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Examining Factors for the Academic Motivation Based on the Confirmatory, the Exploratory and the Bifactor Exploratory Structural Equation Models

Seval Kula Kartal [i]
Pamukkale University

Abstract

One of the aims of the current study is to specify the model providing the best fit to the data among the exploratory, the bifactor exploratory and the confirmatory structural equation models. The study compares the three models based on the model data fit statistics and item parameter estimations (factor loadings, cross-loadings, factor correlations) provided by the models. The second aim of the study is to examine correlations among the factor scores, the academic achievement and the goal orientations to provide criterion validity for the person parameter estimations of the best-fitting model. The Academic Motivation Scale was conducted on 1,858 junior and senior students. The three measurement models were compared based on the model data fit and parameter estimations. All estimations were done on the Mplus 6.0 statistical program using the Maximum Likelihood method. It was found that the bifactor exploratory structural equation model provided only trivial improvement on the model data fit relative to the exploratory structural equation model. However, the results of the study revealed that including a general factor in the model achieved a decrease in item cross-loadings. In addition, items could lie along the relative autonomy continuum in a consistent way with the Self-Determination Theory according to their general factor loadings estimated by the bifactor model. The model data fit statistics, parameter estimations and correlation coefficients indicated that the bifactor exploratory structural equation better fit to data than the other two models both theoretically and statistically.

Keywords: Academic motivation, exploratory structural equation model, bifactor model, model comparison

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[i] **Seval Kula Kartal,** Research Assist Dr., Measurement and Evaluation, Pamukkale University

Correspondence: seval.kula@hotmail.com

INTRODUCTION

In the 21st century, education has focused on training students who are willing to comprehend and criticize new information, put effort into overcoming difficulties that they come across during their learning process, find solutions to the problematic situations, enrich and manage their own learning, and take responsibility for shaping their future. Education can be considered as a source of power for the development of a student, and motivation plays an important role in using and maintaining this power of education. It is distinguished as an important psychological construct improving and maintaining behaviors leading to new learning (Liu, Wang, & Ryan 2016). Researchers have defined motivation in various ways. According to Franken (1994), motivation is an intrinsic state that drives an individual to specific behaviors and enables the person to direct and maintain those behaviors. Viau (2009) discusses motivation within the context of school learning and defines it as a "psychological construct which originates from the student's perceptions of self and the environment. It focuses the student's attention on the activity provided to him/her, and enables them to persist in accomplishing the activity."

Different explanations for motivation are based on the behavioristic, cognitive and humanistic approaches. According to Deci (1975), cognitive theories ignore people's needs, which initiate their actions. Although the humanistic approach provides an explanation for the source of energy starting specific behaviors, it does not focus on the cognitive processes of people that progress their action toward the goal. Deci and Ryan (1985) consider that a motivation theory is required to account for both the needs initiating the behaviors and the cognitive process of organizing the behaviors. So, the motivation is explained on the basis of the needs of individuals and the cognitive basis of their behaviors in the Self-Determination Theory developed by Deci and Ryan (1985).

The Self-Determination Theory puts emphasis on the need for competence and autonomy (Ryan & Deci 2000a; Ryan, Rigby, & Przbylski, 2006). The need for competence lies behind and provides energy for learning (White 1954 as cited in Deci & Ryan 1985). According to Deci (1975), the need for competence leads individuals to seek the optimal difficulties for their capacity and make an effort to overcome those difficulties. The need for autonomy is related to the freedom or will that is perceived by an individual while performing an action. An autonomous individual initiates an autonomous behavior, chooses preferred outcomes, and determines how he/she can reach those results (Deci & Ryan 1987; Deci, Koestner, & Ryan, 1999).

In the Self-Determination Theory, six different motivation types are defined: external regulation, introjected regulation, identification, intrinsic motivation to experience stimulation, intrinsic motivation toward accomplishments and intrinsic motivation to know. In addition, it is accepted that different motivation types can be ordered on a general dimension based on their level of autonomy (Ryan & Deci 2000a; 2000b). Motivation types differ from each other in terms of the level of autonomy that they reflect. Therefore, different motivation types are regulated on a general continuum so that they can reflect various levels of autonomy. For example, the external regulation reflects the lowest level of extrinsic motivation. Next, with introjected regulation, one is motivated to engage an action so as to avoid pressure, feeling guilty or embarrassed (Vansteenkiste, Lens, & Deci 2006; Ryan, Patrick, Deci, & Williams 2008; Viau 2009). An individual who regulates the extrinsic motives through identification completes specific actions since he/she knows that the outcomes of those actions are important for himself/herself (Deci & Ryan 2000; Viau 2009). Extrinsic motivation types locate on the left side, while intrinsic motivation types locate on the right side of the continuum. Deci and Ryan (2000) argue that the general dimension representing the autonomy continuum is developmentally important. Researchers emphasize that individuals might regulate their behaviors at any point along the continuum based on their previous experiences in that context or situational factors.

The Academic Motivation Scale builds upon the Self-Regulation Questionnaire, a well-known measure published for the first time by Ryan and Connell (1989) and the Self-Determination Theory. Since then, the measure has been adopted by researches exploring varied domains, including work motivation, academics etc. The Academic Motivation Scale is one example of the adaptation of the Self-regulation Questionnaire in the academic domain. According to the theory, the relative autonomy continuum is expressed by different reasons for engagement in school work (from controlled reasons to autonomous reasons). Therefore, most of the measures building upon the Self-Regulation Questionnaire do not include amotivation, because it does not reflect reasons for engagement. In other words, the notion of amotivation is not part of the relative autonomy continuum. Thus, the Academic Motivation Scale is unique in this family of measures because it includes amotivation.

As explained before, the Self-Determination Theory defined the a general motivation dimension which represent the autonomy continuum and sub-factors which represent different motivation types such as extrinsic or intrinsic motivation. This motivation structure defined in the theory has been statistically examined by researchers, and the existence of the general dimension representing the autonomy continuum has been mostly analyzed by utilizing correlation analysis in the early studies. For example, the first of the studies testing the presence of a general dimension representing the autonomy continuum was conducted by Ryan and Connell (1989). Researchers investigated whether the relationships among subscales measuring different motivation types follow a simplex structure or not. In simplex structure, it is expected to have high relationships among subscales, which measure more theoretically related constructs. In contrast, low relationships are expected among theoretically distinct constructs. The researchers found that there are high relationships among the subscales measuring different types of extrinsic motivation. However, there are lower relationships among the subscales measuring extrinsic and intrinsic motivation. Researchers accepted relationships that were consistent with the simplex pattern as evidence for the existence of a general motivation dimension. Supportively, Vallerand, Pelletier, Blais, Brière, Senécal and Vallières (1993) examined relationships among subscales of the Academic Motivation Scale. The study revealed that there are low relationships among subscales whose locations on the general dimension are far from each other. In addition, a meta-analysis study done by Howard, Gagne and Bureau (2017) evidences that the pattern of relationships among subscales measuring different motivation types supported the existence of a general motivation dimension.

More recent methods, the bifactor modeling and the structural equation modeling, provide more sophisticated ways to examine and test the factorial structure of motivation. The structural equation and the bifactor model analyses can be conducted based on a confirmatory or an exploratory approach. The confirmatory structural equation model (the C-SEM) accepts that the cross-loadings of items on factors to which they do not belong are zero (Chen, West & Sousa 2006; Immekus & Imbrie 2008). However, the exploratory structural equation model (the E-SEM) avoids this limitation of confirmatory approach by including item cross-loadings in the model. The exploratory approach allows items to have factor loadings on all of the sub-factors measured by the scale. In addition, the exploratory approach includes some of the advantages of the confirmatory approach; such as making comparisons based on the model data fit statistics. Therefore, it provides a mixed approach in which factors are defined depending on the assumptions of the confirmatory approach, and in which cross-loadings of the items are estimated (Howard, Gagne, Morin, Wang & Forest 2016).

The bifactor model has recently been used more frequently to model multi-dimensional psychological traits (Reise 2012; Periard 2016). The bifactor model assumes that inter-item covariances can be explained by a general factor and one or more sub-factors (group factors) that are not correlated (orthogonal) with each other. In the bifactor model, each item is allowed to have factor loading on the general factor and one of the sub-factors. Thus, the model partitions the inter-item covariance into the general factor underlying all items and one or more sub-factors. Partitioning covariance into general and sub-factors is possible thanks to the orthogonality assumption of the model. This assumption seeks to explain the common variance shared by all items with the general factor, and variance shared by item clusters with sub-factors (Gibbons & Hedeker 1992). Similarly, the bifactor model analysis can be conducted based on the confirmatory or exploratory approach. The confirmatory bifactor model shares the limitations of the confirmatory approach. Therefore, the confirmatory bifactor model does not allow cross-loadings, which means that an item can have factor loadings on the general factor and only one of the group factors. (Chen, West & Sousa 2006; Immekus

& Imbrie 2008). However, the bifactor exploratory structural equation model (the B-ESEM) includes cross-loadings in the model, which means that items can have factor loadings on the general factor and on the one or more group factors (Howard, Gagne, Morin, Wang & Forest 2016).

Few studies have utilized the E-SEM and the B-ESEM to investigate the dimensionality of the data obtained from the motivation scales developed based on the Self-Determination Theory. For example, Gunnell and Gaudreau (2015) used a motivation scale developed based on the Self-Determination Theory to find evidence regarding the existence of a general motivation factor representing the autonomy continuum and contributions of sub-factors to the explained variance. As a result of the study, the B-ESEM provided the best item fit statistics. In addition, the results of the study supported the existence of a general motivation factor. Supportively, Howard, Gagne, Morin, Forest (2016) and Litalien, Morin, Gagne, Vallerand, Losier, Ryan (2017) compared model data fits of the E-SEM and B-ESEM with the confirmatory structural equation model (the C-SEM) on the data set obtained from individuals responses to the Academic Motivation Scale, and the Work Motivation Scale items. The studies revealed that the B-ESEM provided the best model data fit statistics among the three models. In addition, the B-ESEM provided item factor loadings that were more consistent with the motivation structure defined in the Self-Determination Theory.

The present study extends the related researches in various ways. The previous studies examined the dimensionality of the motivation data obtained from Western respondents. However, it is necessary to explore the replicability of the findings supporting superiority of the B-ESEM in explaining the structure of the data obtaining from the administration of the Academic Motivation Scale on Eastern respondents. Therefore, one aim of the present study is to specify the model providing the best fit to the data obtained from an Eastern sample by comparing model data fit statistics and item parameter estimations (factor loadings, cross-loadings, factor correlations) of the E-SEM, C-SEM and B-ESEM. In addition, it is necessary to analyze relationships between the person parameter estimations of the model and the criterion variables so as to examine the validity of estimations provided by the model. Accordingly, the second aim of the study is to examine correlations among factor scores estimated based on the model providing the best fit to the data, the academic achievement and goal orientations. In the current study, the academic achievement and goal orientations were preferred as the criterion variables because studies on academic motivation revealed that motivation increases students' academic achievement (Pintrich & De Groot 1990; Gottfried 1990 as cited in Lai 2011; Grolnick, Ryan, & Deci 1991; Lepper, Corpus, & Iyengar 2005; Kusurkar, Cate, Vos, Westers, & Croiset 2012). In addition, positive relationships are obtained among goal orientations, intrinsic motivation and academic achievement in the related studies (Elliot & McGregor 2001; Finney, Pieper & Barron 2004).

MATERIALS AND METHODS

Participants

This study was conducted on a data set that was collected during the 2016-2017 academic year. The data set was obtained from 1,858 students studying at seven different faculties of Ankara University, Turkey. Researcher ensured the inclusion of participants who might provide a heterogeneous distribution in terms of their motivation levels. Therefore, students were selected from different faculties. In addition, the scale was conducted on juniors and seniors since it was expected that those students might have more conscious and decisive perceptions and attitudes toward university life.

Measures

The Academic Motivation Scale (Vallerand, Pelletier, Blais, Brière, Senécal, & Vallières 1992) was used with the aim of measuring the academic motivation of students. The scale includes seven factors: three are related with intrinsic motivation, three are related with extrinsic motivation, and one measures amotivation. Each dimension has four items, so the scale includes 28 items. The Turkish form of this scale adapted by Karagüven (2012) was used in this study. As a result of the confirmatory factor analysis done on the study group of the current research, a seven-factor structure provided high model data fit values, (χ^2=3902.5 $_{(sd=329,\ p<0.01)}$, GFI=0.87, CFI=0.95, SRMR=0.07, RMSEA=0.07). The Omega reliability coefficient for the total scale was calculated as 0.96. Omega coefficients for sub-scales ranged from 0.80 to 0.93. The Achievement Goal Orientation Scale was used to get information regarding students' goal orientations. The scale was adapted from English to Turkish by Akın and Çetin (2007). Information regarding the academic achievement of students was obtained through students' self-reports by asking students to specify their grade-point average on the scale of one hundred.

Analyses

The three measurement models (C-SEM, E-SEM, and B-ESEM) were compared based on the model data fit statistics and item parameter estimations. All estimations were done on the Mplus 6.0 statistical program by using Maximum Likelihood method. In the C-SEM, items were allowed to load on the factor to which they belong, while their cross-loadings on other factors were accepted as zero. In the E-SEM, items were allowed to load on the factors to which they belong, and the cross-loadings of items on other factors were also estimated. In the B-ESEM, the item general factor loadings were estimated for the items in addition to the factor loadings estimated on the related group factor and cross-loadings estimated on the other group factors. The model that provided the best fit to the data was identified based on the general model data fit statistics. Model comparisons were done through RMSEA, SRMR model data fit statistics, Akaike (AIC), Bayesian (BIC), and adjusted Bayesian (A-BIC) information criteria (Tabachnick & Fidell 2001; Kline 2011). It was accepted that the model providing the lowest model data fit statistics is the model that best fits to the data (De Ayala 2009).

Results

Firstly, the three models were compared in terms of the model data fit statistics and the information criteria presented in Table 1.

Table 1. The Model Data Fit Statistics

	χ^2	df	SRMR	RMSEA (90% C. I.)	AIC	BIC	A-BIC
C-SEM	39484.3*	278	0.070	0.276 (0.273-0.278)	386985.1	387565.4	387231.8
E-SEM	947.8*	203	0.017	0.044 (0.042-0.047)	384037.3	385314.1	384580.2
B-ESEM	760.1*	182	0.014	0.041 (0.038-0.044)	383890.5	385283.4	384482.8

C-SEM= Confirmatory Structural Equation Model, E-SEM= Exploratory Structural Equation Model, B-ESEM= Bifactor Exploratory Structural Equation Model, df= Degree of Freedom, C. I. = Confidence Interval, *p<0.01

According to Table 1, all of the chi-square values calculated for the three models were significant at 0.01. The lowest chi-square value was obtained for the B-ESEM. As stated by Tabachnick and Fidell (2001), small differences between expected and observed correlations might cause significant chi-square values, especially when it is calculated on a large sample. Therefore, examining the ratio of the chi-square value to the degree of freedom was preferred. A ratio value between 2.0 and 5.0 was accepted as the indicator of a good model data fit (Hooper, Coughlan, & Mullen 2008). It was found that the ratio value (34.11) calculated for the C-SEM was much higher than the accepted criterion. The ratio values estimated for the E-SEM and the B-ESEM were 4.66 and 4.17, respectively. Obtaining a chi-square/degree of freedom ratio lower than 5.0 showed that the exploratory models fit to the data. In addition, the B-ESEM provided the best fit to the data because it had the lowest ratio value among the three models.

The RMSEA and SRMR values gave information regarding differences between sample and population covariances-correlations. SRMR and RMSEA values lower than 0.05 indicated that the model fits to the data (Hooper, Coughlan, & Mullen, 2008). Since the confirmatory model had values higher than 0.05, the confirmatory model did not fit to the data. The values calculated for both exploratory models were lower than 0.05. In addition, the confidence interval for RMSEA of the confirmatory model did not overlap with the confidence intervals for the exploratory models. This meant that the exploratory models displayed an important improvement on model data fit relative to the confirmatory model. The B-ESEM provided smaller SRMR and RMSEA values than the E-SEM. However, overlapping confidence intervals for RMSEA indicated that the B-ESEM provided only marginal improvement on model data fit relative to the E-SEM.

The model comparisons were also done based on the AIC, BIC and A-BIC information criteria, which took into consideration the number of estimated parameters (De Ayala 2009). According to Table 1, the bifactor model provided the lowest information criteria among the three models. The information criteria indicated that the B-ESEM provided better model data fit than the E-SEM and the C-SEM. However, it was found that the information criteria calculated for the E-SEM and the B-ESEM were very close to each other. Furthermore, the present study evidenced that the confidence intervals for RMSEA of the two models overlapped with each other, and the two models had very close chi-square and degree of freedom ratio values.

According to model data fit statistics, the exploratory models provided better fits than the confirmatory model. This finding indicated that cross-loadings of items were required to be included in the model. The factor correlations were estimated based on the C-SEM and the E-SEM so as to examine the effect of including cross-loadings in the model on factor correlations. The factor correlations were presented in Table 2.

Table 2. Factor Correlations Estimated Based on C-SEM and E-SEM

	KNO	ACH	STI	IDE	INT	EXT	AMO
KNO		0.312*	0.535*	0.424*	0.205*	0.075**	-0.439*
ACH	0.888*		0.386*	0.345*	0.298*	0.148*	-0.278*
STI	0.899*	0.800*		0.323*	0.328*	-0.006	-0.238*
IDE	0.617*	0.705*	0.433*		0.303*	0.514*	-0.517*
INT	0.534*	0.888*	0.478*	0.562*		0.352*	0.016
EXT	0.297*	0.497*	0.129*	0.759*	0.710*		-0.115*
AMO	-0.498*	-0.443*	-0.359*	-0.506*	-0.142*	-0.155*	

Note= Correlations above and below the diagonal show E-SEM and C-SEM correlations, respectively. KNO= Intrinsic motivation to know, ACH= Intrinsic motivation toward accomplishments, STI= Intrinsic motivation to experience stimulation, IDE= Identified regulation, INT=Introjected regulation, EXT= External regulation, AMO=Amotivation, *p<0.01, **p<0.05

According to Table 2, the factor correlations estimated by the E-SEM were lower than the ones obtained based on the C-SEM, which was parallel with the researchers' expectation. Item cross-loadings accepted as zero in the C-SEM resulted in higher factor correlations. Obtaining high factor correlations based on this model was an expected result because this was the only way through which item cross-loadings could be reflected. In addition, this finding indicated that cross-loadings should be included in the model because excluding them from the model resulted in biased factor correlations.

It was found that factor correlations estimated based on the C-SEM and E-SEM were both partially consistent with the autonomy continuum hypothesis of the Self-Determination Theory. However, factor correlations calculated based on the E-SEM provided results a bit more consistent with the expectation regarding pattern of factor relations. For example, a high correlation coefficient (0.866) was estimated between the intrinsic motivation toward the accomplishments sub-scale and the introjected regulation sub-scale, although they were theoretically distinct and far from each other on the relative autonomy continuum. However, in the E-SEM, the intrinsic motivation towards the accomplishments dimension had the highest correlation (0.386) with the intrinsic motivation to experience stimulation dimension, which was the theoretically closest dimension to it. Item loadings estimated by the E-SEM and the B-ESEM were given in Table 3 and 4.

Table 3. Item Factor Loadings and Cross-Loadings Estimated Based on E-SEM

	KNO	ACH	STI	IDE	INT	EXT	AMO
KNO							
2	0.57*	0.06	0.06	0.14	-0.01	-0.11	-0.03
9	0.53*	-0.02	0.25*	0.15*	0.07	0.02	-0.05
16	0.40*	0.25*	0.29*	0.08	-0.05	0.08	-0.08*
23	0.22**	0.20*	0.37*	0.19*	-0.03	0.01	-0.11*
ACH							
6	0.45*	0.11	0.06	0.07	0.15**	-0.00	-0.11*
13	0.31*	0.26	0.07	0.12**	0.12	0.12*	-0.11*
20	0.03	0.13	0.37*	-0.00	0.19*	-0.10**	0.11*
27	0.03	0.35*	0.09**	0.10**	0.46*	0.05	-0.01
STI							
4	-0.05	0.08	0.12	-0.15	-0.10	0.08	-0.05
11	0.26*	-0.10	0.62*	0.01	0.05	-0.03	-0.03
18	0.09	0.10**	0.64*	-0.02	0.04	0.00	-0.03
25	0.15**	0.17*	0.59*	0.09**	0.00	-0.04	-0.09*
IDE							
3	0.23*	0.02	-0.14*	0.62*	-0.01	-0.14**	-0.07
10	0.00	-0.22*	0.03	0.63*	0.02	0.27**	-0.03
17	-0.03	0.01	0.06	0.59*	-0.06**	0.26*	-0.04
24	-0.05	0.23*	-0.01	0.61*	-0.00	0.00	-0.06
INT							
7	-0.03	-0.08	0.08	-0.10	0.63*	0.10	0.04
14	0.25*	0.29	-0.11**	-0.07	0.28*	0.37*	-0.12*
21	0.05	0.01	-0.06	0.05	0.04	-0.03	0.05
28	-0.13**	0.23**	-0.02	0.11*	0.74*	-0.04	0.03
EXT							
1	0.06	-0.15**	0.01	0.06	0.09	0.23*	0.06
8	0.07	-0.13	-0.05	0.14**	0.23*	0.60*	-0.06*
15	0.07	0.17*	-0.06	0.12	-0.07	0.65*	-0.03
22	-0.23*	0.04	0.05	0.19*	0.05	0.60*	0.13*
AMO							
5	0.00	-0.04	0.05	-0.17*	0.002	0.16*	0.58*
12	0.08**	-0.02	0.01	-0.12**	0.04	0.04	0.60*
19	0.05	0.05	-0.04	0.07	-0.01	-0.05	0.89*
26	0.03	0.07**	-0.01	0.08**	-0.01	-0.00	0.92*

*p<0.01, **p<0.05

Table 4. Item Factor Loadings and Cross-Loadings Estimated Based on B-ESEM

	G	KNO	ACH	STI	IDE	INT	EXT	AMO
KNO								
2	0.56*	0.61*	-0.02	0.01	-0.02	-0.09*	-0.11*	-0.04**
9	0.72*	0.23*	-0.15**	0.21*	0.05	-0.03	-0.06	-0.01
16	0.77*	0.13	0.02	0.13*	-0.06	-0.11*	-0.06**	-0.03
23	0.74*	0.14	0.15	0.19*	0.01	-0.07**	-0.06**	-0.07*
ACH								
6	0.65*	0.12*	-0.20**	0.04	-0.01	0.03	-0.09*	-0.04
13	0.74*	-0.05	-0.13	-0.05	0.01	0.03	-0.00	-0.01
20	0.35*	0.03	0.09	0.23*	-0.11*	0.15*	-0.13*	0.18*
27	0.58*	-0.06	0.15	-0.05	-0.04	0.39*	0.08**	0.12*
STI								
4	0.01	0.01	0.04	0.05	-0.11	-0.07	-0.01	-0.01
11	0.57*	0.15*	-0.09*	0.48*	-0.05	-0.00	-0.15*	0.05**
18	0.59*	0.02	0.04	0.41*	-0.12*	0.01	-0.14*	0.07*
25	0.73*	0.07	0.11*	0.36*	-0.07**	-0.05**	-0.16*	0.00
IDE								
3	0.51*	0.17*	-0.03	-0.17*	0.37*	-0.06**	-0.02	-0.15*
10	0.44*	-0.02	-0.11	0.02	0.54*	0.02	0.37*	-0.09*
17	0.54*	-0.07*	0.01	-0.05	0.43*	-0.05**	0.31*	-0.09*
24	0.59*	-0.09*	0.14*	-0.13*	0.34*	-0.02	0.08**	-0.09*
INT								
7	0.21*	-0.05	-0.06	0.12*	-0.05	0.53*	0.17*	0.17*
14	0.63*	-0.13*	-0.17	-0.21*	-0.08**	0.20*	0.25*	0.03
21	0.02	0.02	-0.01	-0.04	0.02	0.03	-0.01	0.04
28	0.43*	-0.05**	0.18	-0.05**	0.00	0.69*	0.09*	0.16*
EXT								
1	0.06**	0.18*	0.01	0.04	0.08**	0.10*	0.31*	0.04
8	0.38*	-0.05	-0.15*	-0.06	0.22*	0.19*	0.60*	0.00
15	0.44*	-0.04	0.04	-0.20*	0.12*	-0.03	0.58*	0.00
22	0.19*	-0.15*	0.14*	-0.07	0.20	0.12*	0.63*	0.14*
AMO								
5	-0.37*	0.01	0.02	0.07**	-0.13*	0.08*	0.15*	0.51*
12	-0.32*	0.03	-0.01	0.05	-0.12*	0.08*	0.04	0.51*
19	-0.41*	-0.02	0.03	-0.01	-0.03	0.08*	-0.01	0.73*
26	-0.37*	-0.06**	0.03	0.00	-0.02	0.09*	0.02	0.77*

G= General Factor, *p<0.01, **p<0.05

Table 3 indicated that items had generally high loadings on their own factors. The E-SEM factor loadings of 20 items out of 28 items on the factors to which they belong ranged from 0.35 to 0.92. However, sub-factor loadings lower than 0.30 were calculated for 8 items (items 1, 4, 6, 13, 14, 20, 21 and 23). Generally, low cross-loadings were obtained for items. Item factor loadings estimated by the B-ESEM revealed that 10 items (items 4, 6, 9, 13, 14, 16, 20, 21, 23 and 27) had factor loadings lower than 0.30 on the factors to which they belong. 8 items out of these 10 items (excluding items 14 and 21) belong to the intrinsic motivation factors. While factor loadings of these items on the general factor were higher than 0.50, their loadings on the related sub-factors were lower than 0.30. Very low and statistically non-significant cross-loadings were estimated by the B-ESEM. The number of items having cross-loadings over 0.20 was much less in the B-ESEM than E-SEM. Higher cross-loadings estimated by the E-SEM indicated the existence of a general factor excluded from the model. Including the general factor explaining common covariance among items in the model resulted in lower cross-loadings.

In addition to providing low cross-loadings, the general factor also allowed for measuring the general motivation factor representing relative autonomy continuum. It was found that all of the items, excluding items 4 and 21, which did not function well on the sample of this study, had significant loadings on the general factor. In addition, items lied along the relative autonomy continuum in a way consistent with the hypothesis of the Self-Determination Theory. The general factor loadings of amotivation items ranged from -0.32 to -0.41. According to factor loadings, amotivation items were located on the negative end of continuum as expected. The general factor loadings of items measuring the extrinsic motivation were between 0.40 and 0.60. In line with the researchers' expectations, these items lied along the middle points of the continuum. Items measuring the intrinsic motivation had general factor loadings ranging from 0.50 to 0.77. These items were located on the positive end of the continuum as expected. Comparisons based on the model data fit statistics and parameter estimations revealed that the B-ESEM better fit to data than the other two models both theoretically and statistically. Correlations calculated among the general factor scores, the sub-factor scores and the criteria variables (grade point averages of students, learning, performance approach and performance avoidance orientations) were given in Table 5.

Table 5. Correlation Coefficients Among General Factor Scores, Sub-factor Scores and Criteria Variables

	Academic Achievement	Learning Orientation	Performance Approach	Performance Avoidance
G	0.21*	0.49*	-0.26*	0.17*
KNO	0.04	0.31*	0.49*	-0.14*
ACH	0.12*	0.18*	-0.35*	0.14*
STI	0.02	-0.02	0.16*	-0.12*
IDE	-0.01	-0.22*	0.03	-0.01
INT	0.12*	0.20*	0.34*	0.16*
EXT	-0.17*	0.31*	-0.21*	0.07
AMO	-0.08*	-0.07	*0.01	-0.01

*p<0.01

Table 5 indicated that the correlations of the general and sub-scale scores with academic achievement of students ranged between 0.17 and 0.21. Although a higher correlation was obtained between the general factor and academic achievement relative to the ones calculated between the sub-factors and academic achievement, it could be stated that correlations among variables were mostly low. In line with the researcher's expectation, there are negative correlations among external regulation, amotivation and academic achievement. The correlation between the general factor scores and the learning orientation is higher than the correlations among the sub-factor scores and the learning orientation.

DISCUSSION

The current study compared the three models (the C-SEM, the E-SEM, and the B-ESEM) based on the model data fit statistics and parameter estimations in order to determine the measurement model that provides an inferior explanation for the factorial structure of the data obtaining from the administration of the Academic Motivation Scale. The results of the present study indicated that including item cross-loadings in the E-SEM achieved an important decrease in the correlations among factors. In addition, it was found that including the general factor in the B-ESEM provided lower cross-loadings for items. Furthermore, the B-ESEM had slightly better model data fit statistics than the E-SEM. Supportively, Guay, Morin, Litalien, Valois and Vallerand (2015) revealed that the E-SEM displayed improvement on model data fit relative to the confirmatory model, and also provided lower factor correlations. Similarly, Howard, Gagne, Morin and Forest (2016) found that the E-SEM provided better model data fit statistics and lower factor correlations than the C-SEM. The B-ESEM displayed an insignificant improvement on model data fit relative to the ESEM. However, including the general factor provided much lower item cross-loadings, which is in line with the finding of the current study. Litalien et al. (2017) obtained better model data fit statistics for the E-SEM than the C-SEM. Moreover, researchers compared the E-SEM and the B-ESEM on the data sets obtained from two different samples. It was found that the B-ESEM provided decrease in RMSEA values and information criteria on both samples.

The better-fit statistics of the B-ESEM over E-SEM supported the existence of a general factor in addition to the sub-factors explaining variance observed in data set. Having a decrease in item cross-loadings when a general factor was included in the model indicated the existence of common variance among items caused by the the general factor. Supportively, Howard, Gagne, Morin and Forest (2016) found that item cross-loadings ranged between 0.00 and 0.37 in the E-SEM, while they ranged between 0.01 and 0.33 in the B-ESEM. Similarly, Litalien et al. (2017) revealed that item cross-loadings ranged between 0.00 and 0.34 in the E-SEM; however, they were between 0.00 and 0.27 in the B-ESEM.

The most important finding supporting the existence of a general factor was the pattern of factor loadings estimated for items on the general factor. According to the Self-Determination Theory, it was expected that the intrinsic motivation items were located on the positive end, the extrinsic motivation items were on medium points and the amotivation items were on the negative end of the relative autonomy continuum, which was represented by the general factor. It was found that items lied along the continuum in a way consistent with this expectation. The intrinsic motivation items had the highest loadings, the extrinsic motivation items had medium level loadings and the amotivation items had negative loadings. These findings are consistent with the results of the studies in which the existence of a general factor was examined based on the bifactor model. In the study of Litalien et al. (2017), it was found that the general factor loadings estimated for items were in accordance with the one-dimensional continuum hypothesis of the Self-Determination Theory. Supportively, Kula-Kartal (2018) found that items could be ordered along the continuum based on their discrimination parameters estimated by the bifactor multidimensional item response theory.

The model data fit statistics and parameter estimations both indicated that the Academic Motivation Scale items are theoretically and statistically more consistent with the bifactor exploratory structural equation model. Accordingly, scale items both measure autonomy level represented by the general factor and different motivation types represented by the sub-factors of the scale. However, it was found that the intrinsic motivation items did not represent this multi-dimensional structure well enough. According to their general factor loadings, the intrinsic motivation items could discriminate individual differences on the general factor. Yet, representativeness of these items and their relationships with the factor to which they belong are very weak. This finding indicates that a one-dimensional intrinsic motivation dimension can be defined instead of partitioning items into three different sub-factors. In line with this finding, a meta-analysis study done by Howard, Gagne and Bureau (2017) found that correlations among intrinsic motivation factors ranged from 0.86 to 0.96, while correlations among other factors ranged between -0.60 and 0.51. According to researchers, high correlations obtained among the intrinsic motivation factors indicated the need for questioning multi-dimensional representation of intrinsic motivation.

The B-ESEM was the best fitting model among the three models according to fit statistics and parameter estimations. With the aim of examining validity of estimations provided by the model, correlations between factor scores and criteria variables were analyzed. It might be stated that correlations between factor scores and criteria variables estimated based on the B-ESEM generally supported the theoretical expectations. For example, in accordance with the expectation, a positive significant correlation was obtained between the general factor and academic achievement. Supportively, studies on academic motivation revealed that motivation had a positive relationship with students' academic achievement (Pintrich & De Groot 1990; Grolnick, Ryan, & Deci 1991; Lepper, Corpus, & Iyengar 2005).

The model data fit statistics revealed that the B-ESEM provided only a trivial improvement on model data fit relative to the E-SEM. However, it was found that including the general factor in the model achieved a decrease in item cross-loadings. Furthermore, items could lie along the autonomy continuum in a way consistent with the Self-Determination Theory according to their general factor loadings estimated by B-ESEM. The model data fit statistics, parameter estimations and correlation coefficients revealed that the B-ESEM can model motivation in a theoretically and statistically more appropriate way than the other two models.

The current study revealed that it is necessary to use the measurement models enabling to model item cross-loadings in order to have more accurate results regarding individuals' academic motivation. Researchers are recommended to make estimations based on the B-ESEM since it provides significant decrease in item cross-loadings and factor correlations. In the present study, it was found that the intrinsic motivation items had high general factor loadings, but low sub-factor loadings. Therefore, the intrinsic motivation items are weak in terms of providing information regarding individual differences on sub-factors. Therefore, researchers should carefully evaluate the total scores obtained from these sub-factors, or the relationships of these sub-factors with criteria variables. Researchers planning to conduct a study on measuring academic motivation are recommended to edit intrinsic motivation items so that these items can provide better information regarding individual differences on both the general factor and sub-factors.

REFERENCES

Akın, A., & Çetin, B. (2007). Başarı yönelimleri ölçeği: Geçerlik ve güvenirlik çalışması. *Eurasian Journal of Educational Research, 26*, 1-12.

Chen, F. F., West, S. G., & Sousa, K. H. (2006). A comparison of bifactor and second-order models of quality of life. *Multivariate Behavioral Research, 41*(2), 189-225.

De Ayala, R. J. (2009). *The theory and practice of item response theory.* New York: The Guilford Press.

Deci, E. L. (1975). *Intrinsic motivation.* New York: Plenum Press.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York: Springer.

Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology, 53*(6), 1024-1037.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227-268.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on ıntrinsic motivation. *Psychological Bulletin, 125*, 627-668.

Elliot, A. J., & Church, M. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of personality and Social Psychology, 72,* 218-232.

Elliot, A. J., & Harackiewicz, J. (1996). Approach and avoidance achievement goals and intrinsic motivation: A mediational analysis. *Journal of personality and Social Psychology, 70,* 461-475.

Elliot, A. J., & McGregor, H. A. (2001). A 2x2 achievement goal framework. *Journal of personality and Social Psychology, 80*(3), 501-519.

Finney, S. J., Pieper, S. L., & Barron, K. E. (2004). Examining the psychometric properties of the achievement goal questionnaire in a general academic context. *Educational and Psychological Measurement, 64*(2), 365-382.

Franken, R. (1994). *Human motivation.* Pacific Grove, CA: Brooks/Cole.

Gibbons, R. D., & Hedeker, D. R. (1992). Full information item bifactor analysis. *Psychometrika, 57*(3), 423-436.

Grolnick, W. S., Ryan, R. M., & Deci, E. L. (1991). Inner resources for school achievement: motivational mediators of children's perceptions of their parents. *Journal of Educational Psychology, 83*(4), 508-517.

Gunnell, K. E., & Gaudreau, P. (2015). Testing a bifactor model to disentangle general and specific factors of motivation in self-determination theory. *Personality and Individual Differences, 81*, 35-40.

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural Equation Modelling: Guidelines for Determining Model Fit. *The Electronical Journal of Business Research Methods, 6*(1), 53-60.

Howard, J. L., Gagne, M., & Bureau, J. S. (2017). Testing a continuum structure of self-determined motivation: A meta-analysis. *Psychological Bulletin, 143*(12), 1346-137.

Howard, J. L., Gagne, M., Morin, A. J. S., & Forest, J. (2016). Using bifactor exploratory structural equation modeling to test for a continuum structure of motivation. *Journal of Management,* 2-24.

Immekus, J., & Imbrie, P. K. (2008). Dimensionality assessment using the full information item bifactor analysis for graded response data an illustration with the State Metacognitive Inventory. *Educational and Psychological Measurement, 68*(4), 695-709.

Karagüven, H. (2012). Akademik Motivasyon Ölçeğinin Türkçeye adaptasyonu. *Kuram ve Uygulamada Eğitim Bilimleri, 12*(4), 2599-2620.

Kline, R. B. (2011). *Principles and practice of structural equation modeling.* NY: The Guilford Press.

Kula-Kartal, S. (2018). *Analyzing academic motivation scale in terms of dimensionality based on item response theory models* (Doctoral dissertation). Resource document. https://tez.yok.gov.tr/UlusalTezMerkezi/tezSorguSonucYeni.jsp

Kusurkar, R. A., Ten Cate, T. J., Vos, C. M., Westers, P., & Croiset, G. (2013). How motivation affects academic performance: A structural equation modelling analysis. *Advances in Health Sciences Education, 18*, 57-69.

Lai, E. (2011). *Motivation: A literature review.* USA: Pearson Research Report.

Lepper, M. R., Corpus J. H., & Iyengar, S. S. (2005). Intrinsic and extrinsic motivational orientations in the classroom: Age differences and academic correlates. *Journal of Educational Psychology, 97*(2), 184-196.

Litalien, D., Morin, A. J. S., Gagne, M., Vallerand, R. J., Losier, G. F., & Ryan, R. M. (2017). Evidence of a continuum structure of academic self-determination: A two-study test using a bifactor-ESEM representation of academic motivation. *Contemporary Educational Psychology, 51*, 67-82.

Liu, W. C., Wang, J. C. K. & Ryan, R. M. (2016). *Building Autonomous Learners: Perspectives from Research and Practice using Self-Determination Theory.* Singapore: Springer.

Periard, D. (2016). A bifactor model of burnout? *An item response theory analysis of the Maslach burnout inventory* (Doctoral dissertation). Resource document. https://corescholar.libraries.wright.edu/

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-30.

Reise, S. P. (2012). The rediscovery of bifactor measurement models. *Multivariate Behavioral Research, 47*, 667-696.

Ryan, R. M., & Connell, J. M. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology, 57*(5), 749-761.

Ryan, R. M., & Deci, E. L. (2000a). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology,* 25, 54-67.

Ryan, R. M., & Deci, E. L. (2000b). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78.

Ryan, R. M., Patrick, H., Deci, E. L., & Williams, C. (2008). Facilitating health behaviour change and its maintenance: Interventions based on Self Determination Theory. *The European Health Psychologist*, *10*, 2-5.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motiv Emot, 30*, 347-363.

Tabachnick, B. G., & Fidel, L. S. (2001). *Using multivariate statistics*. MA: Allyn & Bacon, Inc.

Vallerand, R. J., Pelletier, L. G., Blais, M. R, Brière, N. M., Senécal, C., & Vallières, E. F. (1992). The academic motivation scale: A measure of intrinsic, extrinsic and amotivation in education. *Educational and Psychological Measurement*, *52*, 1003-1017.

Vallerand, R. J., Pelletier, L. G., Blais, M. R, Brière, N. M., Senécal, C., & Vallières, E. F. (1993). On the assessment of intrinsic, extrinsic and amotivation in education: Evidence on the concurrent and construct validity of the academic motivation scale. *Educational and Psychological Measurement, 53*, 159-172.

Vansteenkiste, M., Lens, W., & Deci, E. L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychologist*, *41*(1), 19-31.

Viau, R. (2009). *Okulda motivasyon: Okulda güdülenme ve güdülenmeyi öğrenme.* (Y, Budak, Çev.). Ankara: Anı Yayıncılık.