Teachers' Beliefs, Mathematics Anxiety, and ICT Literacy: A Systematic Review

Creencias de los docentes, ansiedad matemática y alfabetización en TIC: una revisión sistemática

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ABSTRACT

This paper systematically investigated the relationship between mathematics teachers' beliefs, mathematics anxiety, and ICT literacy for over five years. The study is accordance with the Matrix Method used for reviewing. In addition, the publications were taken as the data, which were databases and references. Twenty-eight (n = 28) publications fulfilled specific inclusion and exclusion criteria and consisted of the final instances. A methodological quality score (MQS) was selected in every research. The correlation between teachers' beliefs and mathematics anxiety, as wella s the ICT literacy obtained in a particular result and was categorized as exhibiting an inverse linear relationship, no statically significant linear relationship, or a positive linear relationship.

Keywords: Teachers' beliefs; Mathematics anxiety; ICT literacy.

RESUMEN

Este documento investigó sistemáticamente la relación entre las creencias de los profesores de matemáticas, la ansiedad matemática y la alfabetización en TIC durante más de cinco años. El estudio está de acuerdo con el método de matriz utilizado para la revisión. Además, las publicaciones se tomaron como datos, que eran bases de datos y referencias. Veintiocho (n = 28) publicaciones cumplieron criterios específicos de inclusión y exclusión y consistieron en las instancias finales. Se seleccionó un puntaje de calidad metodológica (MQS) en cada investigación. La correlación entre las creencias de los docentes y la ansiedad matemática, además de la alfabetización en TIC obtenida en un resultado particular y se clasificó como exhibiendo una relación lineal inversa, ninguna relación lineal estadísticamente significativa o una relación lineal positiva.

Palabras clave: creencias de los docentes; Ansiedad matemática; Alfabetización en TIC.

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1. INTRODUCTION

Personality aspects are more than a significant factor in teaching and learning, especially in the complexity of mathematics belief in teachers. Particular researches cover the area addressing the variety and investigate their origins. Moreover, some factors contribute to mathematics beliefs as stated by some researchers (Beavis et al. 2014; J. Berger et al. 2018; Palak & Walls 2009). Mathematics belief is something crucial for a teacher. It led to the concern on how a teacher transfers the knowledge to students. The idea is similar to the research of Han et al. (2017) as it focuses on teachers' mathematics beliefs in terms of determination, relations with other affective variables and teaching practices.

In addition, mathematics teachers' beliefs have an impact on their classroom practice. It pictures on the ways they perceive teaching, learning, and assessment, and on the ways they perceive students' potential, abilities, dispositions, and capabilities (Adnan, Zakaria & Maat 2012; Haciomeroglu 2013; Siswono et al. 2016). Thus, belief relates to approaches, techniques and methods on teaching for a teacher as these bring about the impact on teachers' beliefs.

The phenomenal issue in the global world is mental psychology mainly about depression and anxiety. Based on the World Health Organization report, the extent of depression and anxiety across the globe has been a noteworthy increase in people suffering from mental disorders in developing countries (Ferguson et al. 2012) is revealed. It brings about parallel growth in the population and life expectancy in those countries. Having depression and anxiety among teachers in teaching and learning in the classroom also bring another issue. The teachers with higher levels of mathematics anxiety tend to prioritize traditional learning compared to teachers who have more ability to explore learning due to less math anxiety when teaching (Novak & Tassell 2017; Wilder 2013). Uysal & Dede (2016) underlined that pre-service elementary teachers' scores on beliefs in teaching mathematics were high whereas mathematics anxiety levels were low in general. As a result, the correlation between the sub-scale of the MARS-SV and child-centeredness beliefs are not significant at the 0.05 level. From the researches, it can be concluded that the teachers who are holding stronger beliefs and feeling of less anxious were more confident on their competency to teach mathematics effectively.

According to World Bank data, basic education does not give proper knowledge and empowering learners' capabilities on technology and ICT (Thani et al. 2008). Basic education brings about the readiness of teachers in using ICT, technology, and literacy. Teachers have a larger perspective on the role of information and communication. The rapid increase in the demand for technology has changed gradually. The use of technology might lead to anxiety for some who do not have readiness in using it during working. Anxiety is a big influence in everyday life supporting the one's performance. Previous research have stated that stress and anxiety lower the effective performance of people. Thus, the effective and cognitive become the contributing factors to the initiative of the use of ICT (Smaldino 2011). Therefore, an understanding of ICT will be beneficial for those in reducing the anxiety in using ICT

In addition to the educational experiences provided to teachers, each internal barrier also influences technology integration as the effective use of technology in the classroom has become one of the major themes in education (Han et al. 2017a). Nowadays, teachers' ability to implement classroom technologies to foster meaningful learning experiences are increasingly important in teachers' education. Previous literature have identified the important factors affecting technology integration: teachers' beliefs (Ghavifekr et al. 2015; Mahmoudikia 2014; Yang & Leung 2015), and teachers' ICT literacy (Alghamdi 2017; Dakich 2005; Kaur & Singh 2014). Therefore, the points among mathematics teachers' belief, anxiety, and teachers' competency in ICT literacy must be approved.

The analysis focuses on the association of teachers' beliefs, mathematics anxiety, as well as ICT literacy. It reflects on the nature of the association and exemplified a protective or risk factors. Thus, other investigations are the methodological characteristics of the literature and the moderate findings on methodological characteristics of mathematics teachers' beliefs.

Psychologically, a belief of an understanding or a proposition about the world that is considered true which can also be assumed as a trust. According to Berger et al. (2018), a trust is more cognitive, but it is difficult to change as compared to attitude. JYang & Leung (2015) documented that a belief can be considered as a basis for influencing one's thinking on the aspects of the world or as a disposition of an action which also contributes to confidence of a person. As stated by Misfeldt et al. (2016) who mentioned that a belief, in contrast to knowledge, can be made at various levels of confidence and are more cognitive than emotional and attitude. Thus, a belief can lead to someone's personality trait as individual and approach as a teacher. Palak & Walls (2009) stated some terms of beliefs expanding in the educational field. They cited a construct on beliefs in the education world or better known as "belief in the world of education" which is widely defined and used to identify a teacher's success, epistemological beliefs, anxiety, self-concept, self-esteem, and beliefs that are Specific. Clarification made by Han et al. (2017) on consideration of beliefs must be seen from the philosophical and psychological perspectives.

Likewise, mathematics teachers' beliefs bring about classroom practices. This can be seen especially on the images of teachers in the teaching method, teaching-learning process, and designing assessment. Moreover, in terms of assessment, it is found to evaluate students' potential, abilities, dispositions, and abilities (Beavis et al. 2014). This interpretation is the same as the definition by Uysal & Dede (2016) on mathematics teaching and teachers' beliefs. These are beliefs which were obtained from elementary mathematics teachers who were involved in peer assurance programs that were not involved in the guidance program. On the other hand, mentor intervention is based on a socio-constructivist approach to mathematics instruction, and teacher treatment groups who participated in small group teaching activities. Yang & Leung (2015) found the socio-constructivist approach to mathematics instruction applied by the program which by the time, the results of the teaching observation found that the teachers showed more traditional method in their teaching process.

Researchers recognized mathematics as a non-concrete study which has significant impacts on emotional condition

towards people causing people to love or leave it, (Wilder 2013). Boyd et al. (2014) showed that many people experienced mathematics anxiety but people could not find reliable records of it as contrast to the fact. Moreover, mathematics teachers assume mathematics anxiety as natural attitudinal and emotional factors. Another fact came from Elementary school teachers which was based on the quantitative data focusing on elementary school teachers who experienced higher mathematics anxiety. It was found as the result of spending less time planning mathematics lessons (Matoti & Lekhu 2016). On the contrary, secondary mathematics teachers who took teacher education programs with the experience on mathematics gained confidence in delivering the subject. (Novak & Tassell 2017).

The Academic Debates Regarding Teachers' Beliefs, Mathematics Anxiety, and ICT Literacy

The belief system is a metaphor in describing how a person believes a certain idea or object. The belief system is connected to three aspects: a) belief in a system that is primary or derivative; b) confidence in a system that has central or peripheral; c) belief on a group. According to Berger et al. (2018) researchers found that the structure belief is perceived as the combination of both philosophical and psychological constructions. The dimensions in the structure of belief are the quasi-logical relationship between beliefs of central-peripheral, and held in groups. Based on their research, Beavis and his colleagues (Beavis et al. 2014) developed a characterization on the structure of secondary school mathematics teachers' trust which is also being used in the case study analysis.

The researchers acknowledged the findings made by previous experts in shaping reflection ideas and proposed the sectional theory in characterizing belief structure of teachers 'intelligence as such: (a) Isolationist: a trust structure and belief in different perspectives. They only believe in their own beliefs, do not care about the trust that others have. Accommodation is not a theme that characterizes isolationists; (b) Idealistic naivety: an observer, people observe others as a case without analysing their belief (c) Connectionist naivety: as a reflection and paying attention. They compare to others' conviction. The naive, however, makes the connectionists fail to resolve conflicts or differences in beliefs; (d) Reflective constructivists: almost the same as the previous belief, but the reflection and paying attention to others' property. Reflective connectionists, however, resolve conflicts through reflective thinking. Siswono et al. (2016) recorded that the cultivation of doubts and the influence of a confusing situation seems to be the centre of transition from being in a certain categories with varied human responses can be seen from ther categories.

On the other hand, numerous researchers discovered some findings with one of them is on the dimensions of mathematics anxiety. Anxiety is measured using The Mathematics Anxiety of Rating Scale (MARS). It is a hypothesis on the mathematics anxiety that reflects on the exploratory factor analysis (EFA) which "seeks to discover if the observed variables can be explained largely or entirely in terms of a much smaller number of variables called factors" (Ramirez et al. 2018). Investigating the dimension of mathematics anxiety is the same as identifying the factors which led to the construct. The more understanding, the better perspective in the nature of mathematics anxiety for accomplishing it will be very useful to prevent or minimize anxiety.

Overall, the case illustrates the view on two factors. Those are Mathematical Test Anxiety, and Numerical Anxiety (Wilder, 2013). In contrast, the Mathematical Test Anxiety and Numerical Anxiety factor deal on different points while Mathematical Test Anxiety related to mathematics ability, while numerical anxiety includes numbers in an everyday setting. This issue is similar to that found in Gnanamuthu & Krishnakumar (2015) who mentioned two elements, which were Course Anxiety, and Numerical Task Anxiety. In contrast to previous findings, Haciomeroglu (2013) stated three free which were Evaluation Anxiety, Social Responsibility Anxiety (Social Responsibility Anxiety relates to mathematical processes in social settings), and Arithmetic Computation Anxiety. However, findings from Ramirez (2018) stated the the three dimensions as Mathematics Test Anxiety, Mathematics Studying Anxiety, and Mathematics Class Anxiety. These studies have failed to report the analysis of anxiety as the lack of rationale due to difficulty to convey disagreement in the findings. Enhancing teachers' competency in cognitive is very essential to support their educational activities. The issue that arose is regarding to teachers' competency in dealing with ICT. Some studies revealed that teachers do not have the required knowledge, which is also mentioned by Fauzi (2017), that a group of educators has lower ICT competency. In addition, most of the teachers have moderate competency which is the lowest level of competence. Thus, it is assumed that the teachers must get involved in a succession of ICT program for better understanding as it was believed that the upgrading level of ICT knowledge is useful for teachers. According to Barkatsas & Malone (2005) ICT covers the development of ICT literacy, knowledge, process, and attitude.

The ICT literacy framework produced by the Delphi panel (Tian et al. 2017) includes four categories of ICT literacy by teachers: (a) category 1: understanding the operational and application of ICT; (b) category 2: pedagogy that is rich in meaning and learning environment; (c) category 3: ICT for learning and professional involvement; and (d) category 4: the relationship between people and environment of life and teaching using ICT. For the dimension 1 consists of three abilities which refer to a) understanding of the operational of teachers and the system of ICT, for instance: getting the latest comprehending of ICTs applied at schools, workplaces, homes, as well as communities; b) showing qualified perspective and skills in computer system; c) presenting closeness and utilization of network resources for communication and academic aims.

Category 2 describes teaching practices including pedagogy that is rich with the ICT usage embedded in constructivist learning (Kafyulilo et al. 2015) and other communities connected by students (Yusri & Goodwin 2013). The focus is on new learning approaches and integrated learning and teaching with ICT. In this case, teachers are as designer and facilitator to engage students' inquiry. Subsequently, category 3 describes teachers' practices including approaches using ICT to support their needs in education as well as professional activities. Critical awareness of ICT is needed by society to be used and support their professional activities. Another phenomenon is the critical awareness on restructuring the school system in term of how students need technology to support their learning. Finally, for

category 4, it discusses social ecology that integrates ICT into daily practice which was mentioned byTomljenović & Zovko (2016), as it deals with the use of a certain strategies showing the same position including behaviours such as moral, and some empowering issues in the use of ICT.

Teachers' beliefs, mathematics anxiety, and teachers' ICT literacy have a special domain which cannot be easily compared as there are several points to measure those. The points are definitions, dimension, object, and stability. The systematic review presented here contributes toward presenting the correlation between beliefs, anxiety on mathematics, and ICT literacy among teachers noted in several types of research for five years.

2. METHODS

This study uses matrix method with the related theory outlined the method for systematic literature review. The theme is on ignorance assumption which is due to the lack of knowledge in an investigation that can be protected. Ingram et al. (2006), also pointed out that matrix method is indicated as an abstract literature conveying table and grid with a rectangular array as a symbol. The method covers verbal information, quotes, summarized text, and extracts from matrices consist of various aspects of the research which are found to be a strong tool being used in many fields.

Conceptual and methodological characteristics were recorded systematically (Tian et al. 2017. For instance, the use of Methodological Quality Score (MQS) shows the highest possible MQS that was 19 which is as the maximum score of methodological characteristics. Table 1 shows the criteria for methodological quality which was presented in the average inter-rater reliability that was 0.887.

Each research examined the relationship between teachers' beliefs, mathematics anxiety, and ICT literacy. There were some variables found, such as the category related to; and the nature of the relationship. The results were categorized as an inverse linear relationship, no statistically significant relationship, or a positive relationship. A positive relationship means that high teachers' beliefs were a risk factor for certain mathematics anxiety or ICT literacy. Conversely, an inverse association is a protective factor.

3. RESULTS

Studies' characteristics

There were 28 examined research which were published in the last five years (between 2013 and 2018) with eighteen articles showing several fields which are discussed on teachers' beliefs, mathematics anxiety, and ICT literacy. Nine articles were published in Academic Search Premiere, ten were published in ERIC databases, seven and two were published in PsycINFO and Sociological Abstract respectively. Six studies examined teachers' beliefs as a minor variable while other 18 research were presented as a disciplinary construct. Regardless of the centrality construct, only 4 articles were depicted as a theoretical elaboration on teachers' beliefs and greater than half reported were associated with mathematics anxiety or ICT literacy. Other theories (3 studies) were cited in the construct of instruments and more than half (7 studies) were reported to be used as literature reviews to guide the inquiry. Last but not least, two studies dealt with the structural equation model for the three variables.

Studies' methodological quality

The study used methodological quality score (MQS). The composite of individual elements for rating every research's quality is shown in Table 1. The 7 to 14 points are the Values for the MQS. The mean = 10.69, SD = 7.96, median = 9.5, and mode = 12. The Methodological Characteristics above explanation are shown in table 1.

Table 1. Criteria for assessment of reviewed studies' of methodological characteristics and frequency distribution for each characteristic from reviewed studies

Characteristics on Methodology	**Scoring The Maximum score is 19 (points)**	**The characteristics of Distribution**	
		(n)	(%)
Meaning of teachers' perceptions/mathematics apprehension/ICT proficiency	Global = 1	12	43
	Facet-specific = 2	16	57
Valid	stated= 1	16	57
	Not stated = 0	12	43
Reliable	Reported = 1	15	54
	Not reported = 0	13	46
Theoretical framework presented of teachers' beliefs/ mathematics anxiety/ICT literacy	displayed theories = 1	20	71
	did not display theories = 0	8	29
Research belief	Quantitative / Qualitative = 1	24	86
	Mixed methods = 2	4	14
The Design	Correlational/Cross-sectional = 1	28	100
	Longitudinal = 2	0	0
The size of Sample	Undetermined = 0	3	11
	Small (< 100) = 1	10	36
	Medium (> 100 and < 300) = 2	7	25
	Large (> 300) = 3	8	29

The design of sample	Convenience/nonprobability = 0 Random/probability but not nationally representative = 1 Random/probability and nationally representative = 2	0 17 9	0 61 32
The analysis of the data	Quantitative (content ; emergent themes analysis; grounded theory) = 1 Univariate statistics/descriptive = 1 Bivariate statistics/ANOVA = 2 Multiple/logistic regression = 3 Multivariate statistics (canonical correlation; discriminant function analysis; path analysis, structural equation modeling) = 4	10 5 7 1 5	36 18 25 4 18
Applicable inferences of causality	Study's conclusion inappropriately implies causality = 0 Study's conclusion appropriately imply causality = 1	1 27	4 96

Some previous studies showed that the frequency distributions for each element of the MQS indicated almost 40% (10 studies) of the analyzed research which conveyed a qualitative research paradigm that is a mixed method used in the research. Cross-sectional designs were featured most commonly with none of the research showed a longitudinal design. Most inquiries (17%) used large samples (>300 respondents), but the majority of these (61%) were of medium samples and small samples are for 25% and 36% respectively. Most of the reviewed were randomly selected but were not nationally representative (61%), and 32% of data were selected and nationally representative. Nine studies (29%) focused on samples in Asia (Indonesia, Malaysia, Korea, Hong Kong, Singapore, Iran, and Saudi Arabia). Three reports employed Australian participants, and both of America and Europe samples were reported in 32% (10 studies).

Systematically, majority of research covered global measures of teachers' beliefs, mathematics anxiety or ICT literacy (43%); and sixteen studies (57%) employed facet-certain measures. Facet-specific measures cover teaching experience, classroom management, motivation, self-efficacy, conceptual knowledge, mathematics' ability, and education technology. Eighteen of the reports (63%) utilized TALIS, Ohio State Teacher Efficacy Scale, and Problem in School Questionnaire, Mathematics Anxiety Rating Scale, as well as Mathematical Beliefs Instrument (MBI).

The report shows testing of the personal researcher data for both validity and reliability. 28% of studies depicts validity including 25% of studies shows reliability testing of their own data for variables on teachers' belief. Correspondingly, for mathematics anxiety variable, validity and reliability testing for their data were shown in 21% and 14% respectively. In the case of ICT literacy variable, 25% of studies pictured for validity testing, and almost the same in reliability testing viewed (21%). Most researchers covered the grounded theory or quantitative analyse to analyse their data (36%). Subsequently, scholars utilized bivariate statistics/ANOVA for their analysed data of 25%, and five studies (18%) reported using of multivariate analytical techniques of structural equational model (SEM) for their three variables.

The final criterion reviewed the inappropriate inference of causality with cause-effect relationship occupied (96%). One study reported (4%) on inappropriately implied of teachers' beliefs, the causes for the outcomes from conceptual knowledge and experience among mathematics teachers.

Studies' findings

The 28 analysed research showed 66 *results* depicted in a total of 66 *results* (average = 2.38/study, range 1 – 16). The majority (64 %) showed tests of teachers' beliefs as an independent or predictor variable whie 36% were tested as dependent variables (teachers' beliefs, mathematics anxiety or ICT literacy).

Most research (n = 15, 23%) contained tests of teachers' beliefs as well as mathematics anxiety. The most frequently examined was teachers' beliefs and ICT literacy, followed by "self-efficacy (n = 3) and "ability handling ICT" (n = 4). The variables consisted of "computation anxiety, test anxiety, course anxiety, application anxiety, and social anxiety which were classified as *dimension of mathematics anxiety* using Mathematics Anxiety Rating Scale – Short Version (MARS-SV). Additional variables of ICT literacy (educational qualification, optional object, and teachers' background) were 11 findings (17%) while another variable ICT literacy that was associated with teachers' beliefs are listed in Table 2.

Table 2. The examined studies' showed percentages on findings-related towards the association among teachers' beliefs, mathematics anxiety and ICT literacy-according to the nature of findings.

Finding: relationship	Nature of finding/relationship			
	Positive n (%)	Inverse n (%)	No relationship n (%)	Total
Teachers' beliefs and ...				
Mathematics Anxiety	2 (33 %)	3 (50%)	1 (17%)	6 (9%)
Test anxiety	1	0	0	1
Computation anxiety	0	2	0	2
Course anxiety	1	0	0	1
Social anxiety	0	0	1	1
Application anxiety	0	1	0	1
ICT literacy	14 (41%)	9 (26%)	11 (32%)	34 (52%)
Self-efficacy	3	0	0	3
Intention to used in learning	0	3	0	3
Time intention	1	0	1	2
Tech-based mathematics	1	0	2	3
Tech-produced in learning	1	0	2	3
Teacher's competency	1	0	1	2
Gender	0	1	2	3
Constructivist use	2	1	0	3
Teacher's qualification	1	1	1	3
Ability handling ICT	2	1	1	4
Teaching process	1	1	0	2
Motivation	0	0	1	1
Performance	0	1	0	1
Tech-used in learning	1	0	0	1
Mathematics anxiety and ...				
ICT litearcy	4 (36%)	4 (36%)	3 (27%)	11 (17%)
Education qualification	1	2	2	5
Optional subject	3	0	0	3
Teacher's background	0	2	1	3
Teachers' beliefs	5 (33%)	5 (33%)	5 (33%)	15 (23%)
Mathematics concept	0	2	3	5
Mathematics knowledge	2	2	1	5
Organization of teaching	3	1	1	5
Total	25 (38%)	21 (32%)	20 (30%)	66 (100%)

The table pictures 49% of findings which were yielded with no statically significant association, whereas 76% showed an inverse relationship. Besides, 74% depicted positive (Table 2). A similar pattern emerged in these relationship: 69% of the attitudinal findings exhibited positive relationship and inverse association as well, and 60% showed no statistically significant relationship. The mixed-gender samples in 4 studies investigated a lot of empirical tests for *female* gender presented inversely with no statistical relationship.

The MQS associated significantly to Cramer's V = 0.363, $p = .001$. Higher quality studies were presented and no relationship and positive relationships were found. Findings exhibited an inverse association on either teachers' beliefs, mathematics anxiety or ICT literacy which originated from studies with average MQSs of 6.25 (SD 5.32; 95% CI 5.62-6.88). Findings of no statical significant relationship showed an average MQS of 5.25 (SD 2.63; 95% CI 4.61-5.89) and findings of positive relationship had lowest average MQS (5.00; SD 4.32; 95% CI 4.45-5.55) (Table 3).

Table 3. Relationship of teachers' beliefs, mathematics anxiety, and ICT literacy (one-way ANOVA)

Nature of statistical relationship	N (% of total)	Mean (SD)	95% CI	F	*p* Value
Inverse relationship	25 (38 %)	6.25 (5.32)	5.62-6.88		
No relationship	21 (32 %)	5.25 (2.63)	4.61-5.89	11.870	.001
Positive relationship	20 (30 %)	5.00 (4.32)	4.45-5.55		

DISCUSSION

The popularity of teacher's beliefs is increasing throughout decades. Beliefs on learning and teaching have attracted much interest from previous researchers (Adnan, Zakaria & Mistima 2012; Beavis et al. 2014; J. L. Berger et al. 2018). Han et al. (2017) suggested that belief is very influential in the classroom involving learning and teaching process. Siswono et al. (2016) mentioned that there were teachers who applied new methods or programs in their classroom which related to the teachers' beliefs by using the new proposed method or program. Tian et al (2017) compared and contrasted among preservice teachers and the comparison showed that teachers' belief can also be found in both countries such as China as well as Thailand. This exemplifies that mathematics teachers' applied thinking, logic, and usefulness rather than a subject on calculableness and preciseness. The findings display preservice teachers' beliefs in China are more like constructivist. Meanwhile, Rizal and Zakaria (2016) identified students' level of self-confidence from the aspects of mathematics students, mathematical discipline, teaching and learning mathematics. According to Siswono et al. (2016) analysis of teachers' beliefs on problem solving pictures indicated that teachers showed both mathematics problem and the strategies in learning mathematics from the body static perspective as students by using the dynamic approach in

teaching mathematics.

A lot of discussions conducted on mathematics teachers as candidates who experienced mathematics anxiety as well as anxiety not associated with mathematics. The main source of this problem is the transfer of knowledge from teacher to student which must be addressed immediately because the mathematics teachers' anxiety will get a long effect on leaners' comprehension of this field (Boyd et al. 2014; Novak & Tassell 2017; Ramirez et al. 2018). Mathematics anxiety in teachers is also described as a tense feeling that differs them from numbers and solving mathematical problems in daily context and academic terms (Wilder 2013). The researchers designed a tool to measure mathematics anxiety which is called the Mathematical Anxiety Scale (Mathematics Anxiety Rating Scale / MARS). A number of researches have investigated mathematics anxiety and negative attitudes toward mathematics (Matoti & Lekhu 2016; Wilder 2013) with findings that teachers with mathematics anxiety affect high proportions of students who are preparing to become teachers (Boyd et al. 2014).

Other previous studies indicated that teachers who have low mathematics anxiety perceived the anxiety as useful for them as it becomes motivation to further enhance their potential in achieving the comprehension on mathematical disciplines and becoming a better teacher from what they are (Ramirez et al. 2018). Moreover, a significant correlation between beliefs and the way students construct mathematical knowledge and social anxiety ($r = -.11, p < .05$ $r = -.11, p < .05$). The correlation coefficient between pre-service teachers' MARS and their MBI scores is calculated to be $r = -.117 r = -.117$. The results of the Pearson product correlation coefficients of the pre-service teachers MBI and MARS pictured that a small negative significant correlation was found between mathematics anxiety and mathematical beliefs scores of pre-service teachers. The results of the analysis showed that the pre-service teachers with higher level of mathematics anxiety had lower mathematical beliefs and the pre-service teachers with low levels of mathematics anxiety had higher mathematical beliefs (Haciomeroglu 2013).

Therefore, the existence of mathematics teachers' beliefs and anxiety that have an impact on the application of classroom teaching, the application of technology included in the teaching of content mathematics have also influenced the level of teaching ability of the teachers in the classroom. In order to lessen the teachers' difficulty to balance traditional teaching skills that they normally have, technology is intensively applied in the classroom with the demands of the times that. This has an impact on changing the way teachers teach in the classroom (Matoti & Lekhu 2016; Wilder 2013).

In most cases, teachers only adapted traditional school structures, classroom organizations and existing teaching practices (Berger et al. 2018), and failed to address comprehensive educational reforms (Uysal & Dede 2016). Hence, teachers are the key agent of any policy implementation which is related to teaching and learning process (Chia & Maat 2018). A one-way between groups analysis of variance was conducted to convey the impacts of mathematics anxiety on levels of mathematical beliefs, as measured by the Mathematical Belief Instrument (MBI). Pre-service teachers were divided into three groups according to their mathematics anxiety scores: low ($M = 3.83. n = 75 M = 3.83. n = 75$), moderate ($M = 3.74, n = 149 M = 3.74, n = 149$) and high ($M = 3.73, n = 77 \backslash M = 3.73. n = 77$). Results of the analysis showed that there was a statistically significant difference on the $p < .05 p < .05$ level in MBI scores for the three anxiety groups [$F(2, 298) = 3.607, p = .02 F(2, 298) = 3.607, p = .02$]. Despite of reaching statistical significance, the actual difference in mean scores between the groups is quite small. The effect size was calculated using eta squared which is $. 02$ (Haciomeroglu 2013). According to Uysal & Dede (2016), this value would be considered a small effect size. The resulting eta value is according to the Tukey's HSD tests with the mean differences in MBI scores between low and moderate anxiety groups and between low and high anxiety groups were found to be statistically significant.

On the other hand, as for teachers' ICT literacy, Yusri & Goodwin (2013) stated that Indonesian teachers' participation in training was limited due to venue, time allocation, budget of a program and opportunity. One of the strategies for teachers to adapt technology to be involved in any group interaction with different level of competencies as it can be one of the ways to contribute to each other (Tian et al. 2017). According to Yusri & Goodwin (2013), age plays an essential role in ICT application that led to productive age in Indonesia around is said to be around 25-30 years old. The percentage also appeared as the result of observation on teachers who used ICT which only reached 35% with 43% of teachers aged 30-35 used ICT compared to teachers on the upper age, 40-45 years. This is supported by the factor of age as an influence on ICT integration and ICT literacy skills in the classroom. Based on previous research, the teachers aged 21-40 years are more likely to use ICT in their learning than other age groups.

Pearson correlation analysis based on their responses to the four scales. The scales are was the nature of mathematics, beliefs about mathematics teaching and learning, attitudes towards ICT, and their beliefs about ICT literacy Both the Static Belief and Dynamic Belief were found to be significantly and positively correlated with Constructivist Use and Traditional Use of ICT literacy ($r - vr - v$alues range from 0.16 to 0.50). However, only the correlation between Dynamic Belief and Constructivist Use has a coefficient larger than 0.5, suggesting a moderate relationship (Palak & Walls 2009).

CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

In conclusion, mathematics education has pictured teachers' beliefs as an essential guarding factor for some behaviours. In spite of the recognition, the protective factor is inconclusive, and within mathematics anxiety or ICT literacy. The limitations in the literature on mathematics teachers' anxiety that exclusively focuses only on primary schools and not yet expanded to research on the destructive nature of mathematics anxiety for teachers at the secondary school level. One of

the reasons mathematics anxiety at the secondary school level is overlooked because researchers reasoned that teacher's high school mathematics anxiety might not be present. It was assumed that teachers use mathematics in daily routine and have a good specialization in mathematics. However, competent and high-performing adults can worry about mathematics too (Boyd et al. 2014; Ramirez et al. 2018), and individuals in professions who use mathematics regularly also range in performance. Lacking in the area of their specialization as a consequence of mathematics anxiety. For example, nurses handling drug dosage calculations show an inverse relationship between mathematics anxiety and the accuracy of drug dosage calculations (Boyd et al. 2014). Therefore, it brings about the secondary mathematics teachers' experience anxiety in mathematical situations.

Moreover, according to the former studies, ICT literacy and skills essential are factors affecting teachers' usage of ICT. Some research identified the shortcoming of teachers' ICT literacy which aid the parties to make teachers' literacy standards and it can encourage the use of ICT literacy at school (Gnanamuthu & Krishnakumar 2015). In addition, some ICT problems such as teaching experience are extensive, therefore more research is needed to get a clearer understanding of the problems as according to Dakich (2005). Alghamdi (2017) believed that studies on second-order barriers are mainly based on questionnaires to explore teachers' beliefs on ICT usage in teaching. The investigation addressed teachers' beliefs, mathematics anxiety, and ICT literacy which were mentioned as not authentic. For future studies, essential factors contributing to teachers' belief, ICT, including anxiety must be considered.

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