# THE EXAMINATION OF MEASUREMENT INVARIANCE OF MOTIVATIONS TO BECOME A TEACHER SCALE IN TERMS OF **DEPARTMENT AND GENDER**

Serhat Aydin<sup>1</sup>, Murat İbrahim Yazar<sup>2</sup>

<sup>1</sup>Department of Mathematics and Science, Karamanoğlu Mehmetbey University, Karaman, Turkey <sup>2</sup>Department of Mathematics and Science, Karamanoğlu Mehmetbey University, Karaman, Turkey

#### Abstract

Measurement instruments used in psychology or education are expected to work similarly in different groups in order to make meaningful comparisons and assessments across these groups. This issue is handled via conducting measurement invariance (MI) tests on data collecting tools. Usually only a single parameter is addressed in MI studies and one of the most frequently examined parameter is gender. In Turkey, measurement invariance studies are still limited in number and they concentrate also on the gender variable. In this study, factor structure of 9-items Motivations to Become a Teacher Scale developed for international Teacher Education and Development Study in Mathematics (TEDS-M) and measurement invariance of these factors in terms of department and gender were examined. For this aim, the 5-stage method recommended by Vandenberg and Lance was used. This method is based on the progressive application of different models from the least restricted through the most restricted one. The study sample consisted of 1878 preservice teachers from four different departments from 16 different universities randomly selected in Turkey. The data was analyzed using multi-group confirmatory factor analysis in Lisrel 8.80 software. In order to determine invariance, several fit indices were used together. According to 5-stage analysis outputs, it was concluded that the scale had two factors such as "intrinsic motivation" and "extrinsic motivation", these factors had measurement invariance in terms of department and gender and the Scale could be used to compare different departments and sexes.

Keywords: Motivations to Become a Teacher, Measurement Invariance (MI), Preservice Teachers, Intrinsic

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Motivation, Extrinsic Motivation

# **1. INTRODUCTION**

Motivation has been classically defined as a function of the value placed on certain goals and the perceived likelihood that a behavior will lead to those goals [1]. Although the term has emerged from observation of inner mechanisms of action [2], it's also effected from outer causes, it forces the person to act and is one of the most significant variables in determining why someone behave in a particular way [3]. This deep inner mechanism, which is fueled and controlled by several inner(intrinsic) and outer (extrinsic) factors [4], acts on every decision a human being takes one of which is choosing a profession. The motivation to choose a profession was defined as the orientation of a person to the profession which she/he sees most fulfilling and promising [5]. The motivation to become a teacher might explain how determined, decisive and ambitious someone is to teach. The motivation for becoming a teacher was found related to engagement in and commitment to the profession [6; 7; 8]. Several inner and outer factors are probably effecting this mood.

So far, many studies in EU [9;10; 7; 11] Australia [12], China [13], US [14] and Turkey [15; 16; 17] were conducted in order to identify the motivations of in-service and preservice teachers to choose the teaching profession. The literature shows that there are basically two latent variable

groups acting on these decisions which are intrinsic and extrinsic factors [4]. Intrinsic factors include reasons such as "love for a specific subject", "love for spending time with kids", and extrinsic factors include reasons such as "long term job security" [4; 7].

By identifying the motivations of (preservice teachers) to become a teacher, possible solutions for the retention of teachers in the teaching profession [18; 8] might be developed. Identifying and improving teacher motivation might increase job satisfaction [5] and allow teachers improve pupils' motivation [19; 20]. Longitudinal studies might also identify the motivations of the "best achieving" pre-service and in-service teachers in order to make plans to attract more of these to teaching profession [21]. In addition, motivationally advantaged groups in terms of demographic variables might be determined [22].

As mentioned above, many studies have explored the motivation to become a teacher though it was criticized that these studies had used weak methodologies [8] or not provided evidence for the validity of the scales used across different contexts [23]. Motivations to become a teacher should be compared across groups, but to be able to make meaningful comparisons, the measurement instruments should have construct validity. Construct validity of a measurement instrument means that it really measures the construct it is intended to. Construct validation is the basic prerequisite to the proper interpretation of a test score [24]. However, successfully measuring the construct in the entire sample doesn't even suffice that the construct will measure the construct in homogenous subgroups such as females successfully. This concept is defined as measurement invariance and is needed to be able to compare these groups meaningfully [25] but usually is not tested [26]. The number of studies on the measurement invariance of instruments are scarce [27] and no studies were encountered yet on the MI of scales measuring motivations to become a teacher. At this point, TEDS-M Intentions/Motivation to be a teacher" scale [21] which was adapted from English into Turkish and shown to be valid and reliable (total variance explained by the whole scale = % 50, alpha = 0.75 Mc Donald Omega = 0.85, item-total correlations above 0.54) is an important and robust measurement instrument [28]. The original scale and its Turkish form has nine items, three of which are related to extrinsic reasons and the remaining six are related to intrinsic reasons. The original scale was used in international comparative study Teacher Education and Development Study in Mathematics (TEDS-M) in 17 countries on more than 8000 preservice teachers [21].

Based on the literature mentioned above research questions of this study were posed as follows:

- 1. Does the Turkish adaptation (of TEDS-M Motivations to Become a Teacher Scale have measurement invariance across different departments?
- 2. Does the Turkish adaptation of TEDS-M Motivations to Become a Teacher Scale have measurement invariance across different genders?

# 2. METHOD

In this part, the study sample, instruments and data analysis procedures are explained.

## 2.1 Study Sample

The study sample consisted of 1878 preservice teachers from 16 different universities randomly selected in Turkey. It is illustrated in Table 1.

Variable	Variable	Frequency	Percentage
	Levels		(%)
Gender	Female	1446	77,0
	Male	432	23,0
Year of study	1 <sup>st</sup> Year	1364	72,6
	2 <sup>nd</sup> Year	176	9,3
	3 <sup>rd</sup> Year	187	9,9
	4 <sup>th</sup> Year	151	8,0
Department	Preschool	216	11,5
	Primary	624	33,2
	Elementary	917	48,8
	Maths		
	Secondary	121	6,4
	Maths		
	Total	1878	100

Table -1: Study Sample

Table 1 illustrates that the study sample consisted of 1446 (% 77) female and 432 (% 23) male preservice teachers. In terms of year of study, 1364 (% 72,6) are 1st years (Freshmen), 176 (% 9,3) are 2nd years (Sophomores), 187 (% 9,9) are 3rd years (Juniors) and 151 (% 8,0) are 4th years (Seniors). In terms of department, 216 (% 11,5) are in preschool education, 624 (% 33,2) are in primary education, 917 (% 48,8) are in elementary mathematics education and 121 (% 6,4) are in secondary mathematics education department.

#### **2.2 Instruments**

In this study, factor structure of the Turkish form of 9-items Motivations to Become a Teacher Scale developed for international Teacher Education and Development Study in Mathematics (TEDS-M) [21] and measurement invariance of this factor structure in terms of department and gender was explored. The original scale was reported to have two factors such as "intrinsic motivation" (6 items) and "extrinsic motivation" (3 items). The Turkish adaptation of the scale was also reported to have the same two factors and alpha coefficients above ,74 for both factors and the whole scale [28].

#### 2.3 Data Analysis

First of it was checked whether the dataset met the assumptions of multi-group confirmatory factor analysis method (MGCFA). For this aim, the five-stage method such as i) seperate CFAs for each level of variables, ii) configural invariance test, iii) weak (metric) invariance test, iv) strong (scaler) invariance test and v) complete (strict) invariance test was used [29]. The tests were conducted hierarchically and step by step. The scale was accepted to have measurement invariance for a variable if and only if it had passed these five tests.

## **3. FINDINGS**

In this part of the study, the findings of the study are presented. Firstly, 13 missing values and 25 outliers (z-score smaller than -3 or larger than 3) were removed from the study. Then, normality assumption was tested for all 9 items. Skewness and kurtosis values between -1 and 1 were taken as evidence that an item met the assumption of normality [30]. Table 2 shows the skewness and kurtosis values for all items.

		Ger	ıder						•	
		Female				Male				
Items		Ske	w.		Kurt.		Skew.	Skew.		
1		0,54	1		-0,81		0,59		-0,84	
2		0,17	7		-1,08		0,37		-1,00	
3		-0,2	4		-1,05		-0,13		-1,01	
4		-0,5	9		-0,19		-0,59		-0,14	
5		-0,5	3		-0,72		-0,43		-0,76	
6		0,74	1		-0,16		0,81		-0,20	
7		-0,8	9		0,39		-0,78		0,27	
8		-0,0	2		-1,06		-0,03		-1,07	
9		-0,27		-0,84		-0,18		-1,04		
Department									•	
Preschool			Primary			Elementary	Maths	Secor	ndary M	aths
Skew.	Kurt.		Skew.	Kurt.		Skew.	Kurt.	Skew	•	Kurt.
0,95	-0,21		0,42	-0,94		0,53	-0,86	0,67		-0,70
0,75	-0,68		0,29	-1,01		0,11	-0,97	-0,08		-1,01
1,06	0,02		0,47	-1,05		-0,93	0,11	-0,52		-0,87
-0,54	-0,14		-0,68	0,04		-0,56	-0,19	-0,72		-0,16
-1,05	0,88		-0,63	-0,58		-0,34	-0,86	-0,51		-0,58
0,81	0,05		0,76	-0,32		0,87	0,27	0,68		-0,38
-1,12	0,71		-0,99	0,93		-0,72	0,08	-0,74		-0,09
-0,20	-0,98		-0,11	-1,04		0,04	-1,03	-0,01		-0,93
-0,25	-1,07		-0,19	-0,90		-0,26	-0,87	-0,37		-0,95

Table - 2: Findings of skewness and kurtosis tests for all items across subgroups

The skewness and kurtosis values for the items shown Table 2 provides evidence that the normality assumption was met for the data at hand. Then a preliminary CFA was conducted to test find out how much the 9-item model provided a good fit. The results of the preliminary CFA on 9-item two-factor model is shown in Figure 1.



**Fig -1**: Preliminary CFA findings of 9-item bidimensional model tested on the entire sample

The preliminary CFA findings of 9-item bidimensional model tested on the entire sample did not provide a good fit ( $\chi 2(df) = 500(26)$ ,  $\rho < ,000$ , RMSEA [90% CI] =,142 [,13;,15], SRMR=,13, NNFI=,71). This lack of fit was

thought to be stemming mainly from item INT\_03. This item reads "I want to be a teacher because I like mathematics" which is rather relevant to preservice elementary and secondary mathematics teachers but not to preservice primary or preschool teachers. So this item was excluded from the analysis which led to 8-item bidimensional baseline model which reveled acceptable fit indices ( $\chi 2(df) = 72(26)$ ,  $\rho < ,000$ , RMSEA [90% CI] =,07 [,07], 07], SRMR=,06, NNFI=,93). The baseline model is illustrated in Figure 2.



Fig - 2: Adjusted baseline model of 8-item bidimensional model tested on the entire sample

Then the hypothesized baseline model shown in Figure 2 was tested across subgroups within gender and department variables. The first item in each factor (dimension) of the scale was fixed to 1 as reference. The findings of separate CFA tests on each subgroup is presented in Table 3.

Tabl	e - 3: F	it indic	ces for	the ba	seline	model	in s	subgroup	s
	-	_							_

Groups	Subgroups	χ2	RMSEA [90%	SRMR	NNFI	CFI	Decision
		(df)	CI]				
	Female	51	.05 [.05;.06]	.05	.96	.95	Accept
ar		(19)					
nde	Male	42	.05 [.05;.05]	.05	.97	.95	Accept
Ge		(19)					
	Preschool	27	.04 [.04;.04]	.04	.98	.97	Accept
		(19)					
	Primary	29	.04 [.04;.05]	.05	.98	.96	Accept
		(19)					
ent	Elem. M.	31	.04 [.04;.05]	.05	.98	.96	Accept
tt		(19)					
раг	Sec. M.	30	.04 [.04;.05]	.05	.98	.96	Accept
De		(19)					

According to the fit indices shown in Table 3, the original baseline model fitted the data for each subgroup separately. After the fit of data to the model for each separate subgroup was shown, one-way ANOVAs for department and t-tests for independent samples for gender groups were conducted. The t-tests indicated no statistically significant variation in

responses of males and females. On the other hand, one-way ANOVAs indicated statistically significant variation in responses of preservice teachers from different departments in three items. The findings of ANOVAs and t-tests are shown in Table 4.

Table - 4: Findings of ANOVAs and t-tests for the items

	Gender			Department		
Item	t	df	р	F	р	df
1_INT	-,121	1870	,904	,813	,487	3
4_INT	1,453	1868	,146	2,680	,045*	3
5_INT	,978	1864	,328	2,151	,092	3
7_INT	,970	1866	,332	1,417	,236	3
8_INT	-,347	1866	,729	3,456	,016*	3
2_EXT	,402	1866	,688	,640	,589	3
6_EXT	-1,739	1868	,082	,679	,565	3
9_EXT	1,383	1868	,167	2,750	,041*	3
* p < .05						

The statistically significant variations in some items across different departments shown in Table 4 can indicate a real variation of responses in these subgroups. On the other hand, this might also indicate a measurement invariance problem. In order to eliminate this probability, invariance tests should be conducted and comparability of results obtained from this scale should be proven. Findings of measurement invariance tests are shown in Table 5. At the first stage of measurement invariance analysis illustrate in Table 4 the fit of data separately to each subgroup of gender, department and year of study variables were shown. At this point four more stages of analysis were conducted. These tests were conducted from the least restricted model (Configural) to the most restricted one (Strong).

Fable - 5:	Findings	of Measuren	nent Invariance	Tests
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	MI	χ2	Δχ2	RMSEA [90% CI]	CFI	NNFI	Comparison
		(df)	$(\Delta df)$				Decison
			р				
ar	Co.	50	-	.04 (.04;.04)	.98	.97	-
nde		(38)					Accept
Ge		>.05					

	Me.	61 (44)	11 (6) >.05	.04 (.04;.05)	.97	.97	C. vs. M. Accept
	Sc.	84 (58)	23 (14) >.05	.05 (.05;.05)	.97	.97	M. vs. S. Accept
	St.	103 (69)	19 (11) >.05	.06 (.06;.06)	.96	.96	S. vs. S. Accept
	Co.	98 (77) >.05	-	.03 (.03;.04)	.99	.98	- Accept
	Me.	113 (85)	15 (8) >.05	.05 (.05;.05)	.97	.97	C. vs. M. Accept
ent	Sc.	137 (102)	24 (17) >.05	.05 (.05;.05)	.97	.96	M. vs. S. Accept
Departm	St.	152 (114)	15 (12) >.05	.05 (.05;.06)	.98	.97	S. vs. S. Accept

The analyses above in Table 5 support the measurement invariance of the six-factor model across gender and department subgroups. Configural invariance held for both variables respectively (i.e. for gender group  $\chi 2=50$ , df=38, χ2/ df=1.31, p>.05, RMSEA=.04 [.04;.04], CFI=.98, NNFI=.97), indicating two-factor model was acceptable across all subgroups of gender and department. Secondly, metric (weak) invariance was checked by testing equality of factor loadings. When looked at the fit indices, it was found that metric invariance held (i.e. for gender group  $\Delta \chi 2=11$ , ∆df=6, p>.05, RMSEA=.04 [.04;.05], CFI=.97, NNFI=.97) and the scale had equal factor loadings across all subgroups of gender and department. Thirdly, according to the fit indices in Table 5, scalar (strong) invariance tests were able to produce non-significant findings (i.e. for gender group Δχ2=23, Δdf=14, p>.05, RMSEA=.04 [.04;.05], CFI=.97, NNFI=.97) for both gender and department variables. Finally, strict (complete) invariance held (i.e. for gender group  $\Delta \chi 2=19$ ,  $\Delta df=11$ , p>.05, RMSEA=.06 [.06;.06], CFI=.96, NNFI=.96) across all subgroups of gender and department.

Overall, the findings indicated that measurement invariance held for both variables and a bidimensional 8-item model was tenable. The five-stage model confirmed the separate, configural, weak, strong and complete invariance of the scale across all subgroups of the three variables.

# 4. CONCLUSION

In this study, five-stage model [29] was used to confirm the separate, configural, weak, strong and complete measurement invariance of the Turkish adaptation [28] of TEDS-M Motivations to Become a Teacher Scale [21] across all subgroups of gender and department variables. The results indicated measurement invariance and provided evidence that the scale might be used to compare males and female preservice teachers. According to the results, the

scale might also be used to compare preservice teachers from different departments. Previous studies reported that motivations to become a teacher have two dimensions (latent variables or factors) such as intrinsic [31] and extrinsic motivation [32]. These intrinsic and extrinsic motivations were shown to vary significantly across different subgroups of the population both in the world [32] and in Turkey [15; 33]. However, the robustness and measurement invariance of these instruments have not been shown which is being strongly criticized by some researchers [8; 23]. In response, this study was provided evidence for MI and robustness of the Turkish adaptation of the TEDS-M Motivations to Become a Teacher Scale [21] across subgroups of gender and department. This study is in a sense extension of the work by Aydın and Çelik [28] who provided evidence for the validity and reliability of the scale but only for the sample of preservice elementary mathematics teachers which is made up of both males and females. Future research might concentrate on proving MI of the same scale across subgroups of other demographic variables such as year of study or level of general achievement (GPA).

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## BIOGRAPHIES



Aydın, S. has obtained his Ph.D. degree from Karadeniz Technical University, Turkey (2014). His areas of interest are teacher education, beliefs, attitudes, and pedagogical content knowledge.



YAZAR M. İ. has obtained his Phd degree - Mathematics from Yüzüncü Yil University, Turkey (2014). His areas of interest are Soft set theory, fuzzy set theory, decision making problems.