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Structural Equation Modeling Approach to Determine the Effect of Attitude towards Statistics on Statistical Self-efficacy Belief

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Abstract
In this study, it is aimed to examine the relationship between students' statistical self-efficacy beliefs and their attitudes towards statistics and to propose a structural equation model by identifying the factors affecting them. IBM SPSS and AMOS package program were used in the data analysis. Data were collected from 330 university students who took statistics and biostatistics lessons to form the sample of the study. As a result of the analysis, it was concluded that the self-efficacy beliefs and attitudes towards to statistics lesson of students were at a moderate level. A positive and significant correlation was obtained between statistical self-efficacy belief and attitude. It was determined that statistical attitude explains 33% of the statistical self-efficacy belief. We propose to use modified multi-factor first-order and multi-factor first-order models for statistical self-efficacy belief and attitude levels, respectively. This result was supported with the values of goodness of fit indices.

1. Introduction

It is known that the attitudes that students who take statistics lesson develop towards statistics and their self-efficacy belief affect their success.

Statistical information and methods are used for making an assessment and taking decisions in any matter. The reason why statistics course is taught in schools is because it is a tool used in different fields, to enable individuals to benefit from this subject in daily life and to look at events more critically [1], [2]. According to Bandura [3], self-efficacy is the beliefs and perceptions that a person creates about his personal skills specific to the situation that concerns a specific job, task, activity or field. Self-efficacy belief affects individuals' emotions, thoughts, forms of motivation, learning methods and using those and their behaviours of asking for help in situations that require support in academic sense [4], [5]. In addition, it has been shown that the effective use of learning methods by individuals affects their success.

Attitude is an orientation which is assigned to the person and which constitutes the person's emotions, thoughts and behaviours related to a psychological object decisively [6]. Aydın and Sevimli [7] stated that self-efficacy is an important factor for developing positive attitude towards statistics education and meeting cognitive competencies.

In many study in the literature, statistical methods such as explanatory (EFA) and confirmatory (CFA) factor analysis, path analysis and structural equation modeling (SEM) are used when examining the relationships between variables [8]-[13].

There are many studies in the literature that investigate self-efficacy and attitude levels. These studies vary according to the subject area.

Aydın and Sevimli [14] aimed to study the validity and reliability of the statistical self-efficacy belief scale developed by Finney and Schraw [15] in Turkish language and culture. Yaşar [16] and Koparan [17] developed a 20-item attitude scale

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towards statistics, which was determined to be valid and reliable. In order to evaluate the reflections of self-efficacy and attitude levels in teaching practice, a great deal of attention was given to the studies carried out with teachers and pre-service teachers. Altunçekiç et al. [18] discussed the proficiency levels and problem-solving skills of pre-service teachers in science teaching. Çakıroğlu and Işıksal [19] investigated the variables that have an effect on pre-service teachers' self-efficacy beliefs and attitudes towards mathematics. While gender and grade level did not have a statistically significant effect on attitude, it was found that there was a significant difference on self-efficacy perceptions. Uysal and Kösemen [20] examined the general self-efficacy beliefs of pre-service teachers in terms of some demographic variables. Aydın et al. [21] investigated the relationship between pre-service teachers' self-efficacy perceptions and their levels of academic delay of gratification. Gündüz [22] examined statistical literacy and attitudes towards statistics of pre-service teachers. According to the results, it was determined that the students had a positive attitude towards statistics and their statistical literacy levels were generally at a moderate level. Aydın and Sevimli [7] aimed to examine pre-service teachers' self-efficacy beliefs towards statistics and their attitudes towards statistics and the relationships between them. It has been determined that pre-service teachers' self-efficacy beliefs towards statistics course are high and their attitudes are moderate.

On the other hand, students' self-efficacy and attitudes towards statistics lesson is an important concept for statistics learning. In studies conducted with undergraduate students, Bandalos et al. [23] did not find any relationship between self-efficacy and statistical success; Finney and Schraw [15] found an improvement of two standard deviations between pre- and final self-efficacy in the introductory statistics lesson. Girginer et al. [24] examined the relationship between the attitudes of students and their personal characteristics. It was determined that the individual characteristics of the students were effective in their attitudes towards the statistics lesson. Eskici [25] and Salihova and Memmedov [26] used the statistical attitude scale to reveal the attitudes of the students. Emmioğlu et al. [27] investigated the attitudes of students studying in engineering fields towards statistics. Alkan [28] aimed to examine how different applications in the statistics lesson affect the change in students' attitudes towards statistics and whether this effect is statistically significant.

It is extremely important to determine self-efficacy beliefs and attitudes towards statistics, especially in terms of disciplines such as statistics and mathematics where failure anxiety is high. Statistics lessons are taught at the undergraduate level in universities in Turkey. Thus, students' learning and success in the statistics lesson during their graduate education will be very beneficial for scientific studies of students.

In this study, it is aimed that factors that affect university students' self-efficacy beliefs and their attitudes towards statistics are identified, the relations among those factors are determined and a suitable path model is created by presenting the correlations between observed and unobserved variables.

2. Material and Method

In this study, the sample consists of 330 students who take Statistics and Biostatistics lessons at Bitlis Eren University in 2019-2020 academic year. As standardized values which are average score of statistical self-efficacy belief (SEB) and attitude towards statistics (SA) were outside the range of -2.5 and +2.5, 26 questionnaires were excluded from the data set. As the number of students in the population is known, sample size was obtained with the formulation suggested by Sümbüloğlu and Sümbüloğlu [29].

This study was conducted by taking 08/05/2019 dated and 2019/05-XI numbered permission from Bitlis Eren University Ethics Committee. Demographic informations of the students, SEB [14] and SA [17] scales were used in the questionnaire form as the data collection tool in the study. SEB and SA scales were prepared with 14-item 6-point likert scale and 20-item 5-point likert scale, respectively.

The data was analysed via IBM SPSS and AMOS softwares. Firstly, descriptive statistics (number, percentage, average, standard deviation, etc.) were obtained. It was examined with Kolmogorov-Smirnov and Shapiro-Wilk goodness of fit tests whether the data complies with normal distribution. Independent sample t-test/Mann Whitney-U test and One-way Analysis of Variance (ANOVA)/Kruskal Wallis H test were used to determine whether scores of variable obtained from two or more independent samples differ from each other.

In addition, LSD and Bonferroni post-hoc tests were preferred to determine which groups are the source of difference. Before applying the SEM, firstly, outlier and item analysis were conducted to prepare the dataset for analysis. Later, as a statistical method order, EFA, Reliability Analysis and CFA were used to test construct validity of scales. Furthermore; suitable model was tested with path analysis using SEM. In this study, p-values lower than 0.05 were considered as significant.

2.1. Factor Analysis

Factor analysis is a statistical method that allows to explain a structure that is tried to be explained with a large number of variables (dimensions) that are related to each other, with a smaller number of unrelated new factors (variables). These new factors revealed as a result of the factor analysis are orthogonal to each other, the correlation coefficients between the factors are zero and they are the linear components of the main factors [30]. There are mainly two types of factor analysis that are EFA and CFA.

EFA is used to determine the structure of the items in a scale and to determine under which dimension they are collected [30]. EFA explains the correlation between observable and unobservable variables. Basically, it makes the data easier and more understandable. Furthermore, it explains the covariance and correlations between the observable variables correlatively by the help of fewer number of latent variables.

CFA is a method created with the purpose of presenting the latent structure of a measurement tool. This analysis is developed with the purpose of testing hypotheses formed on factor analysis. Rather than determining with which factors variables have high level correlation as in EFA; CFA determines on which level the variable clusters that affect a certain number of previously designed factors are represented by means of determined factors [31]. While factor analysis allows development of many measurement tools, CFA allows testing whether these models are verified or not for the data set in the study. The purpose of CFA is to test whether the data fit a measurement model. Tested models are known as single factor model, the first level multifactor model, the second level multifactor model and the unrelated model. The model, which is formed by clustering all variables under one dimension, is called the first level single factor dimension. The model, which is formed by clustering more than one variable under independent dimensions, is a first-level multi-factor model. A second-level multi-factor model is formed by collecting the variables under more than one unrelated dimension and then collecting these dimensions under another dimension. An unrelated model is formed by clustering the variables under unrelated dimensions [32].

CFA tests and verifies the hypotheses established via the relationships between the variables. For this, it is necessary to examine the relations between the factors and between the variables and the factors according to the previously established hypotheses.

2.2. Structural Equation Model

SEM is a statistical method, which is based on the definition of observable and unobservable variables in a causal and correlational model based on a certain theory, and brings a hypothesis-testing approach to the multivariate analysis of the relevant structural theory. It associates unobservable variables such as attitude, emotion, intelligence, and satisfaction with observable independent variables [32]. The aim of SEM is to test whether a model with a theoretical basis is compatible with the data obtained. If the fit indices as a result of the tested model show that there is a fit between the model and data, the hypotheses formed structurally are accepted. Otherwise, the hypotheses are rejected.

It contains both observed and latent variables in its structure together. For that reason, it is a modelling method in which CFA and path analysis are used together as a structure. This model explains measurement errors in the research clearly. Variables which cannot be observed directly, but are the main researched variables by the researcher are called latent variables. Since latent variables cannot be measured, researchers measure the latent variable with observed variables that they think to be representing the latent variable [33]. This method is known to be better than other multivariate statistical techniques [34].

SEM consists of two parts. The first part which is the measurement model expresses the correlation of observed variables and latent variables. It is also named as CFA model. Latent variables in the model are calculated by observed variables. The second part of SEM is the structural model. Structural model connects unobservable variables by implementing simultaneous equation systems among them. Structural model is a general model and it expresses the correlation between latent and observed variables [35].

This approach allows the modelling of a phenomenon by considering both the unobserved 'latent' constructs and the observed indicators that describe the phenomenon [36]. The measurement equations for endogenous and exogenous variables are given as in Eq. 1 and Eq. 2, respectively.

$$y = \Lambda_y \eta + \varepsilon \tag{1}$$

$$x = \Lambda_y \xi + \delta \tag{2}$$

Structural model is notated mathematically as in Eq. 3 [37]:

$$\eta = \beta\eta + \Gamma\xi + \zeta \quad (3)$$

where
x: Observed exogenous variable,
y: Observed endogenous variable,
η: Latent endogenous variable,
ξ: Latent exogenous variable,
λ: Structural coefficient,
Ɛ: Measurement error in the observed endogenous variable,
δ: Measurement error in the observed exogenous variable,
ζ: Error term related with latent endogenous variable,
β: Structural effect of an endogenous variable to another endogenous variable,
γ: Structural effect from an exogenous variable to an endogenous variable.

SEM and CFA are similar methods. The aim of SEM is to test the established structure and model. Various models are compared in SEM and it is tried to form the most suitable model for the data set. In CFA, it is tried to verify a previously determined model. CFA is a measurement model and tests how the analyzed structure of the factor adjusts to the data. In addition, CFA includes measurement error in the model and estimates such errors. Restrictions in EFA are eliminated with CFA and it allows that various restrictions that can explain the model in the best way are included in the model [35]. Contrary to traditional methods, SEM takes into account all measurement errors in error calculations and obtains much clearer results than other methods [38].

2.3. Path Analysis

Path analysis is a model in which correlation coefficients and regression analysis are used together for modelling more complex correlations among observed variables based on cause-effect relation [39]. The purpose of this analysis is to predict the importance of the hypothetical causal correlations between the variables and to make policy implications [40]. The model in path analysis presents the correlation of exogenous variables with another variable in the model and the degree of effect of such correlation.

A path analysis has two components: path coefficients and a path diagram. Path coefficients represent the mathematical part of the analysis. There are figures to express the effect of variables on another variable. These expressions are called path diagrams [40].

Path analysis has some features which make is superior to multiple regression. The number of dependent variables is only one in multiple regression. However, it is possible to determine a number of dependent variables simultaneously in SEM. In regression models, dependent and independent variables are expressed in a single way with these names. However, a variable can be identified as both dependent and independent variable simultaneously in SEM.

3. Results

Distribution of students according to their demographic characteristics is given in Table 1. According to this; it was determined that 70.7% of the students are female, 29.3% are male; average age is 21.16±1.99; 59.9% are having associate degree and 40.1% are having bachelor's degree education. It was seen that the majority of the students were in the health department and were in the first year (Table 1).

Table 1. Some demographic characteristics

		N	%
Gender	Male	89	29.3
	Female	215	70.7
Age ($\bar{x}$ ± *sd)*		(21.16±1.99)	
Education	Associate Degree	182	59.9
	Bachelor's Degree	122	40.1
Department	Health	222	73.0
	Social	46	15.1
	Other	36	11.8
Class	1	120	39.5
	2	98	32.2
	3	38	12.5
	4	48	15.8

Normal distribution of the data depends on the fact that skewness and kurtosis values are between ±3. According to result of goodness of fit test and skewness/kurtosis values, it was found that SEB and SA levels have normal distribution (p>0.05, Table 2).

Table 2. Kolmogorov-Smirnov goodness of fit test, skewness and kurtosis values

Scale	*p*-value	Skewness	Kurtosis
SEB	0.094	0.671	-0.699
SA	0.137	-0.978	-1.534

The descriptive statistics of the answers given by the students to the SEB and SA scales are given in Table 3-4, respectively.

In Table 3, the means of items vary between 3.3303 and 3.7061. The results show that the two items with the highest perceived self-efficacy are EB5 and EB4.These items are to interpret the results of the statistical method in terms of the research problem and to choose the right statistical method to answer a research question.

Table 3. Some descriptive statistics for SEB

	Mean	SD*	SE**
EB1	3.3303	1.49263	0.08217
EB2	3.5061	1.43606	0.07905
EB3	3.6030	1.47006	0.08092
EB4	3.6333	1.41274	0.07777
EB5	3.7061	1.39527	0.07681
EB6	3.3879	1.45484	0.08009
EB7	3.5455	1.44169	0.07936
EB8	3.3364	1.53150	0.08431
EB9	3.4121	1.54561	0.08508
EB10	3.5061	1.47984	0.08146
EB11	3.4424	1.45386	0.08003
EB12	3.3758	1.45176	0.07992
EB13	3.6273	1.46401	0.08059
EB14	3.4939	1.53825	0.08468

* standard deviation, ** standard error

Table 4. Some descriptive statistics for SA

	Mean	SD*	SE**
A1	3.1818	1.48661	0.08184
A2	3.3212	1.29759	0.07143
A3	3.3667	1.26999	0.06991
A4	2.9485	1.16447	0.06410
A5	2.9303	1.28043	0.07049
A6	2.4121	1.32769	0.07309
A7	2.5061	1.38872	0.07645
A8	2.6000	1.35180	0.07441
A9	3.3333	1.23934	0.06822
A10	2.5667	1.24631	0.06861
A11	3.2515	1.22800	0.06760
A12	3.3030	1.15606	0.06364
A13	3.0970	1.24126	0.06833
A14	3.3545	1.26144	0.06944
A15	3.4121	1.27156	0.07000
A16	2.9424	1.39463	0.07677
A17	2.9303	1.28043	0.07049
A18	3.3364	1.24951	0.06878
A19	3.1939	1.21988	0.06715
A20	3.2182	1.31428	0.07235

* standard deviation, ** standard error

The two items with the lowest self-efficacy are EB1 and EB8. They are to determine the scale of measurement for a variable and to distinguish between Type I and Type II errors while testing the hypothesis. The average of each item in the scale is above 3 out of 6 points. We can say that self-efficacy of students is at medium level (Table 3).

In Table 4, the item with the highest attitude (A3) states that many problems can be easily solved using statistics. On the other hand, the lowest item (A6) say that understanding statistics does not benefit people. The means of items vary between 2.4121 and 3.3667. We can say that attitudes towards statistics of students are generally at a moderate level except A6 and A7.

Table 5. The test results for SEB and SA levels

Scale	Min	Max	Mean	SD*	SE**
SEB	14	84	48.9061	14.0708	0.7745
SA	19	95	58.2636	12.1056	0.7194

* standard deviation, ** standard error

Since the SEB scale consists of 14 items and is prepared in a 6-point likert type, the highest possible score is 84 and the lowest score is 14. On the other hand, SA scale consists of 20 items and is prepared in a 5-point likert type, the highest possible score is 100 and the lowest score is 20. In Table 5, we see that the ranges for SEB and SA scales are 70 (84-14) and 76 (95-19), respectively. Also, the mean of these scales are 48.9061 and 58.2636. Thus, average self-efficacy and attitude scores for all items are 2.9131 (58.2636/20) and 3.4932 (48.9061/14).

Table 6. Exploratory factor analysis results of statistical self- efficacy belief scale

	Factor			
	SEB1	SEB2	SEB3	Item-total correlation
EB12	0.756			0.520
EB11	0.740			0.623
EB13	0.705			0.625
EB14	0.693			0.534
EB10	0.671			0.618
EB9	0.484			0.558
EB1		0.844		0.468
EB2		0.822		0.557
EB3		0.669		0.598
EB4		0.563		0.541
EB6			0.828	0.475
EB7			0.721	0.576
EB5			0.684	0.596
Reliability	0.826	0.787	0.746	0.880
Explained variance	24.500%	19.760%	16.298%	60.557%
Eigenvalue (Λ)	5.355	1.413	1.104	

KMO =0.883, $\chi2(78)$ =1510.818, Bartlett's test of spherycity (p) = 0.000

In Table 6, it was determined that KMO value is 0.883 and the Chi-square value is on acceptable level ($\chi2(78)$ =1510.818; $p<0.01$, Bartlett's test of spherycity (p) = 0.000). SEB scale is grouped under three theoretical dimensions. These dimensions are named as EB1, EB2 and EB3. Items with low factor load could not be found in the dimensions and item 8 which causes cross loading was removed from the analysis. These three factors explain 60.557% of total variance. First factor EB1 explains 24.500%, second factor EB2 explains 19.760%, third factor EB3 explains 16.298% of total variance. Principal components analysis and varimax, which is one of the orthogonal rotation methods, are used as factorizing method for revealing factor pattern. As a result of EFA, it was determined that factor load values are above 0.40 (0.484-0.844) and factor loads are on acceptable level (Table 6).

When reliability analysis results for scale and subdimensions are examined; reliability coefficient was found as 0.880 for overall SEB scale, 0.826 for first dimension, 0.787 for second dimension, 0.746 for third dimension. In that case, it can be said that the scale has high degree of reliability (Table 6).

Table 7. Multi-factor first-order CFA model fit indices for statistical self-efficacy belief scale

Modification	RMSEA	CFI	IFI	GFI	CMIN/df
Before	0.086	0.904	0.905	0.906	3.260
	RMSEA	CFI	IFI	GFI	CMIN/df
After	0.077	0.927	0.928	0.924	2.777

(RMSEA: Root Mean Square Error of Approximation, CFI: Comparative Fit Index, IFI: Incremental Fit Index, GFI:Goodness of Fit Index, CMIN/df: chi-square fit statistics/ degree of freedom)

According to CFA, it was seen that structural model result of SEB was statistically significant for p=0.000. It was proven that 13 items and three subdimensions that constitute the scale are correlated with scale structure (Table 7). Modifications were made on the model to obtain goodness of fit results more suitable [41]. New covariances were created between error terms with high covariance (e1-e4; e7-e8). According to multi-factor first-order CFA results, after modification, it was seen that these fit indices were on acceptable level (Table 7).

Table 8. Results of CFA for statistical self-efficacy belief scale

Factor	Factor load	Standard error	t-value (critical ratio)	*p*-value
SEB1				
EB9	0.640			
EB10	0.712	0.106	10.050	0.000
EB11	0.737	0.106	10.299	0.000
EB12	0.653	0.115	8.347	0.000
EB13	0.698	0.103	9.904	0.000
EB14	0.613	0.108	8.955	0.000
SEB2				
EB1	0.602			
B2	0.696	0.104	10.686	0.000
EB3	0.741	0.140	8.728	0.000
EB4	0.632	0.123	8.050	0.000
SEB3				
EB5	0.729			
EB6	0.648	0.097	9.588	0.000
EB7	0.727	0.099	10.440	0.000

In Table 8, it is seen that factor loads are between 0.602 and 0.741 and are statistically significant (p<0.05).

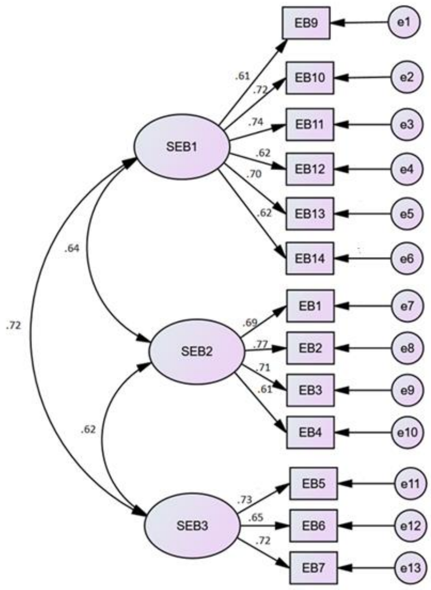

Figure 1. Multi-factor first-order CFA model for statistical self-efficacy belief.

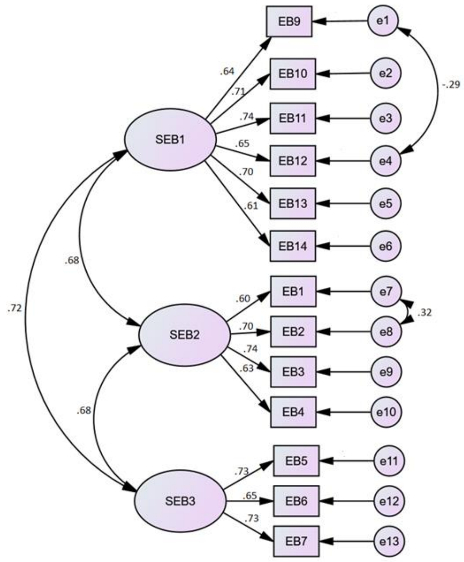

Figure 2. Modified multi-factor first-order CFA model for statistical self-efficacy belief.

It was determined that average scores of SEB and its subdimensions do not statistically significant according to gender, education status and class of students (*p*>0.05, Table 9).

In Table 10, it was determined that KMO value is 0.857 and Chi-square value is on acceptable level ($\chi2(66)$ =1078.876; p<0.01). The factors were named as A1, A2 and A3. These factors explain 58.387% of total variance. A1, A2, A3 explains 19.754%, 19.760% and 19.013% of total variance, respectively.

Table 9. Independent t-test and one-way ANOVA results for statistical self-efficacy belief scale

	SEB1	SEB2	SEB3	SEB
Gender				
Male*	3.44±0.93	3.63±1.15	3.70±1.14	3.56±0.87
Female*	3.52±1.10	3.50±1.06	3.51±1.11	3.51±0.92
t-value	-0.651	1.006	1.328	0.425
p-value	0.516	0.315	0.185	0.671
Education				
Associate Degree*	3.49±1.06	3.47±1.09	3.54±1.16	3.50±0.91
Bachelor's Degree*	3.51±1.05	3.64±1.09	3.61±1.06	3.57±0.90
t-value	-0.130	-1.287	-0.596	-0.718
p-value	0.897	0.199	0.552	0.474
Class				
1*	3.42±1.04	3.40±1.03	3.44±1.10	3.42±0.83
2*	3.58±1.10	3.68±1.15	3.77±1.18	3.65±0.96
3*	3.35±1.19	3.59±1.21	3.39±1.09	3.43±1.05
4*	3.63±0.85	3.55±0.99	3.63±1.02	3.60±0.81
F-value	0.929	1.172	1.976	1.488
p-value	0.427	0.321	0.118	0.218

* : Each value is expressed as mean±standard deviation.

Table 10. Exploratory factor analysis of statistical attitude scale

	Factor			
	SA1	SA2	SA3	Item-total corelation
A15	0.718			0.528
A14	0.718			0.560
A16	0.666			0.334
A12	0.636			0.467
A13	0.564			0.526
A19		0.825		0.516
A18		0.742		0.589
A17		0.687		0.395
A20		0.685		0.399
A2			0.837	0.535
A1			0.783	0.507
A3			0.755	0.576
Reliability	0.734	0.756	0.788	0.833
Explained variance	19.754%	19.620%	19.013%	58.387 %
Eigenvalue (Λ)	4.327	1.488	1.191	

KMO =0.857; $\chi2(66)$ =1078.876; Bartlett's test of spherycity (p) = 0.000

It was determined that factor loads are between 0.564-0.837. Items 5-10 which have total item correlation below 0.30 were excluded from the analysis. Reliability coefficient was found as 0.833 for overall SA scale, 0.734 for first dimension, 0.756 for second dimension and 0.788 for third dimension. According to these results, it was determined that the scale has high degree of reliability (Table 10).

Table 11. Multi-factor first-order CFA model fit indices for statistical attitude scale.

RMSEA	CFI	IFI	GFI	CMIN/df
0.029	0.987	0.987	0.966	1.257

The goodness of fit indices of the SA were obtained as 0.029 for RMSEA, 0.966 for GFI, 0.987 for CFI, 1.257 for $\chi2$ /df and this values were on acceptable level and statistically significant with p=0.000 (Table 11).

Multi-factor first-order CFA model for SA is given in Figure 3.

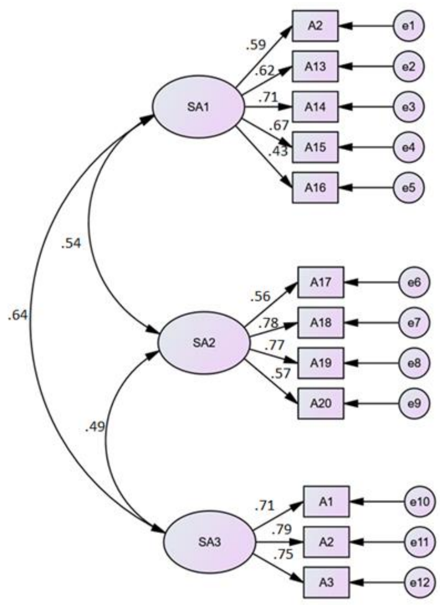

Figure 3. Multi-factor first-order CFA model for statistical attitude.

Table 12. Results of CFA for statistical attitude scale

Factor	Factor load	Standard error	t-value (critical ratio)	*p*-value
SA1				
A12	0.591			
A13	0.619	0.142	7.997	0.000
A14	0.711	0.152	8.689	0.000
A15	0.668	0.151	8.391	0.000
A16	0.425	0.148	6.021	0.000
SA2				
A17	0.558			
A18	0.776	0.152	8.722	0.000
A19	0.773	0.147	8.713	0.000
A20	0.568	0.142	7.356	0.000
SA3				
A1	0.713			
A2	0.788	0.086	11.173	0.000
A3	0.746	0.081	10.875	0.000

As shown in Table 12, it was determined that factor loads are between 0.425 and 0.788 and are statistically significant (p<0.05).

In Table 13, there is no statistically significant difference between average score of SA and its subdimensions according to gender (p>0.05).

Table 13. Independent t-test and one-way ANOVA results for statistical attitude scale

	SA1	SA2	SA3	SA
Gender				
Male*	3.30±0.93	3.20±1.02	3.24±1.21	3.25±0.78
Female*	3.26±0.82	3.22±0.89	3.41±1.05	3.28±0.72
t-test statistics	0.354	-0.160	-1.227	-0.353
p-value	0.723	0.873	0.221	0.724
Education				
Associate Degree*	3.22±0.87	3.12±0.97	3.21±1.10	3.18±0.75
Bachelor's Degree*	3.35±0.81	3.35±0.83	3.57±1.07	3.41±0.70
t-test statistics	-1.307	-2.229	-2.813	-2.584
p-value	0.192	0.027	0.005	0.010
Class				
1*	3.23±0.85	3.01±0.86	3.21±1.14	3.15±0.66
2*	3.31±0.89	3.30±1.01	3.35±1.06	3.32±0.83
3*	3.39±0.81	3.41±1.00	3.96±0.92	3.54±0.70
4*	3.19±0.78	3.40±0.75	3.27±1.10	3.28±0.71
F	0.567	3.407	4.745	2.843
p-value	0.637	0.018	0.003	0.038
LSD	-	1<2; 1<3; 1<4	1<3; 2<3; 4<3	1<3

* : Each value is expressed as mean±standard deviation.

It was determined that SA2 and SA3 subdimension average scores were statistically significant according to education status and class ($p<0.05$). Thus, average score of SA that has bachelor's degree education is higher than the student that has associate degree education. In addition, average score of 3rd class student is higher than other students. According to LSD post-hoc test results; it was seen that SA2 average score of the 1st class student is lower than 2nd, 3rd, 4th class students. SA3 average score of the 3rd class student is higher than 1st, 2nd, 4th class student (Table 13).

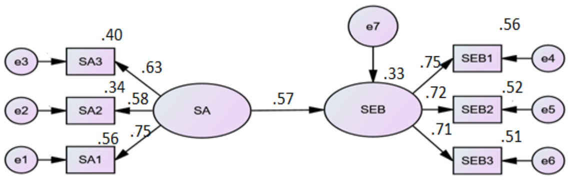

Figure 4. Path diagram.

To prove whether hypothesis test result is verified or not, path diagram was obtained (Figure 4). Correlation coefficients in the path analysis are a measurement of the linear correlations between variables. Research hypothesis is determined as "H_1: statistical attitude affects statistical self-efficacy belief positively". While SA is independent variable, SEB is determined as dependent variable. β is standardized value and hypothesis results are given in Table 14.

Table 14. Result of hypothesis test

Standardized β	*p*-value	accept/reject
0.572	0.000	accept

Hypothesis H_1: statistical attitude → statistical self-efficay belief

According to path analysis results; it is determined that SEB will increase as the coefficient value of SA increases (Table 14). Path coefficients between SA and sub-factors were obtained as 0.75 for SA1, 0.58 for SA2 and 0.63 for SA3. In addition, between SEB and sub-factors were determined as 0.75 for SEB1, 0.72 for SEB2 and 0.71 for SEB3. It was seen that these values are statistically significant ($p<0.05$). As a result of the analysis, standardized β coefficient that affects SEB of SA was determined as 0.572 ($p<0.05$). As a result of path analysis, it was seen that the 33% of the change in SEB is explained with SA.

4. Conclusion and Suggestions

In this study, SEB and SA were grouped under three theoretical dimensions and it was seen that structural models was statistically significant ($p<0.05$). SEB level was found not to be significant ($p>0.05$) in terms of gender, education status and class. However, it was seen that SA level was found not to be significant ($p>0.05$) in terms of gender but found to be significant ($p<0.05$) in terms of education status and class. Modified multi-factor first-order and multi-factor first-order models are proposed for SEB and SA, respectively. As a result of the path analysis, a positive and significant correlation was obtained between SEB and SA.

As a conclusion; it was concluded that students' having positive attitude towards statistics would affect their self-efficacy beliefs positively. University students' self-efficacy beliefs towards the statistics course and their attitudes can also explain the individual's perception of teaching practice along with his/her success in this course. Learning and being successful in statistics during their graduate education will guide them in scientific studies. It will also play an important role in their orientation towards advanced research. This study will be a guide for the factors that the lecturers who teach the statistics lesson should consider in their teaching. Thus, determining self-efficacy belief and attitude levels of students in statistics lesson and taking them into account in the regulation of educational activities will positively affect student achievement. In future studies, different models could be tested by determining a mediator variable between these two scales.

Contributions of the authors

The authors confirm that the contribution is equally for this paper.

Conflict of Interest Statement

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

The study is complied with research and publication ethics

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