceptions in solving higher-order thinking Skills (HOTS) questions based on the Newman Procedure. VOSviewer software is used to display visualizations based on bibliographic pairs and keyword co-occurrences by the author. This research uses a qualitative approach. The analysis technique used is descriptive bibliometric analysis. The data used in this analysis was obtained from Google Scholar for the 2019-2023 period, with the help of Publish or Perish software. The research results showed that there were 380 articles with a total of 8135 citations, an average of 1627 citations per year, and 21.41 citations per article. The H and G indices were recorded as 34 and 87, respectively, indicating the influence and scope of literature in this field. The network visualization identified six major interrelated clusters, including the topic "Newman and Higher Order Thinking Skills." Overlay and density analysis revealed that the most research was conducted in 2019, and there are still less researched terms such as "strategy" and "error analysis," which offer opportunities for further research. These findings provide insight into current trends, and research gaps, as well as directions for future studies regarding misconceptions in the context of HOTS and the Newman Procedure.
Kata kunci: bibliometric analysis; misconceptions; Newman procedure; HOTS questions.

ABSTRAK
*Miskonsepsi merupakan pemahaman yang menyimpang dari konsep yang diterima oleh para ahli, dapat menghambat proses pembelajaran siswa**.** Tujuan penelitian ini adalah untuk menganalisis tren publikasi ilmiah terkait miskonsepsi dalam penyelesaian soal Higher Order Thinking Skills (HOTS) berdasarkan Prosedur Newman. Software VOSviewer digunakan untuk menampilkan visualisasi berdasarkan pasangan bibliografi dan kejadian bersama kata kunci oleh penulis. Penelitian ini menggunakan pendekatan kualitatif. Teknik analisis yang digunakan adalah analisis bibliometrik deskriptif. . Data yang digunakan dalam analisis ini diperoleh dari Google Scholar untuk periode 2019-2023, dengan bantuan perangkat lunak Publish or Perish. Hasil penelitian menunjukkan adanya 380 artikel dengan total 8135 sitasi, rata-rata 1627 sitasi per tahun, dan 21.41 sitasi per artikel. Indeks H dan G masing-masing tercatat 34 dan 87, menunjukkan pengaruh dan cakupan literatur dalam bidang ini. Visualisasi jaringan mengidentifikasi enam klaster utama yang saling terkait, termasuk topik "Newman dan Higher Order Thinking Skills." Analisis overlay dan density mengungkapkan bahwa penelitian paling banyak dilakukan pada tahun 2019, dan terdapat istilah yang masih jarang diteliti seperti "strategi" dan "error analysis," yang menawarkan peluang untuk penelitian lebih lanjut. Temuan ini memberikan wawasan mengenai tren terkini, kekosongan penelitian, serta arahan untuk studi mendatang mengenai miskonsepsi dalam konteks HOTS dan Prosedur Newman.*
***Keywords**:. analisis bibliometrik; miskonsepsi; prosedur newman; soal HOTS.*

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Introduction

A concept can be defined as something that is accepted in the mind or a general and abstract idea. A person's concepts are largely shaped by experience (Mulyani et al., 2020). The mathematics learning process consists of various concepts arranged hierarchically, logically, and systematically. In other words, concepts are learned sequentially, and simpler concepts are used to learn the next more complex concept. Mathematics is a field that studies deductive thinking and abstract concepts (Agustina and Fuadiah 2018). Correct understanding of mathematical concepts is an absolute requirement for students. This is because students not only need to fully understand relevant mathematical concepts, but also need to anticipate the problems they will face in the future (Darwani et al., 2023).

Based on the 2018 PISA evaluation and test data, Indonesia is ranked 72nd out of 78 countries that are considered to have low mathematical abilities, with a score of 371 out of an average score of 487. Students' inability to study, provide reasons, and solve guiding questions is the cause of their low understanding of mathematics. The quality of education in Indonesia is low. Students' reading ability is shown by ranking fifth from last (Mulyani et al., 2020). Reading is an important skill to improve good understanding (Khasanah & Cahyani, 2016 in Shofiani 2019). Good reading skills are necessary to learn certain information. Lack of support in education to improve critical thinking skills and understanding of concepts causes students to lack understanding (Ayuni & Arif, 2023).

Mathematics learning is hierarchical, meaning that concepts are related to each other. As a result, it is very unfavorable if students have difficulty understanding certain concepts, which are known as misconceptions (Nurussama & Hermanto, 2022). The consequences of misconceptions make students feel that learning mathematics is difficult, lower their enthusiasm, and cause them to take longer to understand it. If allowed to continue, misconceptions will also have a negative impact on student learning outcomes (Mulyani et al., 2020). According to Urey and Calik, other factors that cause misconceptions include: (1) Students' lack of knowledge; (2) Doubtful student knowledge; (3) Lack of motivation; (4) Weak teacher knowledge; (5) Focusing on specific things to the point of forgetting the basis of the concept itself; (6) There are misconceptions in the source book; and (7) Use of terms that are common in society compared to scientific terms (Gumilar, 2016).

Based on the research results done by (Khusna & Rosyadi, 2021) entitled "Characteristics of Student Misconceptions on the Concept of Sets Judging from Their Ability to Construct Mathematical Proof", he found Many students still experience misconceptions.. One example is an incorrect understanding of the concept of subsets. Students give the same reasons to assess the truth of two different statements. that is $\{\emptyset\} \in \{\emptyset, \{\emptyset\}\}$ And $\{\emptyset\} \subseteq \{\emptyset, \{\emptyset\}\}$. A similar thing was also revealed in the results of research conducted by (Melianti et al., 2020) entitled "Students' Misconceptions in Solving Set Problems Based on Masonic Stages". Caused by students' associative thinking, incomplete or erroneous reasoning, and

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wrong intuition. Based on these facts, it can be indicated that there are misconceptions among students in understanding the questions.

One way to detect misconceptions that occur in students is to use the Higher Order Thinking Skills (HOTS) procedure. Mathematics is a scientific discipline that teaches students to think critically, logically, creatively, systematically, and work effectively (Qadriah, 2019). According to Goodson and Rohani's research, the levels of thinking skills included in HOTS are critical, reflective, logical, metacognitive, and creative thinking abilities (Januariawan et al., 2020). The same thing was also expressed by Brookhart who studied higher-order thinking skills: transference, critical thinking, and problem-solving (Saraswati & Agustika, 2020). Apart from that, according to (Widana, 2020), skills in HOTS include skills in problem-solving, critical thinking, creative thinking, reasoning, and decision-making. Several views state that critical thinking is closely related to HOTS.

Research related to misconceptions in solving HOTS questions has been carried out in various contexts. For example, research conducted by (Sari, 2023) found that misconceptions in mathematics often occur at the stage of students' understanding of concepts and procedural skills. Another study by (Fridatama, 2021) shows that misconceptions can be caused by internal factors of students, such as learning styles and low levels of understanding of basic concepts. In addition, research results by (Siagian & Manalu, 2018) reveal that misconceptions are often triggered by less interactive learning methods and a lack of emphasis on high-level problem-solving. Recent research by (Anggara, 2020) also shows that a diagnostic test-based approach can help identify and reduce student misconceptions in solving HOTS questions.

Although various studies have highlighted misconceptions in solving HOTS questions, several gaps have not been widely discussed. First, most previous research focused more on analyzing misconceptions in general, without using a systematic approach such as the Newman Procedure. Studies by (Sari, 2023) and (Fridatama, 2021) have not specifically analyzed the stages of student errors in solving HOTS questions based on Newman's stages. Second, research conducted by (Siagian & Manalu, 2018) and (Anggara, 2020) focuses more on intervention methods and correcting misconceptions, but has not discussed in much detail how errors occur at each stage of problem-solving.

This research contributes to the literature by filling this gap through an in-depth analysis of the types and causes of students' misconceptions in solving HOTS questions using the Newman Procedure. Thus, this research offers a more systematic approach to understanding students' errors, which can be the basis for developing more effective learning strategies in overcoming misconceptions in mathematics.

Several previous studies have revealed that misconceptions in solving HOTS questions often occur among students at various levels of education. However, not many researchers have specifically studied this misconception using a systematic approach such as the Newman Procedure. In addition, despite the analysis bibliometrically has been used in various fields of science. For example, research conducted by (Haryani & Sudin, 2020) on Bibliometric Analysis of Publication Trends and Levels of Collaboration in the Situation-Based Learning Model (2010-2019), study conducted by (Syafitri et al., 2023) research on Bibliometric Analysis

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of the ability to Understand Mathematical Concepts, as well as research conducted by (Putri & Soebagyo, 2022) on Bibliometric Analysis of Mathematical Concepts Based on Conceptual Understanding Based on VOSViewer, its application in the context of mathematical misconceptions is still limited. Therefore, the research aims to analyze trends in scientific publications related to misconceptions in problem-solving higher-order thinking Skills (HOTS) based on the Newman Procedure.

Research Methods

This research uses bibliometric analysis methods. Bibliometrics is a statistical approach (analysis quantitative) to measure literature (books or articles) (Haniyah & Soebagyo, 2021). Bibliometric measurements consist of the number of literature publications, number of authors, and number of citations, as well as understanding current research trends to evaluate the impact of research. This approach is used to measure literature, both books, and articles, using quantitative analysis (Glänzel, 2003 in Lestary, 2023). Bibliometric analysis techniques are divided into two categories, namely performance analysis and structuring (Donthu et al., 2021). In line with this research, this research analyzes 68 documents indexed by Scholar between 2019 – 2023 which specifically examines misconceptions and Newman procedures.

Software Publish or Perish Harzing is used to collect data using bibliometric mapping which includes authors, publications, journal titles, and databases VOS viewers (Arwendria, 2021). Search database google scholar can be seen in Figure 1.

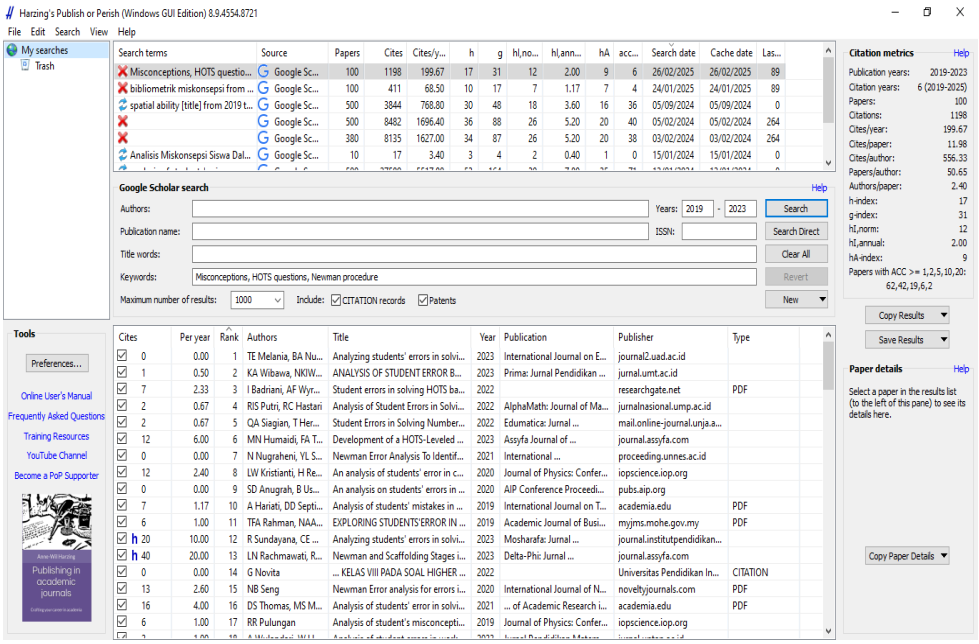

Figure 1. Search database google scholar

Figure 1 is The first step in bibliometric analysis is to collect articles related to "Misconceptions, HOTS questions, Newman procedure" through Publish or Perish (PoP), and the year the article was published is "2019 – 2023". Based on the results of data searches through PoP, 100 were the population of this study. Of the 100

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articles, 68 articles were obtained as sample studies because they meet the criteria study, namely articles published in journal form and related to Misconceptions in solving HOTS questions based on the Newman procedure. This data is stored in the form of RIS for use on software VOSviewer. VOS Viewer software is used to analyze the development of scientific publications regarding misconceptions in solving HOTS questions based on the Newman Procedure. The output from data processing includes network visualization, overlay visualization, and density visualization. Network visualization is used to see relationships and clusters of research themes based on keywords. Overlay visualization helps identify the years when the research themes are examined. Meanwhile, density visualization is used to analyze research themes that are saturated or still rare (Van Eck & Waltman, 2015).

Results and Discussion

Data was collected using Publish or Perish from Google Scholar with PoP software for the 2019-2023 period, as shown in Figure 1. Search Database Google Scholar. For the publication of articles about misconceptions in solving HOTS problems based on the Newman Procedure, 100 articles were found, with a total of 1198 citations, 199.69 citations per year, 11.98 citations per article, and 50.65 authors per article. The H index is 17, the G index is 31, the individual H index is 12, the annual H index is 2.00, and the hA index is 9.

Mapping the development of scientific publications was carried out using the binary calculation method, using a minimum number of words of 8 out of 4464 words, where only 50 words met the threshold and 30 words were selected. In the visualization, nodes or circles represent authors, while edge or network shows the relationship between authors. The closer the sphere is to the network, the more variables will be examined simultaneously. Result of network visualization VOS Viewer can be seen in Figure 2.

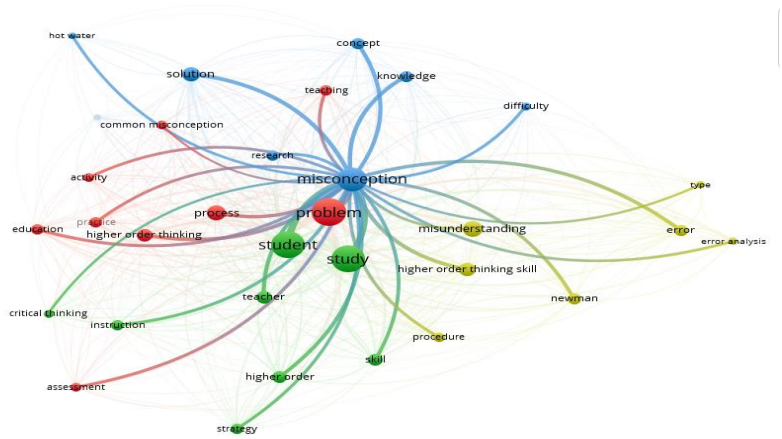

Figure 2. Result of network visualization VOS Viewer

Based on Figure 2, this research center regarding the ability to understand mathematical concepts shows that there are 6 clusters or groups marked with color: red for Group 1), green for Group 2), blue for Group 3), yellow for Group 4), purple for group 5), and light blue for group 6). The results of network visualization using

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the VOS Viewer application show the relationship between variables or themes. For example, in cluster 1, the misconception variable is related to another variable, namely HOTS (Higher Order Thinking Skills) and Newman. This means that research on Misconception Analysis in solving hot questions based on the Newman procedure is interrelated. There are also many other variables related to misconceptions which can be seen in Figure 2. Then Results of overlay visualization VOS Viewer can be seen in Figure 3.

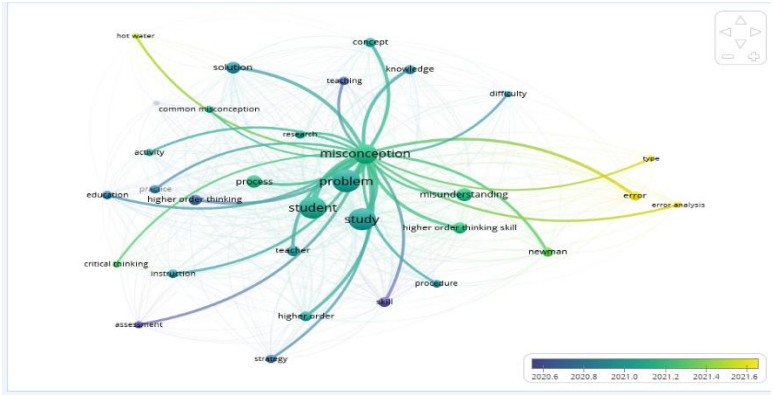

Figure 3. Results of overlay visualization VOS Viewer

The results of the Visualization Overlay in Figure 3 regarding the appearance of shared keywords based on the year of publication in the image above, there are three different colors, namely: yellow indicates the keyword was used together around 2021, green shows the keyword used together around 2020, and blue around 2020. This shows a change in terms within a certain period. Based on the amount of indexed research data regarding Misconceptions in solving HOTS questions based on the Newman Procedure, it is still relatively small, therefore it is a great opportunity for researchers to conduct further research on Misconceptions in solving HOTS questions based on the Newman Procedure. So far, many students still experience misconceptions in solving mathematics problems. Results of density visualization VOS Viewer can be seen in Figure 4.

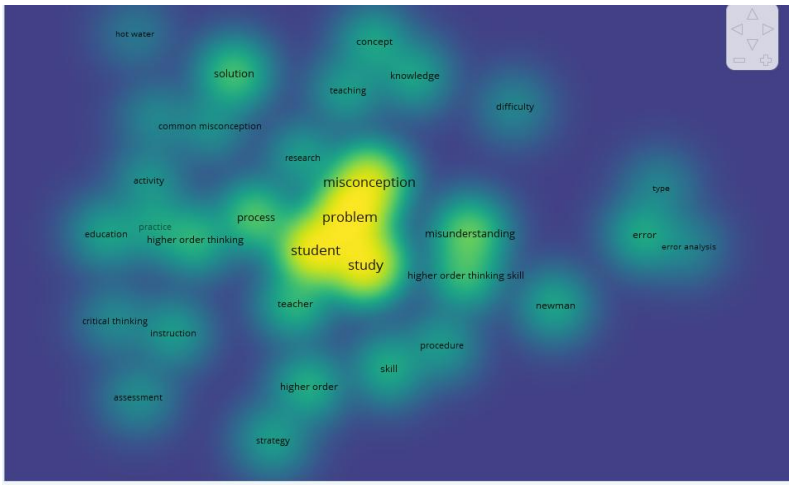

Figure 4. Results of density visualization VOS Viewer

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Result of density visualization using VOSviewer software in Figure 4 shows the density level. Research themes marked in bright yellow indicate high density, meaning that a lot of research has been conducted on that theme. On the other hand, themes with darker colors indicate that research on this theme is still rarely carried out. The misconception lies in the yellow theme, which means that many people have carried out the research. Dim-colored themes such as Newman, higher-order thinking skill, error', error analysis, strategy, skill, assessment, and others are themes that can be used as references for further research. The results of research conducted by (Ramadahan, Sunardi, 2022) entitled "Analysis of Student Misconceptions in Solving Pisa Standard Mathematics Problems Using Certainty Of Response Index (CRI)" Also found was one faintly colored theme, namely "strategy," from the results density visualization.

From the results of the discussion above, research or publication of mapping results in network visualization, overlay visualization, and density visualization. Taken from the theme "Misconceptions, HOTS questions, Newman procedure" it is still rarely researched related to the analysis of misconceptions in solving HOTS questions on the Newman procedure. This can provide the latest research and reference material for further research development. This is in line with research conducted by (Juhji, 2017) and (Utami, 2019) which revealed that further research is needed to analyze the "misconceptions" made by students in solving questions. Research by (Khusna & Rosyadi, 2021) revealed that it is not only students who experience misconceptions, but many students also experience misconceptions in solving questions, this is a challenge for further research to be able to overcome what is done by students. As far as researchers have made observations related to the analysis of misconceptions in solving the HOTS questions on the Newman procedure, few articles are relevant to this research. This is one of the limitations of researchers in terms of obtaining research data.

Conclusion and Suggestion

Based on the findings and analysis results, the most scientific publications on Google Scholar from 2019-2023 occurred in 2019. The network visualization results identified 6 clusters with related topics, such as "Newman and Higher Order Thinking Skills." Overlay visualization and density visualization show that from 2019-2023, much of the research focus centered on misconception variables, indicating that many researchers have explored this topic.

Based on these conclusions, the researcher suggests that further research can explore the relationship between misconceptions and terms that are still unclear in Figure 4 Full Counting Density Visualization Display, which has not been widely researched. These terms include Newman, Higher Order Thinking Skill, error, error analysis, strategy, skill, and assessment. This openness can become a basic idea or new innovation for future research on misconceptions. For future researchers, when collecting data, they can use other databases Google Scholar namely with Scopus, apart from that, keywords can be further detailed to maximize bibliometric results.

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