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Development of Self-Regulatory Strategies Scale (SRSS)

Özdüzenleyici Öğrenme Stratejileri Ölçeğinin (ÖÖSÖ) Geliştirilmesi

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Abstract

The purpose of this study was to develop a scale assessing high school students' use of self-regulatory strategies while studying. In the pilot study, the scale was administered to 422 students. Eight factors were obtained through explanatory factor analysis: namely, motivation regulation, effort regulation, planning, attention focusing, summary strategy, highlighting strategy, using additional resources, and self-instruction. In the validation study, the 29-item final version of the scale was administered to 616 students. Results of confirmatory factor analysis confirmed eight factor solution. The Cronbach's alpha for each factor ranged from .68 to .82. Additionally, results of Multivariate Analysis of Variance revealed significant gender differences. Findings provided some evidence for the validity and reliability of the Self-Regulatory Strategies Scale scores.

Keywords: Self-regulation, self-regulatory strategies, scale development, chemistry education.

Öz

Bu çalışmanın amacı, lise öğrencilerinin ders çalışırken kullandıkları özdüzenleyici öğrenme stratejilerini ölçmek için bir ölçek geliştirmektir. Pilot çalışmada ölçek 422 öğrenciye uygulanmıştır. Açıklayıcı faktör analizi sonuçları, ölçeğin sekiz faktörden oluştuğunu göstermiştir. Bu faktörler, motivasyon düzenleme, çaba düzenleme, plan yapma, dikkat toplama, özetleme, vurgulama, ek kaynakları kullanma ve özyönlendirmedir. Geçerlilik çalışmasında ölçeğin 29 maddelik son hali 616 öğrenciye uygulanmıştır. Doğrulayıcı faktör analizi sonuçları,sekiz faktörlü yapıyı doğrulamıştır. Her bir faktör için Cronbach Alfa iç güvenirlik katsayısı ise .68 ile .82 aralığında değişmiştir. Ek olarak çok değişkenli varyans analizi sonucunda cinsiyet farkı olduğu ortaya çıkmıştır. Sonuçlar, Özdüzenleyici Öğrenme Stratejileri Ölçeği'nden elde edilen puanların güvenilirliği ve geçerliği hakkında kanıtlar sağlamıştır.

Anahtar Sözcükler: Özdüzenleme, özdüzenleyici öğrenme stratejileri, anket geliştirme, kimya eğitimi.

Introduction

One of the major problems that students experience while studying is that they are not aware of what they are learning or what they are doing. Students have many difficulties in managing time, choosing effective learning strategies, note taking, and preparing for tests (Zimmerman, Bonner, & Kovach, 1996). Enhancing learning does not mean just improving content knowledge; it also includes developing study skills, social skills, and desired motivational orientations to help students become independent life-long learners. Recent studies give priority to 'how individuals learn' and 'how individuals regulate themselves for learning', more specifically self-regulation. Research studies provided empirical evidence for the association between self-regulatory

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strategies and learning outcomes such as academic achievement, motivational orientations, and self-efficacy beliefs (Arsal, 2009; Arsal, 2010; Haşlaman & Aşkar, 2007; Pape & Wang, 2003; Pintrich & DeGroot, 1990; Orhan, 2008; Sperling, Howard, Staley, & DuBois, 2004; ; Yumusak, Sungur, & Cakiroglu, 2007; Yükseltürk & Bulut, 2009; Zimmerman, 1990; Zimmerman & Martinez-Pons, 1990; Zusho, Pintrich, & Coppalo, 2003). Therefore, in education, self-regulation is one of the most essential constructs. All learners are assumed to use self-regulatory strategies to some degree; thus, it is not appropriate to talk about *absence of self-regulation* or *un-self-regulated* learners (Winne, 1997), teachers should determine students' existing strategies and help them develop new strategies as well as enhance their content knowledge. To make correct judgments about students' use of SRL strategies, accurate measurement of the construct is needed. Once students' initial levels are determined, teachers can organize their classrooms to promote development of these strategies.

Zimmerman (2000) defined self-regulation as "self-generated thoughts, feelings, and actions that are planned and cyclically adopted to the attainment of personal goals" (p.14). Different models have been proposed to provide a comprehensive explanation about the cognitive and motivational variables in this self-regulatory process (Zimmerman, 2001). In the present study, Zimmerman (2000)'s model based on social cognitive theory (Bandura, 1986) has been used to explain students' use of self-regulatory strategies. Social cognitive theory explains human functioning through reciprocal interactions among personal factors, environmental factors, and behaviors (Bandura, 1986). In Bandura's triadic model of reciprocal determinism, personal, behavioral, and environmental factors are viewed as separate but interdependent sources that influence each other bi-directionally. For example, learner's self-efficacy beliefs influence his/her task choice, effort, and persistence in a task, which shows the influence of personal factor on behavior. On the other hand, when learner experiences success after working hard on a task (behavioral factor), his/her self-efficacy beliefs (personal factor) may increase (Schunk & Zimmerman, 1997). Another reciprocal interaction exists between environmental and behavioral factors. After teacher presents the rules for group work (environmental factor), learners form groups (behavioral factor). If the learners raise their hands to ask a question about the rules (behavioral factor), the teacher review the rules (environmental factor). The last interaction exists between personal and environmental factors. When the learner believes that s/he cannot achieve the task, the teacher tries to persuade the student to believe his/her capability. This feedback, in turn, generates self-confidence in the learner (personal factor influences environmental factor, which then influences personal factor). This reciprocal interaction plays a role in self-regulated learning (SRL) in that students guide their learning by interpreting the information both from their environment and self orientations (motivational and cognitive characteristics).

Zimmerman and Martinez-Pons (1986) defined SRL strategies as "actions directed at acquiring information or skill that involve agency, purpose (goals), and instrumentality self-perceptions by a learner" (p.615). Through interviews, they identified 14 strategies which students commonly use in their learning processes : self-evaluation, organizing and transforming, goal-setting and planning, seeking information, keeping records and monitoring, environmental structuring, self-consequences, rehearsing and memorizing, seeking peer assistance, seeking teacher assistance, seeking adult assistance, reviewing tests, reviewing notes, and reviewing text. Zimmerman (2000) utilized these strategies in his model explaining SRL. Zimmerman's model includes three phases: forethought, performance, and self-reflection. These processes help students motivate and guide their own learning. The first phase, forethought phase, includes processes which prepare students for learning. After evaluating their prior knowledge, students set their own learning goals and determine which strategy to use. For example, goal setting and planning strategies fall under this phase. The second one, performance phase, includes the implementation of strategies for learning and monitoring their accuracy like environmental structuring. The third phase, self-reflection phase, consists of processes that occur after learning. Students judge what they have learned and what they need to learn further. Because personal, behavioral, and environmental factors

are constantly changing and students need to use feedback from prior experiences to adjust their current efforts, SRL is a cyclical process (Zimmerman, 2000). Self-reflection phase is followed by the forethought phase of the next learning process. Indeed, Zimmerman (1990) considers that there is a self-oriented feedback loop in SRL. Learners are also expected to be metacognitively, motivationally, and behaviorally active in their own learning. In sum, "self-regulated students select and use self-regulated learning strategies to achieve desired academic outcomes on the basis of feedback about learning effectiveness and skill" (Zimmerman,1990, pp 6-7).

Although there have been several studies on students' self-regulatory strategies in literature, these studies suffer from lack of accurate measures. For example, Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991) is one of the most commonly used instruments to assess students' motivational orientations (31 items) and use of learning strategies (50 items). The motivation section includes six subscales (e.g., intrinsic goal orientation, task value, and test anxiety), while learning strategies section includes nine subscales (e.g., rehearsal, organization, and effort regulation). The instrument was used in a variety of studies, and administered to different subject groups such as elementary school students (Karadeniz, Büyüköztürk, Akgün, Kılıç-Çakmak, & Demirel, 2008; Pintrich & DeGroot, 1990), high school students (Rao, Moely, & Sachs, 2000**;** Karadeniz et al., 2008; Yumusak, Sungur, & Cakiroglu, 2007), and undergraduate students (Haşlaman & Aşkar, 2007; Zusho et al., 2003). However, this scale does not have desirable psychometric characteristics. For instance, the motivation section and the learning strategies section had goodness of fit indices (GFI) of .77 and .78, respectively. In addition, some of the subscales yielded poor Cronbach alpha coefficients as low as .52 (Pintrich et al., 1991). Therefore, an alternative instrument measuring students' use of self-regulatory strategies with improved validity is warranted.

Accordingly, the purpose of this study was to develop a scale with good psychometric characteristics assessing self-regulatory strategies that high school students use while studying. Although all SRL processes have equal importance and are interrelated to each other, study strategies are implemented by students mainly in forethought and performance phases. This study was limited to the strategies that high school students use during forethought and performance phases. In addition, students evaluate their performance and attribute success or failure to several factors in self-reflection phase. Therefore, it would be more appropriate to assess first the strategies in forethought and performance phase; then to measure the strategies in self-reflection phase after their performance.

Method

Subjects of the Study

The target population of the present study was all tenth grade students in Ankara, Turkey. The study required two data collection processes for pilot and validation study. Therefore, two independent samples were selected in the study. During the selection process, first, the list of high schools in Ankara was obtained. Then, four high schools for pilot study and five high schools for validation study were selected randomly. In the pilot study, the data were collected from two regular high schools (N=168), one Anatolian high school (N=147) and one private school (N=107). There were a total of 422 tenth grade students (190 male, 219 female, and 13 nonrespondents to the gender item). On the other hand, three regular high schools (N=240), one Anatolian high school (N=208) and one private school (N=168) participated in the validation study. After revisions based on the pilot data analysis, the revised instrument was administered to validation sample consisting of 616 tenth grade students (312 male, 291 female, and 13 nonrespondents to the gender item). All administrations were completed in a regular class hour (in 10 to 15 minutes). Students were informed about the confidentiality of the results.

Instrumentation

An initial pool of 48 items was generated based on interviews conducted with high school students (Kadıoğlu, Uzuntiryaki & Capa Aydin,2006), Zimmerman's self-regulation model (Zimmerman, 2000), and existing self-regulation instruments such as MSLQ (Pintrich et al., 1991), motivational regulation scale (Wolters, 1999), and achievement goal orientations scale (Middleton & Midgley, 1997). Authors (Kadıoğlu, Uzuntiryaki & Capa Aydin,2006) conducted semi-structured interviews with a small group of high school students (n=3) from different school types. Interview questions were developed based on Zimmerman's self-regulation model (Zimmerman, 2000). These interview findings provided preliminary information to understand which strategies are commonly used by high school students while studying. Students' statements revealed from the interview were transformed into items for the present study. Followings are the descriptions of the proposed constructs. Table 1 presents the sample items.

Table 1.

Construct Names and Sample Items of the Self-Regulatory Strategies Scale (SRSS)

Constructs	Sample Items
Motivation Regulation	I persuade myself to work hard in order to learn the topic.
Planning	I decide on what to learn before I start studying a task.
Effort Regulation	While studying for a task, I give a break if I do not understand the topic.
Attention Focusing	Before starting to study, I organize my study environment.
Task Strategies	I list the concepts that I cannot understand.
Using Additional Resources	I study the topic from different resources.
Self-Instruction	While solving a problem, I explain to myself how to solve the problem.

Motivation regulation and planning strategies are employed during the forethought phase. Students' desire to engage in, pursue, and complete a task is defined as *motivation regulation.* Students' remembering the importance of the subject for their future life can be given as an example of this strategy. *Planning* is adjusting time, resources, and strategies to perform optimally such as making a "to-do" list before beginning to study.

Effort regulation, attention focusing, summary strategy, highlighting strategy, using additional resources, and self-instruction strategies are used during the performance phase. Students' showing effort in continuing or completing a task regardless of difficulties is called *effort regulation.* For example, "keeping studying even when get bored" falls under this category. *Attention focusing* is described as students' attempts to arrange their surroundings in order to avoid distractions and increase their concentration. For instance, keeping only study materials on the table is one way of employing this strategy. *Task strategies* are used to organize main ideas through reducing the task into meaningful parts such as summarizing the topic by use of maps or charts. *Using additional resources* involves using a variety of resources different from course materials. In the s*elf-instruction,* students overtly or covertly explain how to perform a task.

In the present study, chemistry course was selected arbitrarily to provide students with a context in which they utilize self-regulatory strategies while studying. All of the items were written in first person (e.g., "While I am studying a task, I summarize the concepts that I can not understand"). Items were formatted on a six-point rating scale of frequency ranging from 1 (never) to 6 (always). Each item in the scale was examined by three experts in the fields of science education, and educational measurement regarding content validity and format of the scale. After receiving feedback from the experts, the number of items was reduced to 33 and the scale was checked for grammar and language structure by a Turkish teacher.

Results

Results are presented in two sections: Findings obtained from pilot study and findings of validation study.

Pilot Study

The data gathered from 422 students were analyzed using Exploratory Factor Analysis (EFA) to explore the underlying dimensions; in other words to decide the number of factors and which items were loaded on which factors (Çokluk, Şekercioğlu, & Büyüköztürk, 2010; Tabachnick & Fidell, 2007). Maximum likelihood method of extraction was used considering the suggestion of Fabrigar, Wegener, MacCallum, and Strahan (1999). Fabrigar et al. state that maximum likelihood is commonly used because "it allows for the computation of a wide range of indexes of the goodness of fit of the model … also permits statistical significance testing of factor loadings and correlations among factors and the computation of confidence intervals" (p. 277). To simplify the data structure, oblique rotation, more specifically direct oblimin, was preferred over orthogonal rotation restricting the factors to be uncorrelated (Preacher & MacCallum, 2003, p. 25). Preacher and MacCallum recommend that, If the researcher does not know how the factors are related to each other, there is no reason to assume that they are completely independent. It is almost always safer to assume that there is not perfect independence, and to use oblique rotation instead of orthogonal rotation. (p. 26).A variety of criteria was used to determine the number of common factors to retain: the eigenvalue greater than 1 criterion, the scree test, the amount of common variance explained, and conceptual interpretability of the factor structure. These criteria suggested the adequacy of extracting eight factors, accounting for 62% of the common variance. Full factor loading matrix is given in Table 2. With a cutoff value of .30 (Hair, Black, Babin, Anderson, & Tatham, 2005) for item inclusion in a factor, the factors were labeled respectively: motivation regulation, effort regulation, planning, attention focusing, summary strategy, highlighting strategy, using additional resources, and self-instruction. Results indicated that the items related to task strategies were scattered on two factors. After examining the content, the first factor was named as summary strategy since it included strategies such as summarizing in his/her own words (item 19: "I summarize the subject in my sentences while studying for a task") . The second factor was named as highlighting strategy as it is related to emphasizing the important points in the task. For example, item 12 read "I underline important points while studying for a task." Two items (Items 2 and 21) had relatively low loadings. However, these items were retained because they reflect important aspects of the construct. In addition, three items (Item 15, Item 25, and Item 27) did not load on any factors. Moreover, Item 17 ("I study the topic by dividing into small tasks") loaded on the Factor 8 (Self-instruction), but the content was not appropriate for that factor. For those reasons, these four items were excluded from the scale, resulting 29 items.

Table 2.

Full factor loadings for Self-Regulatory Strategies Scale (SRSS)

	F1	F2	F3	F4	F5	F6	F7	F8
ITEM5	.672	-.047	-.071	-.011	.067	-.094	-.023	-.033
ITEM30	.579	-.056	.062	.005	.115	-.019	-.065	.063
ITEM14	.488	-.008	.039	.102	.031	.005	-.087	.036
ITEM3	.297	-.046	.011	.192	.225	-.053	-.060	.152
ITEM21	.265	.067	-.193	.153	.111	-.154	.020	-.005
ITEM15*	.218	-.020	-.175	.059	.099	-.105	.112	.102
ITEM23(R)	-.041	.734	.061	-.171	.000	-.032	-.072	.039
ITEM32(R)	.020	.684	.026	-.012	-.053	.044	.033	-.025
ITEM11(R)	-.037	.595	-.058	.107	.088	.023	-.004	-.005
ITEM6	-.049	.011	-.907	-.001	.034	-.018	.016	-.054
ITEM1	-.062	-.040	-.576	.042	.113	.062	-.042	.059
ITEM18	.045	-.021	-.544	.013	-.084	-.214	-.036	.152
ITEM8	.096	-.059	-.382	.063	.104	-.177	-.015	.036
ITEM9	-.086	-.078	-.011	-.703	.018	-.071	-.030	-.079
ITEM33	.039	.006	-.068	-.658	-.018	.015	-.053	.071
ITEM10	.133	.005	-.008	-.528	.108	-.020	-.082	-.086
ITEM31	.263	.023	-.072	-.358	-.016	.012	-.038	.148
ITEM2	.122	.005	-.040	-.255	.056	.152	-.132	.102
ITEM7	.035	.024	-.149	.019	-.688	-.020	-.151	.008
ITEM28	.074	.037	-.007	.042	-.537	.064	-.022	.017
ITEM22	.139	-.026	-.008	-.061	-.437	-.148	-.076	.055
ITEM27*	.071	-.154	-.071	.068	-.173	.016	.005	.097
ITEM20	-.020	.019	-.080	.044	-.034	.555	-.062	.077
ITEM19	.076	-.102	-.071	.029	.059	.549	-.065	.072
ITEM16	.119	.033	-.144	.034	-.057	.453	-.077	-.006
ITEM12	-.051	.057	-.039	.263	.115	-.121	-.573	.099
ITEM26	-.014	-.005	.020	.151	.169	-.162	-.453	.077
ITEM4	.141	.061	-.031	.015	.059	.010	-.449	-.059
ITEM25*	.149	.012	-.111	-.079	.042	-.087	-.219	.217
ITEM29	.103	-.064	-.067	-.066	-.001	-.032	-.049	.538
ITEM13	.070	-.087	-.256	.149	-.091	-.003	-.126	.422
ITEM17*	.192	-.032	-.075	-.006	-.005	-.030	-.032	.410
ITEM24	-.036	-.098	-.053	-.061	-.033	-.066	-.219	.405

* Items deleted

(R) Items reverse coded

F1: motivation regulation; F2: effort regulation; F3: planning; F4: attention focusing; F5: using additional resources; F6: summary strategy; F7: highlighting strategy; F8: self-instruction

In addition, Cronbach alpha and 95% confidence interval for reliability coefficients were calculated to determine the internal consistency of the scores obtained from the scale. The Cronbach alpha coefficients over .70 are stated as adequate for an instrument to be used (Nunnaly, 1978; Özgüven, 2004). The alpha coefficients [and 95% confidence intervals] for the factors of motivation regulation, effort regulation, planning, attention focusing, using additional resources, summary strategy, highlighting strategy, and self-instruction were .77 [.74, .81], .69 [.63, .74], .82 [.79, .84], .78 [.75, .81], .72 [.67, .76], .73 [.68, .77], .73 [.70, .76], and .77 [.72, .80], respectively.

Validation Study

The revised 29-item scale was administered to 616 tenth students from five different schools in order to validate the factor structure obtained from the pilot study. A confirmatory factor analysis was performed using LISREL 8.30 for Windows (Jöreskog & Sörbom, 1993) in order to test how well the factor structure emerges from the pilot data fits the validation data; in other words to confirm the initial model suggested by the EFA (Jöreskog & Sörbom, 1993, Kline, 2005). Eight-factor solution was tested and each item on the scale was assigned to the specified factor. To assess the model data fit, Adjusted Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI), Root Mean Square Residual (RMR) and Standardized Root Mean Square Residual (SRMR) were used. The values of AGFI, NNFI, and CFI above .90 are indicative of good fit (Jöreskog & Sörbom, 1993; Kline, 2005). For RMSEA, values less than .05 indicate good model data fit, values ranging from .05 to .08 indicate mediocre fit, and values greater than .10 indicate poor fit (Browne & Cudeck, 1993). Root Mean Square Residual (RMR) and Standardized Root Mean Square Residual (SRMR) should have values less than .05 for a good model fit (Jöreskog & Sörbom, 1993; Kline, 2005). Findings indicated that initial fit indices were not at the satisfactory level. After examining modification indices, the error covariances between items 23 and 12, 27 and 2, and 24 and 7 were set free. After this revision, the eight-factor model proposed for the confirmatory factor analysis yielded an AGFI of .84, RMSEA of .064, NNFI of .89, CFI of .91, RMR of .060, and SRMR of .060. Overall these fit indices indicated a moderate fit.

The Lambda-x estimates, which indicate the loadings of each item on respective factor, for each item were given in Figure 1. They ranged from .53 to .90. In addition, confirmatory factor analysis also produces correlations between the factors. For the simplicity, these values are presented in Table 3. Kline (2005) suggested that estimated correlations should not exceed the value of .85 for discriminant validity. In the present study, only one correlation estimate between summary strategy and highlighting strategy was slightly high (r = .87) which was in line with the Zimmerman's (2000) model.

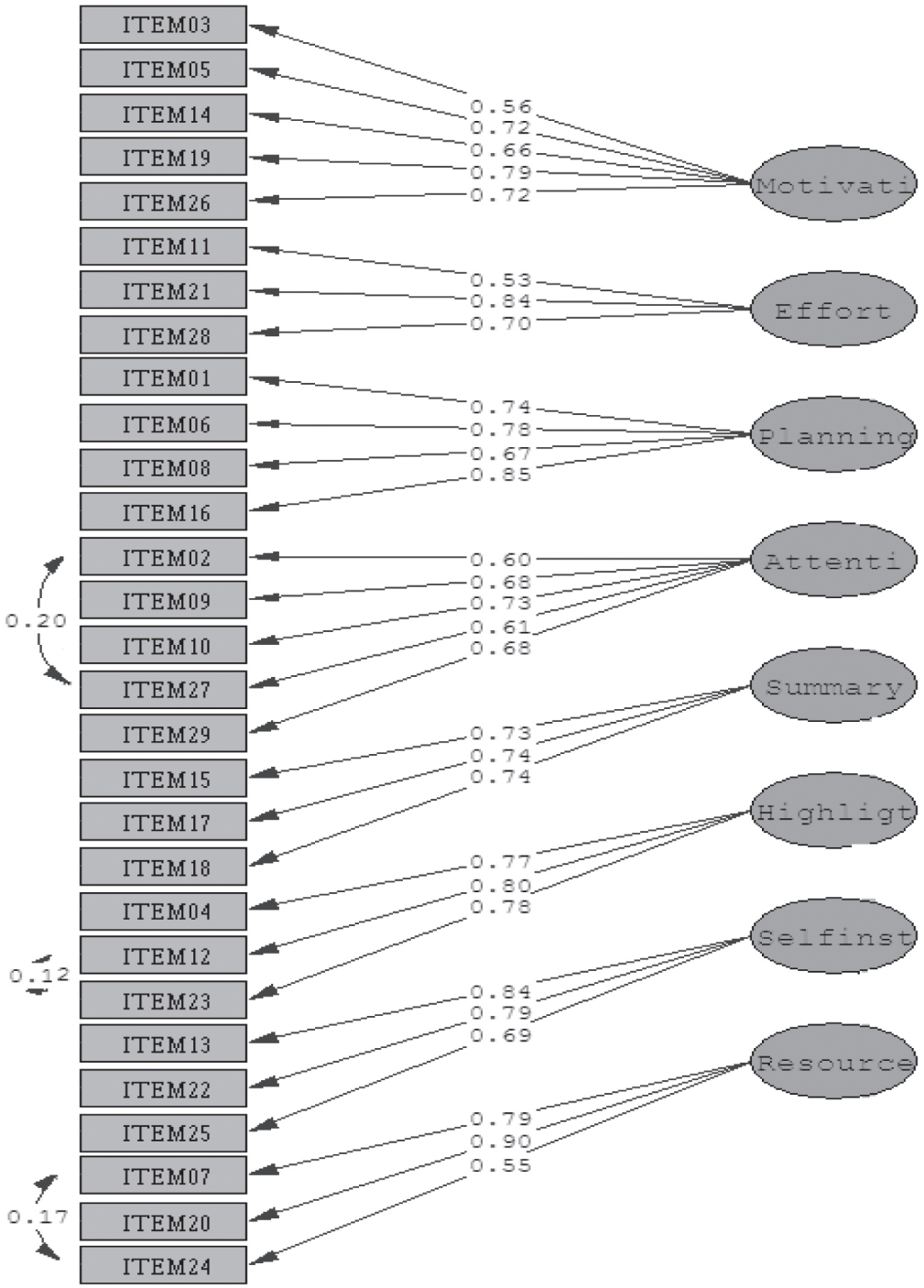

Figure 1. Structural Model for the 29-Item Scale
Note. Motivati = motivation regulation; Effort = effort regulation; Planning = planning; Attenti = attention focusing; Summary = summary strategy; Highligt = highlighting strategy; Selfinst = self-instruction; Resource = using additional resources. Correlations among factors were not included in Figure 1 for simplicity. Please refer to Table 3 for these values.

Table 3.

Intercorrelations Among Factor

Factor Name	1	2	3	4	5	6	7
1. Motivation Regulation	1.00						
2. Effort Regulation	0.26**	1.00					
3. Planning	0.77**	0.26**	1.00				
4. Attention Focusing	0.71**	0.19**	0.64**	1.00			
5. Summary Strategy	0.78**	0.17**	0.70**	0.51**	1.00		
6. Highlighting Strategy	0.77**	0.16**	0.65**	0.65**	0.87**	1.00	
7. Self-Instruction	0.79**	0.09*	0.65**	0.58**	0.83**	0.73**	1.00
8. Using Additional Resources	0.70**	0.18**	0.62**	0.49**	0.65**	0.70**	0.62**

* Correlation is significant at the .05 level (2-tailed)

** Correlation is significant at the .01 level (2-tailed)

Table 4 displays the Cronbach's alpha coefficients along with 95% confidence interval. Findings indicated that all factors yielded adequate internal consistency estimates, ranging from 0.68 to 0.82.

Table 4.

Cronbach Alpha Values and 95% Confidence Intervals for Reliability

Factor Name	Cronbach Alphas	95% Confidence Interval	
		Lower Bound	Upper Bound
Motivation Regulation	.77	.74	.80
Effort Regulation	.68	.64	.72
Planning	.82	.79	.84
Attention Focusing	.76	.73	.79
Using additional Resources	.78	.74	.81
Summary Strategy	.74	.70	.77
Highlighting Strategy	.79	.76	.82
Self-Instruction	.77	.73	.80

Finally, to provide additional validity evidence, *differentiation between groups* approach was used as a procedure for construct validation (Crocker & Algina, 1986 ; Tezbaşaran, 2008). In the literature, girls were found to be using self-regulatory strategies more frequently than boys (Ablard & Lipschultz, 1998; Pokay & Blumenfeld 1990; Zimmerman & Martinez-Pons, 1990). To test whether factors differentiated in the hypothesized direction, Multivariate Analysis of Variance (MANOVA) was used. Eight factors were used as dependent variable and gender as an independent variable. Before conducting the analysis, the assumptions of MANOVA were checked and findings indicated that homogeneity of the covariance assumption was violated (*Box's M* = 69.04, $p < .05$). Therefore, a more robust statistic, Pillai's Trace, was selected for reporting. The results of MANOVA revealed significant differences between males and females (Pillai's Trace = .232, F (594, 8) = 22.402, $p< .05$, $\eta^2 = .23$). The multivariate η^2 of .23 implied that the magnitude of the difference between the groups was large according to the generally accepted criteria (Cohen, 1988). Bonferroni adjustment was utilized to evaluate further univariate F statistics and assumed alpha level of .05 divided by the number of dependent variables (i.e., eight). Therefore, obtained F statistics were evaluated at the alpha level of .01. Table 5 displays the results of follow-up univariate analyses accompanied with means and standard deviations. Results revealed that there were significant gender differences on dependent variables for all factors except effort regulation. Girls were found to use self-regulatory strategies more frequently than boys, as expected.

Table 5.

Follow-up Univariate Analyses Along with Associated Descriptive Statistic

Factor Name	*Female*		*Male*		
	M	*SD*	*M*	*SD*	*F*
Motivation Regulation	3.74	1.12	3.18	1.05	41.194*
Effort Regulation	3.04	1.18	3.03	1.20	.003
Planning	3.39	1.24	2.82	1.14	34.683*
Attention Focusing	4.59	1.09	4.08	1.14	30.892*
Summary Strategy	3.57	1.21	2.61	1.14	102.245*
Highlighting Strategy	4.52	1.19	3.25	1.33	151.187*
Self-Instruction	3.82	1.30	3.14	1.23	42.540*
Using Additional Resources	4.44	1.23	3.64	1.19	65.367*

* F values are significant at the .01 level (2-tailed)

Discussion and Implications

Findings of this study indicated that the SRSS provides valid and reliable scores to examine high school students'use of self-regulatory strategies while studying. It is also a practical tool for teachers to use because administration does not require long periods of time and it is not difficult to interpret the results. Confirmatory factor analysis supported the claim that self-regulation is a multidimensional construct consisting of different processes. The final version of the SRSS includes 29 items in eight factors. These factors were motivation regulation, effort regulation, planning, attention focusing, summary strategy, highlighting strategy, using additional resources, and self-instruction. The reliability coefficients of the factors were also found to be reasonably high ranging from .68 for effort regulation and .82 for planning.

Additionally, findings indicating a gender difference in the use of self-regulatory strategies provided another validity evidence. Boys and girls differed with respect to all factors except effort regulation. Further, girls were found to use self-regulatory strategies more frequently than boys. These findings are parallel with the previous studies indicating gender differences in favor of girls. For example, Zimmerman and Martinez-Pons (1990) found that girls used more strategies (e.g., goal-setting, planning strategies, keeping records and self-monitored) than did boys. Similarly, Pokay and Blumenfeld (1990) found that girls used more metacognitive, general cognitive, and effort management than did boys. Likewise, Ablard and Lipschultz (1998) reported that girls used SRL strategies such as personal regulation or optimizing the environment more often.

Zimmerman (2000) proposes three cyclic phases (forethought, performance, and self-reflection phases) while defining the structure of self-regulated learning. He also defines many sub-processes under these three phases such as goal setting, outcome expectations, task strategies, self-evaluation, or causal attributions. The high correlations between factors in the present study were evident that the self-regulatory processes were different but interrelated. For example, the correlation coefficient between motivation regulation and planning was found to be .77, which indicates that highly motivated students use planning strategies more frequently. In this study, the most frequently used self-regulatory strategy was attention focusing, while effort regulation, summary strategies, and planning were the least often used ones. Results pointed out that students tended to give up when they came across with difficulties, not to summarize the topic meaningfully, and not to make strategic planning.

Implications for Practice

Zimmerman et al. (1996) proposed that every student can become successful learner by using self-regulatory strategies. Therefore, teachers should teach students how to be self-regulated

learners. However, teaching students to be strategic learners involves more than acquisition of new strategies. It requires implementing the strategies in new tasks and adjusting the strategies concerning the changes in environmental, behavioral, and personal factors. Teachers should make students responsible for their learning and guide them in this learning process. Additionally, Pape, Bell and Yetkin (2003) argued that strategy instruction should be individualized because different students have difficulty in different tasks. Some students may have difficulty in analyzing the tasks, while others struggle with monitoring their performance effectively. Therefore, teachers can benefit from this instrument in order to determine each student's strengths and weaknesses.

Based on social cognitive theory, environmental factors (such as instruction strategy or teacher support) influence the development of these skills and learners become more self-regulated when they internalize the strategies and use them in different tasks and contexts (Meyer & Turner, 2002; Paris & Paris 2001). This instrument can provide chemistry teachers information about which strategies high school students use while studying for chemistry class and how often they use them. In a recent review on study strategies and science education, Schraw, Crippen, and Hartley (2006) discussed the implications of SRL in science education and suggested several instructional strategies for science classes such as inquiry based learning and cooperation. These strategies can be employed in chemistry courses to develop authentic classroom activities to promote development of SRL strategies.

Implications for Further Studies

The present study has some suggestions for further studies: First, the data were gathered from tenth grade students taking chemistry classes. Findings can be tested at different grade levels and courses (e.g., mathematics, physics). Second, longitudinal studies can be conducted to examine the changes in individuals' use of self-regulatory strategies. Likewise, cross-sectional studies are important to understand what kind of strategies elementary and secondary students use or need. Third, the strategies in the scale did not cover three phases of self-regulated model proposed by Zimmerman; in future, the scale can be improved considering different sub-processes (e.g., self-evaluation). Finally, in this study, students' use of self-regulatory strategies were assessed through a self-report instrument. Even though this data collection method provides some understanding of student cognition and motivation, they may not reflect all complex internal processes. For that reason, qualitative studies can be conducted in order to explain these internal processes.

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