

ANALYSIS OF MISCONCEPTIONS IN CHEMISTRY LEARNING: LITERATURE REVIEW

Lina Fauziyah, Candra Prasetyo*, Ardinal Efendi

Pendidikan Kimia, UIN Walisongo Semarang, Indonesia

*Corresponding author's email: cprasetyo789@gmail.com

Abstract

This research aims to analyze research trends regarding misconceptions in chemistry majors. This research contains an analytical study of the number of articles published in the last ten years, 2014-2024. This research was carried out by taking 17 SINTA-accredited articles from SINTA 2-5 and International Journal. This research method uses literature review carried out through the identification and analysis of journals. We found National and International journals published in 2014-2024. The analysis step begins with reading the abstract and data reduction and drawing data conclusions based on the research instruments used. Research topics include the number of publications, type of research, chemical material studied, research subjects, and data analysis techniques. The primary research is qualitative, and the dominant material is acid-base material. Based on the results of this research, several recommendations can serve as guidelines for further research to produce research results that are more useful and have an impact on the lives of Indonesian people, especially in terms of teaching and learning.

Keywords: *Misconceptions, Learning Models, Chemistry Education*

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INTRODUCTION

Chemistry is a branch of science that studies matter, structure, properties, changes, and the reactions that accompany these changes. Students often need help understanding chemistry because its scope is abstract and straightforward. The three levels of chemical representation are macroscopic, submicroscopic, and symbolic. Research (Sari & Helsy, 2018) found that students more readily understand macroscopic to submicroscopic representations than macroscopic to symbolic representations. One of the factors causing misconceptions is the inability of students to interpret representations in various forms (Zidny, 2015). Literature studies regarding misconceptions in chemistry are critical to improving the quality of chemistry education and the conceptual understanding of students and professionals in this field. Misconceptions, or Wrong understanding of chemical concepts, often become a significant obstacle in learning how to teach. Research shows that misconceptions hinder understanding in-depth and can negatively impact students' ability to apply chemistry concepts in real-life and scientific contexts (Azura et al., 2017).

Misconceptions in chemistry can stem from various factors, including deficiencies in methods teaching, the complexity of the chemical material itself, and the way students process the information provided. For example, many students misunderstand the concepts of molecules and chemical bonds by assuming molecules as simply collections of atoms together without understanding electrons' complex interactions. In addition, basic concepts such as the laws of thermodynamics or the properties of solutions are often misunderstood, which results in difficulties in studying more advanced chemistry topics (Noviani & Istiyadji, 2017). The urgency of studying literature on this misconception is very high, considering its broad impact on chemistry education and research. First, by understanding the types and causes of common misconceptions, educators can design more effective teaching strategies to overcome them. Second, it can develop better evaluation and intervention tools to identify and improve misconceptions in the early stages. Third, awareness of these misconceptions is also essential for the development curriculum that can help students build correct understanding from an early age (Mukhlisa, 2021).

Additionally, in-depth literature studies can help identify trends and patterns within chemistry misconceptions at various levels of education and different cultural contexts. This is the possible development of approaches tailored to specific student needs and teaching contexts. Thus, literature studies regarding misconceptions in chemistry do not only contribute to improving the quality of education but also encourage the development of innovative teaching methodologies and effective (Rahayu & Fitriza, 2021).

RESEARCH METHODS

This research uses a literature study method to identify and analyse journals. We found national and international journals published every year 2014-2024. This research focuses on content analysis regarding journal publications about skills scientific arguments on chemistry subjects in the last ten years in Indonesia. Collection data in this research by collecting several articles through applications such as Publish or perish, as well as AI assistance such as Connected Papers and also Google Scholar. This data collection is based on criteria as follows:

Table 1. Research Article Inclusion Criteria

No	Criteria	coverage
1	Year of publication	Last 10 years (2014-2024)
2	Research subject	Teachers, pupils and students
3	Scope of article	Sinta and articles are open access
4	Keywords	Misconceptions, Learning Models, Chemistry Learning

From the predetermined criteria, 17 suitable journals were obtained. Overall article published in 11 different journals in Indonesia's research scope. This section will discuss types of research, research subjects, and data analysis techniques. In conducting research must be guided by valid instruments. In this research, researchers used instruments the same as research conducted by (Rery & Rahmasari, 2023) with a few additions and modifications according to the theme the researcher will analyze. Aspects and categories used in the analysis The contents of the research are as follows:

Table 2. Aspects and Categories Used for Content Analysis in Research

Aspect	Criteria
Types of research	A.1- Qualitative Research A.2- Quantitative research A.3-R&D A.4-Mix method A.5- Descriptive A.6- Classroom Action Research (PTK)
Type of quantitative research	B.1-Non-experimental B.2-Experimental factorial B.3-Quasy experiment B.4-Experimental semu B.5-Pre-experimental B.6- Observational study B.7- Correlation research
Research subject	C.1- Junior High School Students (SMP) C.2- High School Students (SMA) C.3- Mahasiswa
Data collection instrument	D.1- Observation sheet D.2- Questionnaire sheet D.3- Test sheet D.4- Interview sheet D.5- Not identified D.6- Two-tier multiple choice test D.7-Three-tier test D.8- Multiple choice test

Data analysis methods

- E.1-Percentage analysis technique
- E.2- Technical analysis of averages
- E.3- Correlation analysis technique
- E.4-N-gain
- E.5-ANCOVA
- E.6-MANOVA
- E.7- Undefined
- E.8- Other

Researchers categorize articles according to the aspects listed in the research instrument. Conclusions are presented as findings in the form of data content analysis from the abstract, methods and discussion article discussed. The data is presented in graphs or data to make it easier for readers to understand, analyze and understand the information from the articles that have been discussed.

RESEARCH RESULTS AND DISCUSSION

Research must have sufficient data to support its findings and results. The research results should answer the hypothesis or research question mentioned in the introduction section.

Number of Publications

Several publication findings show how many research publications have misconceptions researchers have carried out in a decade. Based on the analysis of 17 journals in The last ten years, data can be presented in Figure 1. Research must have sufficient data to support its findings and results. The research results should answer the hypothesis or research question mentioned in the introduction section.

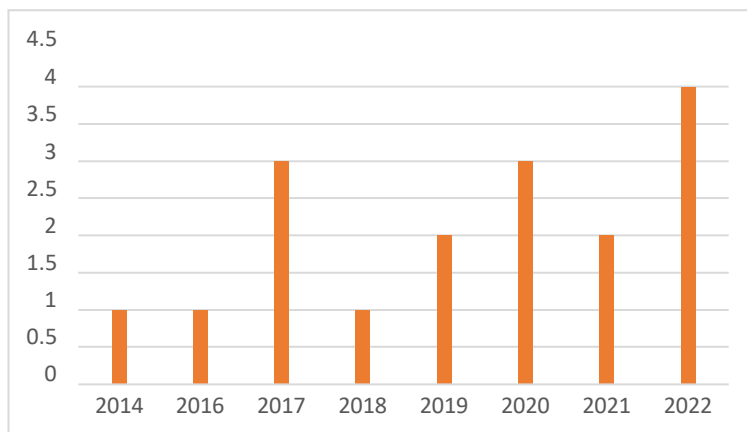


Figure 1. Distribution of Number of Publications in the Last 10 Years (2014-2024)

Based on the graphic analysis above, it can be concluded that research on misconceptions began in 2014. Most research on misconceptions was carried out in 2022. One of the research characteristics is analyzing students' misconceptions about chemistry material. From the research that has been carried out, various factors can be found that cause misconceptions (Hidayat et al., 2020).

Types of research

This discussion focuses on the types of research that many researchers carry out in context misconceptions. Based on Figure 2, qualitative research is frequently research done. In qualitative research, researchers use instruments such as two-tier and three-tier tests. From the test results, students' misconceptions about the existing material are then analyzed. Research these misconceptions Students or teachers can do it.

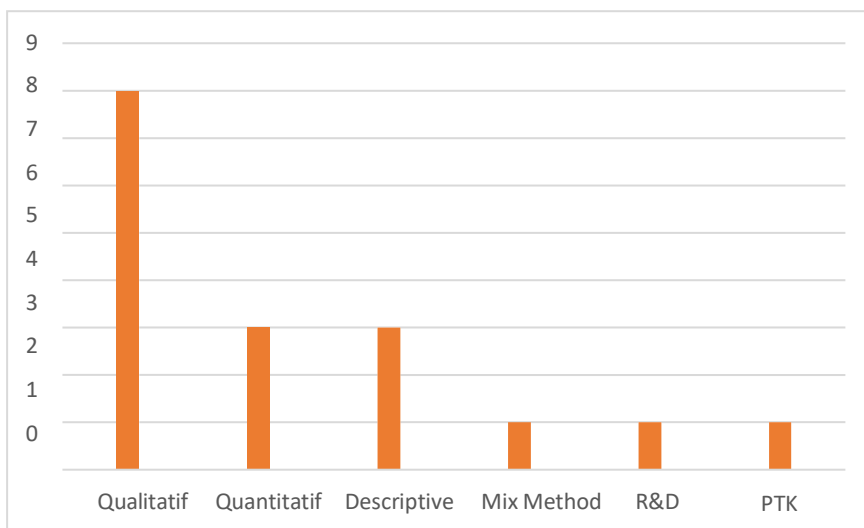


Figure 2. Distribution of Types of Research Conducted by Researchers in the Last 10 Years (2014-2024)

Recent quantitative research shows that investigations into Misconceptions about new chemical materials have become prominent since 2019 and will be most prevalent in 2022. Therefore, the author estimates that quantitative studies concerned with data analysis will only begin in 2022. The ability of researchers to engage in similar studies is an advantage due to the current scarcity of research in the field. Basic differences between research Quantitative and qualitative research differ in their respective data analysis approaches. Quantitative research primarily centres on statistical methods to analyze data, while qualitative research covers a broader range of data collection methods, including observation, interviews, and questionnaires. (Boeren, 2018). Only now, a combination of these two methods, known as mixed method research, and further Research and Development (R&D) regarding misconceptions still need to be used. This source can be a reference for further research.

Research Subjects

The majority of research on student misconceptions, a crucial area in education, is aimed at high school students. This research, as depicted in Figure 3, plays a significant role in shaping our understanding of student learning. The research subjects that are often measured are high school students with various materials delivered. This is in line with research conducted by (Marmoah et al., 2022) that has often been carried out over the last three years involving students as research subjects. This matter It can be seen from the search results for the keywords high school (secondary school) students who are most searched for on Google Scholar.

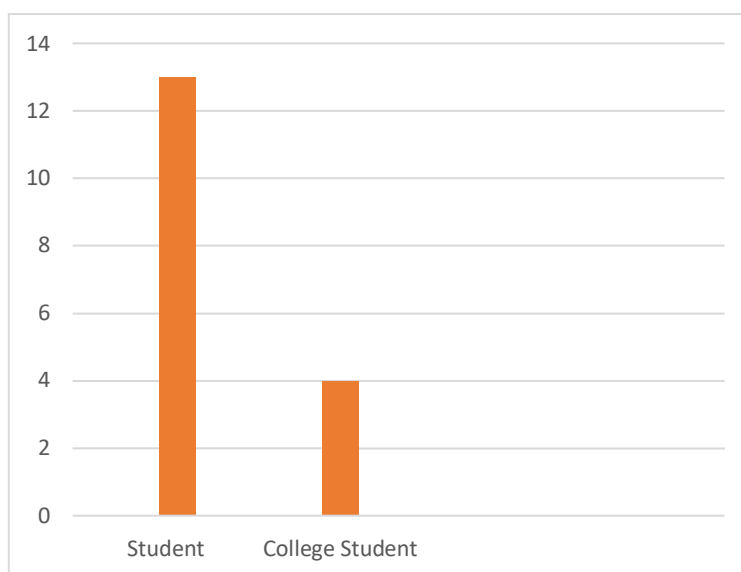


Figure 3. Distribution of research subjects conducted by researchers in the last 10 years (2014-2022)

In addition, the material data analysis used by researchers is very diverse. Results of analysis of chemistry topics can be seen in Table 3.

Table 3. Chemistry Topics Selected by Researchers in the Last 10 Years (2014-2024)

Chemistry Topics	Number of Articles
Acid base	5
Hydrocarbons	1
Chemical equilibrium	3
Redox	3
Chemical bond	1
Electrolyte and non-electrolyte solutions	1
Basic laws of chemistry	1

From the data above, acid-base materials are more widely used in research. Because acids and bases are complex, students need more clarification about them. This is in line with the results of research (Gazali & Yusmaita, 2018), which states that most of the students who were his research subjects experienced difficulties with the acid-base material.

CONCLUSIONS AND SUGGESTION

A. Conclusions

This research focuses on the analysis of creative thinking abilities published in journals. Indonesia with a duration of the last ten years (2014-2024), which has been reviewed. Research trends show that the research that is often carried out is qualitative research on secondary school students on acid-base material using average comparative analysis. Results from a review of 17 Articles on student misconceptions in chemistry subjects at the high school level for ten years are still frequent. The majority of chemistry misconceptions occur due to a mismatch between students' preconceptions and scientist concept.

B. Suggestion

The recommended type of research is quantitative research and experimental methods for Analyzing Misconceptions in Chemistry Learning. Second, studies for higher students are still minimal to do so that the research subjects can be changed to allow for variations.

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