The Moderating Model of Teaching Anxiety on Teaching Beliefs and TPACK Effect to ICT Literacy Among Pre-Service Mathematics Teachers

Wanda Nugroho Yanuarto[1], Siti Mistima Maat[2], Eka Setyanigsih[1], Muhammad Galang Isnawan[3], Mohamad Ikram Zakaria[4]

[1]Mathematics Education Department of Universitas Muhammadiyah Purwokerto, Indonesia

[2]Mathematics Education Department of Universiti Kebangsaan Malaysia, Malaysia

[3]Mathematics Education Department of the Universitas Nahdlatul Wathan Mataram, Indonesia

[4]School of Education of the Universiti Teknologi Malaysia, Malaysia

wandanugrohoyanuarto@ump.ac.id, sitimistima@ukm.edu.my, ekasetyaning13@gmail.com, galangisna19@gmail.com, mohamad.ikram@utm.my

Abstract: Research on teaching anxiety has increased dramatically during the previous two decades. Teachers who experience significant anxiety in the classroom are also more likely to lack confidence in their abilities. How teachers evaluate their pedagogical abilities in areas like TPACK and ICT literacy may potentially play a role in the development of teaching anxiety. We have 458 pre-service teachers in Indonesia and Malaysia who are immersed in a specific training program. To choose our samples, we relied on a criteria sampling strategy. Structural equation modeling (SEM) is a powerful statistical analysis method for theory creation because it allows researchers to test ideas about connections between observable and latent variables while also analyzing those associations. The result of the study state that pre-service teachers' levels of ICT literacy is influenced by the beliefs teachers hold about the relationship between TPACK and ICT literacy, as revealed by the structural equation model designed to examine this relationship. The author agrees that more research is always needed in this field but believes that the results of this study could be valuable to other researchers interested in beginning new studies or expanding existing studies linked to the ICT literacy paradigm.

Keywords: ICT Literacy, structural equation model, teacher's beliefs, TPACK, teaching anxiety

INTRODUCTION

Over the past 20 years, more and more study has been done on occupational anxiety in teaching. This reflects a growing interest in the topic worldwide (e.g., Bringula et al., 2021; Lea, 2019). Connie (2020) shows that 60% and 70% of teachers experience anxiety, and 30% feel burned out. Also, Agus and Mastika (2018) say that teachers have one of the highest amounts of anxiety at work compared to other jobs. There is proof that teacher anxiety has adverse effects on teachers' mental health (Matoti & Lekhu, 2016), teachers' beliefs (Uysal & Dede, 2016), and student's academic performance (Omar et al., 2020). This has led to what some call a "teacher exodus" across the country (Fisher, 2019). It has been noticed that teachers who feel much anxiety in the classroom also tend to have less belief in their skills (Uysal & Dede, 2016).

Teaching anxiety has also been linked to how they see their skills in the classroom (Bringula et al., 2021), what they think about their abilities (Novak & Tassell, 2017), and how they feel about mathematics (Ramirez et al., 2018). Ersozlu (2019) examined the link between teaching anxiety and epistemological views among future teachers. In the same study, anxiety about content knowledge, attitude towards mathematics teaching, and pedagogical content knowledge were all found to be negatively correlated with constructivist beliefs, which are part of beliefs about mathematics teaching and learning. Anxiety about self-confidence was also negatively correlated with constructivist beliefs, but only at a low level. Wilson (2018), also did a similar study with mathematics teachers. Still, there are studies on different methods that could help with mathematics teaching anxiety and typical methods tend not to work (Connie, 2020; Omar et al., 2020).

Also, Eickelmann and Vennemann (2017) say that the greater use of technology in mathematics education over the past two decades has likely led to a decrease in teachers' anxiety about teaching mathematics. If this is true, then the goal of Barry (2017) and Bouzid et al. (2021) has been met. Technological Pedagogical Content Knowledge (TPACK) is one type of technology skill that teachers should have. Still, there aren't many studies on how TPACK and mathematics anxiety are related in real life. More study must give us a fuller picture of what's happening here. Experiments mentioned in the research on TPACK and anxiety have shown that worry about teaching mathematics goes down. Exercises based on WebQuest (Nejem & Muhanna, 2018) and GeoGebra (Eickelmann & Vennemann, 2017) have been found to make teaching mathematics less stressful. But there isn't much study on how technology affects mathematics anxiety in the classroom. Nisfah and Purwaningsih (2018) looked at how TPACK competencies and teachers' feelings about using technology in the classroom connect to mathematics teaching anxiety. In addition, mathematics teachers who used technology to help them with their work said they felt less stressed. Prestridge (2018) meta-analysis showed that using technology to teach mathematics made teachers less worried about mathematics. Also, learning experiences made with GeoGebra (Velázquez & Méndez, 2021) and content-based and technology-supported projects (Nejem & Muhanna, 2018) helped teachers feel less afraid of mathematics. Lastly, there have been no studies done that look into the link between TPACK and mathematics anxiety.

Naziri et al. (2019) argue that much work must be done to fully understand how students' technology pedagogical and subject knowledge, along with some information, communication, and technology (ICT) literacy, could affect how teachers teach. So, many programs that train teachers for the classroom include ICT literacy in their course modules or have separate units on how to use these tools to teach. While there has been more focus on digital problem-solving skills in society (Hatlevik & Arnseth, 2018), there has been more interest in how ICT can be used in educational settings. Because of this, mathematics teachers need to have a firm grasp of how to use ICT in the classroom and evaluate their students' progress in mathematics while using ICT themselves (Gurcay et al., 2018). Peters-burton (2019) says that teachers' knowledge, views, and attitudes have much to do with how well ICT is used and integrated with the classroom.

This study examined how teachers' anxiety is affected by how teacher training programs use ICT literacy to help teachers feel less anxious about teaching. On the other hand, few studies show how these three things are related, and teaching anxiety is a variable that can't be ignored in the relationship between TPACK and teachers' views about ICT literacy. So, this study aimed to examine how mathematics teaching anxiety works as a bridge between TPACK and teachers' beliefs. Then, there's the linked concept of how ready mathematics teachers are for ICT literacy. So, this study aimed to determine how mathematics anxiety affects the relationship between TPACK and teachers' views about ICT literacy. The researchers used structural equation modeling (SEM) because it can account for measurement errors and show both direct and indirect links between factors, which regression analysis can't do. An evaluation of preservice teachers in this area will likely add to the body of knowledge because these three factors significantly affect how students learn.

LITERATURE REVIEW

Teaching Anxiety

Several widely used strategies for teaching arithmetic have been connected to elevated stress levels among teachers. The teacher's aptitude or knowledge of the issue, the teacher's attitude toward the topic, the teacher's reaction to queries or clarification requests from students, and the teacher's public humiliation in front of the class are all factors. But when it comes to teacher stress, Bouzid et al. (2021) zero attention to the teachers' subjective experiences in the classroom, including how they feel, how they are evaluated, and where they choose to pursue their education. This indicates that their performance in the mathematics lesson reflects the teacher's anxiety about the topic. Potential classroom anxiety causes include a lack of self-assurance, tiredness from teaching, and concern about the student's learning ability. Students' self-efficacy, grade anxiety, future, in-class, and assignment factors are also used as indicators of anxiety and attitude in the mathematics classroom (Ersozlu, 2019).

Teacher's Beliefs

Teachers have strong opinions about the nature of the knowledge (Prestridge, 2018), what makes for good teaching, and how students should be trained (Ellerani & Gentile, 2018). To characterize these convictions, however, much more theoretical work is needed (Berger et al., 2018). According to Masibo and Barasa (2017), there are three distinct approaches to teaching mathematics: techniques that emphasize the students, methods that prioritize the transfer of knowledge, and methods that stress student performance. Teachers with a learner-centered vision see mathematics instruction as a group effort to build knowledge. In mathematics education, there are two primary schools of thought: those that emphasize conceptual understanding and those that emphasize the development of procedural fluency. Several authors contrast teachers who focus on school subjects and teachers who focus on student growth (Han et al., 2017).

TPACK

TPACK is the intersection of three types of expertise: technological, instructional, and subject matter. From this intersection, discussions expanding to include the overlap of PCK, TPK, and TPK were often launched (Koehler et al., 2014). A more recent moniker for TPCK is TPACK, which stands for the "whole package" of skills needed to effectively incorporate digital tools into mathematics education for both the teaching and learning (Suharyati et al., 2022). As a result, the relevance of the relationship between these concepts is being more widely acknowledged. Because of the ever-changing nature of technology, students, teachers, and classroom contexts, it is crucial that teachers have a flexible framework for understanding the knowledge teachers need to design curriculum and instruction that focuses on preparing students for mathematical thinking and learning with digital technologies (Sunman, 2022).

ICT Literacy

Researchers Hatlevik and Arnseth (2018) found a correlation between a person's computer literacy and ICT literacy (also known as computer fluency, computer competence, cyber literacy, digital literacy, or electronic literacy). This electronic, digital, or ICT literacy encompasses many skills, including reading, writing, exchanging information, and communicating. ICT literacy has been connected to the ability to use various software programs, including those used for word processing, spreadsheets, and presentations. These ideas allow us to evaluate teachers' familiarity with digital and computer technologies. The original "ICT literacy" concept heavily emphasized knowing and understanding the basics of utilizing a computer (Novita & Herman, 2021). Common computer hardware knowledge, program fluency, the ability to articulate one's computing preferences, and skill with application management are all indicators of a user's computer literacy level.

METHOD

Research Design

This study set out to answer the question, "How do teaching anxiety, teacher beliefs, TPACK skills, and ICT literacy all relate to one another?" Anxiety about the classroom was thought to influence the relationship between teachers' ICT literacy and their TPACK attitudes and practices. Hence, the researchers employed a causal survey approach to determine a possible relationship between variables. This method works within a cause-and-effect framework (Kline, 2017) to determine how various elements interact. By simultaneously testing hypotheses about correlations between observable and latent variables and analyzing those relationships, structural equation modeling (SEM) provides a potent statistical analysis tool for the theory development (Byrne, 2019). Also, SEM can be utilized to obtain more believable results because it calculates linear relations between variables more correctly than regression and path analysis (Bauldry, 2019). The resulting study plan is shown in Figure 1.

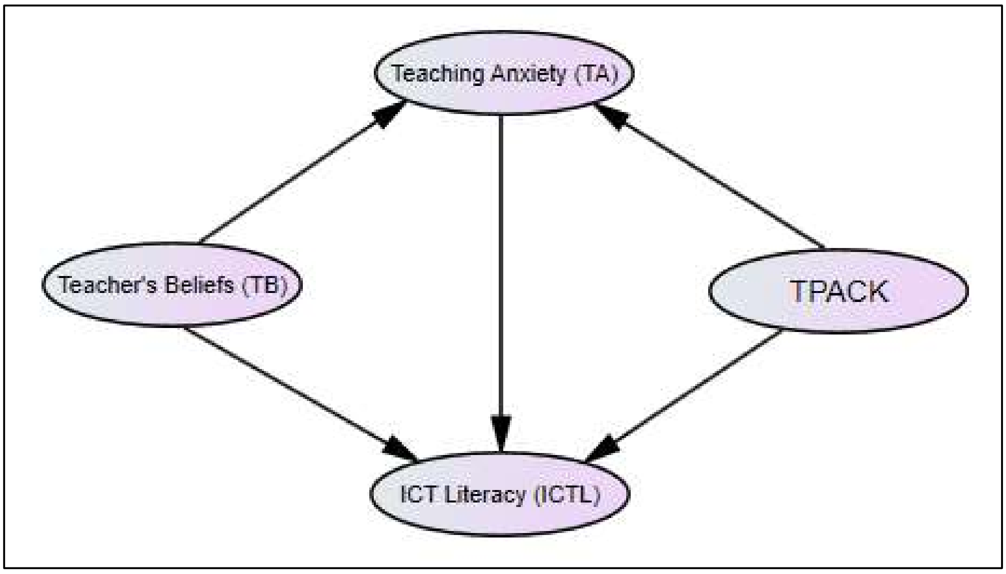

Figure 1: Model of Study

Meanwhile, these are the seven hypotheses that will guide this research: H1: Teachers' beliefs in their ability to use ICT literacy effectively; The use of ICTs is associated with TPACK, as stated in H2; Hypothesis 3: Teaching anxiety in the Classroom Reduces ICT Literacy. H4: Teacher views are inversely connected to anxiety when teaching; H5: Teacher TPACK is inversely associated with anxiety. Two hypotheses are tested here: H6: teaching anxiety moderates the connection between teachers' beliefs and ICT literacy; and H7: teaching anxiety moderates the connection between teachers' TPACK and ICT literacy.

Participants

To assess hypothesized correlations when there is even a slight measurement error, using the standard error of the mean necessitates a sample size greater than N (Kline, 2017). As a result, in Indonesia and Malaysia, 458 pre-service teachers are concentrating on a program tailored to the four categories (grade, gender, locations, and the use of technology per day). We used a criteria sampling method to pick our samples. Pre-service mathematics teachers must have completed coursework in analysis, geometry, algebra, statistics, probability, and computer-assisted mathematics education. Because the study took place towards the end of the 2020-2021 school year, participants could sign up for TPACK competencies and field courses. Table 1 shows a breakdown of the participants by four categories.

Category	Sub-category	Total	Percentage (%)
Grade	Third	48	10.48
	Fifth	131	28.60
	Seventh	279	60.92
Gender	Male	248	54.15
	Female	210	48.85
Location	Urban	292	63.80
	Sub-urban	166	36.24
The use of technology per day	< 3 hours	28	6.11
	3 – 5 hours	242	52.84
	> 5 hours	188	41.05

Table 1: The Participants of the Study

Data instruments

Mathematics Teaching Anxiety Rating Scale

Michael (2018)-created a scale that aspiring mathematics and elementary school teachers can use to assess their anxiety levels about teaching mathematics. The 23-item scale is divided into four categories, and respondents were given the option of selecting a response between 1 (strongly agree) and 5 (strongly disagree) on a Likert scale. Anxiety in the classroom can be broken down into two categories: mathematics teaching anxiety (KsM) and pedagogical content knowledge anxiety (KsP). Bayat (2018), reported a Cronbach's Alpha for this scale of 0.91; the current study confirmed that value, locating it at 0.90. The maximum possible score is 115, while the minimum is 23. The score reflects the degree to which a potential teacher is anxious about leading a mathematics lesson. The first ten items are listed in the wrong sequence. Exploratory factor analysis of the scale's validity reveals that the factor loadings for the 23 items range from 0.528 to 0.857, explaining 56.5% of the total variance.

Technological Pedagogical Content Knowledge Scale

To evaluate the TPACK skills of aspiring mathematics teachers, Valtonen et al. (2019) created a scale. There are nine groups, each including five items (5 = I am thoroughly competent, 1 = I am entirely inept) from the 5-point Likert scale. Examples include TK ("technological"), CK ("Content"), PK ("pedagogical"), PCK ("pedagogical content"), TCK ("technological content"), TPK ("technological pedagogical content"), TPCK ("technological pedagogical content knowledge"), and so on (for "technological pedagogical content"). For this study, researchers employed both online and offline TPK and evaluated the results using eight criteria. Scores range from a high of 295 down to a low of 59. No items on the scale have inverse-coded counterparts. Higher exam scores indicate more TPACK competence amongst preservice teachers. The present study confirmed the 0.97 value reported by Fitri (2019) for the Cronbach's Alpha of this scale.

Factor loadings for the 59 items on the scale ranged from 0.495 to 0.797, explaining 66.2% of the total variance, as shown by exploratory factor analysis of the scale's validity.

Teaching Beliefs Scale

Both the treatment and control groups filled out the Teaching Beliefs questionnaires in person. There are three components to the TB scale: the belief in mathematics (KpSM), the belief in teaching and learning (KpPM), and the belief in the use of technology (KpPT) (Connie, 2020). The survey includes 55 questions. Each respondent saw the same set of questions in the same order since the random number generator chose them. After recalibrating the scale using the information from both surveys, only 21 of the original 55 questions made it into the final survey.

ICT Literacy Scale

As the prevalence of ICT and digital technologies grows, Markauskaite (2019), presented a model based in part on the language competency model given by Hatlevik and Arnseth (2018). Current definitions of digital literacy stress a wide range of language skills, including procedural competence (LiPP), social-digital competence (LiES), digital discourse competence (LiPO), and strategic competence (LiPK). Many dimensions of digital competency are essential for efficient "diagnosis, analysis, and repair of learners' digital requirements" (Abdulteeef & Khateeb, 2017).

Data Collection

The pre-service teachers were initially briefed on the study's goals. Due to the technical issues regarding the two countries participants, 458 willing individuals took the tests online using Google Forms. Standard method bias can be avoided by collecting data from many sources or by collecting data on the dependent, independent, and moderator variables at intervals apart from one another (Hollweck, 2016). All three scales were completed by the same people, who received them one week apart. Each scale took the pre-service teachers five days to complete. The respondents took their time completing the questionnaires. We couldn't include 32 scale forms since they were either randomly filled out or extreme outliers.

Data Analysis

Path analyses were run on the model's measurement and structural components to determine whether AMOS fit the data well. SEM model fits were evaluated using several different metrics, including the chi-square to the degree of freedom (Chi-square/df) ratio, *root mean square error of approximation* (RMSEA), *standardized root mean square residual* (SRMR), *normed fit index* (NFI), *non-normed fit index* (TLI), and *comparative fit index* (CFI) (Harahap et al., 2020). The difference test was run after each round of error binding, and appropriate indices and chi-square significance were evaluated between the old and new models. ICT Literacy was tested as a dependent variable, and TPACK and Teachers' Beliefs are independent variables via the moderator variable of mathematics anxiety. There are three prerequisites for conducting a moderator analysis (Syafiq et al., 2022).

First, the independent and dependent variables must have a strong and direct relationship. Second, the independent and moderator variables should be related by linear regression. Lastly, when the effect of the moderator variable is removed, the link between the dependent and independent variables should weaken (absolute value) to demonstrate the moderating role in the moderator model. Field Bauldry (2019) states that the moderator variable may entirely or partially explain the underlying link between dependent and independent variables. When the moderator explains the entire relationship, it is termed the full moderator. When the moderating variable is included in an analysis of a full moderator, the relationship between the dependent and independent variables weakens and becomes statistically insignificant. Partial moderator occurs when the link between the dependent and independent variables is too complex for the moderator variable to capture fully. There is still a substantial association between the dependent and independent variables, but the effect coefficient and degree of significance have decreased. Following the advice of Preacher and Hayes, we conducted a bias-corrected bootstrapping approach using AMOS to examine the potential impact of Teacher Beliefs, ICT literacy, and TPACK competence on mathematics teaching anxiety. The confidence interval was secured by increasing the sample size to 5.000. For Bootstrap assessments of moderator effects to be valid, the 95% confidence interval must contain at least one value that is not zero (Kline, 2017).

The Bootstrapping for Moderated Model

To estimate a population parameter, statisticians use "bootstrapping," which involves drawing and replacing samples from the population many times. Estimating a parameter directly from the dataset using this method is impractical. Hence a sampling strategy is employed instead. The dataset stands in for the population in this scenario, and the samples are constructed to represent a range of possible outcomes in the actual population. Between one thousand and ten thousand samples are collected on average. The bootstrap method can produce confidence intervals for your statistical estimate, which could be helpful. This provides us with crucial information regarding the likely value of a parameter in contrast to the single number provided by the p-value, which evaluates the likelihood of our statistic under the null hypothesis.

Direct and indirect effects can be broken down and comprehended using the moderated model. People form opinions depending on their interactions with one another. The only things keeping these two nouns apart are the free modifier and the modifier. A free mod's immediate effect is modified by an intermediate mod (Masunga et al., 2021). An example of the intermediate effect at work explaining how two shapeshifters (Hair et al., 2014). If it can successfully shift the dynamic between the two main modifiers, we can call him a full moderator (complete moderator). If two modifiers are related, but not exclusively through an intermediary moderator, then there is partial moderator between them (Byrne, 2019).

RESULT AND FINDINGS

Participant Profile

Pre-service teachers from two universities in Indonesia and Malaysia comprised 458 participants. Whereas 248 (or 54.15%) of the students are men, only 210 (or 45.85%) are women. Of 279 students who have completed all seven semesters of their degree program, 28.60% are in their third semester, 48 are in their fifth semester, and 34.41 are in their seventh semester. Most students (63.80%) are in metropolitan regions, while just 166 are in rural areas. Just 28 students have access to the internet for less than 3 hours per day, whereas 242 have access between 3 and 5 hours per day, and 188 have access for more than 5 hours per day.

Reliability and Constructs Consistency

Constructs	Sub-Constructs	Factor loading	CR >0,6	AVE > 0.5	Alpha Cronbach >0.70	Decision
Teacher's Beliefs (TB)	KpSM	0.773	0.682	0.533	0.766	Achieved
	KpPM	0.795	0.782	0.554	0.722	Achieved
	KpPT	0.793	0.645	0.576	0.775	Achieved
Teaching Anxiety (TA)	KsM	0.883	0.663	0.658	0.856	Achieved
	KsP	0.739	0.637	0.522	0.738	Achieved
Technological Pedagogical Content Knowledge (TPACK)	PT	0.774	0.718	0.635	0.883	Achieved
	PP	0.772	0.692	0.656	0.875	Achieved
	PKP	0.794	0.634	0.585	0.826	Achieved
	PKT	0.733	0.786	0.567	0.778	Achieved
	PPT	0.723	0.751	0.644	0.752	Achieved
ICT Literacy (ICTL)	LiES	0.863	0.637	0.734	0.731	Achieved
	LiPP	0.773	0.678	0.674	0.889	Achieved
	LiPK	0.873	0.765	0.552	0.777	Achieved
	LiPO	0.753	0.643	0.641	0.754	Achieved

Table 2: The Cronbach Alpha, CR, AVE, and Factor Loading

The consistency with which a measurement represents a concept is an excellent indicator of its reliability; one way to quantify this consistency is with Cronbach's alpha. The reliability coefficient that results from such an exhaustive measure assessment can take any value between 0 and 1. If there is a strong relationship between the items on an infinite scale, the alpha will be close to 1, while if there is no relationship, the alpha will be close to 0. (i.e., they share no covariance). High alpha coefficients for items indicate their ability to measure the same underlying concept through common covariance. The high value of 0.8705 for Cronbach's alpha in this study shows that the items are highly consistent with one another, exceeding the level of acceptability set by the researchers (see Table 2 for details; keep in mind that a reliability coefficient of 0.7 or higher is generally considered "acceptable" in social science and humanities studies). However, for the rating to be credible, it must meet both the *Composite reliability* (CR) and *average variance extraction* (AVE) criteria, wherein the CR must be more excellent than 0.6, and the AVE must be greater than 0.5. The following CR, AVE, and Cronbach Alpha values were calculated after performing a Confirmatory Factor Analysis (CFA) TPACK analysis. Table 2 summarises the CR, AVE, and Alpha Cronbach values for the TPACK construct. This would indicate significant connections (correlations) among the elements under scrutiny.

Measurement Model of Teacher's Beliefs in ICT Literacy

The same holds for measurement models; they are only reliable if they are unidimensional and valid. To guarantee these three requirements are met, a pooled CFA should not be carried out until after the structural model analysis has been completed. When all the loading factors for the items and dimensions add up to more than 0.6, we have achieved dimensional consistency. One way to accomplish this is by using this method. The *Exploratory Factor Analysis* (EFA) analysis can reveal multiple types of validity, such as convergent validity, construct validity, and discriminative validity. In a minute, we'll delve deeper into each form of validity. We have achieved convergent validity when all of the measurement model's components either have a statistically significant value or can be independently confirmed using the Average Variance Extracted (AVE) value. Convergent validity refers to a measuring model in which all parts have the same numerical value. Construct validity was determined by the value of the fit indicator (*goodness-of-fit*/GOF), and discriminative validity was attained when the measurement model did not include any items measuring the same two things as the construct validity item. The goodness-of-fit indicator value was calculated for each type of validity. When comparing two exogenous constructs, a correlation value of less than 0,4 is used as evidence that discrimination is legitimate. Figure 2: A Model for Assessing Teachers' Beliefs Towards ICT Literacy.

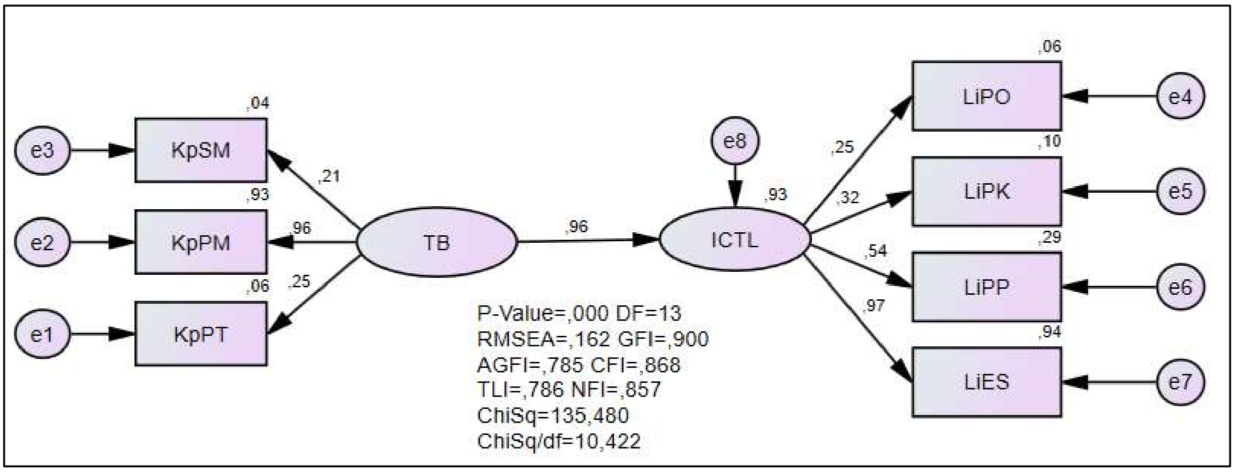

Figure 2: The Measurement Model of Teacher's Beliefs and ICT Literacy

For this investigation, we can classify the strength of the connection into three levels: small, simple, and strong, with small corresponding to values less than 0.10 and vital to values greater than 0.50. We found a moderate correlation (β = 0.010) in our analysis. A statistically significant correlation was found in the measurement analysis, with a p-value of 0.962. To identify the optimal measuring framework, several frameworks were investigated. Table 3 below provides the results of every conceivable set of correlations between the two variables.

Sub-constructs			*β*	SE	CR	p	Decision
KpSM	←	TB	0.682	0.544	1.453	0.059	Significance
KpPM	←	TB	0.683	0.572	2.054	0.000	Significance
KpPT	←	TB	0.643	0.591	3.164	0.004	Significance
LiPO	←	ICTL	0.763	0.574	0.867	0.656	Significance
LiPK	←	ICTL	0.757	0.644	2.943	0.016	Significance
LiPP	←	ICTL	0.663	0.641	2.457	0.019	Significance
LiES	←	ICTL	0.682	0.642	2.953	0.000	Significance
ICTL	←	TB	0.683	0.586	2.577	0.000	Significance

Table 3: The Measurement Analyze of Teacher's Beliefs and ICT Literacy

Measurement Model of TPACK to ICT Literacy

The validity of CFA was calculated using Cronbach's Alpha. Design the parameters for estimating validity on average and creating a CR score. Cronbach's Alpha > 0.7, Cronbach's Rho > 0.6, and AVE > 0.5 indicate that all three constructs are reliable. However, examining the measurement model distinguishes between two distinct types of TPACK and ICTL. The TPACK component was divided into five smaller factors: PKPT, PPT, PKT, PKP, and PP. The ICTL framework is divided into three sub-factors (LiPK, LiPP, and LiES). Figure 3: The outcomes of the measuring model.

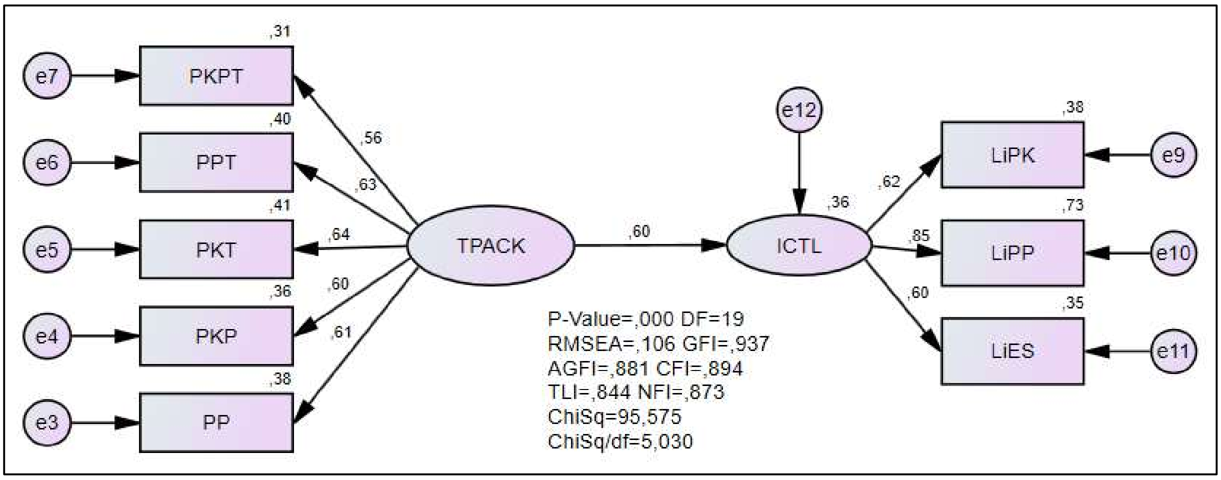

Figure 3: The Measurement Model of TPACJ to ICT Literacy

Figure 3 indicates a correlation between the two factors (β= 0.604). The potential measurement models were evaluated to select the most suitable one. Table 4 displays the findings of every possible correlation between the two variables.

Sub-constructs			*β*	SE	CR	p	Decision
PKPT	←	TPACK	0.644	0.674	2.909	0.000	Significance
PPT	←	TPACK	0.746	0.584	1.975	0.005	Significance
PKT	←	TPACK	0.635	0.678	1.487	0.004	Significance
PKP	←	TPACK	0.774	0.674	1.667	0.748	Significance
PP	←	TPACK	0.674	0.535	0.654	0.742	Significance
LiPK	←	ICTL	0.678	0.745	1.743	0.890	Significance
LiPP	←	ICTL	0.642	0.677	3.574	0.000	Significance
LiES	←	ICTL	0.654	0.564	2.631	0.000	Significance
ICTL	←	TPACK	0.635	0.674	1.435	0.000	Significance

Table 4: The Measurement Analyze of TPACK and ICT Literacy

The Moderating Model of Teaching Anxiety

Figure 4 depicts the three models used to analyze the connection between teacher beliefs and TPACK and ICT literacy. In all three models, we discovered results with statistical significance. Anxiety about both teaching and learning, as well as mathematics, played a moderating role. Teacher beliefs were shown to be negatively associated with teaching anxiety. At the same time, TPACK was found to be positively associated with teaching anxiety, teaching anxiety was found to be positively associated with ICT literacy, and teacher beliefs were found to be positively associated with ICT literacy.

Findings suggest that teacher beliefs and TPACK safeguard ICT literacy. The more frequently these two strategies are used the less intense the discomfort. Instead, ICT literacy was hampered by pessimistic mindsets and actions like pointing fingers and not caring. Figure 4 displays the results of five interactions between stressors and coping mechanisms, showing that teacher anxiety moderates the link between teachers' views and students' ICT literacy ($\beta = 0.02$; $p = 0.000$).

Figure 4 shows a positive correlation between TPACK and ICT Literacy, with Teaching Anxiety as a moderator. The upper line shows the effect of teachers' beliefs on students' ICT literacy ($\beta = 0.961$; $p = 0.000$), whereas the lower shows the direct correlation between TPACK and students' ICT literacy ($\beta = 0.053$; $p = 0.000$). Those who used it occasionally experienced a decrease in Teaching Anxiety, while those who frequently observed a moderate decrease in the intensity of their Teacher's Beliefs and TPACK linked with ICT Literacy. This evidence lends credence to the theory that using accommodation as a Teaching Anxiety strategy exacerbates the unfavorable effects of pre-service teachers' challenges on teachers' anxiety in the classroom.

Cronbach's residuum, alpha for internal consistency, and alpha for reliability were then calculated for the CFA of teachers' beliefs, TPACK, teaching anxiety, and ICT literacy (Table 5).

Constructs	Item	Factor loading	CR >0.6	AVE > 0.5	Alpha Cronbach >0.70	Decision
Teacher's Beliefs (TB)	KpSM	0.852	0.743	0.584	0.769	Achieved
	KpPM	0.744				
	KpPT	0.776				
TPACK	PT	0.746	0.683	0.649	0.737	Achieved
	PP	0.835				
	PKP	0.764				
	PKT	0.775				
	PPT	0.736				
Teaching Anxiety (TA)	KsM	0.757	0.763	0.673	0.784	Achieved
	KsP	0.866				
ICT Literacy (ICTL)	LiES	0.753	0.684	0.692	0.743	Achieved
	LiPP	0.734				
	LiPK	0.825				
	LiPO	0.757				

Table 5: The CFA of Constructs Values in CR, AVE, and Alpha Cronbach

The results of the moderated model study were used as the foundation for a comparative analysis to establish the superior model. The total worth of the deal can be broken down into three parts for the sake of this discussion. Interactions with values below 0.10 belong to the weak group, those between 0.10 and 0.50 to the simple group, and those above 0.50 to the solid group. Our findings indicate that the relationship between TPACK, TA, and ICTL is weak ($\beta = 0.023$), as is the relationship between TB, TA, and ICTL. However, when examining the direct link between TPACK and ICTL, we find a weak interaction ($\beta = 0.052$). A strong correlation ($\beta = 0.964$) exists between TB and ICTL. The moderated analysis showed no significant correlation between TB and TA ($\beta = -0.051$). As seen in Figure 4, this study uses a modified version of the Teaching Anxiety model.

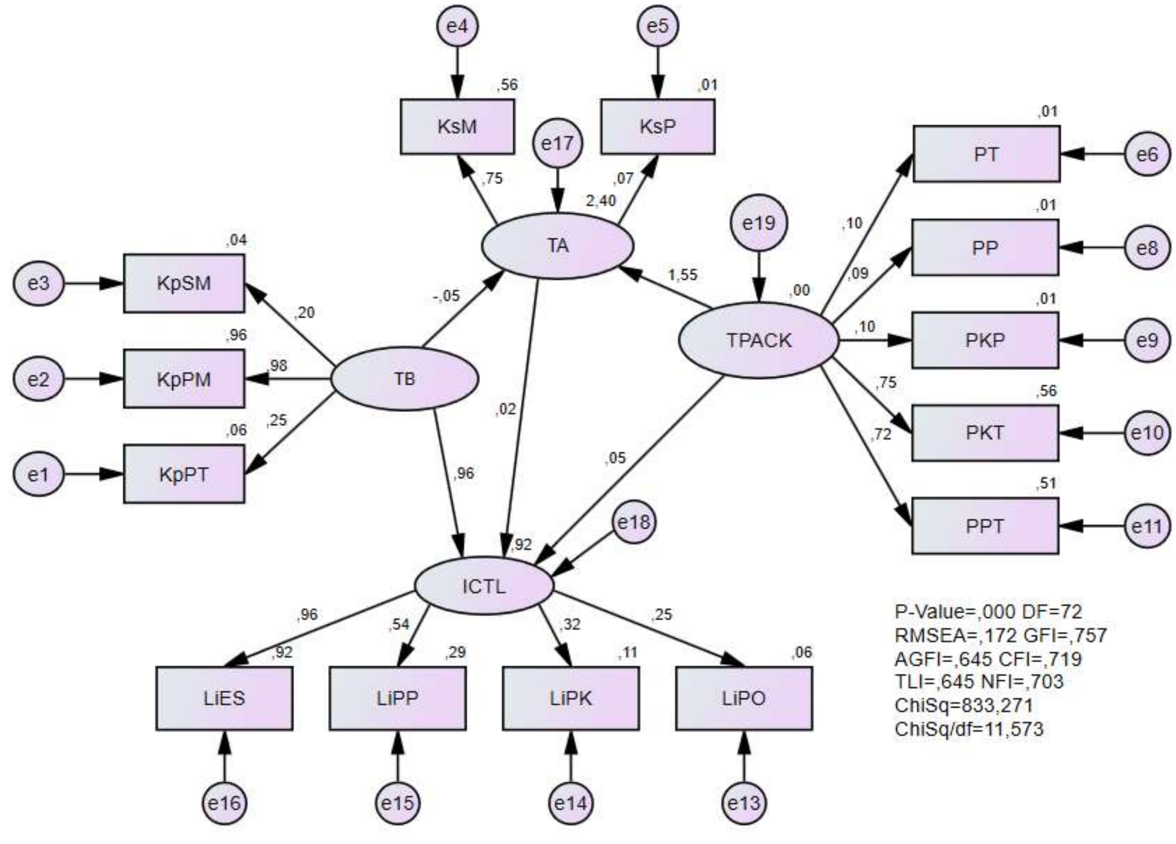

Figure 4: The Moderated Model of Teaching Anxiety

The Bootstrapping Analyse for Moderated Model

Reviewing the significance of the relationship is a crucial initial step in evaluating a moderator's effectiveness since it is the fundamental factor in determining whether the moderator's influence is complete or partial. The procedures provided by Hair et al. (2014) have been applied to determine if a full or partial moderator is present. Figure 4 helps judge the validity of the model—the immediate impact of teachers' TPACK on ICT literacy. Subsequently, a very high ($\beta = 0.963$) value of equivalence between teacher beliefs routes and literacy ICT (Kp→Li) is indicated by a decrease in chi-square (chi-square = 1.096; df = 15). The analytical decision is displayed in Table 4; it shows no effect of a complete moderator for this route budget since the direct impression of teacher beliefs in ICT literacy (Kp→Li) is substantial. Therefore, where there is evidence of a solid indirect belief in ICT literacy, the moderator can be utilized to identify a partial moderator. A glance at the bootstrapping result confirms that Kp→Li is sizable. The chain reaction from Kp to Ks to Li has a significant knock-on effect. Hair et al. (2014) state that if both direct and indirect impressions are essential, then a partial moderator exists. This suggests that the Ks, as a partial moderator, influence the Kp→Li pathway significantly. The results of bootstrapping the model are displayed in Table 6.

Aspect	Substantial indirect impact	Substantial direct effect
Bootstrapping value	Kp→Ks→Li (0.03) Kp→Li (0.08)	Kp→Ks→Li (0.03) Kp→Li (0.08)
Decision	Achieved	Achieved
Bootstrapping Model	Partial Moderator	Partial Moderator

Table 6: The Bootstrapping Value

DISCUSSION

This study employs a belief measurement paradigm built on beliefs in mathematical nature, the efficacy of education, and the value of technology in the classroom. All of these factors have substantial effects on the belief hidden variable. Covariance between constructs indicates the strength of the relationship between them (Hair et al., 2014).

The highest correlation coefficient is found between belief in the intrinsic worth of mathematics and belief in the educational potential of technology. Covariance can be thought of as a multiple of the Pearson correlation coefficient, as shown by the work of Creswell (2014). This long-held belief about mathematics' essential character may have survived because the high covariance value has provided mathematics teachers with a solid basis for developing their strategies for conveying mathematics ideas. Statements like "Mathematics is a set of rules that define how to solve problems, involving the reminder and use of Mathematical formulas, facts, and procedures" are supported by the teachers in this review because they refer to items that evaluate the consistency of Mathematical properties.

It follows that the mathematical components inherent in technology are likely to be associated with each other, as there is a significant correlation between the view that technology plays an essential role in education and the belief that mathematics is a core subject area. As a bonus, Novita and Herman (2021) shed light on this phenomenon by showing that a trait of beliefs in mathematics is adaptive and in step with the technological function. The importance of technology in teaching is intrinsically tied to this problem, as solving it effectively necessitates a solid grounding in mathematics. Since there are numerous approaches to solving mathematics problems, choosing objects is crucial. Technology in education, which has proven effective and efficient, is another tool for education.

Second, consider the degree to which various instructional theories are interconnected. The belief, like Mathematics, is discovered to have a more vital link with the belief in the use of technology in education. This happens because each teacher's views on the merits of technology are reflected in the various components of Mathematics instruction. This problem can be used by any mathematics teacher, regardless of their ideology or educational background. According to Liu (2019), Mathematics Teacher is an application that successfully combines cutting-edge pedagogical practices with substantive mathematics information.

Thus, attitudes about mathematics as a discipline are the weakest link in the confidence chain. This is due to the participants' emphasis on instilling traditional values in their young charges. The teacher is open to learning about mathematics' underpinnings but needs to put more stock into becoming an expert in the field herself. Lessons built on the items of the belief structure of mathematics education that were confirmed to be accurate in this research may increase student engagement and discussion. Therefore, teachers should ensure their teachings are as precise and comprehensive as possible. Therefore, there is a wiggle area for the message to be conveyed by trial and error. Calculus and other advanced mathematics classes are usually taught in a separate room so the teacher can focus on the argument. According to this metric, students' confidence in mathematics and their teacher’s mathematics skill are unrelated. Stephen (2018) agrees with these findings, stating that a teacher is a transmitter of knowledge and that the content is not generated by the existence of impediments to confidence in the unique nature of Mathematics.

As a result, there is a robust and statistically significant relationship between LiPK and LiPP. This confirms the conclusion drawn by Juniati (2018), who found that the quality and professionalism of mathematics teachers improve when ICT is utilized in the classroom. The close relationship between LiPK and LiPP exemplifies the linked nature of the ICT components that comprise teachers' knowledge. As previously mentioned, ICT's indirect emphasis on professional teaching was used to establish that the roundtable members valued education highly.

Because of their extensive ICT, this problem is connected to teachers' work and classroom instruction. The existence or absence of ICT-friendly variables, such as an open classroom climate and a teacher's willingness to adapt teachings to students' ICT levels, can provide insight into this question. Additional study results include knowledge of effective pedagogical practices and the ability to select ICT, which increases lesson content. Then, using a simple technique, figure out how well LiPO and LiES are linked. The views of mathematics educators on their students' procedural and applied knowledge of ICT are available, as are aspects of social ecology and the instruction of the ICT (Kiswanto & Helsa, 2019). Please explain why selecting elements that depict the LiPO and LiES constructs significantly impacts their connection stability. Teachers with access to a wide range of ICT and are more likely to use pedagogical content knowledge to solve mathematics issues and have better success in the classroom are given adequate opportunities to teach with each type. When teachers decide to include ICT in the school, they want to challenge their students to reach higher levels of knowledge and skill acquisition (Sukmana et al., 2019).

In contrast, the analysis of moderator modifiers sheds light on a nuanced and shifting interaction (Byrne, 2019). Moderators are used to explaining freedom and leaning against one another of many modifiers in an interaction (Kline, 2017). The presence of a moderator in a model is currently more sought after in social science research and theory-building fields(Jackson, 2018), and this line of inquiry has been active for over twenty years. The authors of this study propose two possible routes: the first involves using belief moderators. In contrast, the second begins with limitless alternatives for modifying material pedagogical and technological expertise.

Problem-solving skills that integrate mathematics and ICT necessitate an active learning approach. As a result of its behavioural and direct cognitive nature, teaching ICT mathematics has been shown to increase ICT literacy. This is true because the standards for efficiency or appropriateness must coincide with the notion of belief. With ICT literacy, the moderator for teaching anxiety can determine the extent to which teachers feel anxious about the subject.

Despite this, ICT literacy (the intersection of subject pedagogy and ICT) adheres to a different route of concern than a moderator effect. This study's findings suggest that teachers may impact their students' ICT literacy levels by instruction in content pedagogy technological knowledge. Just how much do you fear failure in mathematics? In what ways do you fear instructing Mathematics? These two inquiries are linked to ICT literacy, as shown by the degree of worry. ICT proficiency may or may not be affected by the author's acquaintance with mathematical concerns related to educational technology. Teachers must be well-versed in cutting-edge subject pedagogy and how technology might influence their students' topic knowledge and skill development to prepare them for high-stakes mathematics assessments. Having a firm grasp of the content and pedagogy of mathematics within the context of ICT is crucial for students aiming for proficiency in advanced mathematics. As a result, students' ICT proficiency in content pedagogy may benefit from, or suffer from, a moderator’s level of care.

The structural model created for this study supports the hypothesis that anxiety may have a secondary effect on ICT literacy. To restate, anxiety can affect ICT literacy and the relationship between belief in and knowledge of content pedagogical technology, the other two moderators. In line with these findings, Fu (2017) found that knowing how much to worry about something functions as a facilitator to change the moderator between educational technology material and a believing attitude towards it. This research shows that anxiety moderates belief and ICT competence, altering the nature of that relationship. It connects the fields of pedagogy, technology, subject matter, and ICT literacy. According to Hausfather (1996), technological competence is influenced by three interrelated elements, one of which is anxiety. Equally crucial to using and believing in technology is the ability to articulate one's anxiety. According to Brady and Bowd (2016) findings, this makes it difficult to evaluate the technological competence of teachers who suffer from high levels of anxiety. Vygotsky's theory of cognitive development characterizes anxiety as a mental state. The mathematics a teacher exhibits can affect students' technological ability (Hadley & Dorward, 2018). That is to say, and while some research supports Vygotsky's theory, other studies show that the associations between the variables are, at best, weak. There has yet to be a decision made. One possible reason for this constancy is the moderator-changing function played by teaching anxiety or other crucial modifiers (Lea, 2019).

The structural model created for this study supports the hypothesis that anxiety may have a secondary effect on ICT literacy. To restate, anxiety can affect ICT literacy and the relationship between belief in and knowledge of content pedagogical technology, the other two moderators. In line with these findings, Fu (2017) found that knowing how much to worry about something functions as a facilitator to change the moderator between educational technology material and a believing attitude towards it. This research shows that anxiety moderates belief and ICT competence, altering the nature of that relationship. It connects the fields of pedagogy, technology, subject matter, and ICT literacy. According to Vygotsky (1978), technological competence is influenced by three interrelated elements, one of which is anxiety. Equally crucial to using and believing in technology is the ability to articulate one's anxiety. According to Brady and Bowd (2016) findings, this makes it difficult to evaluate the technological competence of teachers who suffer from high levels of anxiety.

According to the results of this research, developing and refining belief as a set of skills is essential for enhancing ICT literacy. First, mathematics teachers need to believe that students' technological competence can be developed (Misfeldt et al., 2016). This is because jobs that require the use of technology are notoriously challenging. As a result, there is a compelling motivation for the professor to carve out time in the curriculum for students to work on expanding their capacity for original thought.

The findings also show how crucial it is to consult with professionals in the knowledge content pedagogical technology field. This is especially true for mathematics classrooms, where there is a direct correlation between ICT literacy and the implementation of technology-enhanced, content-based pedagogy. To this end, knowledge-content education and technological advancement must work together to encourage classroom mastery effectively. In addition, many believe that mathematics teachers should have a solid understanding of the technological competence content (Lamichhane, 2018).

CONCLUSION

Academic success, information (technological or content knowledge), content and pedagogy, and the cultivation of good values are all essential aspects of creating knowledgeable, inventive, and moral persons. However, teachers' ICT literacy did not increase, and widespread concern exists. This calls for swift action to take preventative steps. As a result, there needs to be a shift in how Mathematics is taught in the classroom, emphasizing giving teachers the tools they need to become more proficient with technological tools. The use of technology in the classroom can be managed in several ways; one is to encourage secondary school teachers to use their understanding of technology, the mathematics curriculum, and teacher pedagogy.

The developed structural equation model shows that the ICT literacy of pre-service teachers is affected by the interplay between the teacher's belief aspects to the TPACK and ICT literacy. This approach can help teachers, educational institutions, and the Ministry of Education by fostering a climate of belief and reducing anxiety among teachers. The researcher thinks that the results of this study could be helpful to other researchers interested in starting new studies or expanding on existing studies relating to the ICT literacy model and acknowledges that more research is always needed in this area.

ACKNOWLEDGEMENTS

The authors thank the participating schools for participating in this study. The authors thank the academic members who provided exceptional support and assistance during the fieldwork.

References

[1] Abdulteeef, A., & Khateeb, M. Al. (2017). Measuring Digital Competence and ICT Literacy : An Exploratory Study of In-Service English Language Teachers in the Context of Saudi Arabia. International Education Studies, 10(12), 38–51. https://doi.org/10.5539/ies.v10n12p38

[2] Agus, P., & Mastika, E. (2018). Kecemasan Matematika Pada Pendidikan Guru. Journal of Education Technology, 2(2), 36–45.

[3] Barry, A. (2017). Alleviating Math Anxiety through the Integration of Teacher Beliefs in Senior School. Journal Basic of Education, 3(April), 335–342.

[4] Bauldry, S. (2019). Structural Equation Modeling. International Encyclopedia of the Social & Behavioral Sciences: Second Edition, 4(3), 615–620. https://doi.org/10.1016/B978-0-08-097086-8.44055-9

[5] Bayat, S. (2018). Relationship between mathematical thinking, mathematics anxiety and mathematics learning anxiety. Procedia - Social and Behavioral Sciences, 8(5), 537–542. https://doi.org/10.1016/j.sbspro.2010.12.074

[6] Berger, J. L., Girardet, C., Vaudroz, C., & Crahay, M. (2018). Teaching Experience, Teachers' Beliefs, and Self-Reported Classroom Management Practices: A Coherent Network. SAGE Open, 8(1). https://doi.org/10.1177/2158244017754119

[7] Bouzid, T., Kaddari, F., Darhmaoui, H., & Bouzid, E. G. (2021). Enhancing math-class experience throughout digital game-based learning, the case of moroccan elementary public schools. International Journal of Modern Education and Computer Science, 13(5), 1–13. https://doi.org/10.5815/ijmecs.2021.05.01

[8] Brady, P., & Bowd, A. (2016). Mathematics anxiety, prior experience and confidence to teach mathematics among pre-service education students. Teachers and Teaching: Theory and Practice, 11(1), 37–46. https://doi.org/10.1080/1354060042000337084

[9] Bringula, R., Reguyal, J. J., Tan, D. D., & Ulfa, S. (2021). Mathematics self-concept and challenges of learners in an online learning environment during COVID-19 pandemic. Smart Learning Environments, 8(1), 33–46. https://doi.org/10.1186/s40561-021-00168-5

[10] Byrne, B. M. (2019). Structural Equation Modeling with Amos: Basic Concepts, Applications and Programming. Journal of Applied Quantitative Methods, 5(2), 365–367.

[11] Connie, C. (2020). Teacher Perceived Impact of Technology on Elementary Classrooms and Teaching. Journal of Digital Learning in Teacher Education, 7(2), 147–173.

[12] Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Method. In Research design Qualitative quantitative and mixed methods approaches. https://doi.org/10.1007/s13398-014-0173-7.2

[13] Del Cerro Velázquez, F., & Méndez, G. M. (2021). Application in augmented reality for learning mathematical functions: A study for the development of spatial intelligence in secondary education students. Mathematics, 9(4), 1–19. https://doi.org/10.3390/math9040369

[14] Eickelmann, B., & Vennemann, M. (2017). Teachers' attitudes and beliefs regarding ICT in teaching and learning in European countries. European Educational Research Journal, 16(6), 733–761. https://doi.org/10.1177/1474904117725899

[15] Ellerani, P., & Gentile, M. (2018). The Role of Teachers as Facilitators to Develop Empowering Leadership and School Communities Supported by the Method of Cooperative Learning. Procedia - Social and Behavioral Sciences, 93(October), 12–17. https://doi.org/10.1016/j.sbspro.2013.09.144

[16] Ersozlu, Z. (2019). Mathematics Anxiety : Mapping the Literature by Bibliometric Analysis. EURASIA Journal of Mathematics, Science & Technology Education, 15(2), 1–12.

[17] Fisher, R. (2019). Teaching thinking and creativity Developing creative minds and creative futures Thinking. Early Child Development and Care, 141(2), 1–15.

[18] Fitri, I. (2019). Technological Pedagogical Content Knowledge (TPACK): Kerangka Pengetahuan Guru Abad 21. Journal of Civics and Education Studies, 6(1), 222–230.

[19] Fu, J. S. (2017). ICT in Education : A Critical Literature Review and Its Implications. International Journal of Education and Development Using Information and Communication Technology, 9(1), 112–125.

[20] Gurcay, D., Wong, B., & Chai, C. S. (2018). Turkish and Singaporean Pre-service Teachers' Beliefs about ICT Literacy and Use of Technology. Asia-Pacific Education Researcher, 22(2), 155–162. https://doi.org/10.1007/s40299-012-0008-2

[21] Hadley, K. M., & Dorward, J. (2018). Investigating the Relationship between Teacher Mathematics Anxiety, Mathematics Instructional Practices, and Technological Achievement. Journal of Curriculum and Instruction, 5(2), 27–44. https://doi.org/10.3776/joci.2011.v5n2p27-44

[22] Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). Multivariate Data Analysis. In Pearson Education Limited.

[23] Han, I., Shin, W. S., & Ko, Y. (2017). The effect of student teaching experience and teacher beliefs on pre-service teachers' self-efficacy and intention to use technology in teaching. Teachers and Teaching: Theory and Practice, 23(7), 829–842. https://doi.org/10.1080/13540602.2017.1322057

[24] Harahap, H., Andriani, D., & Oemar, H. (2020). Structural Equation Model to Measure the Leveraging Factors of Research Productivity in Private Universities: Lecturers' Perceptions. International Journal of Scientific Research and Management, 8(10), 1964–1982. https://doi.org/10.18535/ijsrm/v8i10.em02

[25] Hatlevik, O. E., & Arnseth, H. C. (2018). ICT, teaching and leadership: How do teachers experience the importance of ICT-supportive school leaders? Nordic Journal of Digital Literacy, 2(1), 55–69.

[26] Hausfather, S. J. (1996). Vygotsky and Schooling: Creating a Social Context for Learning. Action in Teacher Education, 18(2), 1–10. https://doi.org/10.1080/01626620.1996.10462828

[27] Hollweck, T. (2016). Case Study Research Design and Methods. The Canadian Journal of Program Evaluation, 30(1), 1–5. https://doi.org/10.3138/cjpe.30.1.108

[28] Jackson, de C. (2018). Applications of Structural Equation Modeling in Social Sciences Research. American International Journal of Contemporary Research, 4(1), 6–11.

[29] Juniati, D. (2018). Analysis of ICT Literacy Competence among Vocational High School Teachers Analysis of ICT Literacy Competence among Vocational High School Teachers. Journal of Curriculum and Teaching, 3(2), 211–220. https://doi.org/10.1088/1757-899X/306/1/012097

[30] Kiswanto, A., & Helsa, Y. (2019). Literasi ICT Guru Matematik SMA di wilayah Bengkulu. Jurnal Sains Dan Matematik, 3(February), 165–174.

[31]Kli ne, R. B. (2017). Principles and Practice of Structural Equation Modeling. Journal Basic of Education, 3(21), 445–458.

[32] Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2014). The Technological Pedagogical Content Knowledge Framework. In Handbook of Research on Educational Communications and Technology (pp. 101–111). https://doi.org/10.1007/978-1-4614-3185-5

[33] Lamichhane, B. R. (2018). TPACK about Mathematics and Instructional Practices. Journal for Research in Mathematics Education, VIII(February), 14–22.

[34] Lea, A. (2019). Teacher perception of 'Clicker' technology and affect of anxiety in mathematics education. Journal Basic of Education, 2(4), 331–346.

[35] Liu, S. H. (2019). Factors related to technological beliefs of teachers and technology integration. Computers and Education, 56(4), 1012–1022. https://doi.org/10.1016/j.compedu.2010.12.001

[36] Markauskaite, L. (2019). Exploring differences in trainee teachers ' ICT literacy : Does gender matter? Journal for Research in Math Education, 4(3), 445–455.

[37] Masibo, E., & Barasa, J. (2017). Influence of Mathematics Teachers ' Beliefs on the Integration of Technology in Classroom Instruction in Secondary Schools in Kenya. International Journal of Scientific Research and Education, 4(8), 46–55.

[38] Masunga, F. J., Mapesa, H. J., Mwakibete, A. N., Derefa, M. J., Myava, J. E., & Kiria, J. S. (2021). The Role of Mediating effects of User Satisfaction and Behavioural Intention on the

Influence of the e-Tax System on Tax Compliance Behaviour: An application of Bootstrapping Technique. TIJAB (The International Journal of Applied Business), 5(2), 137. https://doi.org/10.20473/tijab.v5.i2.2021.29229

[39] Matoti, S. N., & Lekhu, M. A. (2016). Sources of anxiety among pre-service teachers on field placement experience. Journal of Psychology in Africa, 26(3), 304–307. https://doi.org/10.1080/14330237.2016.1185921

[40] Michael, A. (2018). Dimensions of Math Anxiety as Measured by the MARS-Brief: Factor Analysis. Journal of Applied Quantitative Methods, 3(August), 193–211.

[41] Misfeldt, M., Jankvist, U. T., & Aguilar, M. S. (2016). Teachers' beliefs about the discipline of mathematics and the use of technology in the classroom. Mathematics Education, 11(2), 395–419. https://doi.org/10.12973/iser.2016.2113a

[42] Naziri, F., Rasul, M. S., & Affandi, H. M. (2019). Importance of Technological Pedagogical and Content Knowledge (TPACK) in Design and Technology Subject. International Journal of Academic Research in Business and Social Sciences, 9(1), 99–108. https://doi.org/10.6007/ijarbss/v9-i1/5366

[43] Nejem, K. M., & Muhanna, W. (2018). The Effect of Using Computer Games in Teaching Mathematics on Developing the Number Sense of Fourth Grade Students. Educational Research and Reviews, 8(16), 1477–1482.

[44] Nisfah, N. L., & Purwaningsih, E. (2018). Collaborative inquiry integrated technological pedagogical content knowledge to improve higher-order thinking skills. Jurnal Kependidikan, 6(1), 25–39.

[45] Novak, E., & Tassell, J. L. (2017). Studying preservice teacher math anxiety and mathematics performance in geometry, word, and non-word problem solving. Learning and Individual Differences, 54, 20–29. https://doi.org/10.1016/j.lindif.2017.01.005

[46] Novita, R., & Herman, T. (2021). Digital technology in learning mathematical literacy, can it helpful? Journal of Physics: Conference Series, 1776(1), 554–563. https://doi.org/10.1088/1742-6596/1776/1/012027

[47] Omar, M., Bahaman, A. H., Lubis, F. A., Ahmad, S. A. S., Ibrahim, F., Aziz, S. N. A., Ismail, F. D., & Tamuri, A. R. Bin. (2020). Stress Among Students in Universiti Teknologi Malaysia. Proceedings of the International Conference on Student and Disable Student Development, 470(ICoSD 2019), 1–9. https://doi.org/10.2991/assehr.k.200921.021

[48] Peters-burton, E. E. (2019). Developing student 21 st Century skills in selected exemplary inclusive STEM high schools. International Journal of STEM Education, 1(6), 1–15.

[49] Prestridge, S. (2018). The beliefs behind the teacher that influences their ICT practices. Computers and Education, 58(1), 449–458. https://doi.org/10.1016/j.compedu.2011.08.028

[50] Ramirez, G., Hooper, S. Y., Kersting, N. B., Ferguson, R., & Yeager, D. (2018). Teacher Math Anxiety Relates to Adolescent Students' Math Achievement. AERA Open, 4(1), 233285841875605. https://doi.org/10.1177/2332858418756052

[51] Stephen, M. (2018). Effects of Epistemological and Pedagogical Beliefs on the Instructional Practices of Teachers. Australian Journal of Teacher Education, 38(12), 221–232.

[52] Suharyat, Y., Santosa, T. A., Yulianti, S., & Amalia, K. N. (2022). Literature Review : TPACK-Based Science Learning in Supporting Teacher Quality in Indonesia. International Journal of Education and Literature (IJEL), 1(2), 2014–2020.

[53] Sukmana, A., Sc, M., Chendra, E., Si, M., Chin, L., & Si, M. (2019). Kerangka Literasi ICT Guru Matematika di Jawa Tengah. Jurnal Ilmiah Pendidikan Matematika, 3(5), 321–330.

[54] Sunman, M. (2022). Adaptation of the TPACK-21 Scale to Turkish : A Validity and Reliability Study. Sakarya University Journal of Education, 12(4), 224–255. https://doi.org/10.19126/suje.1064341

[55] Syafiq, M., Sirojuzilam, Badaruddin, & Purwoko, A. (2022). Integrated structural equation modeling and causal steps in evaluating the role of the mediating variable. MethodsX, 9(4), 10–23. https://doi.org/10.1016/j.mex.2022.101777

[56] Uysal, F., & Dede, Y. (2016). Mathematics Anxiety and Beliefs of Turkish Pre-service Elementary Teachers. EURASIA Journal of Mathematics, Science & Technology Education, 12(8), 2171–2186. https://doi.org/10.12973/eurasia.2016.1418a

[57] Valtonen, T., Sointu, E., Kukkonen, J., Kontkanen, S., Lambert, M. C., & Mäkitalo-siegl, K. (2019). TPACK updated to measure teachers ' twenty-first century skills. Austalasian Journal of Educational Technology, 33(3), 15–31.

[58] Vygotsky, L. (1978). Mastery of Memory and Thinking. Mind in Society, 38–51.

[60] Wilson, D. (2018). Investigating Pre-service Teachers' Mathematics Anxiety Towards TPACK in classroom. Journal for Research in Mathematics Education, 3(20), 442–451.