the 5th ICTROPS
International Conference
for Tropical Studies and Its Applications

Islamic Development Bank 4in1 Project
Project Implementation Unit
University of Mulawarman

Co-Organized by :

Exploring Pre-service Teachers Trust in Science-Technology-Engineering-Mathematics (STEM) during the COVID-19 Pandemic

Lola Jovita[1], Riski Amalia[1], Shelly Efwinda[1], Nurul Fitriyah Sulaeman[1]*
Department of Physics Education, Mulawarman University, Indonesia
Corresponding Author: nurul.fitriyah@fkip.unmul.ac.id*

Abstract

When cases of pandemic diseases are made public, unavoidable discussions arise about the public loss of trust in Science-Technology-Engineering-Mathematics (STEM). The discussion about trust in STEM reaches far beyond the pandemic itself. It is fundamental for shaping the public understanding of science. Through their science classroom, pre-service science teacher plays an essential role to developed students trust to STEM. Therefore, it is valuable to exploring pre-service science teacher trust in STEM. Our research was carried out on 132 pre-service science teachers (23 male and 109 female) in a state university in Indonesia. Data was collected with the questionnaire called "Trust in Science and Scientist Inventory" which consists of 20 items. We analyzed the data by categorizing, tabulating, and conducting descriptive statistics to the data. Further analysis to explore the possible different levels of trust by gender was also estimated and confirmed by an independent t-test. From the result, the participants demonstrated a neutral level of trust in STEM. Comparisons by gender showed that male pre-service science teachers had a more positive level than female pre-service teachers. Still, the statistical result showed the difference is not significant. The results indicate the need to enhance knowledge of the latest issues in STEM for a pre-service science teacher to develop their trust. We argue that trust is related to the content knowledge about science. The relation between trust and content knowledge in science is valuable to explore in future research.
Keywords: STEM, Trust, Pre-service Science Teacher

1 Introduction

The development of science and technology cannot be separated from society and culture, with all the norms, values, meanings, beliefs, habits, and mentalities built into them. Trust in science can influence and greatly impact every activity people carry out in everyday life. Trust is a feeling that is based on emotions, knowledge, beliefs, and relationships (Nadelson et al., 2014). Some belief theorists argue that trust is only based on a person's knowledge who can understand the actual risks and benefits associated with that individual (Critchley, 2008). Research conducted by scientific scientists has brought many benefits to people in everyday life. Public trust in science and scientists must be the top priority of science. In line with this, surveys show that people around the world have a close high level of trust in science and scientists (Pew, 2019). Society in today's era where knowledge has been so developed is very dependent on science and technology (Luhmann, 1979). Several other studies have shown that public trust during the COVID-19 pandemic has increased. This is because people are starting to pay attention to news related to vaccine testing and development (Zingg & Siegrist, 2012; Rochman & Pertiwi, 2020). It is undeniable that the public's dependence on information in the media continues to increase during the pandemic because the need for the latest information about COVID-19 continues to be awaited and monitored globally (Battiston et al., 2021). In addition, a potential lack of understanding of scientific knowledge is common in society and can be described as a lack of trust in science and scientists (Miller, 2008). Some scientific practices that are seen by the public do not match those of scientific scientists (Tourney, 1992). This is due to the depictions scientists make on television, film, the internet, books, and other media that can yield strong but potentially inaccurate scientific insights. (Rahm & Charbonneau, 1997; Wyer et al., 2010). Therefore, the practice of science carried out by scientific scientists greatly influences public confidence in science (Finson, 2001).

STEM education is essential for students to survive in the modern era to compete and survive in today's developments. Therefore, students must be prepared with several skills, including the ability to adapt to many situations, communicate at a higher level, and solve problems. It can be obtained by students from STEM Education (Rifandi et al., 2020). STEM education has become a trending topic to be discussed among education experts. One of the preparations in implementing STEM education is to prepare the skills of the prospective teacher. Specifically, the teacher is the person who will implement or integrate STEM education in classroom learning. Many studies have reported that teachers' attitudes toward science teaching are a strong indicator of the quality and quantity of science taught to a student (Russell, 1986; Wallace & Louden, 1992). Teachers who have low confidence in teaching science also develop negative attitudes toward science (Koballa & Crawley, 1985). Teachers who have low trust will eventually avoid teaching science (Ngman-wara, 2016). However, data on teacher candidate trust in STEM is currently still limited (Rifandi et al., 2020). To increase the trust of pre-service teachers, it should be appropriately considered in teacher preparation programs (Tosun, 2000). What can be done is make STEM education an integral part of the preparation of prospective teachers at the university level (Preciado Babb et al., 2016).

Research related to STEM often mentions differences in answers between male and female students. Less than half of men in the U.S. have a bachelor's degree in science (Cheryan et al., 2016). This indicates that there is a difference in trust in STEM between male and female science teacher candidates. According to a World Bank report, the number of women in STEM continues to decline from high school to university, then continued in work in the laboratory, teaching and research and technology policymakers (Candraningrum, 2016; Sadler et al., 2012). Globally it is reported that there are only 30% of women in STEM, and in Asia alone, there are only 18% of women. One of the reasons women believe in science is the bias in the material, curriculum, and strong stereotypes in society that girls are not suitable for STEM (Halpern et al., 2007).

It is important to understand how people rely on scientists and scientists to trust information during the ongoing COVID-19 pandemic (Battiston et al., 2021). In addition, knowing the level of trust in science is essential to enable researchers to explore the relationship between belief and various personal characteristics, such as level of education and involvement in science, and personal worldviews, such as political philosophy or religiosity (Nadelson et al., 2014). Therefore, researchers want to reveal the pre-service teachers' trust in STEM during the COVID-19 pandemic. Analyzing prospective science teachers' trust in STEM and whether or not prospective teachers continue to pursue science work can help is planning the importance of instilling STEM at the college stage.

2 Methodology

This research is included in quantitative research. Quantitative research can be interpreted as research based on the philosophy of positivism, used to examine assured populations or samples, data collection using research instruments, data analysis is quantitative or statistical to test predetermined hypotheses (Sugiono, 2012). The research design used is descriptive. The purposive sampling technique was used to obtain samples from 132 science teacher candidates (23 male and 109 female) in the first year of class 2020 from students of Biology Education, Mathematics Education, and Chemistry Education, Mulawarman University. For this study, the data to be taken is to analyze the level of confidence in STEM during the pandemic COVID-19 and analyze the presence or absence of significant differences based on gender. This questionnaire uses a 5-level Likert scale, namely strongly agree, agree, neutral, disagree, and strongly disagree, with the types of positive and negative questions. The following is the score for each question in the questionnaire given:

Table **1. Scoring System**

Answer	Score	
	Positive	Negative
Strongly Agree	5	1
Agree	4	2
Neutral	3	3
Disagree	2	4
Strongly Disagree	1	5

2.1 Data Analysis Technique

Descriptive analysis used a descriptive analysis of percentages. The first step is to convert the answers into scores. The highest score is 5, and the lowest score is 1. After that, we calculated the average and standard deviation. Next, determine the ideal minimum total score. In this study, the ideal minimum total score is 20 (the minimum score for each item is 1 with the number of items in the questionnaire), while the ideal maximum total score is 100 (the maximum score for each item is 5 with the number of items in the questionnaire). To find out the percentage level of pre-service teachers trust in STEM during the COVID-19 pandemic using descriptive statistical analysis methods, the percentage an obtained by the following formula:

$$\text{score percentage } \% = \frac{\text{total score of respondents}}{\text{the number of ideal answer score}} \text{ x } 100\% \qquad (1)$$

The results of the calculation data with the above formula are then defined by grouping the value intervals and completing them with categories. In this study, five class intervals have has been determined, namely starting from very low, low, medium, high, and very high (Table 2).

Table **2. Class Interval 5 Categories**

Interval	Categories
$X < M - 1{,}5SD$	Very Low
$M - 1{,}5SD < X \leq M - 0{,}5SD$	Low
$M - 0{,}5SD < X \leq M + 0{,}5SD$	Currently
$M + 0{,}5SD < X \leq M + 1{,}5SD$	High
$M + 1{,}5SD < X$	Very High

(Rohman, 2016)

3 Results and Discussion

The number of respondents who have filled out a questionnaire on the trustworthiness of prospective science teacher teachers in STEM during the COVID-19 pandemic is 132, with the number of female respondents being 109 and male respondents being 23. The following is the percentage level of trust of prospective science teachers in STEM during the COVID-19 pandemic.

Table **3. Data Distribution**

Interval	Frequency	Percentage	Category
20-36	6	4%	Very low
37-53	41	31%	Low
54-70	47	35%	Neutral
71-87	29	22%	High
88-104	9	7%	Very high

The results above show that the Science Teacher Candidate Trust Score on STEM during the Covid-19 Pandemic is in the medium category with a percentage of 35%.

To further clarify the results, it is necessary to carry out a Normality test and Homogeneity Test to see normally/not distributed data and have the same/different variance by collecting the results of female and male respondents.

Table **4. Results of Normality Test**

One-Sample Kolmogorov-Smirnov Test		
	Male	Female
N	23	109

Normal Parameters[a,b]	Mean	64.74	62.39
	Std. Deviation	8.874	5.144
Most Extreme Differences	Absolute	.122	.086
	Positive	.059	.084
	Negative	-.122	-.086
Test Statistic		.122	.086
Asymp. Sig. (2-tailed)		.200[c,d]	.044[c]

Based on the results in the output table above, it can show that the data a normally distributed.

Table **5. Results of Homogeneity Test**

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Score	Based on Mean	12.632	1	130	.001
	Based on Median	12.174	1	130	.001
	Based on Median and with adjusted df	12.174	1	108.079	.001
	Based on trimmed mean	12.806	1	130	.000

The table above shows the significant value, which is 0.000, meaning less than 0.05, indicating that the data group has different variances or is not homogeneous. Even though the results show that they are not homogeneous, the independent sample T-Test can still be done.

The following are the results of an unpaired T-Test to see the difference in the level of trust between female respondents and male respondents in STEM during the COVID-19 pandemic.

Table **6. Descriptive Statistics by Gender**

Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
Score	Male	23	64.7391	8.87395	1.85035
	Female	109	62.3945	5.14425	.49273

The results above show in table 5 in the Group Statistics Table, and it is known that the average score for male respondents is 64.7391, and the average score for female respondents is 62.3945.

Table **7. Independent T-Test**

Independent Samples Test		
	Levene's Test for Equality	t-test for Equality of Means

		of Variances								
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Score	Equal variances assumed	12.632	.001	1.720	130	.088	2.34464	1.36354	-.35296	5.04223
	Equal variances not assumed			1.224	25.205	.232	2.34464	1.91483	-1.59740	6.28667

The table above shows that the difference in the level of trust between male respondents and female respondents in STEM during the COVID-19 pandemic is not significant. These results in line with the former result in the scientific literacy in context of Indonesia (Afriana et al., 2016) where the gender factor are not significantly difference**.** However, our results are in contrast from the Switzerland study where the gender differences showed significant results.

This research, which is about exploring Science-Technology-Engineering-Mathematics (STEM) trust in prospective science teachers during the COVID-19 pandemic, found that the trust was in the medium category with a percentage of 35%. This view is important for understanding the extent to which science and scientists are trusted to produce information that can provide certainty and explain the details of highly complex events similar to viral pandemics. (Hunter, 2020). Of course, by demonstrating the need to increase knowledge of the latest issues in STEM for science teacher candidates to develop their confidence in teaching and science learning. It is important to help pre-service teachers to acquire sufficient subject content knowledge in science to create positive attitudes towards science and science teaching (Ngman-wara, 2016). Therefore, building on the current understanding revealed in this survey, it is important to encourage teacher candidates to understand better the nature of integration and explicit relationships among disciplines (Pimthong & Williams, 2020).

4 Conclusions

From the results of this study, it can be concluded that the pre-service teacher's trust in Science-Technology-Engineering-Mathematics (STEM) during the COVID-19 pandemic is overall in the moderate category with a percentage of 35%. The independent T-Test by gender showed there is no significant difference between gender. To increase the trust in the teaching efficacy of pre-service science, lecturer teachers should integrate science content in their methods science courses to increase their knowledge. Research findings indicate a need to increase understanding of the latest issues in STEM for pre-service science teachers to develop their confidence in science teaching and learning.

REFERENCES

Afriana, J., Permanasari, A., & Fitriani, A. (2016). Penerapan project based learning terintegrasi STEM untuk meningkatkan literasi sains siswa ditinjau dari gender. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 202. https://doi.org/10.21831/jipi.v2i2.8561

Battiston, P., Kashyap, R., & Rotondi, V. (2021). Reliance on scientists and experts during an epidemic: Evidence from the COVID-19 outbreak in Italy. *SSM - Population Health*, *13*, 100721. https://doi.org/10.1016/j.ssmph.2020.100721

Candraningrum, D. (2016). Girls in STEM (Science, Technology, Engineering,Mathematics). *Jurnal Perempuan*, *21*(4).

Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2016). Why are some STEM fields more gender balanced than others? *Psychological Bulletin*, *143*(1), 1–35. https://doi.org/10.1037/bul0000052

Critchley, C. R. (2008). Public opinion and trust in scientists: The role of the research context, and the perceived motivation of stem cell researchers. *Public Understanding of Science*, *17*(3), 309–327. https://doi.org/10.1177/0963662506070162

Finson, K. D. (2001). Investigating preservice elementary teachers' selfefficacy relative to self-image as a science teacher. *Journal of Elementary Science Education*, *1*(13), 31–42.

Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbacher, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest, Supplement*, *8*(1), 1–51. https://doi.org/10.1111/j.1529-1006.2007.00032.x

Hunter, D. J. (2020). History in a Crisis: Lessons for Covid-19. *New England Journal of Medicine*, *31*(1), 1969–1973. nejm.org

Koballa, T. R., & Crawley, F. E. (1985). The Influence of Attitude on Science Teaching and Learning. *School Science and Mathematics*, *85*(3), 222–232. https://doi.org/10.1111/j.1949-8594.1985.tb09615.x

Luhmann, N. (1979). Trust and Power. *John Wiley & Sons*.

Miller, K. R. (2008). Only a theory: Evolution and the battle for America's soul. *New Work: Penguin Group*.

Nadelson, L., Jorcyk, C., Yang, D., Jarratt Smith, M., Matson, S., Cornell, K., & Husting, V. (2014). I Just Don't Trust Them: The Development and Validation of an Assessment Instrument to Measure Trust in Science and Scientists. *School Science and Mathematics*, *114*(2), 76–86. https://doi.org/10.1111/ssm.12051

Ngman-wara, E. I. (2016). Pre- Service Basic Science Teachers ' Self -Efficacy Beliefs and Attitudes towards Science Teaching. *International Journal Innovation Education and Reseacrh*, *August*, 20–41.

Pew, R. C. (2019). Trust and mistrust in americans' views of scientific experts. *Technical Report*.

Pimthong, P., & Williams, J. (2020). Preservice teachers' understanding of STEM education. *Kasetsart Journal of Social Sciences*, *41*(2), 289–295. https://doi.org/10.1016/j.kjss.2018.07.017

Preciado B., A. P., Takeuchi, M. A., Yáñez, G. A., Francis, K., Gereluk, D., & Friesen, S. (2016). Pioneering STEM Education for Pre-Service Teachers. *International Journal of*

Engineering Pedagogy (IJEP), *6*(4), 4. https://doi.org/10.3991/ijep.v6i4.5965

Rahm, J., & Charbonneau, P. (1997). Probing stereotypes through students' drawings of scientists. *American Journal of Physics*, *65*(8), 774–778. https://doi.org/10.1119/1.18647

Rifandi, R., Rahmi, Y. L., Widya, & Indrawati, E. S. (2020). Pre-service teachers' perception on science, technology, engineering, and mathematics (stem) education. *Journal of Physics: Conference Series*, *1554*(1). https://doi.org/10.1088/1742-6596/1554/1/012062

Rochman, C., & Pertiwi, C. S. R. (2020). Learning at Covid-19 Pandemic Era: Science Technology Engineering and Mathematic Competencies and Student Character. *SEJ (Science Education Journal)*, *4*(2), 129–142. https://doi.org/10.21070/sej.v4i2.574

Rohman, M. (2016). Kontribusi Status Gizi Terhadap Kemampuan Motorik Kasar Siswa Sekolah Dasar. *Fakultas Ilmu Keolahragaan Universitas Negeri Surabaya*, *4*, 77–84.

Roten, F. C. von. (2004). Gender differences in attitudes toward science in Switzerland. *Public Understanding of Science*, *13*(2), 191–199. https://doi.org/10.1177/0963662504043870

Russell, M. S. & T. (1986). Elementary science as a little added frill: A report of two case studies. *Science Education*, *70*, 519–538.

Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education*, *96*(3), 411–427. https://doi.org/10.1002/sce.21007

Sugiono. (2012). *Metodologi Penelitian Kuantitatif Kualitatif dan R&D*.

Tosun, T. (2000). The Beliefs of Preservice Elementary Teachers Toward Science and Science Teaching. *School Science and Mathematics*, *100*(7), 374–379. https://doi.org/10.1111/j.1949-8594.2000.tb18179.x

Tourney, C. P. (1992). The moral character of mad scientists: A cultural critique of science. *Science, Technology, & Human Values*, *17*, 411–437.

Wallace, J., & Louden, W. (1992). Science teaching and teachers' knowledge: Prospects for reform of primary classroom. *Science Education*, *5*(76), 507–521.

Wyer, M., Schneider, J., Nassar-McMillan, S., & Oliver-Hoyo, M. (2010). Capturing Stereotypes: Developing a Scale to Explore US College Students' Images of Science and Scientists. *International Journal of Gender, Science and Technology*, *2*(3).

Zingg, A., & Siegrist, M. (2012). Measuring people's knowledge about vaccination: Developing a one-dimensional scale. *Vaccine*, *30*(25), 3771–3777. https://doi.org/10.1016/j.vaccine.2012.03.014