

ANALYSIS OF BASIC SCIENCE CONCEPTUAL UNDERSTANDING AMONG ELEMENTARY SCHOOL PROSPECTIVE TEACHERS: A GENDER PERSPECTIVE

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Abstract: This research aims to analyze the understanding of basic concepts of Natural Sciences in prospective elementary school teachers by paying attention to gender differences. This research uses a quantitative approach with a survey method. Data is obtained through assessing the average score in four main materials: work and energy, moments of force and simple planes, ecosystems, and substances and their changes. The number of respondents in this study was 51 prospective elementary school teachers, consisting of 8 male and 43 females. The instrument used in this research is a multiple-choice test. The research results show that there are significant variations between male and female teacher candidates. Male teacher candidates excel in material on work and energy as well as substances and their changes, while female teacher candidates show better performance in material on moments of force and simple planes and ecosystems.

Keywords: conceptual understanding, basic science, elementary school

Abstrak: Penelitian ini bertujuan untuk menganalisis pemahaman konsep dasar Ilmu Pengetahuan Alam (IPA) pada calon guru Sekolah Dasar (SD) dengan memperhatikan perbedaan gender. Penelitian ini menggunakan pendekatan kuantitatif dengan metode survei. Data diperoleh melalui penilaian skor rata-rata dalam empat materi utama: usaha dan energi, momen gaya dan pesawat sederhana, ekosistem, serta zat dan perubahannya. Jumlah responden dalam penelitian ini adalah 51 calon guru SD, terdiri dari 8 laki-laki dan 43 perempuan. Instrumen yang digunakan dalam penelitian ini adalah tes pilihan ganda. Hasil penelitian menunjukkan adanya variasi yang signifikan antara calon guru laki-laki dan perempuan. Calon guru laki-laki unggul dalam materi usaha dan energi serta zat dan perubahannya, sementara calon guru perempuan menunjukkan performa yang lebih baik dalam materi momen gaya dan pesawat sederhana serta ekosistem.

Kata Kunci: pemahaman konsep, konsep dasar IPA, sekolah dasar

INTRODUCTION

Basic education is an important foundation in the formation of students' knowledge and skills. In this context, a conceptual understanding of basic science becomes very crucial for prospective elementary school teachers, because they will be the ones who will teach and guide students in understanding science concepts from an early age. Prospective teachers' deep and correct understanding will ensure that they can deliver material appropriately and interestingly for students (Ibrahim et al., 2024). However, this understanding is often influenced by various factors, one of which is gender differences.

Previous research shows differences in the conceptual understanding of science between male and female (Bahtiar et al., 2022; Sagala et al., 2019; Cislaghi & Heise, 2020). This difference can

be caused by several factors, including differences in learning approaches, interest in science subjects, and the influence of gender stereotypes that exist in society (Ramdani et al., 2021; Husnaini & Chen, 2019). Gender stereotypes often lead to the perception that science is more suited to male than female, which can then influence female's performance and self-confidence in this field.

In addition, the role of higher education in shaping prospective teachers' understanding of science cannot be ignored (Ibrahim & Suranti, 2024). The curriculum, teaching methods, and learning environment in higher education can contribute significantly to the conceptual understanding of basic science (Surya et al., 2018). Higher education institutions need to pay attention to these gender factors to ensure that all prospective teachers have equal opportunities to master basic science concepts.

In the Indonesian context, research on the conceptual understanding of science in prospective elementary school teachers is still limited, especially considering gender perspectives. Knowing the extent to which gender differences influence prospective teachers' conceptual understanding of science can help in designing more inclusive and effective educational programs. This is important to address the gender gap in science education and to promote gender equality in the teaching profession.

This study aims to analyze the conceptual understanding of basic science among prospective elementary school teachers by considering a gender perspective. Through this research, it is hoped that a clearer picture can be obtained regarding the differences or similarities in the conceptual understanding of science between male and female teacher candidates. It is hoped that the results of this research can become the basis for developing educational strategies that are more inclusive and gender sensitive.

The urgency of this research lies in the importance of ensuring that prospective elementary school teachers have a strong and equitable conceptual understanding in the field of science, without being influenced by gender factors. Given the central role of teachers in shaping students' knowledge base, deep and equitable understanding is critical to creating inclusive and effective learning experiences. This research can reveal gender differences or gaps in the conceptual understanding of science, which, if left unchecked, could continue and worsen gender inequalities in education and careers in the future.

METHOD

This research uses quantitative methods with a survey approach to measure conceptual understanding of basic science among prospective elementary school teachers from a gender perspective. The research population was 2nd semester Elementary School Teacher Education (PGSD) undergraduate students at FKIP UNRAM. The research sample was taken from 2nd semester students in class 2E. This sample selection was carried out to ensure there was sufficient representation in analyzing differences in understanding of science based on gender. The research sample data is presented in the following figure.

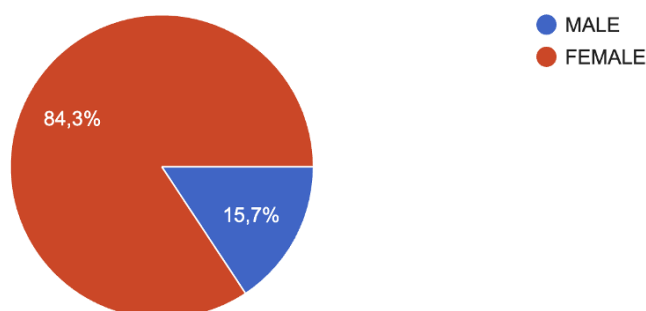


Figure 1. Research Sample

The instrument used in this research is a multiple-choice test consisting of 20 questions, covering ecosystem material, substances and their changes, work and energy, as well as moments of forces and simple planes. This test is designed based on basic education curriculum standards and has been validated by science education experts. Data collection is carried out by conducting tests on predetermined samples. Data analysis uses descriptive statistics with the help of the Rasch model to measure the difficulty level of items and respondents' abilities more accurately. The Rasch model allows researchers to conduct more in-depth item-response theory (IRT) analysis, so that they can identify differences in conceptual understanding of science between male and female teacher candidates with more precision. The results of this analysis will provide a comprehensive picture of the condition of prospective elementary school teachers' conceptual understanding of science and help formulate recommendations for curriculum improvements and more inclusive teaching methods.

RESULT AND DISCUSSION

The aim of this research is to measure the extent of conceptual understanding of basic science among prospective elementary school teachers which includes ecosystem material, substances and their changes, work and energy, as well as moments of force and simple planes. In addition, this research aims to identify and analyze differences in the conceptual understanding of science between male and female teacher candidates. In general, the understanding of basic science concepts for prospective elementary school teachers is presented in the form of the following table.

Table 1. Results of Elementary School Teacher Candidates' Understanding of Basic Science Concepts

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S. E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-CORR.	-AL EXP.	EXACT OBS%	MATCH EXP%	Item
1	27	51	.21	.31	1.08	.78	1.41	2.12	A .33	.42	73.5	66.1	Q1
17	33	51	-.39	.32	1.35	2.62	1.40	1.63	B .13	.38	57.1	69.3	Q17
11	27	51	.21	.31	1.18	1.71	1.25	1.40	C .28	.42	57.1	66.1	Q11
2	45	51	-2.00	.45	1.12	.48	1.24	.58	D .15	.25	87.8	87.7	Q2
20	23	51	.60	.32	1.17	1.47	1.19	1.08	E .33	.44	59.2	67.4	Q20
9	19	51	1.01	.33	1.02	.17	1.18	.88	F .43	.47	73.5	71.4	Q9
14	28	51	.11	.31	1.16	1.48	1.12	.70	G .31	.41	55.1	66.3	Q14
6	37	51	-.82	.34	1.09	.64	1.15	.57	H .27	.34	73.5	73.9	Q6
18	23	51	.60	.32	1.07	.67	1.08	.50	I .39	.44	67.3	67.4	Q18
5	42	51	-1.47	.39	.77	-1.01	1.05	.26	J .41	.29	83.7	82.1	Q5
13	35	51	-.60	.33	.96	-.26	.84	-.55	j .40	.36	69.4	71.4	Q13
3	22	51	.70	.32	.95	-.36	.88	-.60	i .49	.45	65.3	68.2	Q3
16	20	51	.90	.32	.92	-.58	.93	-.27	h .51	.46	77.6	70.3	Q16
10	27	51	.21	.31	.92	-.74	.86	-.77	g .48	.42	69.4	66.1	Q10
12	23	51	.60	.32	.91	-.80	.84	-.88	f .51	.44	67.3	67.4	Q12
7	37	51	-.82	.34	.77	-1.58	.90	-.24	e .48	.34	85.7	73.9	Q7
19	25	51	.40	.31	.90	-.92	.85	-.87	d .50	.43	71.4	66.3	Q19
15	19	51	1.01	.33	.88	-.89	.82	-.83	c .55	.47	73.5	71.4	Q15
8	23	51	.60	.32	.80	-1.83	.72	-1.69	b .59	.44	79.6	67.4	Q8
4	39	51	-1.06	.35	.78	-1.31	.64	-1.11	a .49	.32	81.6	76.7	Q4
MEAN	28.7	51.0	.00	.33	.99	.0	1.02	.1			71.4	70.8	
P. SD	7.8	.0	.84	.03	.16	1.2	.21	1.0			9.4	5.6	

The table above shows that the questions most prospective elementary school teachers answered correctly were questions with code Q2, namely questions on ecosystem material (45 answered correctly). The next question that many prospective elementary schools' teachers answer is questions with codes Q5, Q4, Q6, Q7, Q13, Q17. Meanwhile, the questions with the fewest correct answers by elementary school teacher candidates were questions coded Q9 (19 answered correctly), namely questions on matter and changes, and questions coded Q15 (19 answered correctly), namely questions on work and energy. Analysis of understanding of basic elementary science concepts was also carried out using RASH Model software. The purpose of analysis using the RASH model is to provide a more holistic understanding of the understanding of basic science concepts by prospective elementary school teachers. The results of the analysis of elementary school

teacher candidates' understanding of basic science concepts based on gender are presented in the following figure.

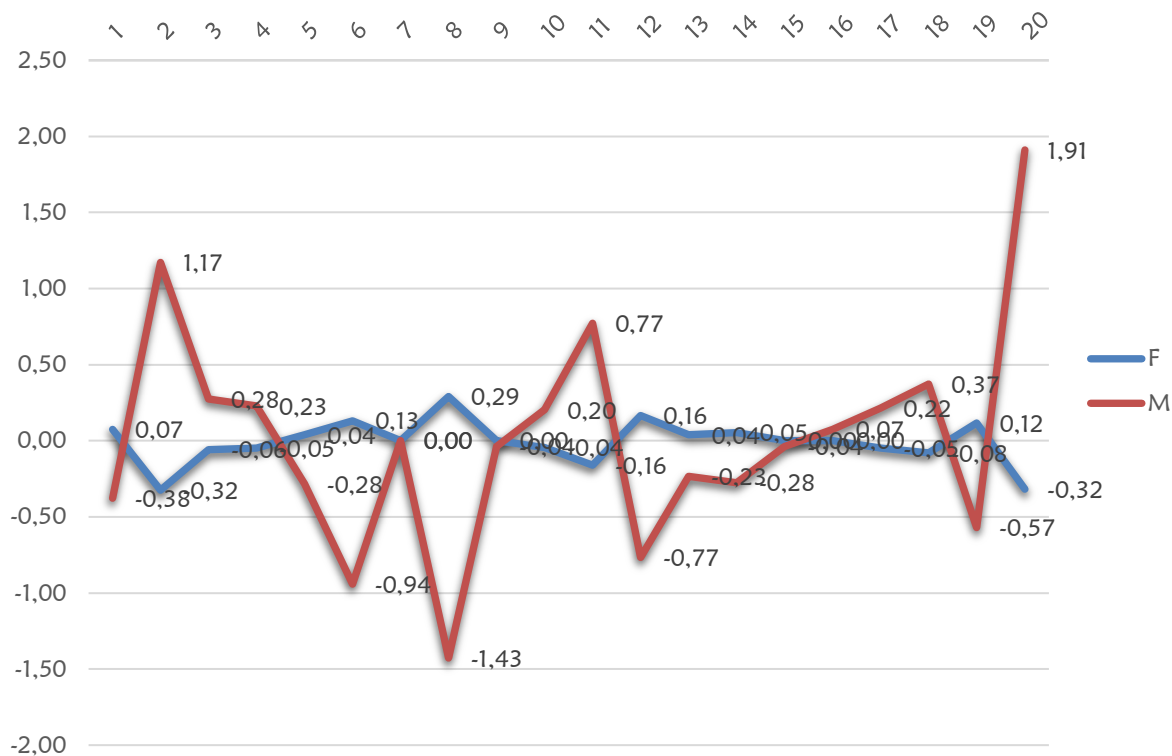


Figure 2. Hasil Differential Item Functioning Size (DIF-Size) IPA Concept Understanding Item

Figure 2 shows the DIF Size values for 20 question items, with respective values for female (F) and male (M). From this analysis, we can see variations in item difficulty between the two groups. For item Q1, female elementary school teacher candidates have a slight advantage with a value of 0.07, while male elementary school teacher candidates have more difficulties with a value of -0.38. In contrast, in item Q2, male have a significant advantage with a value of 1.17, while female experience difficulties with a value of -0.32. Items Q3 and Q4 show smaller differences, with values of approximately -0.06 and 0.28 for male, and almost neutral values for female.

Figure 2 also shows that items Q5 to Q9 generally show little variation, but items Q6 and Q8 stand out with female benefiting more (0.13 and 0.29) than male experiencing greater difficulties (-0.94 and -1.43). Items Q7 and Q9 show neutral values, with 0.00 for both groups.

In Q10 to Q20 items, we see some interesting patterns. For example, item Q12 benefits female (0.16) but disadvantages male (-0.77). In contrast, item Q11 benefits male (0.77) and disadvantages female (-0.16). Item Q19 shows that female benefit slightly (0.12) and male experience difficulties (-0.57). Item Q20 strongly favors male (1.91) and disadvantages female (-0.32).

Overall, this analysis shows that there are some items that appear to be easier or more difficult for one group than another. For example, male appear to benefit most on items Q2 and Q20, while female appear to benefit most on items Q6 and Q8. This indicates that although many items do not show large differences, some items show quite significant differences. The results of research on understanding science concepts for elementary school teacher candidates in general are also presented in the form of the following image.

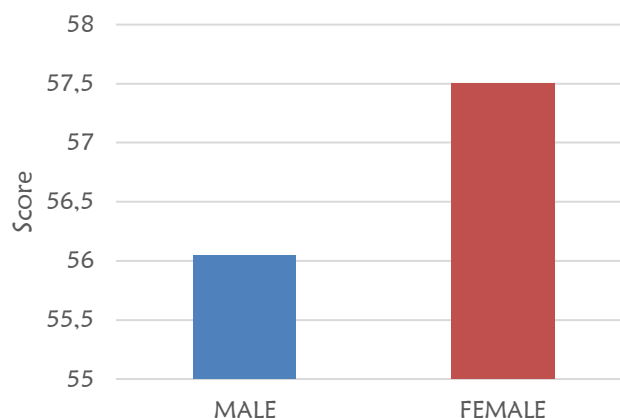


Figure 3. Average Conceptual Understanding of Prospective Teachers

Based on Figure 3, it can be seen that the understanding of science concepts for male prospective teachers is 56.047, while the understanding of science concepts for female teacher candidates is 57.5. These results indicate that female teacher candidates' understanding of science concepts is slightly higher than male teacher candidates' understanding of science concepts. Differences in understanding of science concepts between male and female teacher candidates can be caused by various factors. Female have a more rigorous and disciplined learning style, which helps them understand complex concepts.

Greater motivation and interest in the science field could also be a reason, because high interest can increase effort and persistence in learning. Additionally, the learning environment and social support, such as support from family, friends, or teachers, may differ between girls and boys, with girls receiving more encouragement to excel academically. Social expectations that require female to achieve more also encourage them to try harder. Active involvement in the learning process, such as asking questions, discussing, and seeking additional information, can also deepen their understanding of science concepts. Below is also presented (Figure 2) the understanding of science concepts between male and female teacher candidates based on science sub-material.

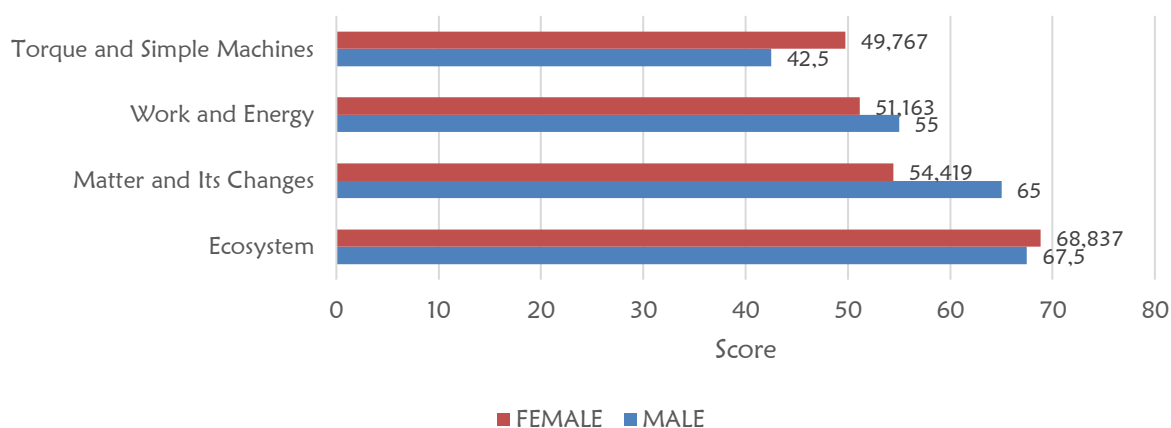


Figure 4. Prospective Teachers' Understanding of Science Concepts Based on Material

In the ecosystem material, the average score analysis shows that female teacher candidates obtained an average score of 68.837, while male teacher candidates obtained an

average score of 67.5. This shows that the average score of female teacher candidates is 1,337 points higher than that of male teacher candidates.

This difference in scores could be due to various factors, including learning methods that are more appropriate or attractive for female teacher candidates, possibly higher levels of motivation and interest in ecosystem material among female teacher candidates, and better or more effective access to resources. learning (Dokme et al., 2022). The implications of these findings are particularly important in the educational context, where the development of teaching materials that are more inclusive and attractive to all prospective teachers regardless of gender could help reduce these score differences (Lovey et al., 2022). Additionally, providing additional support for male teacher candidates can help improve their understanding of ecosystem material.

In the matter of substances and their changes, analysis of the average scores shows significant differences between male and female teacher candidates. Male teacher candidates obtained an average score of 65, while female teacher candidates obtained an average score of 54.419. This means that the average score of male teacher candidates is 10.581 points higher than that of female teacher candidates. This significant difference can be caused by various factors, such as a better level of understanding among male teacher candidates, learning methods that may be more effective for them, higher levels of motivation and interest, and better or more optimal access to learning resources (Regmi & Jones, 2020).

In the work and energy material, the average score analysis shows that male teacher candidates have an average score of 55, while female teacher candidates have an average score of 51.163. The difference in average scores shows that male teacher candidates are 3,837 points superior to female teacher candidates. This difference can be caused by various factors, including level of practice and preparation, motivation and interest in the material, learning methods used, and access to learning resources. The implications of these findings are very important in the educational context. To reduce score differences and improve the learning outcomes of all prospective teachers, it is necessary to develop more inclusive and engaging teaching materials, as well as extra support for groups showing lower performance (Lawrence & Tar, 2018).

In the simple force and plane moment material, the average score analysis shows different results compared to the work and energy material. Male teacher candidates have an average score of 42.5, while female teacher candidates have an average score of 49.767. Thus, the average score of female teacher candidates is 7.267 points higher than male teacher candidates.

This difference in average scores can be caused by various factors. The level of understanding and comfort regarding the material on moments of force and simple planes is higher among female teacher candidates. In addition, teaching methods, interest and motivation, and access to learning resources can also play a role in influencing the results of this score (Keller et al., 2017).

CONCLUSION

Based on the results of research and discussion, it can be concluded that There is significant variation in the understanding of basic science concepts among prospective elementary school teachers based on analysis of average scores in four main materials: work and energy, moments of force and simple planes, ecosystems, and substances and their changes. Male teacher candidates generally excel in material on work and energy as well as substances and their changes, while

female teacher candidates show better performance in material on moments of force and simple planes and ecosystems.

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