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EMOTIONAL INVENTORY OF MATHEMATICS TEACHERS AT MADRASAH IBTIDAIYAH

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Abstract

Although there is an increasing amount of research on assessing teacher emotions in general education, there is still a lack of appropriate measurement tools to measure mathematics teachers' emotions. The aim of this research is to develop an instrument for mathematics teachers' emotions and produce a ready-to-use instrument. The analytical method used is Confirmatory Factor Analysis (CFA). The sample used consisted of 310 mathematics teachers. The sample involved teachers from several madrasah ibtidaiyah in DKI Jakarta. Confirmatory Factor Analysis produces 5 factors, namely, Love, Joy, Anger, Sadness and Fear which produces 29 fit items. Thus, this assessment instrument is valid and reliable for use as a measuring tool for mathematics teachers' emotions.

Key words: mathematics teacher emotions, Confirmatory Factor Analysis (CFA).

INTRODUCTION

In the world of education, emotions play a crucial role in teacher experiences and interactions. Teachers are not only transmitters of lesson material, but also individuals who face emotional pressure, whether from students, colleagues, parents, or the educational environment more broadly. The emotions experienced by teachers can affect their performance, relationships with students, and the way they respond to challenges in teaching.

In education, mathematics is often considered one of the most challenging subjects for both students and teachers. This subject has a reputation as an abstract, logical and structured discipline, but precisely in the context of teaching mathematics, teacher emotions play an important role in the learning process. Mathematics teachers, like teachers in general, are not only responsible for conveying conceptual knowledge, but

also must engage emotionally with students, handle the stress of curriculum demands, and navigate a variety of classroom dynamics that can often trigger strong emotional responses.

Mathematics is often considered an abstract and difficult subject by students, which in turn can affect teachers' emotions when they find it difficult to make students understand the concepts being taught. Students' negative perceptions of mathematics can lead to frustration and anxiety in teachers who feel that they cannot bridge the gap between students' knowledge and curriculum demands.

In many countries, mathematics curricula are very dense, and teachers often feel pressured to cover all the material in a limited time. This can trigger negative emotions, especially when teachers feel that they do not have enough time to provide adequate explanations to struggling students. Day & Qing (2009) note that rigorous curriculum demands can cause teachers to feel a loss of control over the way they teach, which can affect their emotional well-being.

In mathematics classes, there is often great variation in student abilities. This creates a challenge for teachers to develop teaching methods that can meet the needs of all students. When there are significant differences in ability, teachers may find it difficult to balance attention between students who understand the material more quickly and those who take longer.

Mathematics teachers' emotions in teaching elementary school children, especially madrasah ibtidaiyah in this study play an important role in shaping students' attitudes, involvement and learning outcomes. Teachers who are able to manage their emotions effectively can create a positive, supportive and enthusiastic classroom atmosphere, which encourages students to be more interested and motivated in learning mathematics. On the other hand, negative emotions that are not managed well can have a negative impact on the learning process and cause anxiety or rejection of mathematics by students. Therefore, it is important for teachers to continue to develop their emotional management skills, as well as receive adequate support from the school environment in carrying out their teaching duties.

Research on teacher emotions has broad implications for the development of educational policy and professional support for teachers. By understanding teachers' emotions more deeply, schools and governments can design more effective training and support programs to help teachers manage their emotions and improve their well-being. Apart from that, emotional inventory can also be used to develop strategies to improve a healthier and more conducive work environment. The aim of this research is to develop an instrument for mathematics teachers' emotions and produce a ready-to-use instrument. So what is new in this research is a valid and reliable instrument to be used as a measuring tool for the emotions of mathematics teachers at the madrasah ibtidayah level in DKI Jakarta.

LITERATURE REVIEW

Teacher Emotions

Borg (2006) identified an important teacher skill as the ability to communicate and transmit positive energy and feelings. Emotions are socially constructed and personally enacted ways of being that arise from conscious and/or unconscious judgments regarding perceived success in achieving goals or maintaining standards or beliefs during transactions as part of a historical social context (Schutz et al., 2006) . This definition of emotion is used because it is based on the assumption that teachers' emotional experiences do not only occur in individual psychological activities, but also involve the emotional feelings of other people and interactions with the personal, professional and social environment (Chubbuck & Zembylas, 2008). Farouk (2012) states that teacher emotions consist of the dynamic level of individual teacher mental states, self-regulation abilities and emotional responses to external stimuli, and a synthetic approach. Teachers' emotions are not internalized sensations that remain within their bodies, but are an integral part of the way they relate and interact with their students, colleagues, and parents (Farouk, 2012).

Relevant literature has identified the role of teachers' emotions in relation to various aspects of education such as learning. It is widely acknowledged that teachers' emotions influence their teaching and themselves as teachers. Teacher emotions are related to teacher cognition and motivation related to their teaching behavior (Uitto et al., 2015). Teachers' emotions can influence their attention, memory, thinking, and problem solving (Golombek & Doran, 2014). Furthermore, other findings show that teachers' emotions are related to factors such as teacher identity (Lee et al., 2013), vulnerability (Kelchtermans, 2011), personal life, personal and professional life (Schutz & Zembylas, 2016), and well-being (Yin et al., 2016). Teacher emotions influence many aspects of students' lives in the classroom, including student emotions (Van Uden et al., 2014), teacher student relationships (Yan et al., 2011), engagement and motivation (Becker et al., 2014).

Therefore, teacher emotions are related to the environment, which means that teacher emotions do not reside within the individual or the environment independently, but instead involve transactions between people and the environment (Schutz et al., 2006). Overall, research findings on teacher emotions indicate that teacher emotions are multidimensional, impacting student learning and achievement, as well as teachers' professional competence, which also impacts teachers' psychological and physical health (Goetz, 2013).

Research shows that teachers' emotions not only impact their own well-being, but also have a significant influence on student learning outcomes. Frenzel et al. (2009) found that teachers who express positive emotions in the classroom, such as enthusiasm, have a tendency to create a more positive learning atmosphere, which ultimately increases student motivation and participation in learning. Conversely, teachers who show negative emotions, such as frustration or anger, can affect the overall classroom atmosphere and reduce students' learning motivation. Pekrun (2006) states that teachers' emotions can

be transmitted to students, when teachers appear anxious or depressed, students also tend to experience the same feelings.

Mathematics Teacher Emotions

The emotions experienced by mathematics teachers can cover a wide spectrum, from happiness when students achieve a deep understanding, to frustration when students have difficulty understanding the concepts being taught. Sutton and Wheatley (2003) noted that teachers' emotions play an important role in teaching, especially in creating an environment conducive to learning. In the context of mathematics, managing emotions becomes more complex due to society's negative perception of mathematics as a difficult subject and of little interest to most students.

Teacher emotions play a key role in creating a supportive and productive classroom atmosphere. Hargreaves (2000) states that emotions cannot be separated from the act of teaching. Teachers who are able to manage their emotions well can create a more positive and supportive learning environment. Conversely, teachers who are constantly stressed or frustrated may face difficulties in creating good relationships with students and maintaining their motivation. In mathematics teaching, where teachers are often faced with students' negative perceptions of the lesson, the ability to manage emotions becomes very important.

Math teachers must not only understand the concepts they are teaching, but must also be able to recognize and respond to the emotional needs of students who may feel anxious or intimidated by math lessons. Frenzel et al. (2009) examined how teachers' emotions, particularly in the context of mathematics, can influence students' attitudes towards lessons. This research shows that teachers who display positive emotions, such as enthusiasm and happiness, tend to transmit positive attitudes to their students, which ultimately increases student motivation and learning achievement.

In general, teacher emotions can be categorized into two large groups: positive emotions and negative emotions. Positive emotions often arise when teachers feel successful in conveying material effectively, especially when students show deep understanding or significant progress. Teachers who experience positive emotions tend to be more motivated to engage in learning and encourage their students to think critically and creatively.

On the other hand, negative emotions often arise when teachers feel pressured by work demands, students' inability to understand complex mathematical concepts, or lack of support from the school environment. Negative emotions can affect teaching effectiveness, because teachers who feel stressed tend to have a lower capacity to manage classroom interactions productively. In mathematics teaching, negative emotions such as frustration often arise when students have difficulty understanding abstract concepts or when there are large gaps in student ability levels within a class.

Support from coworkers, principals, and administration can influence teachers' emotions. Teachers who feel supported by their school environment tend to be better able

to manage negative emotions and face challenges better. Conversely, a lack of support can cause teachers to feel isolated and burdened by work demands.

Mathematics Teacher Emotion Inventory

Parrott (2001) describes a comprehensive list that organizes emotions into a dimensional tree structure in which basic emotions are divided into secondary emotions, which are then further divided into tertiary emotions. Six primary emotions are included in the first level, namely love, joy, surprise, anger, sadness, and fear. The second level contains more emotions within each primary emotion group. Love, for example, is followed by affection, lust, longing, joy as secondary emotions. Each emotional feeling from the group of secondary emotions has a tertiary division.

Parrott (2001) states that many aspects of emotion are often treated separately even though they can only be understood as a whole. He gives an example by stating that the two secondary emotions, namely disappointment and shame, originate from the primary emotion, namely sadness, although many people who experience them do not realize that both are related to sadness. The Parrott tree structure, which details a list of specific, shallow tertiary emotions as well as deeper secondary and primary emotions, can be a promising research instrument because it provides a research instrument that provides a complete explanation of human emotions and provides an in-depth awareness of how emotions are related to different categories. deeper.

The development of dimensions in the Teacher Emotion Inventory (TEI) stems from the realization that teacher emotions play a much more complex and multidimensional role than previously understood. Research in the field of emotional psychology, especially in the educational context, shows that teacher emotions are not only limited to negative emotions such as stress or burnout, but also include various positive and negative emotions that dynamically interact in the teaching environment.

There are 5 dimensions of the Teacher Emotion Inventory (TEI) including 24 items, namely love (4 items), joy (6 items), anger (4 items), sadness (4 items), and stress (6 items). This research aims to provide better insight into emotional experiences and how they can influence teacher performance in inclusive education environments in Hong Kong. The research results show a statistically significant correlation between positive emotions (joy and love). Negative emotions (anxiety, anger, and stress) seem to be negatively correlated with their attitudes. The results of this study support that the TEI is a useful tool for assessing emotions that plays an important role in helping school teachers (Yang et al., 2022).

The Teacher Emotion Inventory (TEI) includes 26 items and is divided into 5 dimensions, namely love (5 items), joy (5 items), anger (5 items), sadness (5 items), and fear (6 items). Among these feelings, joy and love are positive feelings, while sadness, anger and fear are negative feelings. This research aims to understand the emotions experienced by prospective English teachers and how these emotions influence their approach to teaching in Turkey. The results showed that the most common emotion

among teachers was fear and the most preferred teaching approach was the knowledge transmission approach. Apart from that, the findings also show that sadness is closely related to the knowledge transmission approach (Kirmizi & Saricoban, 2020).

The Teacher Emotion Inventory (TEI) includes 16 items and is divided into 4 dimensions, namely love (3 items), joy (6 items), anger (3 items), and fear (4 items). Among these feelings, joy and love are positive feelings, while anger and fear are negative feelings. The sample in this study was Spanish teachers. The data demonstrated adequate internal consistency of the TEI-BSV subscales, and exploratory and confirmatory factor analyzes provided evidence that the TEI-BSV has a well-adjusted 4-dimensional structure, compared with the proposed 5-dimensional structure. There is evidence of convergent validity, as well as criterion and incremental validity (Rodriguez-Donaire et al., 2024).

The Teacher Emotion Inventory (TEI) includes 26 items and is divided into 5 dimensions, namely love (4 items), joy (7 items), anger (4 items), sadness (4 items), and fear (7 items). Among these feelings, joy and love are positive feelings, while sadness, anger and fear are negative feelings. The participating teachers teach at various levels and branches in public schools in Turkey. Based on confirmatory factor analysis, the 5-dimensional TEI model was successfully confirmed in this study. In addition, the dimensions of joy and love show a positive correlation with job satisfaction. The love and fear dimensions significantly predict job satisfaction with a moderate effect. The love, sadness and fear dimensions significantly predict teacher burnout with moderate effects (Atmaca et al., 2020).

The Teacher Emotion Inventory (TEI) includes 23 items and is divided into 5 dimensions, namely love (5 items), joy (5 items), anger (4 items), sadness (5 items), and fear (4 items). Among these feelings, joy and love are positive feelings, while sadness, anger and fear are negative feelings. The sample consisted of 963 prospective teachers drawn from four universities in China. The research results show that three emotional dimensions have been identified which are related to their practical value, namely, joy, love and anger. Findings regarding these three dimensions can provide a new perspective for effectiveness research by considering teacher emotions and efficacy (Chen, 2018).

The Teacher Emotion Inventory (TEI) includes 26 items and is divided into 5 dimensions, namely love (5 items), joy (5 items), anger (5 items), sadness (5 items), and fear (6 items). Among these feelings, joy and love are positive feelings, while sadness, anger and fear are negative feelings. A model involving three factors (knowledge transmission, teacher-student interaction, and student focus) was confirmed. This research involved elementary school teachers from China and Hong Kong. Structural equation modeling shows that a more student-centered approach is a consequence of positive teacher emotions, whereas a teacher-centered approach is a consequence of negative teacher emotions (Chen, 2018).

The Teacher Emotion Inventory (TEI) includes 26 items and is divided into 5 dimensions, namely love (4 items), joy (7 items), anger (4 items), sadness (4 items), and fear (7 items). Among these feelings, joy and love are positive feelings, while sadness, anger and fear are negative feelings. This research involved elementary school teachers from China and Hong

Kong. This model depicts elementary school teachers enjoying positive interactions with students and colleagues, recognition from school, family, and society, but experiencing negative emotions related to unfair treatment, competition among colleagues, work-life imbalance, and pressure from society, policy , and educational change (Chen, 2016).

The Teacher Emotion Inventory (TEI) was developed by Chen in 2016. This instrument aims to measure teachers' emotions in an educational context, which consists of various dimensions of emotions they experience while teaching. Teacher Emotion Inventory (TEI) dimensions: (1) joy, this dimension describes positive emotions experienced by teachers, such as feelings of pleasure or satisfaction in teaching and seeing students develop; (2) love, this dimension refers to feelings of affection or concern for students, including feelings of empathy and attention to their needs; (3) sadness, measuring negative emotions experienced when teachers feel they have failed or are dissatisfied with their or students' achievements in the learning process; (4) anger, this dimension includes feelings of frustration or anger due to challenging situations in teaching, such as inappropriate student behavior or lack of support from the school environment; (5) fear, measuring feelings of fear or anxiety that arise due to work pressure or concerns about failure in teaching or facing challenges in class.

The mathematics teacher emotion inventory aims to provide in-depth insight into the emotional spectrum experienced by mathematics teachers in their daily activities. By understanding the variety of emotions that arise in the profession, better instruments can be developed to support teachers, both through interventions focused on mental health and emotional training. Additionally, this inventory also allows educational institutions to recognize the emotional needs of their mathematics teachers and create a more supportive work environment.

METHOD

Sample

The population of this study were all Madrasah Ibtidaiyah mathematics teachers in DKI Jakarta Province. The sample used consisted of 310 mathematics teachers. This research was carried out in the odd semester of 2024/2025.

Instrument

Table 1. Statement Items

X1 = Love (Chen, 2018)
(1) I enjoy watching students grow.
(2) I enjoy contributing to student learning.
(3) I love being a teacher because I get a sense of accomplishment.
(4) I am passionate about teaching.
(5) I am happy to be a teacher because I get respect and recognition from society.
X2 = Joy (Atmaca et al., 2020)

(6) I am motivated by student concern.
(7) I feel proud when I see students making progress.
(8) I am pleased that students enjoy teaching.
(9) I really enjoy when students interact with the teaching.
(10) I am motivated by support from colleagues and leadership.
(11)I enjoy sharing with colleagues.
(12) I was touched by my parents' understanding and support.
X3 = Anger (Chen, 2018)
(13) I feel irritated when I fail to optimize students' learning attitudes.
(14) I feel irritated when students don't get along with the teacher.
(15) I feel angry when I am treated unfairly (for example: workload, salary, and evaluation).
(16) I feel angry if the teaching profession is misused.
(17) I am angry when society and/or the public blames teachers without evidence.
X4 = Sadness (Kirmizi & Saricoban, 2020)
(18) I feel sad when students behave badly.
(19) I find it frustrating when students don't have a sense of responsibility for their own learning.
(20) I feel frustrated when the activity plan does not work as expected.
(21) I find it frustrating when professional beliefs conflict with demands for educational reform.
(22) I feel frustrated with rigid policies and systems.
X5 = Fear (Chen, 2016)
(23) I feel pressured by high expectations from my parents.
(24) I worry about how to increase student engagement and achievement.
(25) I worry about competition with colleagues.
(26) I worry that students are not taking responsibility for their studies.
(27) I feel stressed by the imbalance between work and life.
(28) I feel stressed when I lack time because I have too much work.
(29) I felt depressed because students could not accept the new teaching style adapted to the new curriculum.

The instrument used to measure mathematics teachers' emotions is a questionnaire with a Likert scale consisting of 5 options, namely Strongly Agree (SS), Agree (S), Disagree (KS), Disagree (TS), and Strongly Disagree (STS).

Data analysis

A sample of 310 mathematics teachers was tested for construct validity and reliability using Confirmatory Factor Analysis (CFA) both first order and second order. The software used in this research is Lisrel.

RESULTS AND DISCUSSION

Confirmatory Factor Analysis (CFA)

1. CFA first order testing

First order CFA testing is carried out by creating a measurement model to describe how well the indicators in the items in the instrument can be used to directly measure the dimensions.

Table 2. Results of First Order CFA Model Fit Measure Analysis

Goodness of Fit	Fit Criteria	*Results*	Conclusion
A. Absolute Fit Measures			
Chi Square	p > 0,05	0,00	Not Fit
GFI	> 0,90	0,83	Not Fit
RMSEA	< 0,08	0,071	Fit
SRMR	< 0,05	0,022	Fit
ECVI	< ECVI saturated,	3,46 > 2,82	Not Fit
	Independence model	3,46 < 233,39	
B. Incremental Fit Measures			
AGFI	> 0,90	0,80	Not Fit
NFI	> 0,90	0,99	Fit
CFI	> 0,90	0,99	Fit
IFI	> 0,90	0,99	Fit
RFI	> 0,90	0,99	Fit
C. Parsimonius Fit Measures			
AIC	< AIC saturated,	1069,39 > 870,00	Not Fit
	Independence model	1069,39 < 72116,78	
CAIC	< AIC saturated ,	1391,48 < 2930,41	Fit
	Independence model	1391,48 < 72254,14	
PGFI	> 0,60	0,70	Fit

The results of testing the suitability of the measurement model showed that 8 of the 13 Goodness of Fit measures were declared fit. Thus, the results of this test indicate that the overall model fit is good.

After producing a suitable model, analysis is then carried out to see the validity of the items through factor loading. The path diagram for this test can be seen in the following image.

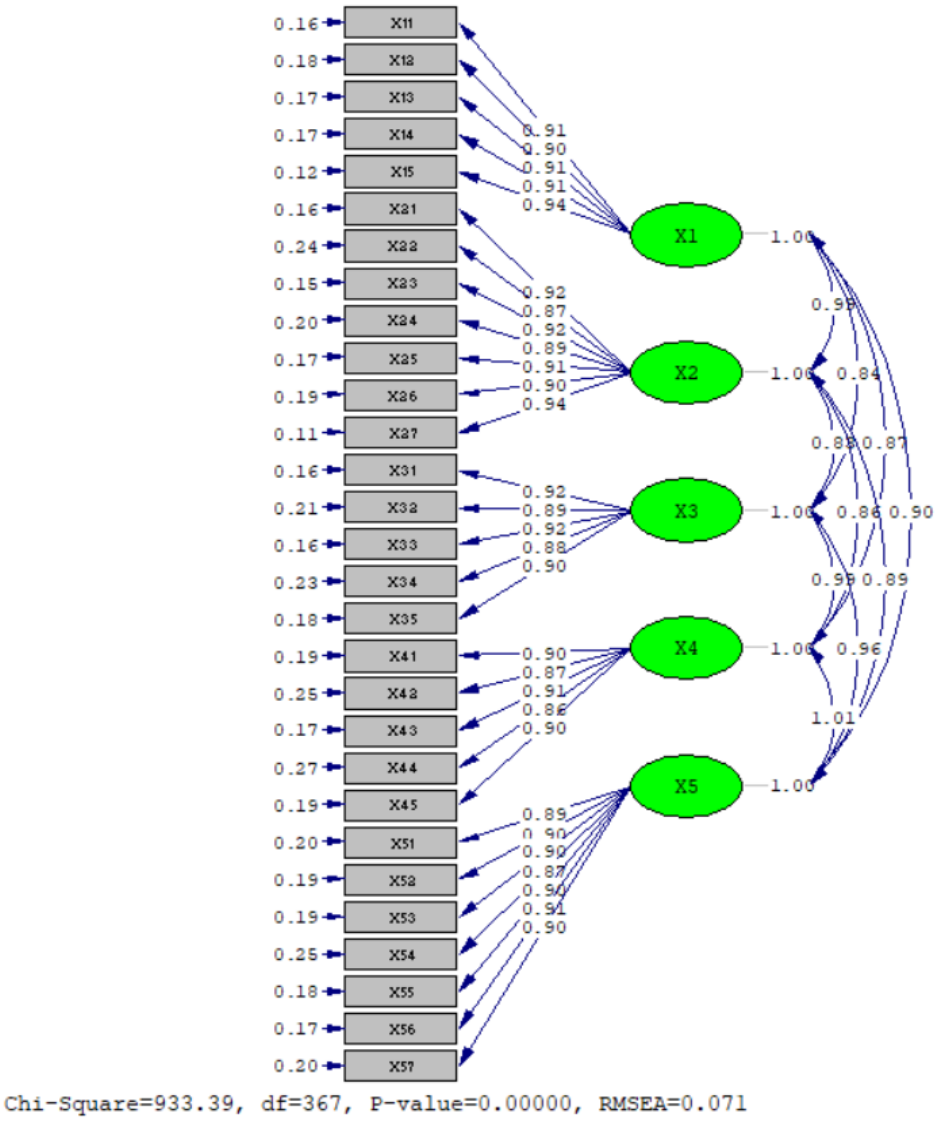

Figure 1. First Order Path Diagram

Testing the validity of the instrument is carried out by looking at the factor loading values on the items produced at the CFA stage. The factor loading value used as the threshold for an item to be considered valid is > 0.5. Below are presented the factor loading values at the first order CFA stage.

Table 3. First Order CFA Validity Test

Dimension	Item	Factor Loadings	Decision
Love	X11	0,91	Valid
	X12	0,90	Valid
	X13	0,91	Valid
	X14	0,91	Valid
	X15	0,94	Valid

Joy	X21	0,92	Valid
	X22	0,87	Valid
	X23	0,92	Valid
	X24	0,89	Valid
	X25	0,91	Valid
	X26	0,90	Valid
	X27	0,94	Valid
Anger	X31	0,92	Valid
	X32	0,89	Valid
	X33	0,92	Valid
	X34	0,88	Valid
	X35	0,90	Valid
Sadness	X41	0,90	Valid
	X42	0,87	Valid
	X43	0,91	Valid
	X44	0,86	Valid
	X45	0,90	Valid
Fear	X51	0,89	Valid
	X52	0,90	Valid
	X53	0,90	Valid
	X54	0,87	Valid
	X55	0,90	Valid
	X56	0,91	Valid
	X57	0,90	Valid

From the results of the first order CFA analysis, it was found that the total factor loading values were > 0.5, which means that the relationship between the indicators and their dimensions was significant.

2. CFA second order testing

Second order CFA testing was carried out to measure the validity and reliability of the latent variable of mathematics teacher emotions indirectly by 5 dimensions, namely Love, Joy, Anger, Sadness, and Fear.

Table 4. Results of Second Order CFA Model Fit Measure Analysis

Goodness of Fit	**Fit Criteria**	**Results**	**Conclusion**
D. Absolute Fit Measures			
Chi Square	p > 0,05	0,00	Not Fit
GFI	> 0,90	0,79	Not Fit
RMSEA	< 0,08	0,085	Marginal Fit
SRMR	< 0,05	0,055	Marginal Fit

ECVI	< ECVI saturated,	4,29 > 2,82	Not Fit
	Independence model	4,29 < 233,39	
E. Incremental Fit Measures			
AGFI	> 0,90	0,75	Not Fit
NFI	> 0,90	0,98	Fit
CFI	> 0,90	0,99	Fit
IFI	> 0,90	0,99	Fit
RFI	> 0,90	0,98	Fit
F. Parsimonius Fit Measures			
AIC	< AIC saturated,	1325,29 > 870,00	Not Fit
	Independence model	1325,29 < 72116,78	
CAIC	< AIC saturated ,	1623,70 < 2930,41	Fit
	Independence model	1623,70 < 72254,14	
PGFI	> 0,60	0,67	Fit

The results of testing the suitability of the measurement model showed that 6 of the 13 Goodness of Fit measures were declared fit and 2 of the 12 Goodness of Fit measures were declared marginal fit. Thus, the results of this test indicate that the overall model fit is good.

After producing a suitable model, analysis is then carried out to see the validity of the items through factor loading. The path diagram for this test can be seen in the following image.

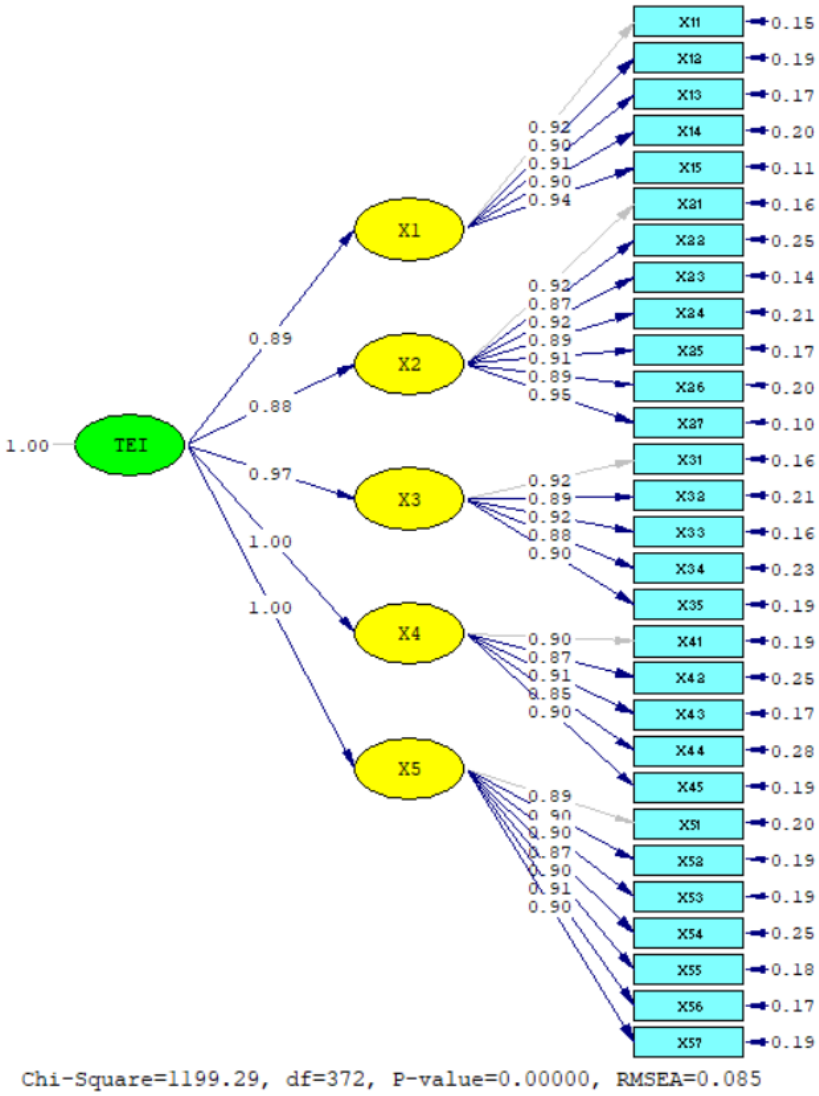

Figure 2. Second Order Path Diagram

Testing the validity of the instrument is carried out by looking at the factor loading values on the items produced at the CFA stage. The factor loading value used as the threshold for an item to be considered valid is > 0.5. Below are presented the factor loading values at the second order CFA stage.

Table 5. Second Order CFA Validity Test

Variable Latent	Dimensions	Item	Factor Loadings	Decision	CR	AVE
Mathematics Teacher Emotions	Love	X11	0,92	Valid	0,94	0,84
		X12	0,90	Valid		
		X13	0,91	Valid		
		X14	0,90	Valid		
		X15	0,94	Valid		
		X21	0,92	Valid		

	Joy	X22	0,87	Valid	0,97	0,82
		X23	0,92	Valid		
		X24	0,89	Valid		
		X25	0,91	Valid		
		X26	0,89	Valid		
		X27	0,95	Valid		
	Anger	X31	0,92	Valid	0,96	0,81
		X32	0,89	Valid		
		X33	0,92	Valid		
		X34	0,88	Valid		
		X35	0,90	Valid		
	Sadness	X41	0,90	Valid	0,95	0,78
		X42	0,87	Valid		
		X43	0,91	Valid		
		X44	0,85	Valid		
		X45	0,90	Valid		
	Fear	X51	0,89	Valid	0,97	0,80
		X52	0,90	Valid		
		X53	0,90	Valid		
		X54	0,87	Valid		
		X55	0,90	Valid		
		X56	0,91	Valid		
		X57	0,90	Valid		

From the results of the second order CFA analysis, it was found that the total factor loading value was > 0.5, which means that the relationship between the latent variable of mathematics teachers' emotions indirectly by the 5 dimensions was significant.

Reliability

Instrument reliability testing in this research was carried out by looking at the CR and AVE criteria resulting from the second order CFA analysis in the previous section. The instrument is classified as reliable because the CR and AVE values in item reliability testing are in accordance with the criteria for reliable items, namely CR > 0.7 and AVE > 0.5, where the CR value is 0.94 – 0.97 and the AVE value is 0.78 – 0, 84.

CONCLUSION

Confirmatory Factor Analysis on mathematics teacher emotions produced 5 factors with a total of 29 fit items consisting of, Love (5 items), Joy (7 items), Anger (5 items), Sadness (5 items) and Fear (7 items). Thus, this assessment instrument is valid and reliable for use as a measuring tool for mathematics teachers' emotions.

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