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RESEARCH ARTICLE

STEM Applications by Science Pre-Service Teachers (Gen-Z Category) During Online Learning: Rasch Analysis

Syarifa Wahidah Al Idrus[1*], I Wayan Subagia[2], I Wayan Suastra[3], I Nyoman Tika[4]

[1,2,3,4] Chemistry Education Study Program, Ganesha University of Education, Singaraja Bali, Indonesia

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***Corresponding Author:**

syarifaidrus@unram.ac.id

ABSTRACT

This research aims to understand the description of the application of STEM among prospective science teachers in the Gen Z category in science learning during online learning. Data was collected through research and analyzed quantitatively. There were 140 participants who took part in this online survey. STEM implementation was assessed using instruments validated for the Indonesian teacher context. Application of STEM In this research, it is divided into seven categories resulting from combining each STEM components include ST, SE, SM, STE, STM, SEM, STEM), where S, T, E, M refer to Science, Technology, Engineering and Mathematics respectively. Based on Rasch analysis of the majority of prospective teachers who implement STEM teaching integration are at a moderate level. The research results show that; 1) Most GEN-Z pre-service science teacher applications are at a moderate level; 2) Based on the comparison of probability values, the results of the Rasch analysis show that gender has a significant influence on the application of variations in STEM models and there is no significant influence of specialization on the application of STEM in prospective teachers.

INTRODUCTION

STEM is an acronym for Science, Technology, Engineering, Mathematics. The term STEM was first launched by the US National Science Foundation in the 1990s under the name SMET, used as the theme of the education reform movement in the four disciplines (Febri Abadi et al., 2023). The STEM model approach in learning aims to prepare students who are competitive and ready to work according to their fields of expertise. Related to STEM literacy, there are four integrated dimensions to support student competencies in schools, namely science, technology, engineering, and mathematics (Rahma Suwarma & Setiawan, 2023).

STEM education has been applied as the core agenda in many countries in the world. This is form of responses toward the rapid development of technology, for instance Industrial Revolution 4.0. Upon talking about education, children should be given strong understanding about the relationship of science learning with engineering and technology to have a meaningful learning (Elayyan, 2021; Yahya & Hashim, 2021). The importance of implementing STEM education also pivots on the characteristics of students from early childhood education until university students who are generation Z (Gen Z) and alpha generation. Their methods of perceiving knowledge tend to better different from previous generation, strengthening the crucial of integrating technology in learning (Mariaaferrara & Stefanoozaa, n.d.). Apart from that, the issue Global warming and various crucial problems force the government to work extra hard to instill future scientists and engineers (Mohd Zahidi et al., 2021).

Currently, Indonesia does not apply STEM education and its descendents such as STEAM (adding art component), STREAM (including religion specialization). STEM education in Indonesia is just a research topics or certain projects for researchers (Bogusevschi et al., n.d.; Khotimah et al., 2021). However, the application of STEM education will be near future considering the good movement of Indonesian curriculum which can transform quickly based on current trends and condition. Indonesia Ministry of Education (MoE) also tend to improve curriculum to be better through many appropriate policies. The application of STEM education will depend on the teachers because they are the factors who will directly implement STEM curriculum. However, current teachers who are mostly millennials teachers and previous generation, it seems uneasy to apply something new. The hope can be given to the native of technology, Gen Z. They are also popular for othernames such as Google generation, Viral generation, Internet generation etc (Poláková & Klímová, 2019). Their learning characteristics are unsuitability of traditional methods of teaching (Szymkowiak et al., 2021) and it potentially related to their teaching style.

The success of implementing STEM in learning depends on teachers as parties directly involved in the learning process, but the phenomenon that occurs is that teachers still have difficulty accepting a new learning method. The hope is that the STEM method will be easily accepted because teachers are part of the millennial generation (gen-Z), because they are the original technology era generation popularly called the google generation, viral generation, internet generation (Poláková & Klímová, 2019). Therefore, the learning characteristics of the Gen Z generation are no longer in accordance with the classical or traditional learning model (Szymkowiak et al., 2021), so it is hoped that the application of the STEM learning method can be carried out optimally for the Gen Z generation.

Teachers, prepared by the government through the pre-service and in-service teacher professional education (PPG) program. The PPG program is a program from the Ministry of Education, Culture, Research and Technology (Kemendikbud Ristek) for graduates to improve the professionalism of educators. Pre-service PPG is an education program held to prepare professional teachers who come from Education, non-education, and applied graduates. The study load that will be taken by prospective teachers during the pre-service PPG activity is 36 to 40 credits.

Prospective teachers participating in the pre-service PPG program carry out teaching activities through the Field Experience Practice (PPL) program, which is part of the PPG program process stages. PPL is a pre-service teacher professional education program designed to train prospective teachers to become skilled and professional teachers in a complete and integrated manner. Pre-service teachers should apply STEM when carrying out PPL learning, because as the gen-Z generation, this method must be prioritized in teaching and learning activities. The extent to which pre-service teachers choose to use the STEM method in PPL is one thing that needs to be observed, the extent to which pre-service teachers prepare themselves to become official millennial teachers who are ready for STEM-based teaching, so a survey needs to be conducted.

The Rasch method is another name for a parameter called Item Response Theory (IRT), which is widely used to establish validity and reliability by reporting detailed analyses such as unidimensionality, reliability, separation, rating scale calibration, item fit statistics, and differential item function (Boone, 2016). The Rasch measurement model is based on two theorems: 1) A more capable person has a higher probability of correctly answering all the items given. 2) Easier items are more likely to be answered correctly by all respondents or examiners (Fan & Bond, 2015)). The Rasch model has been widely applied in science education studies for instrument validation and data analysis (Jin et al., 2020; Qudratuddarsi et al., 2022; Romine et al., 2015).

Considering the importance of educational programs implemented by implementing the STEM model and the very important role of teachers in the teaching and learning process, a survey was conducted to analyze the application of variations of the STEM model by pre-service science teachers (Gen-Z era) using the Rasch method. To align with this aim, the subsequent research questions were raised:

RQ1: What is the level of STEM application of Gen-Z Pre-Service Science Teachers in the brave learning process during Covid-19?

RQ3: How do Gen-Z Pre-Service Science Teachers' STEM applications differ based on specialization and gender?

METHOD

Study Design

This research is quantitative research with data in the form of numbers which are the results of survey research. In this study, we directly asked participants to fill out a Google form without any intervention (Creswell, 2013; Qudratuddarsi et al., 2022). We use an online Google form as an effect of government regulations to control movement by conducting online education (Sukendro et al., 2020). Although there is a tendency to have a lower response rate, this method is enhanced by direct requests using social media such as WhatsApp from Facebook to obtain more responses from the intended respondents (Zuidgeest et al., 2011).

Sample of Research

The sample was prospective teachers who taught during the Covid-19 pandemic. In universities in Indonesia, prospective teachers are given the opportunity to teach their specialty directly for several months depending on the agreement between the university and school. In this phase, due to the Covid-19 pandemic, they also have to carry out bold learning like schools do in responding to human movement. The total sample was 140 students with details as in Table 1.

Table 1. Classification of 140 respondents based on differences in fields and gender

	Amount	**Percentage**
Areas of specialization		
Science	32	22,86%
Chemistry	52	37,14%
Physics	34	24,28%
Biology	22	15,71%
Gender		
Male	48	34,28%
Female	92	65,71%

The instrument used in this study is an instrument that has been developed by previous researchers (Wahono & Chang, 2019) is an instrument with high validity and reliability (0.92 - 0.96), so it can be used as a measuring tool. The instrument has been widely used in several studies, as in the research of (Parmin et al., 2020; Wahono & Chang, 2019). The instrument used was a questionnaire that measured aspects of the implementation of 7 variations of the STEM learning model.

The seven STEM variation models measured are: 1) the Science-Technology (ST) variation, 2) the Science-Technology (SE) variation, 3) the Science-Mathematics (SM) variation , 4) the Science-Technology-Mathematics (STM) variation, 5) the Science-Technology-Engineering (STE) variation, 6) the Science-Engineering-Mathematics (SEM) variation, and 7) the Science-Technology-Engineering-Mathematics (STEM) variation. The application of the STEM variation model is measured by looking at several analysis indicators, namely: 1) analysis based on statistical fit items; 2) analysis based on individual logit values; 3) analysis based on person logit values; 4) analysis based on gender differences; 5) analysis based on science field specialization.

Data analysis

Data were analyzed using the Rasch model. Rasch Model is a modern appraisal theory can classify item calculations and person in a distribution map (Abdullah et al., n.d.). The main analysis includes reliability & separation statistics and Item Fit Statistics.

Reliability and Separation

Reliability is the degree to which an instrument consistently give a similar result among numerous administration (Fraenkel & Wallen, 2009; Shultz, Whitney, & Zickar, 2014).To measure reliability, this study applied Cronbach's alpha internal consistency to elicit the correlation between a score of an individual item in the test and the total gained score for all items (Chua, 2013). Other measures to report reliability are item and person reliability, person reliability elicits the stability of student responses in each instrument, while item reliability elicits the stability of item score (Sumintono & Widhiarso, 2015). The minimum score for each reliability (Cronbach alpha, item and person) is 0.65 (Adams, Chuah, Sumintono, & Mohamed, 2021; DeVellis, 2012), and this study found reliability in the range of 0.92-0.96, delineating an excellent score. Another result to consider is separation either item or person which should be more than 1.5 to be considered acceptable (Suryadi, Hayat, Dwirifqi, & Putra, 2021; Tennant & Conaghan, 2007). Separation of STEM applications in the context of pre-service science teachers during pandemic teaching for both item and person is 3.78 and 3.45 respectively. The result indicates the ability of instruments to distinguish item and respondents into some acceptable groups (Iseppi et al., 2021).

Table 2. Reliability and Separation

	Amount	Percentage
Areas of specialization		
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Chemistry	52	37,14%
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Gender		
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RESULT AND DISCUSSION

RESULT

This research uses the Rasch model to determine the level of STEM application of Gen-Z Pre-service Science Teachers during online learning and differences in Pre-service Science Teachers' STEM application based on specialization and gender.

Item Fit Statistics

As the proof of construct validation, mean square (MNSQ): 0.5 <MNSQ <1,5 (b) the value of tolerated infit and outfit Z- Standard (ZSTD): -2.0 <ZSTD <+2,0 (c) the value of accepted Correlation Points (Pt Mean Corr) must be positive value (Boonee· et al., n.d.; Sadhu et al., 2019). This analysis is very crucial as the strength of Rasch model compared to the analysis using Classical Test Theory (CTT) (Hidayat et al., 2021). This study found that each item fulfilled the criteria well, indicating the instrument in fit Rasch measurement model very well. Even there are some items violate the acceptable score, they are never in the same items all together.

Table 3. Item fit statistics of STEM application instrument

Item	MNSQ	in fit	ZSTD	Outfit	Point Mea Corr
ST	1,32	1,41	2,42	2,4	0,56
SE	1,17	1,33	9,2	2,1	0,60
SM	0,88	0,83	-1	-1.23	0,68
STE	0,83	1,94	-1,5	0.6	0,73
STM	1,06	1,02	0,5	0,16	0,68
SEM	1,91	0,89	-0,8	-0,97	0,75
STEM	0,76	0,79	-2,15	-1.8	0,74

STEM Application based on item logit value

The next analysis is to determine the level of pre-service teacher ability, so that each individual's ability to apply the STEM learning model in several variations can be known through individual logit data. High logit values indicate that the pre-service teacher's ability to apply STEM is high. The results of the Rasch analysis for this individual logit value can be seen from the Wright map shown in Figure 1.

In this Wright map, the left side is item, while the right side is person map. This map is visualization of relationship of person and item in a single line (Abdullah, Noranee, & Khamis, 2017; W.J Boone et al., 2014). From the wright map, we can see that items are in the range of -1 to +1 logit value, while person spread widely from -3 to +6 logit value. Majority of person are in the range of -0.5 to +3, indicating that they have higher average score compared to average of item logit value.

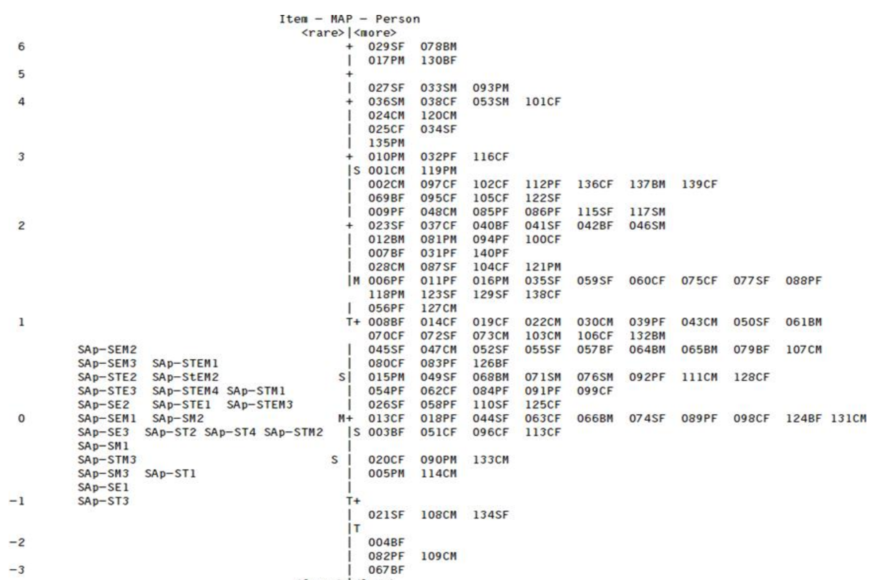

Figure 1. Wright Person's Map on STEM Implementation

Addressing the first research question

The first research question of this study examined the level of STEM implementation in the classroom by pre-service science teachers. the first question was answered using the Winstep 3.73 Rasch model on person logit value, STEM application category, was used into low (LVP ≤0.7), medium

(0.7<LVP<3.71) and high (LVP≥3.71). The category is based on person separation and the division by considering their range of logit values of person (LVP). Table 4 displays categories of STEM implementation in the classroom by pre-service science teachers.

Table 4. Rasch Analysis result for STEM Applications Based on LPV values

	Low (LVP ≤0,7)	Medium (0,7< LVP <3,71)	High (LVP≥3.71)
Whole	44 (31,4%)	85 (60,7%)	11 (7,9%)
Based on Gender			
Male	13	29	6
Female	31	56	5
Based on specialization			
Biology	7	13	2
Chemistry	17	33	2
Physics	11	21	2
Sciences	9	18	5

As shown in Table 4 above, most pre-service teachers (n=85 participants) are in moderate level of STEM application. In details, they are 44 participants (31.43%) in low category, 85 participants (60.71%) in moderate category and 11 participants (7.86%) in high category. The trend is closely similar when considering gender and specialization where most of participants are

categorized in moderate level, the second one is low level, and the least one is high level of STEM application.

Addressing the second research question

The study's second research question examined whether How do Gen-Z Pre-Service Science Teachers' STEM applications differ based on specialization and gender. the second question was answered using the Winstep 3.73 Rasch model on person logit item. With regard to item logit, we also consider average and standard deviation of each sub domain in STEM application as detailed can be seen in Table 5.

Table 5. Mean and Standard Deviation of STEM Applications

Variable Name	Mean (M)	Standard Deviasion (SD)
ST variation model	-0,515	-0,310
SE variation model	0,364	0,538
SM variation model	-0,303	0,317
STE variation model	0,286	0,155
STM variation model	-0,087	0,450
SEM variation model	0,533	0,410
STEM variation model	0,270	0,425

From the table, it is known that the hardest domain is SEM (M=0.533. SD=0.410), higher than STEM with 4 combination of specialization (M=0.270, SD=0.425). The results show how much Gen Z depends on technology, and the least domain is Science-Technology (M=-0.515, SD=-0.310), showing that pre-service science teachers can integrate technology better than integrating other specialization. Differences in the application of STEM are also seen based on gender and specialization

Based on Gender

Gender is an important factor in most social science research. In this research, comparison The implementation of STEM by gender was carefully analyzed using the Rasch model with Winstep version 3.73. Based on the analysis, it is found that gender do not influence STEM application in all items and all sub domain. It implies that Gen-Z can integrate Mathematics, Engineering and Technology in their online science teaching regardless their gender.

Table 6. Comparison of average probability of STEM application based on gender differences

STEM Model Variations	Male (M)	Female (F)	Average of Prob.	Significancy Standard	Significancy
ST	-0,6	-0,47	-0,12	<0,05	Significant
SE	-0,4	-0,3	-0,1		Significant
SM	-0,3	-0,37	-0,06		Significant
STE	0,4	0,27	0,13		Non-Significant
STM	-0,17	-0,03	-0,13		Significant
SEM	0,5	0,3	-0,2		Non-Significant
STEM	0,47	0,4	0,07		Non-Significant

As shown in Table 6 above, the comparison of probability values, the results of the Rasch analysis show that the influence of gender on the application of variations in the STEM model is: 1) significantly different in the ST, SE, SM, and STM models; 2) not significantly different in the STE, SEM, and STEM models.

Based on Specialization

Comparison of the application of variations in the STEM model based on differences in the fields of knowledge of pre-service teachers with the generation Z category was analyzed carefully by considering the Welch, Mantel Haenzel, and Chi-Square values. The specialty of pre-service science teachers in question is: pre-service teachers in the fields of Chemistry, Biology, Physics and Science. The results of the analysis are shown in Tables 7 to 12, with the probability value (Prob.) considered influential if it is less than 0.05.

Table 7. Comparison of average probability values in STEM implementation based on differences in specialization between Biology and Chemistry teachers

STEM Model Variations	Biology	Chemistry	Average of Prob.	Significancy Standard	Significancy
ST	-0,55	-0,72	0,17	<0,05	Non-Significant
SE	0,1	-0,3	0,4		Non-Significant
SM	-0,05	-0,27	0,22		Non-Significant
STE	0,02	0,43	-0,41		Significant
STM	0,13	-0,03	0,16		Non-Significant
SEM	0,43	0,55	-0,12		Significant
STEM	0,46	0,4	0,06		Non-Significant

Based on the average probability value in Table 7, the application of STEM between biology and chemistry teachers shows differences in the STE and SEM variation models. This can be seen, if the Average of Probability value is smaller than 0,05.

Table 8. Comparison of average probability of STEM implementation based on specialization differences between Biology and Physics teachers

STEM Model Variations	Biology	Physics	Average of Prob.	Significancy Standard	Significancy
ST	-0,55	-0,35	-0,2	<0,05	Significant
SE	0,1	-1,1	1,2		Non-Significant
SM	-0,05	-0,7	0,65		Non-Significant
STE	0,02	0,27	-0,25		Significant

STM	0,13	-0,17	0,3		Non-Significant
SEM	0,43	0,58	-0,15		Significant
STEM	0,46	0,49	-0,03		Significant

Based on Table 8, The average probability value, which shows the difference in the application of STEM between biology teachers and physics teachers, is seen in the application of the ST, STE, SEM, and STEM variation models.

Table 9. Comparison of average probability of STEM implementation based on specialization differences between Biology and Science teachers

STEM model Variations	Biology	Sciences	Average of Prob.	Significancy Standard	Significancy
ST	-0,55	-0,38	-0,17	<0,05	Significant
SE	0,1	-0,33	0,43		Non-Significant
SM	-0,05	-0,25	0,2		Non-Significant
STE	0,02	0,15	-0,13		Significant
STM	0,13	-0,18	0,31		Non-Significant
SEM	0,43	0,55	-0,12		Significant
STEM	0,46	0,36	0,1		Non-Significant

Based on Table 9, the application of the STEM model by biology teachers and science teachers has a significantly different average probability for variations of the ST, STE and SEM models. Of the three, the lowest average probability is found in the ST and STE models, so that prospective biology teachers and prospective science teachers differ in the application of engineering and technology aspects.

Table 10. Comparison of average probability of STEM implementation based on differences in specialization between Chemistry and Physics teachers

STEM Model Variations	Chemistry	Physics	Average of Prob.	Significancy Standard	Significancy
ST	-0,72	-0,35	-0,37	<0,05	Significant
SE	-0,3	-1,1	0,8		Non-Significant
SM	-0,27	-0,7	0,43		Non-Significant
STE	0,43	0,27	0,16		Non-Significant
STM	-0,03	-0,17	0,14		Non-Significant
SEM	0,55	0,58	-0,03		Significant
STEM	0,4	0,49	-0,09		Significant

Based on Table 10, The difference in the application of STEM by chemistry teachers and physics teachers is found in the ST, SEM, and STEM variation models, with the smallest average probability comparison in the ST models. This shows that the ability of chemistry teachers and physics teachers in applying STEM is more in the integration of technological aspects

Table 11. Comparison of average probability of STEM implementation based on differences in specialization between Chemistry and Mathematics teachers

STEM Model Variations	Chemistry	Physics	Average of Prob.	Significancy Standard	Significancy
ST	-0,72	-0,38	-0,34	<0,05	Significant
SE	-0,3	-0,33	0,03		Significant
SM	-0,27	-0,25	-0,02		Significant
STE	0,43	0,15	0,28		Non-Significant

STM	-0,03	-0,18	0,15		Non-Significant
SEM	0,55	0,55	0		Non-Significant
STEM	0,4	0,36	0,04		Significant

Based on Table 11, the smallest average probability is found in the ST and STEM model variations, which shows that the differences in the results of applying STEM by chemistry and science pre-service teachers are influenced by aspects of engineering, technology and mathematics. Teachers apply technology according to the facilities available at the school, because the integration of technology and techniques still depends on the tools and type of technology, resources, budget issues, curriculum and guidelines.

Table 12. Comparison of average probability of STEM implementation based on specialization differences between Physics and Mathematics teachers

STEM Model Variations	Physics	Sciences	Average of Prob.	Significancy Standard	Significancy
ST	-0,35	-0,38	0,03		Significant
SE	-1,1	-0,33	-0,77		Significant
SM	-0,7	-0,25	-0,45		Significant
STE	0,27	0,15	0,12	<0,05	Non-Significant
STM	-0,17	-0,18	0,01		Significant
SEM	0,58	0,55	0,03		Significant
STEM	0,49	0,36	0,13		Non-Significant

Based on Table 12, The smallest average probability is found in the SE and SEM model variations, indicating that the difference in STEM implementation results is in the application of the mathematics aspect.

DISCUSSION

The main objective of this study was to identify the level of STEM implementation by pre-service science teachers and differences in STEM implementation between pre-service science teachers. The findings of this research provide the view that gender influences the application of several variations of STEM model. few comprehensive educational and vocational studies have been conducted on the gender gap in STEM fields in many countries (“Advancing Culture of Living with Landslides,” 2017; Ganley et al., 2018; Thurlings et al., 2014; Wang & Degol, 2013)). Teacher specialization also influences differences in STEM implementation.

The level of STEM application of Gen-Z Pre-Service Science Teachers in the online learning process

The research results showed that the majority of prospective teachers (n=85 participants) were at a moderate level of STEM application. In detail, there were 44 participants in the low category (31.43%), 85 participants in the medium category (60.71%), and 11 participants in the high category (7.86%). These trends are almost similar when considering gender and specialty to which most participants belong categorized into medium level, the second is low level, and the lowest is high level STEM applications.

Most pre-service science teachers have implemented STEM in the learning process, and some have not implemented STEM. Currently, there is no interdisciplinary interaction in the curriculum and class hours and the programs are not flexible and results-oriented (Akgündüz et al., n.d.). However, the government made changes to the curriculum in the inherent structure, the importance of individual differences, values and skills rather than simply imparting knowledge to educate individuals with 21st century skills. (Ministry of National Education, 2018a, 2018b). Curriculum integration between scientific disciplines It is very important in order to provide students with skills according to their abilities. many developed countries have used STEM in their education systems and these countries have obtained PISA and TIMSS results high.

Analysis of the Influence of Gender Differences on the Application of STEM Model Variations

Gender is a factor that has a significant influence in most social science research. In this study, comparing the application of the STEM variation model based on gender has been carried out and analyzed carefully by considering the values of Welch, Mantel Haenzel, and Chi-Square. The comparison of the probability values obtained must be lower than 0.05 to be considered that gender has a significantly different influence (Gocen & Sen, 2021; Rouquette et al., 2019).

Based on the comparison of probability values, the results of the Rasch analysis show that the influence of gender on the application of STEM model variations is: 1) significantly different in the ST, SE, SM, and STM models; 2) not significantly different in the STE, SEM, and STEM models. These significant differences are complex problems caused by many factors and require several approaches to overcome them (Cheryan et al., 2016))

This shows that prospective pre-service science teachers from the Gen-Z generation can integrate Technology, Engineering, and Mathematics in science learning (online). However, the highest ability in its application is dominated by male teachers (in 5 variations of STEM the probability is lower) (on the Table 6). There are cultural stereotypes that depict STEM as a male-dominated, white-skinned field ((Tan et al., 2013). Our research results are in line with previous findings showing that male students have higher STEM efficacy than female students (W. C. Mau & Bikos, 2000; W. C. J. Mau & Li, 2018).

The Influence of Differences in Science Specialization on the Implementation of Variations in STEM Models

The application of variations of the STEM model to pre-service science teachers in the Gen-Z category is generally not influenced by specialization. However, several items showed significant differences. Statement in the ST variation "I use ready-made technological tools (not artificial own)", between biology and science teachers shows a significant difference. The next difference is the STE variation with the statement "in one semester I make my own learning media." Most pre-service teachers use existing technological tools without needing to develop their own. Pre-service science teachers experience difficulties in developing science learning media and do not have much time to develop media technology-based learning (Irnin, et al., 2023). The final difference in the STM variation.

Of the three, the lowest average probability is in the ST and STE models, so that prospective biology teachers and prospective science teachers differ in the application of engineering and technology aspects. One of the factors that influences the difference in probability results is the lack of mastery of STEM content and pedagogical knowledge of teachers(Sharma & Yarlagadda, 2018a; Stohlmann et al., 2012a; To Khuyen et al., 2020). Therefore, strengthening teacher capacity in implementing the STEM model is very necessary (Sharma & Yarlagadda, 2018b); (Stohlmann et al., 2012b).

Application of STM variations with the statement "In class I usually use technological tools to analyze observational data mathematically (for example: using a calculator, computers, cell phones, etc.)" shows that there are differences between pre-service Chemistry and Physics teachers, Chemistry-Biology pre-service teachers and Physics-Science pre-service teachers. Teachers apply technology according to the facilities available at the school, because the integration of technology and techniques still depends on the tools and type of technology, resources, budget issues, curriculum and guidelines. The level of integration of the STEM model is greatly influenced by the availability of tools, the training the teacher has received, and the teacher's ability to implement technology integration in a disciplined manner with appropriate pedagogy (Kumar & Daniel, 2016).

However, the fact that occurs in many schools today is that the application of STEM is only used as a substitute for one of the four fields, especially science and mathematics (Breiner et al., n.d.), so that the STEM model is expected to help strengthen scientific disciplines (multidisciplinary integrated STEM, interdisciplinary, and transdisciplinary) (Peterman et al., 2017).

CONCLUSION

This research investigates the application of STEM by prospective teachers and differences in application of STEM based on gender and specialization. This research produces: first, based on the person logit value, the use of SEM model variations (by pre-service teacher candidates) is in the 'medium' category. Second, based on the comparison of probability values, the results of the Rasch analysis show that the influence of gender on the application of STEM model variations. These significant differences are complex problems caused by many factors and require several approaches to overcome them. And there is no significant effect of specialization on the application of STEM by pre-service science teachers.

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