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Analysis of The Effect of Gender on High School Students' Misconceptions

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Abstract

Misconceptions are a problem always faced in education, one of which is in the field of science, especially in chemistry. One of the chemical materials that students consider pretty challenging to understand because it is abstract, making it possible for misconceptions to occur, is chemical bonding. Misconceptions among students need to be identified quickly so they can be addressed immediately so they do not interfere with further learning. This research aims to determine the relationship between gender and the misconceptions of SMA YPK in Merauke Regency regarding chemical bonding material. Research data was analyzed quantitatively descriptively using the Polytomus Rasch Model. The respondents in this study were 76 Class X high school students who were selected using simple random sampling with 46 female and 30 male students. The research results showed that male students' average percentage of misconceptions was 31.9% (medium category), and female students were 18.6% (low type). The question indicators show that the highest percentage of misconceptions is in the question indicator for determining valence electrons; male students are 60% (medium category), and female students are 49% (medium type). Based on the overall misconception results regarding chemical bond indicators, gender influences the level of misconceptions of high school students in the city of Merauke.

Keywords: chemical bond; gender; misconceptions

Abstrak

Miskonsepsi suatu permasalahan yang selalu dihadapi di dunia pendidikan, salah satunya bidang sains terutama pada bidang ilmu kimia. Salah satu materi kimia yang dianggap peserta didik cukup sulit dipahami karena bersifat abstrak, sehingga memungkinkan terjadinya miskonsepsi adalah materi ikatan kimia. Miskonsepsi yang terjadi pada peserta didik, perlu diidentifikasi dengan cepat supaya dapat segera ditangani, sehingga tidak mengganggu pembelajaran selanjutnya. Penelitian ini bertujuan untuk mengetahui hubungan gender terhadap miskonsepsi siswa SMA SATAP Wasur di Kabupaten Merauke pada materi ikatan kimia. Data penelitian dianalisis secara deskriptif kuantitatif menggunakan Polytomus Rasch Model. Responden dalam penelitian ini berjumlah 76 orang peserta didik SMA Kelas X yang dipilih menggunakan simple random sampling dengan jumlah peserta didik Perempuan sebanyak 46 orang dan 30 orang peserta didik laki-laki. Hasil penelitian menunjukkan bahwa rata-rata prosentase miskonsepsi peserta didik laki-laki sebesar 31,9% (kategori sedang) dan peserta didik perempuan sebesar 18,6% (kategori rendah). Berdasarkan indikator soal menunjukkan bahwa prosentase miskonsepsi tertinggi terdapat pada indikator soal penentuan elektron valensi, peserta didik laki laki sebesar 60% (kategori sedang), dan peserta didik perempuan sebesar 49% (kategori sedang). Berdasarkan hasil miskonsepis secara keseluruhan ditinjau dari indikator ikatan kimia, maka gender mempengaruhi tingkat miskonsepsi peserta didik SMA di kota Merauke.

Keywords: gender; ikatan kimia; miskonsepsi

Introduction

Chemistry is a science that studies concepts, laws, theories, and facts and is closely related to everyday life. Chemistry is one of the high school subjects with a hierarchical field of study between competencies. It is arranged sequentially, thus requiring students to understand chemical concepts so they don't experience difficulties learning chemistry (Effendy, 2016). Chemical bonding is one of the studies of chemistry material in high school that is difficult for students to learn (Islami et al., 2018).

Chemical bonding is a matter that has four sub-theme groups, including ionic, covalent, metallic bonds, and intermolecular forces (Vrabec & Prokša, 2016). The study of chemical bonding material explains that atoms are bonded with the same particle and other scraps because groups of atoms are more stable they have lower energy levels than the separate atoms (Effendy, 2013). The chemical bond concept is abstract, so applying it contextually in chemistry learning is challenging.

Understanding the concepts contained in chemical bonds is fundamental for studying other chemical fields, such as molecular structure, molecular shape, chemical reactions, thermodynamics, and chemical equilibrium (Özmen, 2004). Understanding the correct concept makes it easier for students to study this chemical bonding material. However, not all students have an accurate understanding of the concept. Some students experienced deviations from understanding the concept, and some did not understand the concept of the chemical bonding material (Permatasari et al., 2022; Supiah et al., 2017; Suyono, 2020). Deviations in understanding this concept are often referred to as misconceptions.

Misconceptions are often experienced in the world of education, not only experienced by students but also experienced by teachers. The theory influences several factors for misunderstandings explained in textbooks that are not by what occurs scientifically, explanations from teachers, use of methods and tools in learning activities, and students' understanding (Barke et al., 2009; Suparno, 2013). Misconceptions cannot be generalized because the forms of delusions experienced by students are the same, and some are varied. It is influenced by gender differences, commonly known as gender differences.

Gender is an essential element that arises from the human self-concept and is used as self-identity (Sears et al., 2015). Gender is generally divided into two, namely women and men. Gender differences occur because of the genetic factor of the X chromosome in humans carried by each parent and passed on to their children (Relawati, 2021). The clear difference between girls and boys can be seen in their abilities. Girls are more dominant in verbal skills because they like indoor activities, while boys are more dominant in visual, spatial, and temporal skills because they want outdoor activities.

This difference also affects their ability in academic terms. Female students are often superior in academic achievement, while male students are superior in non-academic matters, especially regarding organization (Ali, 2019). Therefore, an assessment instrument is needed that can analyze the effect of gender on students' misconceptions, namely the two-tier multiple choice test. It is in line with previous research regarding the analysis of the influence of gender on the illusions of high school students using a two-tier diagnostic test (Utami et al., 2017).

A two-tier multiple choice test with two-tiered questions, namely tier 1 and tier 2, can detect and analyze students' misconceptions (Marantika Lia Kristyasari, 2018). Using a two-tier multiple-choice test can reduce the effect of guessing answers because students are required to give random answers to the tier 2 that has been chosen (Permatasari et al., 2022). Research on the identification of students' misconceptions using the two-tier multiple-choice assessment instrument has been widely carried out, especially in chemical subjects such as acids and bases, equilibrium, atomic structure, redox

concepts, chemical bonds, and buffer solutions (Afifah et al., 2021; Antari et al., 2020; Drastisianti et al., 2018; Fahmi & Irhasyuarna, 2017; Fajri et al., 2020; Islami et al., 2018; Isminiarti Izza et al., 2021; Pongkendek & Kristyasari, 2021; Qurrota & Nuswowati, 2018; Satriana et al., 2018).

Research on gender differences has existed before, but the focus being studied is not misconceptions but scientific literacy (M. L. Kristyasari et al., 2018), while the influence of gender on misconceptions has also been carried out before but on acid-base material and buffer solution (Marantika Lia Kristyasari & Kusumaningrum, 2023; Kusumaningrum & Kristyasari, 2022; Utami et al., 2017). Based on the data obtained during the field analysis and supported by the relevant research above, the renewal of this research is to analyze the effect of gender on students' misconceptions about chemical bonds.

Method

The research method used is descriptive quantitative. Quantitative descriptive research contains descriptions of students' conditions based on gender differences, which are viewed objectively by using calculations in the form of percentages. The quantitative process starts with data collection, interpretation of calculations, and the final results (Arikunto, 2022). The population and sample collection were done using purposive sampling, considering that the number of classes in the research school was limited to only three. The determination used the average value of student learning outcomes.

The population used was class X MIPA SMA YPK Merauke students, while the research sample was X MIPA 1 and X MIPA 3, totaling 76 people. The data collection technique used an assessment instrument in the form of a two-tier multiple-choice test consisting of 15 items using the GRM scoring guidelines and then analyzed using Rasch modeling. (Sumintono & Widhiarso, 2015). The GRM scoring model used can be seen in Table 1.

Table 1
GRM Scoring Model

Assessment Aspect	Score	Understanding Levels
T1 & T2 True	3	Understand concept
TI True & T2 False	2	Misconception
T1 False & T2 True	1	Misconception
T1 & T2 False	0	Don't understand the concept

Calculate the percentage obtained, then group using the guidelines for general misconception categories (Siwi, 2013) in Table 2.

Table 2
Misconception Category

Criteria	(%)
High	61-100
Moderate	31-60
Low	0-30

The data analysis technique stage was carried out in two phases, including 1) calculating misconceptions based on gender differences and 2) analyzing the influence of gender on misconceptions.

Result and Discussion

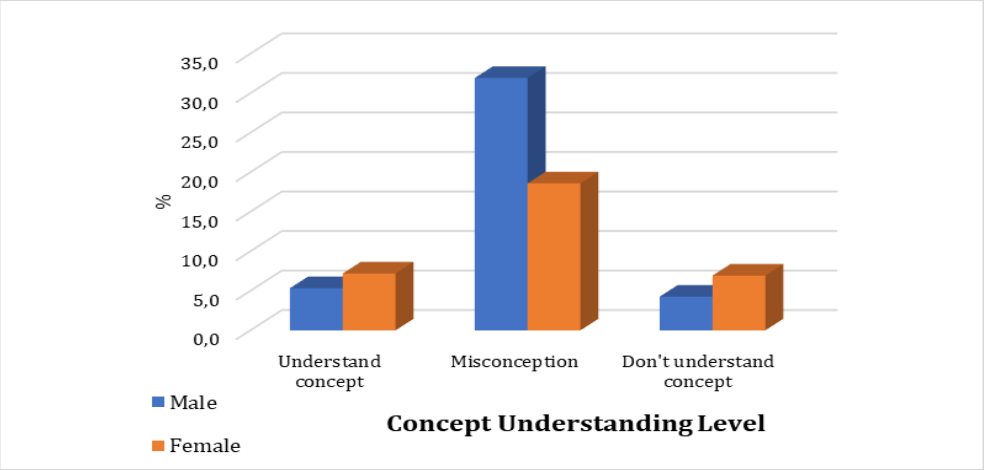
The results of the percentage level of understanding of students' concepts based on gender in chemical bonding material can be seen in Table 3. A comparison of the

percentage level of understanding of concepts between male and female students can be seen in Figure 1.

Table 3
Concept Understanding Level

Understanding Levels	%	
	Male	Female
Understand concept	5.3	7.2
Misconception	31.9	18.6
Don't understand the concept	4.3	6.9

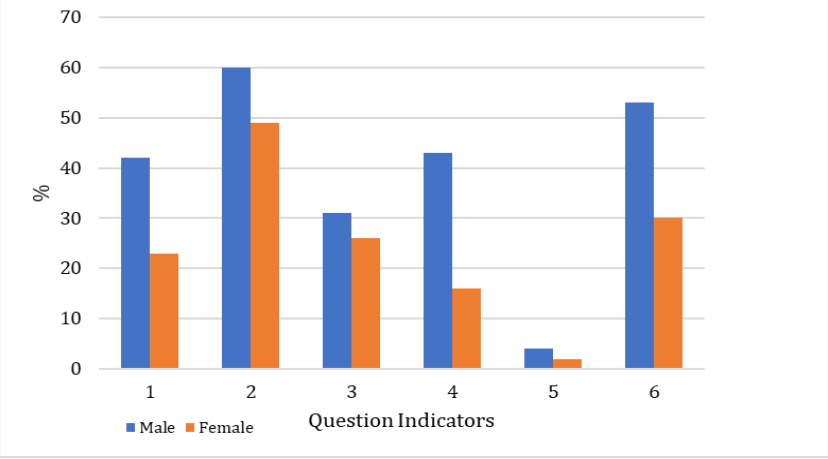
Figure 1
Comparison of Understanding of Concepts



Based on the results of the percentage comparison presented in Figure 1, male students have a misconception percentage of 31.9%, which is included in the medium category. In contrast, the % of female students' misconceptions is 18.6%, which is included in the low sort.

The results of the acquisition of delusions experienced by male and female students were also analyzed based on the question indicators presented in Figure 2.

Figure 2
The Percentage of Misconceptions Based on the Indicator Questions



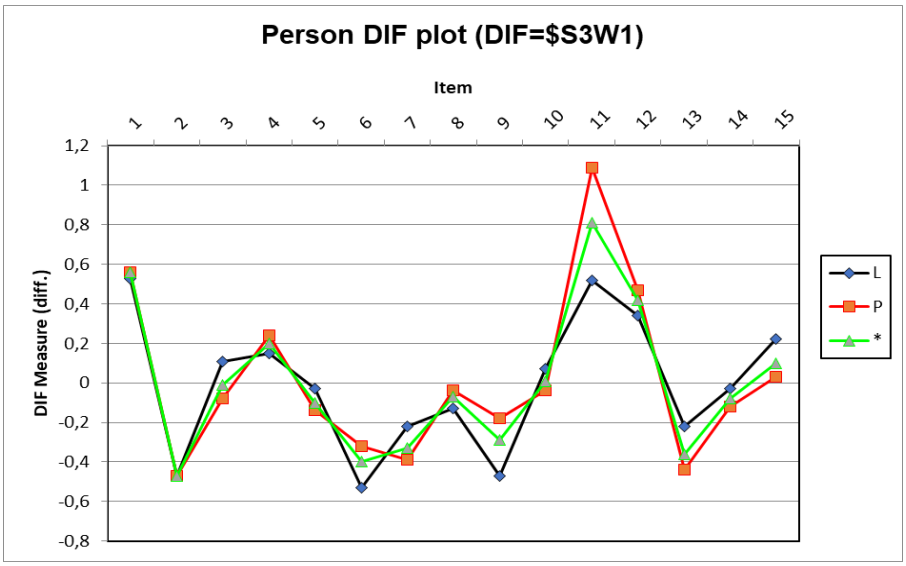
Question Indicators
1. Identify the noble gas electron configuration
2. Valence electron determination
3. Ionic bond determination
4. Analysis of the physical properties of compounds
5. Covalent bond determination
6. Bond type analysis

The results of Figure 2 show that male students have the highest percentage of misconceptions at 60% (moderate criterion) found in the second indicator, namely regarding the determination of valence electrons, and have the lowest rate of fantasies at 4% (common standard) found in the fifth indicator regarding the decision of bonds covalent. Meanwhile, female students had the highest percentage of misconceptions in the second indicator regarding the determination of valence electrons by 49% (medium criterion), and the lowest fantasy was in the fifth question indicator regarding the decision of covalent bonds by 2% (common standard).

Based on the results in Figure 2, male students have a more significant percentage of misconceptions than female students. It can be seen that male students experience general fantasies in the six question indicators compared to female students. It is consistent with research conducted by (Marantika Lia Kristyasari & Kusumaningrum, 2023; Kusumaningrum & Kristyasari, 2022) that male students prefer learning outside the classroom, such as through field observations, while female students like learning in the school. So, it is clear that the results obtained in the chemical bond teaching in the classroom showed male students are more dominant in experiencing misconceptions in all the question indicators used than female students.

From the results above, further analysis can be carried out regarding the influence of gender on the misconceptions experienced by students. This analysis can be done using the DIF calculation contained in the Rasch model. The DIF calculation results can be seen in Figure 3.

Figure 3
The DIF calculation



The results of Figure 3 explain the influence of gender on the misconceptions experienced by students. The results of the overall concept of students (model) show

green, while the conception experienced by male students shows blue and female students show red. The existence of gender differences affects the results of students' misconceptions. It follows the statement (Yamtinah et al., 2017), which states that the misunderstanding experienced by students can be influenced by several things, one of which is gender differences.

Based on the results above, the misconceptions of female students have a higher DIF score (positive value) than male students and the general misconception (Rasch model), which means that the results of misunderstanding experienced by female students are lower than male students. In questions number 6 and 11 with the bond type analysis indicator, female students are more dominant in having the ability to analyze the types of chemical bonds formed. In contrast, male students experience misconceptions; even in question number 6, male students experience the biggest misconception.

It is consistent with research on gender differences that have been conducted in mathematics and science learning; the results show that women have a better level of learning achievement and dominate in pursuing careers in mathematics and science compared to men (Haralambos & Holborn, 2014; Zannah & Andriani, 2017). This difference is influenced by several things, such as motivation and level of intelligence (understanding). Students are more highly motivated to work more diligently than men in school work, causing their ability level of intelligence (knowledge) and also to experience differences. (Firmanti, 2017; Glaze, 2018; Marantika Lia Kristyasari & Kusumaningrum, 2023)

Conclusion

Based on the results and discussion above, it is stated that there is an influence of gender on students' misconceptions. Misconceptions experienced by female students were lower than by male students. The percentage of student misconceptions is 18.6%, while male students are 31.9%. Generally, gender differences influence the misconceptions of high school students in Merauke City.

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