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Examining the Factor Structure of the Teachers' Sense of Efficacy Scale – Short Form in a Serbian Sample of Elementary-level Teachers: A Bifactor-ESEM Approach*

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This study explored the factor structure of the short form of the Teachers' Sense of Efficacy Scale (TSES-Sf) using Confirmatory Factor Analysis (CFA), and Exploratory Structural Equation Modeling (ESEM), as well as bifactor models based on these two approaches. A total of 295 elementary level teachers (80% females) completed measures of interest for this research. The bifactor-ESEM model provided the best fit to the data. The data revealed that a strong general

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factor of teachers' self-efficacy underpins responses to all TSES-Sf items, however, self-efficacy in student engagement and self-efficacy in classroom management had significant specificity after partialling out the general factor. On the other hand, self-efficacy in instructional strategies items loaded primarily on the general factor and showed low specificity over and above the general factor. This study reviews the previous conclusions about the criterion validity of TSES-Sf and proposes bifactor models as a useful framework for evaluating the structural validity of this scale.
Keywords: self-efficacy, bifactor models, exploratory structural equation modeling, criterion validity

Highlights:

- The factor structure of the short form of the Teachers' Sense of Efficacy Scale (TSES-Sf) was explored using Confirmatory Factor Analysis (CFA) and Exploratory Structural Equation Modeling (ESEM) procedures.
- The bifactor-ESEM model provided the best fit to the data**.**
- The data revealed a strong general factor of teachers' self-efficacy, however, self-efficacy in student engagement and self-efficacy in classroom management had significant specificity after partialling out the general factor.
- Self-efficacy in instructional strategies showed low specificity over and above the general factor.

Teachers' self-efficacy, a construct rooted in Bandura‘s social cognitive theory, has attracted attention in educational psychology and other fields of educational research for many years (Bandura, 1977, 1997, 2000, 2006; Pajares, 1997). Bandura defines self-efficacy as "people‘s judgments of their capabilities to organize and execute courses of action required to attain designated types of performance" (p. 391). Following Bandura's definition of self-efficacy, Tschannen-Moran et al. (Tschannen-Moran et al., 1998) define teachers' sense of efficacy as teachers' beliefs about their ability to impact students' motivation and achievements. According to this definition, teachers who are confident in their abilities to organize and execute courses of action required to accomplish a specific teaching task in a particular context will have students who are more motivated and who will achieve better educational outcomes (Tschannen-Moran et al., 1998, p. 233). The level of self-efficacy also depends on how many personal goals a teacher will set, what activities he/she will be ready to implement to achieve these goals, how much effort he/she will put in, and how long he/she will persevere when faced with difficulties (Pajares, 1997). Following this, previous research has found that teachers' self-efficacy is related to increased student motivation (Mahler et al., 2018), a more positive attitude toward school (Miskel et al., 1983), and higher self-esteem among students (Ross et al., 2001). Furthermore, previous research has found that teachers' self-efficacy is associated with a wide range of teachers' personal outcomes, such as well-being and job satisfaction (Caprara et al., 2006), as well as attitudes toward innovation and changes (Fuchs et al., 1992; Guskey, 1988).

Although research into teachers' self-efficacy has been going on for more than four decades, there is no consensus regarding the various measures used in this area or their psychometric characteristics. When it comes to the way teachers' self-efficacy is operationalized, the biggest quandary is whether it is a unidimensional construct or if different dimensions or facets of teachers' self-efficacy can be distinguished from one another (Henson, et al., 2001; Labone, 2004; Wheatley, 2005). A multidimensional operationalization of teachers' self-efficacy was proposed by Bandura (1997), which he implemented when creating his now outdated multifaceted self-efficacy scale. Additionally, the unidimensional measure of teachers' self-efficacy has been shown to be less useful both for research purposes and for assessing the need for school development (Skaalvik & Skaalvik, 2007).

Drawing from the theoretical framework of social cognitive theory, Bandura's operationalization of self-efficacy, and an assumed multifaceted nature of the teachers' self-efficacy, Tschannen-Moran et al., 2001) developed a well-addressed Teachers' Sense of Efficacy Scale (TSES short- and long-form). Although TSES became the predominant measure of teachers' self-efficacy in various parts of the world (e.g., Fives & Buehl, 2009; Knoblauch & Hoy, 2008; Murshidi et al., 2006; Tsigilis et al., 2010; Yilmaz, 2011), there is still no consensus about its structural and criterion validity, especially in non-English speaking areas. In addition, there is not enough research that took into account the overlap between constructs, which suggests the need to use less restrictive models; and high correlations among subscales, which suggests the need to examine the existence of hierarchical organization of this construct (Duffin et al., 2012). In this study, we compared different plausible rival factor solutions using the confirmatory factor analysis (CFA) and exploratory structural equation modeling (ESEM) frameworks, which can include testing all structural models of the TSES short-form tested so far, with the addition of bifactor models previously untested in the context of this scale. The use of these two approaches enables a 1) comparison of a more restrictive and a less restrictive approach when it comes to overlaps between constructs and 2) testing the existence of a hierarchical organization of this construct, taking into account the possibility of the existence of a general factor.

Teachers' Sense of Efficacy Scale: Previous Validations

Based on Bandura's conceptualization of self-efficacy, Tschannen-Moran et al. (1998) proposed a new multifaceted measure to assess teachers' sense of efficacy concerning the teaching tasks involved in student engagement, classroom management, and instructional practices. This instrument is intended to measure teachers' perceived ability and success in optimizing their own teaching (use of alternative teaching practices, assessment strategies, and explanations), strategies that maintain discipline and proper classroom organization without disruptions (classroom management), and the student's involvement in his/her learning (includes emotional and cognitive support and capabilities to motivate students for learning; Brgueño et al., 2021; Sherer et al., 2016). After reviewing previously developed self-efficacy measures (e.g., Ashton, 1984; Gibson & Dembo, 1984; Rose & Medway, 1981), the authors integrated previous research findings with researchers' recommendations and constructed a complex multidimensional scale that measures teachers' evaluation of their performance in different domains of teacher functioning. Given the multidimensional nature of teachers' self-efficacy, the biggest challenge in creating and evaluating the scale was to simultaneously consider facets as interrelated yet also distinct (e.g., Scherer et al., 2016; Tschannen-Moran & Hoy, 2001).

Starting from the originally proposed version of the 52-item scale, and after the first validation study conducted by Tschannen-Moran et al. (Tschannen-Moran et al., 1998), a 24-item long-form scale and a 12-item short-form scale proved to be valid and reliable measures of teachers' sense of efficacy, with correlations between the two forms ranging from .95 to.98. Based on results of their preliminary studies, Tschannen-Moran and Hoy (2001) argued that the TSES short-form (TSES-Sf) could be used for assessment of either a generalized efficacy factor or the three distinct domains of self-efficacy. The TSES-Sf scale has been validated in over 40 countries, and empirical evidence suggests that the TSES-Sf is a reliable and valid measure across different cultural contexts (e.g., Klassen et al., 2009; Nie et al., 2012; Ruan et al., 2015; Scherer et al., 2016; Valls et al., 2020). Most previous studies aimed at testing the psychometric characteristics of TSES-Sf used the Confirmatory Factor Analysis (CFA) approach and tested two competitive models, i.e. one- and three-factor solutions (e.g., Nie et al., 2012; Ruan et al., 2015;). Some previous studies suggest that different factor solutions are obtained depending on the subsamples used. For example, a three-factor structure has been consistently obtained for samples of practicing teachers, whereas for pre-service teachers, self-efficacy beliefs are not as distinct as those of practicing teachers (e.g., Fives & Buehl, 2009; Duffin et al., 2012). More specifically, in a study conducted by Fives and Buehl (2009), the authors' general recommendation was for TSES-Sf to be used as a unidimensional measure with samples of pre-service teachers but not with practicing teachers, for whom three distinctive dimensions were registered.

The results of a study that included five countries (Cyprus, Canada, the United States, Korea, and Singapore) supported the TSES's three-factor structure and supported measurement invariance across countries (Klassen et al., 2009). Similarly, Ruan and colleagues (Ruan et al., 2005) explored the validity of the TSES across three East Asian countries and found an acceptable model fit for a three-factor solution. In a study conducted by Scherer and colleagues (Scherer et al., 2016), the three-factor solution was confirmed in a sample of 32 countries (OECD Teaching and Learning International Survey (TALIS) 2013), but they found that the factor structure of the self-efficacy measure is better represented by ESEM than by CFA models that do not allow for cross-loadings. Following their recommendations, the ESEM approach seems more appropriate when it comes to complex constructs such as teachers' sense of efficacy, as some overlaps between three not strictly distinct aspects of self-efficacy are expected. Sherer and colleagues (2016), state that the correlations between the TSES subscales vary to a certain extent in 32 different countries and depending on the approach used (CFA or ESEM), but that a moderate to a high correlation between the factors is consistently registered (for the Serbian sample in ranging from .65 to .72). In a study conducted on a Serbian sample of teachers in primary and secondary schools, correlations between TSES factors ranged between .75 and .83 (Ninković & Knežević-Florić, 2018). Previous research has largely neglected the overlap between constructs, and high correlations among subscales (Sherer et al., 2016). Since it is expected that teachers have similar self-beliefs in different teaching contexts, items measuring their self-beliefs may not be exclusively related to one domain, but also include aspects of the other two (Scherer et al., 2016). The degree to which such an overlap between the factors of teachers' self-efficacy exists and to what extent it affects the measurement of the construct, has not yet been sufficiently investigated.

Bifactor-CFA and Bifactor-ESEM Models as Promising Untested Options

As mentioned earlier, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) have been most commonly used in previous research to assess the structural validity of the TSES scale. An exception is a study conducted by Scherer et al. (Sherer et al., 2016), in which they used the exploratory structural equation modeling (ESEM) approach to verify the factor structure of the TSES scale and measurement invariance across 32 countries, grouped into three clusters. Sherer et al. (Sherer et al., 2016) hypothesize that the basic assumptions of the CFA models are too restrictive for the TSES-Sf because the items are expected to have loadings only on the target factor, which is not sufficient to fully explore the factor structure of multidimensional scales such as the TSES (Marsh et al., 2014). The ESEM theoretical framework is, therefore, more appropriate for constructs, that encompass more closely related domains composed of items expected to have cross-loadings on other subscales.

Although unidimensional and three-factor models have most often been compared in the context of TSES-Sf, bifactor models have not been tested in previous research, although their use is justified in the case of multidimensional scales with highly related subscales. Chen and colleagues (Chen et al., 2006) suggested a bifactor analytic model as an alternative approach for representing a general construct comprised of several highly related domains. For constructs like teachers' self-efficacy, it is justified to consider bifactor models in which all items are used to define their respective subscales, while also being used to directly define a general factor (Reise, 2012). Although the bifactor model within both the CFA and ESEM approaches would suggest the simultaneous presence of general and specific factors, the main difference is that loadings on the non-target factors are also allowed within the ESEM framework. According to Morin and colleagues (Morin et al., 2016), who offered the bifactor-ESEM model, "[the] assessment of hierarchically organized construction calls for bifactor models, while estimating conceptually adjacent structures call for ESEM" (p. 280).

Following all of these arguments, in this study, we will use CFA, ESEM, and bifactor (both CFA and ESEM) models to test different factor solutions in the case of the TSES short form. Although both the ESEM and CFA approaches have been previously used in the context of this scale, this is the first study to use bifactor models, either CFA or ESEM, to evaluate the factor structure of this construct, even though there are clear theoretical justifications for this. The criterion validity of the best-fitted model will be demonstrated by associating the TSES-Sf factor(s) with the highly related construct of teaching autonomy (e.g., Noughabi & Amirian, 2021; Skaalvik & Skaalvik, 2014).

Teacher Self-efficacy and Perceived Autonomy

According to the theory of self-determination (Deci & Ryan, 2000), the sense of autonomy and the self-perceived ability to perform tasks effectively are considered universal psychological needs that are important for intrinsic motivation and better psychological and subjective well-being. Although the sense of competence cannot be reduced only to self-efficacy, self-efficacy is often defined as mastery expectations and is one dimension of self-perceived competence.

Accordingly, perceived teacher autonomy and self-efficacy are expected to be similarly related to different variables in work contexts, such as work engagement, job satisfaction, or burnout (Pearson & Moomaw, 2005; Skaalvik & Skaalvik, 2014). In addition, teachers who have a high sense of self-efficacy are expected to be more willing to teach following their own ideas, values, and goals. On the other hand, teachers with lower self-efficacy may be less comfortable independently choosing and designing certain teaching methods, as well as taking responsibility for them (Skaalvik & Skaalvik, 2014). The results of previous research indicate a positive correlation between teacher autonomy and the experience of self-efficacy in the classroom context (Federici & Skaalvik, 2012; Federici, 2013; Noormohammadi, 2014). Although they are not two identical motivational constructs, teacher self-efficacy and perceived autonomy are expected to correlate moderately, as well as to be in relationships of similar intensity and the same direction with other important outcome variables in the context of educational psychology.

The Present Study

The main goal of the present study was to evaluate several different structural models based on CFA and ESEM approaches and, in the case of TSES -Sf, on a sample of practicing teachers from Serbia. Previous studies have compared a unidimensional and a three-factor solution by mainly using the CFA approach, with the exception of one large cross-national study that used the ESEM framework to compare the two previously mentioned solutions. However, bifactor models have not been tested in previous research, even though there is a theoretical justification for this, in the case of multifaceted constructs between whose items and domains a high correlation is expected. The bifactor-CFA and bifactor-ESEM models tested in this study allow us to evaluate the assumption that items simultaneously loaded the general self-efficacy factor and the three specific factors proposed by the scale authors. Also, using a less restrictive model, such as ESEM, recognizes and tests the existence of overlap among different domains of teacher self-efficacy. In addition, the second research aim of this study was to verify the criterion validity of the best-fitted model, by testing the association between the TSES-Sf factor(s) and the highly related construct of teaching autonomy.

Method

Sample and Procedure

The sample consisted of 295 elementary-level teachers (237 females and 58 males; *Mage* = 43.34, *SD* = 9.01) from 16 primaries, mixed-sex public schools in Serbia. About a third of the participants have between 15 and 25 years of work experience (34.6%), followed by the group of those with between 5 and 10 years of work experience (27.8%); a slightly smaller percentage of them have less than 5 (16.9%)) and over 25 (20.7%) years of work experience. Participation in the study was voluntary, and anonymity was assured. All participants signed an informed consent form and did not receive any payment for participating in the study. The questionnaires were administered in a paper-and-pencil format. There were no missing data. The study was approved by the ethics committee of the Department of Pedagogy, Faculty of Philosophy, University of Novi Sad.

Instruments

Teachers' Sense of Efficacy Scale – Short form (TSES-SF; Tschannen-Moran & Hoy, 2001) is a 12-item self-report measure of three types of teacher self-efficacy: (1) self-efficacy in student engagement („How much can you do to get students to believe they can do well in schoolwork?"), (2) self-efficacy in instructional strategies („How much can you use a variety of assessment strategies?“), and (3) self-efficacy in classroom management („How much can you do to control disruptive behavior in the classroom?“). Items are rated on a 9-point Likert scale ranging from 1 = *Nothing* to 9 = *A great deal*. The Serbian version of the TSES-SF was translated using a back-translation procedure with the consent of the scale author and demonstrated favorable psychometric properties in previous research (Ninković & Knežević-Florić, 2018). In our study, the reliability of the TSES-Sf subscales estimated via Cronbach’s alpha ranged from .703 to .907.

Teaching Autonomy Scale (TAS; Pearson and Hall, 1993) consists of 18 items designed to measure curriculum autonomy ("In my teaching, I use my own guidelines and procedures.") and general teaching autonomy ("I am free to be creative in my teaching approach"). Curriculum autonomy refers to autonomy in the selection of activities and materials and instructional planning, on the other side, general teaching autonomy refers to classroom standards of conduct and personal on-the-job decision-making (Pearson & Moomaw, 2006). Items are rated on a 4-point Likert scale from 1 = *Definitely false*, to 4 = *Definitely true*. The Serbian version of the TAS was translated using a back-translation procedure with the consent of the scale author. The TAS was previously validated on this sample and three factors were registered: 1) absence of autonomy (negatively worded items), 2) general autonomy, and 3) curriculum autonomy (Marić-Jurišin & Malčić, in press). In our sample, internal consistency reliability for these three subscales ranged between 0.702 and .746.

Statistical Analysis

Data preparation: multivariate outliers were deleted based on the Mahalanobis d square method (the original sample consisted of 310 participants, after deleting multivariate outliers the current sample consists of 295 participants).

A Confirmatory Factor Analysis and Exploratory Structural Equation Modeling were conducted by Mplus version 7.32 (Muthen & Muthen, 2012). The parameter estimates were obtained using the maximum likelihood estimator with robust standard errors (MLR), which is robust to non-normality and non-independence of observations. The following fit indices were used to evaluate the model: (1) Yuan-Bentler scaled chi-square (YBχ2), (2) Akaike Information Criterion (AIC), (3) sample-size adjusted Bayesian Information Criterion (ssaBIC), (4) The Root Mean Square Error of Approximation (RMSEA), (5) Comparative Fit Index (CFI), (6) Tucker-Lewis Index (TLI), and (7) Standardized Root Mean Square Residual (SRMR). The YBχ2 value should be non-significant to indicate a good fit to the data (Barrett, 2007), and a lower AIC or ssaBIC value indicates a better fit. RMSEA values from .06 or less, CFI and TLI above .95, and SRMR values less than .08 are recognized as indicative of a good fit, while RMSEA between .06 and .08, and CFI and TLI between .90 and .95 are considered acceptable (Hu & Bentler, 1999).

Five models were tested. These included (1) Model 1 – a unidimensional solution with all items loading on one general factor; (2) Model 2 – the original three-factor model with three correlated specific factors: self-efficacy in student engagement (items 2, 3, 4, 11), self-efficacy in instructional strategies (items 5, 9, 10, 12), and self-efficacy in classroom management (items 1, 6, 7, 8) (CFA); (3) Model 3 – a bifactor-CFA model with one general factor and three specific factors; (4) Model 4 – an ESEM model in which loadings are allowed for all items for all three factors (target rotation); (5) Model 5 – a bifactor-ESEM model in which all items load the general factor and loadings on each of the three specific factors are also allowed (target rotation).

Criterion validity was investigated via correlational analysis with measures of teachers' self-efficacy and teaching autonomy.

Results

Descriptive Statistics

The means, standard deviations, and indicators of slope and flatness of distributions (skewness and kurtosis) for study variables are shown in Table 1. Participants, on average, achieve high values on the teachers' self-efficacy subscales, while the values on the autonomy subscales are close to the theoretical average. Based on the skewness and kurtosis values, it can be concluded that score distributions do not deviate from the normal distribution.

INSERT TABLE 1 ABOUT HERE

Factor Structure of the TSES-SF

Fit indices for the five tested models are shown in Table 2. The unidimensional solution (model 1) shows unacceptable fit to the data. In case of the original three-factor model (Model 2) the value of SRMR indicate good model fit, a values of CFI and TLI indicate acceptable fit levels, while RMSEA values are slightly above the cut-off score. Goodness-of-fit indices are good (SRMR and TLI) or acceptable (RMSEA and CFI) for the bifactor-CFA model (Model 3) with one general factor and three specific factors, while all goodness-of-fit indices are good for 1) the ESEM model where loadings are allowed for all items for all three factors (Model 4), and 2) the bifactor-ESEM model, in which all items load the general factor and loadings on each of the three specific factors are allowed (Model 5). The lowest AIC and sample size adjusted BIC values for

Model 5 suggest that it is more suitable to use the model in which all items load both the general factor and specific factors, and loadings on each of the three specific factors are allowed.

In the case of the original three-factor solution, the correlations between three specific factors are high and indicate the need to examine the models with a higher-order factor. The correlation was, respectively: .737 between self-efficacy in instructional strategies and self-efficacy in student engagement, .701 between self-efficacy in instructional strategies and self-efficacy in classroom management, and .663 between self-efficacy in student engagement and self-efficacy classroom management. When it comes to the ESEM model where loadings are allowed for all items for all three factors, the obtained correlation between the factors was, as expected, somewhat lower. Within this model, the correlation between three factors ranged between .523 and .606. In this model, it can be observed that, although target rotation was used, item 12 has a higher loading on the self-efficacy in student engagement factor than on the target factor (self-efficacy in instructional strategies).

Both tested bifactor models indicate that when the model contains a higher-order factor, self-efficacy in instructional strategies subscale no longer shows specificity, over and above the general factor. In the case of items that initially load the self-efficacy in instructional strategies factor, three out of four items had low loadings, while the fourth item had a high loading with a high standard error. It is an item that proved to be problematic in the ESEM model as well. In the following, the bifactor ESEM model will be discussed, as the model with the best goodness-of-fit indices. We opted for this model because of the high correlations between the factors in the case of the original three-factor and ESEM model.

INSERT TABLE 2 ABOUT HERE

The Bifactor-ESEM Model of TSES-SF

All items in the bifactor-ESEM model have statistically significant loadings on the general factor in a range of .348 to .814, indicating the existence of a general factor. All items within the subscales self-efficacy in student engagement (4 items) (range from .419 to .711, mean loading =.581) and self-efficacy in classroom management (4 items) (range from .583 to .739, mean loading =.635), significantly load on the target factor, and at the same time, no significant cross-load on non-target factors is registered. Items within the subscale self-efficacy in instructional strategies significantly loaded only on the general factor. Three out of four items had low loadings, while item 12 had a high loading on the target factor and a very high standard error. This is an item that in the ESEM model had a higher loading on the self-efficacy in student engagement factor than on the target factor. The specific factors self-efficacy in student engagement and self-efficacy in classroom management achieve a correlation of .425, while the factor self-efficacy in instructional strategies achieves a correlation with the other two factors close to zero (.124 and -.022). These results indicate that there is a general factor of teachers' sense of efficacy and that specificity is registered when it comes to the factors of self-efficacy in classroom management and self-efficacy in student engagement, while the factor of self-efficacy in instructional strategies does not provide unique information after controlling for the general factor.

INSERT TABLE 3 ABOUT HERE

Criterion Validity of TSES-Sf

The TSES criterion validity was investigated via correlational analysis with measures of teachers' self-efficacy (bifactor-ESEM solution) and teaching autonomy. As shown in Table 4, the general factor, as well as the self-efficacy in student engagement and self-efficacy in classroom management factors achieve significant correlations, in the expected direction, with all three subscales of teacher autonomy. The general factor consistently achieves a slightly higher correlation with the teacher autonomy subscales than the specific factors. No statistically significant correlations were registered for the relationship between self-efficacy in instructional strategies and the three subscales of teacher autonomy.

INSERT TABLE 4 ABOUT HERE

Discussion

The purpose of this study was twofold: 1) to examine the factor structure of the 12-item short-form version of the Teachers' Sense of Efficacy Scale, and 2) to evaluate the criterion validity of the TSES-Sf by examining correlations between the TSES-Sf and theoretically related construct such as teaching autonomy. This study evaluates alternative models for examining the structural validity of the TSES-Sf that are based on both CFA and ESEM theoretical approaches. To our knowledge, this is the first study using bifactor models and, more specifically, both bifactor-CFA and bifactor-ESEM approaches to examine the structural validity of the TSES-Sf. The various alternative models used in this study allowed us to test assumptions about the TSES-Sf's structural validity that were derived from previous studies and from the theoretical rationale of the construct itself. Finally, to evaluate the criterion validity of the model that showed the best fit to the data, we linked the TSES-Sf factors to the construct with which it was expected to correlate.

In this study, we tested five competing structural models of the TSES-Sf that were selected based on theoretical considerations and previous research. In addition to the original three-factor model, models that take into account overlap between constructs (ESEM approach) and high correlations between factors (hierarchical models) were also tested. The CFA model that assumed a one-factor solution for TSES-Sf showed a poor fit to the data, so this model was rejected. However, the original three-factor model that was evaluated using the CFA theoretical approach showed adequate fit to the data in terms of the incremental fit indices (CFI and TLI), but also poor fit to the data in terms of one of the absolute fit indices (RMSEA). On the other side, the three-factor ESEM model, a less restrictive theoretical approach, showed a good fit to the data in the case of both incremental and absolute fit indices. However, strong positive correlations among the three proposed factors in the original three-factor model (in the range between .663 and .737) and ESEM model (in the range between .523 and .606) indicated that models which take the general factor (bifactor models) into account are needed. We evaluated the bifactor-CFA (which does not allow cross-loadings) and the bifactor-ESEM model (which allows cross-loadings) in which all items are used to define their respective subscales, while also being used to directly define a general factor. The bifactor-ESEM model (which assumes a general factor and allows cross-loadings) shows the best fit to the data. Testing bifactor and ESEM models in the context of the TSES scale is in line with the recommendations of Sherer and colleagues (2016). They observed in a sample of 32 countries that the distinction between the three factors is not perfect, since significant cross-loadings existed, and that moderate to high correlations between the factors were consistently registered.

Our findings supported a strong general factor underlying the responses to all TSES-Sf items, and they also suggested that self-efficacy in student engagement and self-efficacy in classroom management have a certain amount of specificity, even though the items of these scales significantly loaded on the general factor. However, self-efficacy in instructional strategies items loaded primarily on the general factor and showed low specificity, after partialling out the general factor. Our findings are not comparable with previous research (e.g., Knoblauch & Hoy, 2008; Murshidi et al., 2006; Tsigilis et al., 2010), as they used only the CFA or ESEM approaches without the assumption of a potential general factor that loaded all items of the scale. However, these findings are consistent with the results obtained by Sherer and colleagues (2016), who state that high overlaps were consistently registered between the factors of instruction strategy and classroom management as well as instruction strategy and student engagement. In that research, the items within the self-efficacy in instructional strategies factor had a consistently high overlap with other factors, and in addition, this subscale registered consistently higher correlations with the other two factors than those two factors with each other. In accordance to Gibson and Dembo (1984) teachers with high self-efficacy in instructional strategies offer extra effort and different techniques, which can affect student engagement and the classroom atmosphere. On the other side, teachers with low instructional efficacy, are more inclined not to believe in teachers' contribution to the learning process, which can lead to lower student motivation. If teachers with lower scores on instructional efficacy invest less effort and give up more easily, it is expected that this will contribute to lower student engagement and a worse classroom atmosphere. Based on the above, it is theoretically expected that the items of this factor load more on the general factor, than for the remaining two factors.

According to previous research, the general factor of teachers' self-efficacy is moderately correlated with teaching autonomy (e.g., Noughabi & Amirian, 2021; Skaalvik & Skaalvik, 2014). In a study conducted by Sokmen and Kilic (Sokmen & Kilic, 2019), the correlation between teaching autonomy and the teachers' sense of efficacy subscales ranged from .30 in the case of self-efficacy in student engagement to .40 in the case of self-efficacy in instructional strategies. In our research, significant correlations were obtained for the relationship between general factor, self-efficacy in classroom management, and self-efficacy in student engagement on one side, and teaching autonomy subscales. An insignificant correlation between self-efficacy in instructional strategies and teaching autonomy subscales also suggests that this TSES-Sf factor has no specificity after partialling out the general factor.

This study has both theoretical and practical significance, as it tests models that are theoretically justified in the case of the TSES-Sf scale, and which have also not been tested in previous research. This study tested competitive models that were obtained in previous studies and, so far, have also not been combined into one study. In addition, the testing of bifactor models, which was for the first time applied in this study in the context of the TSES-Sf scale, represents a step forward in understanding this construct. Our results indicate that a general factor stands out, but also that teachers can differentiate between self-efficacy in classroom management and student engagement, which supports the assumed multidimensional nature of this scale (Tschannen-Moran & Hoy, 2001). However, we found that teachers equate self-efficacy in instructional strategies with general teachers' self-efficacy, meaning that they do not differentiate this teaching context as being specific or unique. Only bifactor models could produce the findings obtained in this study, which emphasizes the need to also test these models in future research.

However, criticism of bifactor models should also be taken into account. Several simulation studies have demonstrated that bifactor models are prone to 1) showing preferential fit compared with correlated factors models even when the population model does not follow a bifactor structure (Maydeu-Olivares & Coffman, 2006), 2) fitting any possible data (Reise et al., 2016) or random response patterns (Bonifay & Cai, 2017; Watts et al., 2019). Although we decided to apply the bifactor model based on recommendations from previous research (Sherer et al., 2016), in order to really conclude about the hierarchical structure of teachers' self-efficacy, it is necessary to replicate this research on other and larger samples. It is important to note that in this research, for one of the four items within the self-efficacy in instructional strategies factor, a large standard error and a negative residual variance are registered, which cannot be fixed at zero in the bifactor-ESEM model. This item proved to be problematic in other models as well, so it is necessary to check whether the problem occurs due to the size and characteristics of this sample or whether it is a generally problematic item. However, in addition to this item, the remaining three items within the self-efficacy in instructional strategies subscale show low and statistically insignificant loadings on the target factor, which speaks in favor of the lack of specificity of this factor.

This study has several drawbacks and limitations. First, it was conducted in only one cultural context and should therefore be replicated in different cultural and cross-cultural contexts. In addition, it would be important to evaluate the factor structure of the TSES-Sf by using the proposed models on different teacher samples, and with teachers teaching in different contexts. Finally, this sample was relatively small, which did not allow for testing of measurement invariance across gender, age, or years of experience. Conducting research on larger samples that would enable measurement invariance testing is clearly necessary in order to determine to what extent can findings from different subpopulations be compared.

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Ispitivanje faktorske strukture kratke verzije Skale osećaja samoefikasnosti nastavnika na uzorku nastavnika osnovne škole iz Srbije: bifaktorski ESEM pristup

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Ova studija je ispitivala faktorsku strukturu krate verzije Skale osećaja samoefikasnosti nastavnika (TSES-Sf), koristeći konfirmatornu faktorsku analizu (CFA) i eksplorativno modeliranje strukturalnim jednačinama (ESEM), kao i bifaktorske modele bazirane na ova dva pristupa. Ukupno 295 nastavnika osnovne škole (80% žena), je popunilo upitnike od interesa za ovo istraživane. Bifaktorski ESEM model je najbolje odgovarao podacima. Podaci pokazuju da snažan opšti faktor nastavničke samoefikasnosti stoji u osnovi odgovora na sve ajteme TSES-Sf. Međutim, samoefikasnost u radu sa studentima i samoefikasnost u upravljanju razredom su pokazali značajan specificitet posle izdvajanja opšteg faktora. Sa druge strane, ajteme koji se odnose na samoefikasnost u nastavnim strategijama primarno zasićuje opšti faktor i oni su pokazali nizak specificitet kada se uzme u obzir varijansa koja je već objašnjena opštim faktorom. Studija razmatra prethodne zaključke o kriterijumskoj validnosti TSES-Sf i predlaže bifaktorske modele kao koristan okvir za procenu strukturalne validnosti ove skale.

Ključne reči: samoefikasnost, bifaktorski modeli, eksplorativno modeliranje strukturalnim jednačinama, kriterijumska validnost

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Table 1

Descriptive statistics

	Range	M	SD	*Sk*	*Ku*
Total TSES score	3.83 – 9	7.02	.93	-.59	.64
Efficacy in student engagement	3.25 – 9	6.63	1.09	-.29	-.29
Efficacy in instructional strategies	4 – 9	7.27	.96	-.53	.16
Efficacy in classroom management	2.75 – 9	7.16	1.20	-.86	.93
Absence of autonomy	1 – 4	2.43	.58	.04	-.39
Curriculum autonomy	1.20 – 4	3.05	.56	-.66	.72
General teaching autonomy	1 - 4	3.51	.42	-.77	.72

Table 2

Goodness-of-fit indices of the TSES-SF

Model	$YB\chi^2$ $_{(df)}$	AIC	ssaBIC	TLI	CFI	SRMR	RMSEA (90% CI)
Model 1: Single-factor model	382.554 $_{(54)}$	10511.79	10530.36	.745	.792	.087	.144 (.130-.157)
Model 2: Original three-factor model	154.306 $_{(51)}$	10240.45	10260.56	.934	.915	.056	.089 (.088 - .098)
Model 3: Bifactor CFA model	110.004 $_{(42)}$	10194.91	10219.66	.957	.932	.042	.074 (.057-.091)
Model 4. ESEM model	67.787$_{(33)}$	10171.33	10200.73	.978	.956	.023	.060 (.039-.080)
Model 5: Bifactor ESEM model	46.255$_{(24)}$	10156.34	10190.37	.986	.961	.015	.056 (.031-.080)

Note. $YB\chi^2$ = Yuan-Bentler chi square; *df* = degrees of freedom; AIC – Akaike Information Criterion; ssaBIC – sample-size adjustet Bayesian Information Criterion; TLI = Tucker-Lewis Index; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error Of Approximation; CI = confidence intervals.

Table 3

Standardized factor loadings and strength indices for four different factor solutions of the TSES-Sf questionnaire

	Three-factor model	Bifactor CFA model		ESEM model			Bifactor ESEM model			
	Sf	Gf	Sf	SE	IS	CM	Gf	SE	IS	CM
SE										
Y2	.697**	.595**	.360**	.630**	-.017	.282	.348**	.520**	.034	.219
Y3	.836**	.585**	.562**	.854**	.061	-.065	.513**	.711**	-.010	-.086
Y4	.810**	.660**	.471**	.784**	.027	.006	.485**	.675**	-.044	-.037
Y11	.635**	.652**	.188	.557**	.242	-.080	.500**	.419**	.060	-.071
IS										
Y5	.624**	.533**	.307	.011	.588**	.104	.666**	.027	-.159	.011
Y9	.673**	.752**	.219	.042	.483**	.193	.617**	.023	-.043	.119
Y10	.661**	.624**	.070	-.111	.866**	-.015	.767**	-.087	-.146	-.070
Y12	.667**	.717**	.853	.409**	.325**	.056	.814**	-.002	1.396	-.007
CM										
Y1	.802**	.587**	.555**	.037	-.065	.834**	.471**	.037	-.006	.658**
Y6	.876**	.505**	.444**	.073	.145	.731**	.640**	.056	-.019	.559**
Y7	.858**	.625**	.630**	-.059	-.015	.927**	.522**	-.059	.027	.739**
Y8	.876**	.701**	.491**	.031	.154	.756**	.635**	.023	-.022	.583**
ECV							.453	.152	.213	.182
ωh							.752	.085	.018	.110
ωr							.783	.088	.018	.110

Note. *ECV* – Explained common variance; ωh – omega hierarchical, ωr – relative omega; ** $p < .01$, * $p < .05$.

Table 4

Correlations between TSES-SF factors and the teaching autonomy subscales

	Absence of autonomy	Curriculum autonomy	General autonomy
General factor	-.365**	.248**.	.306**
Student engagement	-.285**	.148*	.170**
Instructional strategies	-.105	.068	.041
Classroom management	-.273**	.140*	.144*

Note. ** $p < .01$, * $p < .01$.