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Correlation between belief in science and belief in pseudoscience in high school students

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ABSTRACT

Dissemination of news through social media is one of the biggest causes of increasing student's trust in pseudoscience. The purpose of this correlational study was to analyze the relationship between belief in science and pseudoscience beliefs related to biology in high school students. This research entails a correlational study conducted through a survey methodology. The results of the study show that the ability to believe in science has a significant effect on students' belief in pseudoscience related to biology for high school students. Based on the research, the initial hypothesis of the study was rejected, that there is a positive relationship between belief in science and belief in pseudoscience related to biology, thus indicating that increasing students' confidence in science will also increase students' confidence in pseudoscience related to biology. This is due to the continuous spread of unscientific issues through social media which will affect the increase in trust in pseudoscience. The increase in pseudoscience is due to the lack of student media literacy so that it can affect the way students respond to news that is on social media. The lack of education regarding students' media literacy is a factor in increasing students' confidence in pseudoscience related to biology for high school students.

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INTRODUCTION

Belief in science is an important competency for students, by believing in science students will easily believe in scientific truths. Belief in science can make science-based thinking (Hendriks et al., 2016). In the field of education, science-based thinking is needed, namely as a reference for students' mindsets, and is considered capable of directing students' thinking towards scientific truths. According to Farias (2013), belief in science can be used as a certainty of thinking for individuals in understanding the context of science in learning activities. By believing in science, students will follow scientific developments developed by researchers so that learning will take place optimally. The more students believe in science, the more open they will be in accepting scientific findings. Belief in science will affect students' acceptance of scientific findings (Solloway, 2020). Along with the development of the times, students get information from social media and often the data is not in accordance with scientific principles so that it can lead to pseudoscience.

The spread of news through social media is one of the biggest causes of pseudoscience (Benjamin & McLean, 2022). In a 2017 study conducted by the Pew Research Center, only about a quarter of social media users (26%) follow science accounts (Supratmn & Abdullah, 2020). The number of platforms on social media plunges students into pseudoscience. Many of the pseudosciences that are spread on social media are related to science. One of the fields of knowledge contained in science is biology, there are several examples of pseudoscience related to biology that students believe that humans only use 10% of their brain capacity (Swami et al., 2012). This is pseudoscience because basically the use of the brain is influenced by one's activity and level of thinking (Wahyuningsih & Sunni, 2020). Additionally pseudoscience that students believe personality traits are related to month of birth (Peña & Paco, 2004). It is also not a scientific thought because scientifically personality is related to genetic factors and environmental factors (Ayun, 2017). Belief in circulating myths can occur due to a lack of student confidence in science.

The attitude of students' trust in pseudoscience is caused by the low quality of science education so that it can affect students' trust in science. According to Krüge (2022), pseudoscience is still a problem today. Pseudoscience has been a problem in the 21st century for more than 50 years (Metin et al., 2020). The attitude of students' belief in pseudoscience is influenced by a lack of cognitive ability and scientific proof in the science learning process. Scientific evidence in science is able to increase students' confidence in science (Ningrum et al., 2019). Low students' understanding of science can affect students' cognitive. According to Azizah's statement (2021), the level of understanding and errors in understanding concepts can affect students' cognitive. Belief in science is more general than belief in pseudoscience. Therefore, the identification of students' beliefs in science can be used as a way to see students' beliefs in pseudoscience can be done to deal with this problem. Thus, the purpose of this study was to analyze the relationship between the level of belief in science and the level of belief in pseudoscience in high school students. The results of this study are expected to be able to overcome the problem of knowing the relationship between belief in science and pseudoscience related to biology.

METHODS

Research Design

This study uses a survey method with a quantitative approach. This research is a correlational study because it wants to see the relationship between students' belief in science and pseudo-science related to biology among high school students. The location of the research implementation was in one of the high schools in Batu, Malang, East Java. The research was conducted May 5 – May 26 2023, with the study population being students majoring in natural sciences. The sample for this study comprised 55 students from class X and class XI of a senior high school's science program (Table 1). The sampling technique employed was random sampling, wherein data collection was conducted randomly among all students within these two grade levels. This approach was adopted to ensure a representative sample. The decision to focus solely on classes X and XI stems from the consideration that the learning dynamics for students in these grades tend to be more consistent. Class XII students are notably preoccupied with intensive preparation for their final examinations, involving numerous practice tests and diverse activities. Thus, by concentrating on classes X and XI, coherence in the collected data is maintained, consequently enhancing the validity of the research findings.

Table 1.
Research sample

No	Grade	Amount of Sample
1.	X IPA	21
2.	XI IPA	34
	Total	55

Instrument

The research instrument is a tool that functions to collect data or measure the variable value of a data. The instrument used is a questionnaire on the Google form in the form of a question. The variables used are belief in science and belief in pseudoscience related to biology. Instruments of belief in science and pseudoscience were obtained through studies of previous research literature. The steps for compiling an instrument of trust in science are collecting instrument items from previous publications, selecting items that are appropriate to the dimensions and conditions in Indonesia, deleting items that are similar and retaining non-repeating items, then grouping items based on 3 aspects including aspects of scientific sources, certainty and the character of scientists, then instrument validation is carried out.

Procedure

The procedure in this study went through 3 stages, namely the preparation stage, the implementation stage, and the data collection stage. The research preparation stage is used to prepare things that will be needed in research. This stage consists of observations used to determine research locations, administering permits used for research, preparing tools used in research and compiling instruments of belief in science and belief in pseudoscience.

Furthermore, the implementation and flow of the research was in the form of an application for an observation permit at high school, joint agreement with maple teachers to conduct research, sending a Google form link to students, giving directions to students on how to fill out research instruments and providing time for filling out instruments, filling in instruments via the Google form link by respondents according to directions, during the filling in progress, students will continue to be accompanied by researchers, withdrawing instruments via Google form. Finally, the data collection stage is the stage for collecting the results of respondents' answers from the Google form in the form of an excel file. The collected files will automatically contain the results of filling out the respondents and the student's choice of options will be recorded.

Data Analysis Techniques

Research data analysis techniques were carried out after obtaining data from all respondents, the activities carried out were grouping data, entering data from all respondents, presenting data, and calculating the results of all variables, in order to answer the problems that had been formulated in the problem formulation. The data analysis technique used is simple linear regression, before the regression test is carried out, the prerequisite assumption test is first carried out in the form of a linearity test, homoscedasticity test, and data normality test.

RESULTS AND DISCUSSION

To measure students' belief in science, 16 closed questions were used with 5 answer options. Details of the data distribution of trust responses to science are presented in Table 1. Furthermore, in measuring students' belief in pseudoscience, 12 closed questions with 5 answer options were used. The distribution of student responses is presented in Table 2.

Table 2.
Data on the Distribution of Belief Responses to Science

Item	Response n(%)				
	0	1	2	3	4
1	0 (0)	0(0)	0(0)	14 (25.45)	41 (74.55)
2	1 (1.82)	0(0)	0(0)	23 (41.82)	31 (56.36)
3	0(0)	0(0)	1 (1.82)	28 (50.91)	26 (47.27)
4*	3 (5.45)	14 (25.45)	18 (32.73)	18 (32.73)	2 (3.64)

Item	Response n(%)				
	0	1	2	3	4
5*	6 10.91)	8 (14.55)	24 (43.64)	15 (27.27)	2 (3.64)
6*	8 (14.55)	17 (30.91)	21 (38.18)	8 (14.55)	1 (1.82)
7	0(0)	3 (5.45)	8 (14.55)	30 (54.55)	14 (25.45)
8	0(0)	2 (3.64)	9 (16.36)	27 (49.09)	17 (30.91)
9*	2 (3.64)	8 (14.55)	7 (12.73)	27 (49.09)	11 (20.00)
10*	6 (10.91)	10 (18.18)	13 (23.64)	20 (36.36)	6 (10.91)
11*	5 (9.09)	18 (32.73)	11 (20.00)	19 (34.55)	2 (3.64)
12*	4 (7.27)	12 (21.82)	20 (36.36)	16 (29.09)	3 (5.45)
13*	2 (3.64)	6 (10.91)	14 (25.45)	26 (47.27)	7 (12.73)
14*	2 3.64)	17 (30.91)	12 (21.82)	20 (36.36)	4 (7.27)
15*	4 (7.27)	27 (49.09)	7 (12.73)	14 (25.45)	3 (5.45)
16	1 (1.82)	1 (1.82)	6 (10.91)	30 (54.55)	17 (30.91)
Total	44 (5)	143(16.25)	171(19.43)	335(38.07)	187 (21.25)

Information:
Question items
Positive statements Negative statements (*)
0 = strongly disagree 4 = strongly disagree
1 = do not agree 3 = do not agree
2 = Doubt 2 = Doubt t
3 = somewhat agree 1 = somewhat agree
4 = strongly agree 0 = strongly agree

Table 3.
Data on Distribution of Belief Responses to Pseudoscience

Item	Response n (%)				
	0	1	2	3	4
1	12 (21.82)	12 (21.82)	15 (27.27)	11 (20.00)	5 (9.09)
2	2 (3.64)	10 (18.18)	19 (34.55)	14 (25.45)	10 (18.18)
3	24 (43.64)	19 (34.55)	11 (20.00)	1 (1.82)	0(0)
4	27 (49.09)	19 (34.55)	6 (10.91)	3 (5.45)	0(0)
5	7 (12.73)	9 (16.36)	14 (25.45)	13 (23.64)	12 (21.82)
6	1 (1.82)	3 (5.45)	6 (10.91)	16 (29.09)	29 (52.72)
7	13 (23.64)	14 (25.45)	26 (47.27)	2 (3.64)	0(0)
8	8 (14.55)	16 (29.09)	22 (40)	8 (14.55)	1 (1.82)
9	1 (1.82)	14 (25.45)	22 (40)	10 (18.18)	8 (14.55)
10	0(0)	7 (12.73)	12 (21.82)	24 (43.64)	12 (21.82)
11	1 (1.82)	8 (14.55)	29 (52.72)	14 (25.45)	3 (5.45)
12	12 (21.82)	17 (30.91)	14 (25.45)	8 (14.55)	4 (7.27)
Total	108 (16.36)	148 (22.42)	196 (29.70)	124(18.79)	84(12.73)

Information:
0 = very precise
1 = somewhat precise
2 = doubt
3 = not quite right
4 = very imprecise

Furthermore, the data is processed to obtain descriptive statistical results. This descriptive analysis shows the frequency distribution of the variable belief in pseudoscience related to biology which includes the mean, standard deviation, maximum value, and minimum value, presented in Table 3.

Table 4.
List of Descriptive Statistical Beliefs in Pseudoscience

n	Mean	SD	Maximum	Minimum
55	47.2729	10.94265	66.67	18.75

Next, an F-test and regression equation calculations were conducted to determine whether there is a significant relationship between the independent variable and the dependent variable. The results of the F-test and simple linear regression equations are presented in Table 4 and 5.

Table 5.
Summary of ANOVA table for Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	881.555	1	881.555	8.366	.006[b]
	Residual	5584.492	53	105.368		
	Total	6466.047	54			

Table 6.
R Square of the Simple Linear Regression Test

Model	R	R Square Adjusted	Square	Std. Error of the Estimate	Durbin-Watson
1	.369	.136	.120	10.26488	1.728

Based on Tables 5 and 6, a significant regression equation was obtained [F(1.53) = 8.366, p = 0.006], with an R^2 of 0.136. This indicates that there is a statistically significant relationship between the independent variable and the dependent variable. The F-statistic of 8.366 with a corresponding p-value of 0.006 suggests that the regression model accounts for a significant amount of the variance in the dependent variable. The R^2 value of 0.136 indicates that approximately 13.6% of the variance in the dependent variable can be explained by the independent variable(s) included in the model. In other words, the contribution of Belief in Pseudoscience to Belief in Science is approximately 13.6%. Therefore, the regression model provides a meaningful prediction of the dependent variable based on the independent variable(s) included in the analysis. Furthermore, the results of calculating the regression equation of trust in science with pseudoscience related to biology are presented in Table 7.

Table 7.
Regression Equation Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std.Error	Beta		
1	(Constant)	20.650	9.308		2.219	.031
	Belief in science	.418	.145	.369	2.892	.006

Based on Table 6, students' belief in pseudoscience can be predicted using the regression equation y = 20,650 + 0.418x. The regression coefficient (B = 0.418) indicates that an increase in the score of belief in science by 1 point will increase the score of belief in pseudoscience related to biology for high school students by 0.418. The y variable in the equation represents belief in pseudoscience and the x variable represents belief in science. If x is substituted with a value, it will have an impact on y and the results will show a straight comparison (a high x value has an impact on a high y value, and vice versa). These results are inconsistent with the initial hypothesis that the level of trust in science has the potential to have a negative relationship with the level of trust in pseudoscience related to biology. This can happen due to the lack of education regarding students' media literacy, thus increasing students' confidence in pseudoscience related to biology.

The rise of news through social media is the reason students believe in pseudoscience (Benjamin & McLean, 2022). Intense use of social media makes students believe more in pseudoscience, so that students tend to think that all information on social media has been scientifically proven. In accordance with Claassen's statement (2021) which states that the continuous spread of unscientific issues through social media will affect the increase in pseudoscience. The increase in pseudoscience is due to the lack of student media literacy, which affects the way students respond to news on social media (Saputra et al., 2015).

Today, in the digital era, media literacy skills are very much needed for students, because apart from the positive impacts there are many negative impacts of social media. The need for media literacy

skills to be applied in schools, this is because the biggest consumers of media are students who occupy school benches. Based on a survey by the Indonesian Internet Service Providers Association (APJII) that internet users in Indonesia are dominated by the 15-19 year old age group. (Sari & Prasetya, 2022). Therefore, Saputra (2015) states the need for media literacy education for students in school so that they are not easily affected by the negative effects of social media and can improve their attitude of being able to select information circulating on social media.

There are still many social media users who do not sort, select information obtained from social media, thereby increasing trust in pseudoscience. Someone who is intense with social media and is not accompanied by the ability to do media literacy or criticize the messages conveyed, will tend to be careless in responding to various information from social media (Hidayat et al., 2023). Empowerment of digital literacy is needed especially in biology subjects. In accordance with Amboni's statement (2021) which states that biology subjects require an understanding of scientific sources, and students' abilities in media literacy so that students are able to sort scientifically based information on social media appropriately.

Some interesting findings to discuss are that in belief in science there is the highest score obtained, namely on the dimension of certainty in science which means that students trust the certainty of science-based information, namely question number 1 reads "Science provides accurate information about our nature" on a scale (strongly agree) answered by 41 students with a percentage of 74.55%. This shows that students believe in certainty in science. Science is closely related to nature, namely finding out about nature as a whole and contains a collection of knowledge in the form of scientific facts, concepts and principles (Wulandari, 2016).

The lowest score measuring students' scientific belief in the dimensions of the scientist's character is in question number 6 which reads "Scientists deliberately keep their work secret", on a scale (strongly agree) of 8 students with a percentage of 14.55%. This shows the attitude of students who do not fully trust scientific organizations such as scientists, due to the lack of involvement of students in the scientific world so that students' knowledge about scientists is only limited to scientists, researchers and conducting scientific publications.

In the science field, scientists conduct research following factual and structural procedures (Milasari et al., 2021). But there are several attitudes of scientists that must be understood by students such as being open, honest and responsible so that they will be able to increase students' interest in science. In science, when you become a scientist you have to have the attitude of being able to accept other people's opinions, not knowing despair, perseverance and openness (Ulfa, 2018).

On the other hand, the statement of belief in pseudoscience related to biology with the lowest level of confidence answers, namely the answers of students in option 4 (very imprecise) question number 6 as many as 29 students or 52.72% and answers in option 3 (inaccurate) as many as 16 students or 29.09%, with the question saying "Zodiac will determine what disease a person may have", these statements are about health from a scientific perspective, these results show SM students do not fully trust pseudoscience related to biology that is spread in society, especially related to zodiac, because students background from the science major that underlies students' thinking to think scientifically, especially knowledge related to disease. Students who have a basic knowledge of science tend to believe that there is a disease. While the level of trust in pseudoscience related to biology with the highest choice of options, namely as many as 27 students with a percentage of 49.09% in option 0 (very correct) is found in question number 4, which discusses nutrition from a scientific perspective saying "Consuming food containing chemicals is bad for health". This shows that many students believe that consuming foods containing chemicals is bad for health, whereas we cannot conclude directly that foods containing chemicals are harmful to health, before laboratory tests are carried out.

On the other hand, conclusions in science must be based on facts and evidence, namely before checking in a food laboratory it cannot be stated with certainty that consuming food containing chemicals will be harmful to health. The laboratory is used as a place to conduct research, experiments or scientific research related to science (Candra & Hidayati, 2020).

Based on the research that has been done, the level of students' belief in pseudoscience related to biology is quite high with a high value of trust in science. Meanwhile, belief in science should have a negative effect on the level of students' belief in pseudoscience. This is due to the lack of education regarding students' media literacy, thus increasing students' confidence in pseudoscience related to biology.

CONCLUSION

The results of this study are that there is a positive relationship between belief in science and pseudoscience related to biology. An increase in the score of trust in science by 1 point will increase the score of trust in pseudoscience related to biology for high school students by 0.418. The results of this study are not in accordance with the initial hypothesis that the level of belief in science has the potential to have a negative relationship with the level of belief in pseudoscience related to biology. This can happen due to the lack of education regarding students' media literacy, thus increasing students' confidence in pseudoscience related to biology.

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