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Gender Differences in Science Inference skill on Elementary School

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Abstract: The study aimed to investigate the differences between male and female students in inference skill. This is quantitative research with descriptive and inferential statistical approaches. The total 32 students comprised of 11 males, 13 females. Determination of the sample was done by random sampling. The whole sample was divided into two groups based on their gender. The data were collected through using multiple choice test and inference test. The findings of this research are described in our paper and seem to be encouraging. This research would suggest that there may be differences in cognitive processing between males and females that could potentially influence science learning. For example, research has examined spatial reasoning abilities, with some findings indicating that males may perform slightly better on certain spatial tasks. However, these differences are often small and can vary widely among individuals. In terms of inference and problem-solving, studies have suggested that males and females may approach scientific tasks differently. Some research has indicated that males might be more inclined toward deductive reasoning, while females might excel in inductive reasoning. However, these differences are not consistent across all tasks and individuals. The results from such a study cannot automatically be generalized to elementary students in real classes and to other subject matters.

Keywords: gender differences, inference skill, science learning

INTRODUCTION

The gender gap in academic science is a topic of ongoing policy and scholarly debate for over a span of many decades (Ding, 2006; Ingalhalikar et al., 2013) and have received serious attention in the science education research (Dimitrov, 1999; Nosek et al., 2009). However, the studies about gender differences in particular science learning showed inconsistent trends. Thus, although there are some variations, there is a consensus that, overall, gender differences in science learning have existed in the past and are still present.

The topic of gender has sparked engaging discussions and has evolved into a captivating subject. It encompasses the essential elements of socio-cultural interactions between individuals of different sexes, aimed at gaining insights and knowledge (Kurniawan & Purnamawirayuda, 2020).

Some research found that male students had a better than female students on science achievement (Englehard Jr. & Anderson, 1998; Reis & Park, 2001), average science performance (Hamilton, 1998), expressing an interest in most of these fields of scientific application (S. Johnson, 1987), prior science experiences outside of school with a variety of tools and objects (Jones, Howe, & Rua, 2000), and belief in ability to do science (Trankina, 1993; Kahle, Parker, Rennie, & Riley, 1993; National Assessment of Educational Progress,

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1997). In other hand, some research showed that female students had a better science achievement (Falvo & Suits, 2009), on levels of scientific knowledge (Hayes & Tariq, 2000), and even no gender differences on science achievement (Linn, De Benedictis, Delucchi, Harris, & Stage, 1987; Adamson, Foster, Roark, & Reed, 1998).

One crucial 21st-century competency is inference skill, which involves the capacity to use available information or evidence, even when it's not directly stated, to logically deduce conclusions or make reasoned judgments. Inference skill enables individuals to draw meaningful insights from implicit data, fostering effective problem-solving and decision-making across various contexts (Teo & Goh, 2019). This skill is particularly relevant to scientific understanding and investigations, and it is one major component of science process skills (Zorlu & Sezek, 2020). (Cruz, 2015) argued that Foundational science process skills serve as building blocks for the eventual development of more advanced integrated skills. Therefore, it is essential to prioritize these fundamental skills during the early stages of primary education. This emphasis in the early years lays the groundwork necessary for students to cultivate and apply more intricate skills as they progress through higher levels of primary education. Basic science process skill includes observation, measuring, inference classifying, predicting and communicating (Wazni & Fatmawati, 2022). Conceptual and procedural knowledge influence one another (Rittle-Johnson & Koedinger, 2002).

Based on the results of a preliminary study at one of elementary school on science learning activities, information was obtained that: There is no measurement to determine the ability of students' inferrence skills; There is no measurement of students' inferrence skills based on indicators; There is no measurement to determine differences in the science inferrence skills of class students based on gender (gender homogeneous class). Based on this, researchers are interested in conducting research to fi nd out; Description of students' inferrence skills; Describe students' inferrence skills based on indicators of inferrence skills skills; Are there any differences in the science process skills of class VI students elementary school based on gender (gender homogeneous class). The findings could provide insights for teachers in identifying strategies to address their students' learning and development in science inference skills. Hence, this study investigated student's inference skill based on gender differences on science learning. These findings may have implications for teaching and learning practices.

METHOD

This study employed a quantitative descriptive research method with a descriptive observational research design. The independent variables included Gender of the participants. While dependent variable was inference skills.

The participants of this research was 32 students of VI grade in elementary school in academic year of 2017/2018. They consisted of 17 males and 15 females almost in similar ages (12 year old). Determination of the sample is done by random sampling / probability sampling. The whole sample was divided into two groups, namely male students and female students.

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In this study, the quantitative data used were data on Inference skills. 9-item essays were constructed to assess inference about "Heat Transfer". While the acquisition of data on Inference skills researchers used an instrument which is presented in Table 1

Table 1. Student's Inference Skills Assessment

Basic Competency	Dependent variable	Indicators
1. Applying the concept of heat transfer in everyday life. 2. Reporting the results of observations about heat transfer.	Inference skills	Students can draw conclusions based on observation data.

Descriptive statistics is the selected approach for examining the data. It involves summarizing and presenting the data in a manner that provides a clear and straightforward understanding of its key characteristics. Rather than making inferences or drawing broader conclusions about a population, this method focuses on describing and organizing the available data that descriptive statistics are used to describe or provide information on conditions or problems using data (Li Vigni, Durante, & Cocchi, 2013).

In the context of descriptive analysis, the following statistical measures are considered: the mean, median, mode, and standard deviation values (Fricker, 2001). The mean is calculated by dividing the sum of scores in the frequency distribution by the total number of data points. The median is a value located at the middle of a frequency distribution. The mode is a statistical measure used to identify the phenomenon that has the highest frequency or is the most frequently occurring in a dataset (Johnson, 2018).

The basis for calculating the standard deviation is the desire to know the diversity of a data group. Data were analyzed using descriptive statistical analysis. Data were analyzed with the help of IBM SPSS Statistics 25 Software. Data will be homogeneous if the Sig value obtained is more than 0.05 (Sig > 0.05). After the data is said to be homogeneous, then the final analysis test can be carried out.

FINDINGS AND DISCUSSION

The research was conducted to examine the inference skill of students on the material of Heat Transfer.

Table 2. Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
Inference skill	Males	,149	17	,200*	,937	17	,281
	Females	,184	15	,184	,894	15	,077

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the table 2, the p-value for the male group is 0.281 and the p-value for the female group is 0.077. Since both p-values are greater than 0.05, it can be concluded that the

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student learning outcomes data for both the male and female groups are normally distributed. Then, the results of test on students' inference skill on the material of Heat Transfer are shown in Table 3.

Table 3. Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Inference skill	Male	17	18,235	4,9941	1,2113
	Female	15	16,867	3,9797	1,0276

Based on the table 3, the mean inference skill score for the male group is 18.235, while for the female group it is 16.867. Therefore, based on descriptive statistics, it can be concluded that there is a difference in the average learning outcomes between the male and female groups. To determine whether this difference is statistically significant or not, we need to interpret the output of an independent sample t-test as follows:

Table 4. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Inference skill	Equal variances assumed	,169	,684	,849	30	,402	1,3686	1,6115	-1,9224	4,6597
	Equal variances not assumed			,862	29,723	,396	1,3686	1,5884	-1,8766	4,6138

Based on the table 4, it is known that the p-value for Levene's test for equality of variances is 0.684, which is greater than 0.05. This indicates that the variances of the data between the male and female groups are homogeneous or equal. Therefore, the interpretation of the output table for the independent test is based on the values found in the equal variances assumed table. Based on the output table for the independent sample test in the equal variances assumed section, the p-value (2-tailed) is 0.402, which is greater than 0.05. Therefore, it can be concluded that there is no significant difference between the average inference skill scores of students in the male and female groups.

Result from table 4 reveals that there were no statistically significant differences in the achievement mean scores of male and female students, though the male students' academic achievement mean scores at dependent measures level were a little bit higher than those of the female students, the differences were not significant. This result is in line with some of the research findings of Aguele & Uhumniah (2008); Billings (2000); Eccles, Lord, Roeser,

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Barber, & Jozefowicz, (1997); Hyde & McKinley, (1997); Kolawole, (2007), etc., who found in their studies, at various times, that male students achieved better than female students in science subjects.

Gender differences in science learning are also influenced by sociocultural factors, such as societal expectations, stereotypes, and classroom dynamics (Kahle, Parker, Rennie, Riley, 2010). These factors can impact self-efficacy, motivation, and participation in science-related activities. Research has shown that males and females may have different learning preferences and strategies (Wehrwein, Lujan, DiCarlo, 2007). For instance, females might lean towards collaborative and context-based learning approaches, while males might exhibit a preference for more competitive and individualistic learning environments.

The classroom environment plays a crucial role in shaping gender differences in science learning (Carrier, 2007). Research has highlighted the importance of promoting an inclusive and equitable learning environment that encourages all students to engage with scientific concepts and processes (Aguillon, Siegmund, Petipas, Drake, Cotner, Ballen, 2020). To address gender differences in science learning, educators have developed interventions and teaching strategies aimed at promoting equal participation and understanding among all students (Khine, 2016). These interventions often focus on fostering a growth mindset, providing diverse role models, and incorporating active learning strategies.

The renewal of this research can be seen from utilizing gender as a distinguishing factor to examine students' science inference skills. A potential limitation of this study is the relatively small sample size when segregating participants by gender. For further research, the researcher suggests adding a pretest and posttest. Furthermore, other variables should be added in the research on science inference skills so that they can be analyzed for relationships and their eff ects on other indicators and make them more complex. This research aims to serve as a reference point for teachers, allowing them to assess students' inference skills. The goal is to enable teachers to tailor their teaching and learning methods to meet students' needs effectively. By doing so, it is anticipated that the educational experience in schools can be enhanced, leading to an improvement in students' inference abilities.

CONCLUSION

After discussing the findings to the relevant theories and literature, it can be concluded that there may be differences in inference skill, studies have suggested that males and females may approach scientific tasks differently. Some research has indicated that males might be more inclined toward deductive reasoning, while females might excel in inductive reasoning. However, these differences are not consistent across all tasks and individuals. Science inference skills should be trained eff ectively in the elementary school both for male and female students.

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