



Development of Metacognitive Skills Inventory for Internet Search (MSIIS): Exploratory and Confirmatory Factor Analyses*

İnternet Aramalarında Üstbilişsel Beceriler Envanterinin Geliştirilmesi: Açımlayıcı ve Doğrulayıcı Faktör Analizleri

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Abstract. This study reports the development of metacognition inventory for Internet search for middle school students. In this study, analysis and results of both exploratory and confirmatory factors are reported. Firstly, 37-items were generated considering literature review and metacognitive challenges faced during the search process, and pilot exploratory factor analysis was conducted. Secondly, the final version of the scale was distributed to 273 seventh grade students, and the existing constructs were extracted through exploratory factor analysis. Thirdly, 321 seventh graders completed the inventory, and then the data were used for confirmatory factor analysis. As a follow-up, test-retest reliability was tested with 101 sixth graders. Based on the findings, the sub-scales of the inventory included (1) reflection and regulation, (2) monitoring, (3) planning, (4) control of attention, and (5) strategy generation.

Keywords: Internet search, metacognition, metacognition inventory for Internet search

Öz. Bu çalışma ortaokul öğrencileri için İnternet aramalarında üstbiliş envanterinin geliştirilmesini kapsamaktadır. Makalede, açımlayıcı ve doğrulayıcı faktör analizleri ve bulguları sunulmuştur. İlk olarak alanyazın taraması ve İnternet aramaları sırasında karşılaşılan güçlükler dikkate alınarak 37 madde oluşturulmuş ve pilot açımlayıcı faktör analizi yapılmıştır. İkinci olarak, son haline getirilmiş envanter 273 yedinci sınıf öğrencisine uygulanmış ve açımlayıcı faktör analizi yapılarak faktörler ortaya konmuştur. Üçüncü olarak envanter, 321 yedinci sınıf öğrencisine uygulanmış ve doğrulayıcı faktör analizi yapılmıştır. Son olarak, 101 altıncı sınıf öğrencisi ile test-tekrar test güvenilirliği ölçülmüştür. Bulgular, envanterde (1) yansıtma ve düzenleme, (2) kontrol etme, (3) planlama, (4) dikkatin kontrolü ve (5) strateji oluşturma olmak üzere beş faktör ortaya koymuştur.

Anahtar Sözcükler: İnternette arama, üstbiliş, İnternet aramalarında üstbiliş envanteri

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INTRODUCTION

Searching the Internet is one of the most challenging tasks for users since it requires a series of decision-making processes. As online information resources become more popular day by day, the density of available information on the Internet increases. In turn, it brings about more complex Internet searches. Considering such a sophisticated environment, metacognitive skills are more essential than ever for Internet users, especially for the younger ones. Flavell (1976) emphasizes the importance of external storage and retrieval resources, which are obvious in our daily online tasks. Internet search for homework purposes can be an example for the use of external resources as well as the internal ones. There is a huge amount of data externally stored on the Web. The critical point for students is to learn how, where, and when to store them in addition to learn how, where, and when to retrieve them in order to achieve the objectives or goals. The objectives are generally external, but the student individually selects and decides on what to use, which information should be stored, which information should be skipped, how to interpret differences in the same information, what to trust, and how to use and combine what is already known and recently searched online.

In his attempts to create the term metacognition, Flavell (1976) defines it as “active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear, usually in the service of some concrete goal or objective” (p. 232). More specifically, metacognition is “the deliberate conscious control of cognitive activity” (Schunk, 2012, p. 286). Gredler (2009) indicates that metacognition has two related sets of skills: (a) Knowledge about one’s own thinking and (b) knowledge of how and when to use skills and strategies to complete the task successfully (p. 228). The maturity of learners, the nature of task and the strategies employed interact with each other when students engage in metacognitive activities (Dunlosky & Metcalfe, 2009; Gredler, 2009; & Schunk, 2012).

Tu, Shih, and Tsai (2008) indicate that metacognitive skills have important roles in successful searches especially with regards to close-ended tasks. Finding, evaluating, and synthesizing the relevant information among a large number of resources require the use of metacognitive skills, which can be defined as “the ability to plan, monitor, and evaluate one’s own actions” (Lazonder & Rouet, 2007, p. 7). Woolfolk (2004) defines planning as making decisions within the time allotted, as well as determining on strategies to be used, the sources needed, and sequences to be followed to perform a task. Monitoring is defined as having an awareness of the performance. Evaluating is mainly about “making judgments about the processes and outcomes of thinking and learning” (Woolfolk, 2004, p. 257).

Metacognitive skills are different from metacognitive knowledge. The former emphasizes self-regulatory activities throughout the problem solving process (Veenman, Prins, & Elshout, 2002), whereas the latter is contingent upon the interaction among characteristics of a person, the task, and his/her available strategies (Flavell, 1979). While metacognitive skills require procedural knowledge, metacognitive knowledge typically deals with declarative knowledge (Veenman & Spaans, 2005). Metacognitive knowledge enhances and develops between the ages of 4-6 while metacognitive skills starts to improve when children come to the age of 11-12. An individual’s metacognitive skills have influence on both learning processes and achievement (Sánchez-Alonso & Vovides, 2007), and can be improved through practice (Flavell, 1979). The literature provides evidence about the successful trainings of metacognitive skills (Veenman & Spaans, 2005).

Although the word metacognition was not used evidently, early studies tried to measure monitoring skills under the name of feeling of knowing, judgment of learning, and etc. (Perfect & Schwartz, 2002). There are some classifications used in measuring metacognitive skills in the literature (Butterfield, Nelson, & Peck, 1988; Mazzone & Kirsch, 2002; Nelson & Naren, 1990; Pintrich, Smith, Garcia, & McKeachie, 1991; Zimmerman & Martinez-Pons, 1988). Most of these classifications generally include monitoring and control. Along with these, there are more focused classifications such as planning skills that are essential for effective Internet searching (Lazonder & Rouet, 2007). In creating the metacognitive skills inventory for Internet search (MSIIS), which

aims to measure the metacognition needed for effective Internet searching, we used the framework proposed by Quintana, Zhang, and Krajcik (2005).

In Quintana et al.'s (2005) framework, the main focus is on the metacognitive challenges of online inquiry and the target population constitutes middle and high school students. The metacognitive challenges in the framework are categorized into three: (1) task understanding and planning (TUP); (2) monitoring and regulation (MR); and (3) reflection (R). TUP consists of knowledge related to the cognitive nature, demands, and strategies needed to complete given tasks, and a series of actions that should take place. MR requires identification of the current task, evaluation of one's progress, prediction of the outcomes and decisions for the distribution of resources, and speed and intensity of steps. R includes a deliberate thinking about both the processes invoked and the outcomes achieved.

During online inquiry, learners engage in certain cognitive activities (Quintana et al. 2005). An inquiry starts with asking questions. During this time, learners, especially the novice ones, may ask poor or inappropriate questions for the aim of the inquiry, give up when needed information was not found, and have no idea about the content and the quality of their questions. The next step of online inquiry is searching; during which novice learners may expect to find everything they need on one Web site, and make no plans to complete additional sub-steps, do not develop keywords and spend time without considering other activities, and fail to reflect on the efficacy of the search process. During evaluation and reading activities, novices may not have clear purposes for reading, and the process fails to go beyond skimming. While reading, novice learners can easily be distracted and fail to monitor their comprehension. In addition, they fail to reflect on the quality of resources. The last cognitive activity is synthesizing during which novices tend to just copy and paste from a resource, use inadequate criteria for the quality of the final product, and reflect very little on gathered (rather than synthesized) information to build the final argument.

In the literature, there are varieties of instruments that measure metacognition. These include State Metacognitive Inventory, Metacognitive Awareness Inventory and Metacognitive Skills Inventory. However, most of these instruments are not specific to web search context. Hence, there is a need to develop a new instrument that measures the metacognitive skills utilized by students for the Internet search within educational boundaries. Internet search is one of the important ways to access information and therefore can be referred as basics of 21st century skills. In classical information literacy, discriminating valid, reliable, current, accurate, and related information from the rest of the resources is necessary. Having its roots from that construct, digital literacy extends the boundaries of information. Online resources are very hard to manage in comparison to traditional resources such as books, periodicals, etc. Dealing with the online resources may require different skills due to the existence of such tools as search engines. As a result, this study is an attempt to shape the boundaries of metacognitive skills utilized for Internet searching. The purpose of this study is two-folded: (1) to determine and extract a set of common dimensions of metacognition among an item pool based on the framework; (2) to test and confirm the patterns of metacognition used for Internet search. The theoretical framework was used only for deciding on the content of items, thus the aim is not to confirm the group of constructs parallel to Quintana et al.'s (2005). Throughout the paper, the procedures followed in the development of the instrument, the characteristics of the subjects, and the final version of the instrument after EFA and CFA will be explained. In addition, the analysis to compare the mean scores of subscale will be reported. It includes information about the purpose, significance, conceptual – theoretical framework and study in general.

METHOD

The methodology followed in the development process of MSIIS is explained in four titles. In the first part, the development process of the items is introduced, then exploratory factor analysis and revisions are explained, and then confirmatory factor analysis is summarized. Finally, the procedures to ensure validity and reliability of the instrument are provided. The overall process of the study is demonstrated in Figure 1.

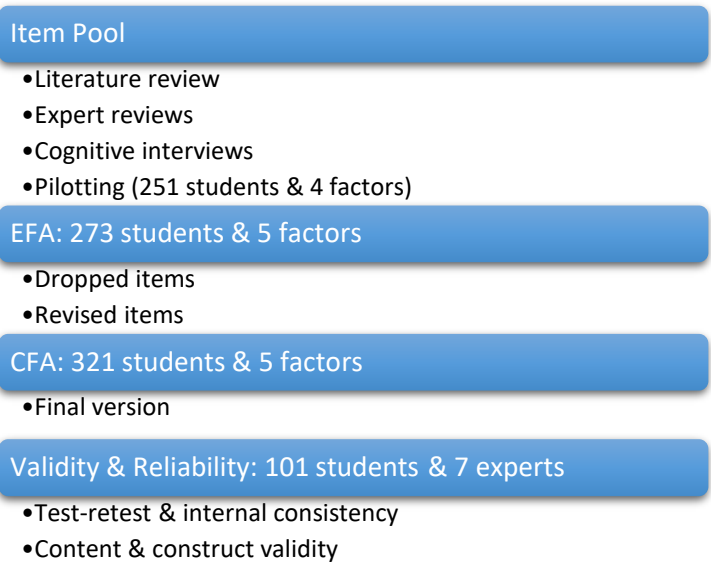


FIGURE 1. *Procedures of the study*

MSIIS Items Pool Development Process

Literature Review

The first stage of the development of the current instrument was to write an inclusive item pool. In order to find out subcategories related to metacognitive skills, the literature was reviewed (Butterfield, Nelson, & Peck, 1988; Lazonder & Rouet, 2007; Mazzoni & Kirsch, 2002; Nelson & Naren, 1990; Pintrich et al., 1991; Quintana et al., 2005; Zimmerman & Martinez-Pons, 1988). It was explored that Quintana et al.'s (2005) framework includes all metacognitive categories specified in the literature. Moreover, this framework was designed specifically for the Internet search process completed by middle and high school students, and therefore the categories were more specific. Considering that framework, metacognitive skills used during the Internet search were classified into five categories: task understanding, planning, monitoring, regulation, and reflection. Based on five categories, 57 items were developed. During this process, Roedel, Schraw, and Plake's (1994) mastery goal items, Schraw and Dennison's (1994) metacognitive awareness inventory items, O'Neil and Abedi's (1996) state metacognitive inventory items, and the strategic teaching and reading project guidebook (Kujawa & Huske, 1995) were reviewed. Following this, some of the items, especially the ones related to monitoring and control were adapted for our purposes.

Experts Reviews

A language expert checked the items for the clarity of language and recommended certain changes on 10 items, and suggested elimination of two items from the inventory. In order to adjust the level of statements for middle school (six to eight grade levels) students, the items were examined by a middle school instructional technology teacher. Considering the feedback, four items were revised and four items were deleted. Following this, two measurement and evaluation experts reviewed the items. Based on their recommendations, eight items were excluded, four items were revised, and one item with two dimensions was divided into two items. Lastly, three instructional technology experts examined the items and recommended revisions of seven items and elimination of 11 items. The revisions offered by language expert were similar to proof reading, but other experts' revisions were all based on the relevance of the constructs. They warned the researchers if there is a danger of misunderstanding/misconception. Therefore, the items were reworded, split, or paraphrased.

Cognitive Interviews

After making all the changes recommended by our expert reviewers, the final version comprised a 39-item scale, which was piloted with one 7th grader and one 8th grader through individual cognitive interviews. During the interviews, students explained their understandings of each statement and the reasons for their answers. The observations indicated that one of the statements was difficult to understand for the 8th grade student. In addition, the 7th grader read the same item three times and stated that the item was hard to understand. Instead of removing the statement, the item was revised and simplified due to its theoretical importance. Two of the statements were eliminated since they were understood in ways different from their intended meanings. Some problematic or advanced words in five items were replaced with terms more familiar to the interviewees. Two of the items were revised due to misunderstandings and complex sentence structures. After the necessary revisions, the scale consisted of 37 4-point (1 refers to 'never'; 2 refers to 'sometimes'; 3 refers to 'often'; and 4 refers to 'always') Likert type items.

Piloting

With the permission of the parents, six teachers administered the instrument with 251 seventh and eighth grade students. All teachers were informed about the instrument and the issues to be considered during the implementation process. The aim of the instrument and directions were provided with written format at the beginning of the instrument. Students were asked to rate how often they experienced the statements in the instrument during their searches on the Internet. Survey completion lasted about 15 minutes for eighth graders and about 25 minutes for seventh graders.

The gathered data were analyzed through EFA. The results of this pilot study revealed that the five basic constructs of metacognition experienced during Internet searches exist. However, because they referred to a similar dimension, regulation and reflection factors were combined. As a result, four factors were titled as follows: (factor 1) "critical investigation with respect to awareness and strategies", (factor 2) "level of distraction during Internet search", (factor 3) "task understanding and purpose of search", and (factor 4) "regulation and reflection on search process". Seven items were removed due to their low correlations. According to the findings, some of the items were revised to minimize close loadings and low loadings.

Exploratory Factor Analysis & Revisions

Participants

273 (111 female and 162 male) seventh grade students were randomly selected from two urban elementary schools. Socio-economic-status of the students enrolled in the two schools was very similar, and both schools had Internet access. Because of the constructivist curriculum, the teachers frequently assigned performance tasks to students that required Internet searches. The data gathered from the students indicated that 47.4 % of the students used the computer more than six hours a week, 26.8 % of them used the computer about 4-6 hours, and 25.8% of them used the computer less than four hours in a week.

Procedure

MSIIS had 30 4-point Likert type items (1 refers to 'never'; 2 refers to 'sometimes'; 3 refers to 'often'; and 4 refers to 'always'). Since the instrument aims to discover general trends and specific metacognitive skills used for searching the Web, it was administered in a content- and context-free environment, i.e. no tasks were assigned to participants. Students were expected to answer according to their previous Internet search experiences. In this way, it is expected to find out specific metacognitive constructs that are experienced throughout any Internet search event.

After getting permissions from parents, students were asked to complete the instrument. The students completed the instrument in their regular classrooms based on paper-pencil procedures. The instrument was completed between 10 to 25 minutes depending on the reading speed of the students.

Data Analysis

EFA was conducted by using SPSS 15.0. First, missing value analysis was performed to find the percentage of missing data. There were less than 10 %, thus no manipulation on them was performed. Second, assumptions were checked to see whether the data were appropriate for factor analysis. After deciding on sampling adequacy, common factor analysis was conducted through principal axis factors (PAF) because of its iterative and inclusive nature regarding correlations and covariances. The PAF with oblique rotation was run due to expected correlations among factors. All analyses were performed at .05 alpha level.

Although there are no strict rules for sampling adequacy, at least 5 observations per item are acceptable according to Hair, Anderson, Tatham, and Black (2005). In this study, there were 9.1 observations per item. Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy equaled .85, which is above Kaiser's recommendation of .60, indicating adequate sample size to produce distinct and reliable factors. Bartlett's Test of Sphericity was found to be significant ($\chi^2(435) = 2389, p < .001$), which refers to the presence of correlations among variables. Correlation matrix coefficients were also examined since the tests are known for their sensitivity to large sample size. Except for item 14, all items were above the cut-off level of .30.

Histograms, Q-Q plots, skewness and kurtosis values, and Kolmogorov-Smirnov normality tests were all checked for normality. All histograms and Q-Q plots were examined for each item and no violations were observed. Skewness and kurtosis values were within the range of -1.00 and +1.00, except for two items: Item 2 (Skewness=-1.37, Kurtosis=1.47) and Item 14 (Kurtosis=1.57). However, since their histograms and Q-Q plots showed normal distribution patterns, they can be assumed to be normal. According to Tabachnick and Fidell (2007), the items can be considered as normally distributed. Finally, a few outliers were detected in some of the items (items 1, 2, 6, 9, 10, 16, 24, 26, 29) but they were ignored because of not affecting the normal distribution.

Confirmatory Factor Analysis

Participants

Data for CFA were collected from 321 7th grade students from one public and one private school in Ankara. About half of the students were from public school. Distribution of females (47 %) and males (53%) was very close. Almost all of the participants had computer access (99%) and most of them used computers more than 6 hours in a week (71%).

Procedure

The purpose of this phase is to explore how the determined dimensions of MSIIS in EFA fit the model. A teacher who had training for data collection administered the instrument in addition to a researcher. All possible scenarios were discussed with the teacher and assistance was provided whenever needed. The data were collected during Information Technology classes. It took about 10 to 20 minutes to complete the instrument for both samples.

Data Analysis

In order to check the consistency of the collected data within the determined constructs of MSIIS, confirmatory factor analysis (CFA) was conducted with the help of LISREL 8.51 (Jöreskog & Sörbom, 1993). Using maximum likelihood (ML) estimation, 30 items were examined to see

whether they fit well with the 5 latent factors which were previously determined through EFA. ML was used due to its unbiased and consistent nature within multivariate normal distribution. Those factors were called reflection and regulation, monitoring, planning, control of attention, and generating strategies. Through CFA, we aimed to support construct validity.

Procedures for Reliability & Validity

Reliability

In order to ensure the reliability of the developed inventory, we considered delivering and redelivering the instrument within 4 weeks interval. In this way, the test-retest reliability was confirmed. Moreover, we applied split-half reliability test to ensure the internal consistency.

101 6th graders participated to the smaller study and data were used for test-retest reliability of the instrument. Participants were all from a public school in Ankara. This data set was also used for split-half reliability test. Necessary permissions were taken, and then the instrument was administered with 101 students from this school. Available class hours and classrooms were used during this process. The trained researcher collected the data. It lasted 15 to 30 minutes to complete the instrument for the sixth graders. After the first delivery of the MSIIS to that sample, 4 weeks were counted. The same test was delivered again to the same sample under the same conditions after 4 weeks.

For test-retest reliability, Pearson correlation coefficient (r) was used. In addition, the internal consistency was tested through split-half test. In other words, the correlation between two halves of the same form was calculated, and then Spearman-Brown test provided with the internal consistency coefficient.

Validity

The validity of the developed inventory was evaluated through focusing on both content and construct validity. Experts' opinions were sought for content validity. A language expert reviewed the items in the pool, and advised certain changes. Since the items appeal to the middle school students, the statements should be clear to them, and that's why a teacher's revision was needed to ensure if they were all appropriate. The teachers advised a few changes, too. Two measurement and evaluation experts and three subject matter experts also reviewed the items in the pool, and thus final revisions were completed. For construct validity, exploratory and then confirmatory factor analysis were utilized and the inventory had reached its final version.

RESULTS

Results for Exploratory Factor Analysis

EFA was performed by using PAF extraction. Because of the expected correlation among the factors, oblique rotation was chosen (Tabachnick & Fidell, 2007). This expectation was confirmed after examining the factor correlation matrix, that is, there were correlations ranging from $r = -.002$ to $r = .43$ between the five factors (see Table 1). For discovering the number of factors, Eigenvalues and Scree Plot were examined. Eight factors fit the data well when Eigenvalues exceeding 1.00 are considered. Those eight factors explain 56.81 % of total variance which can be considered high. When the scree plot is inspected, after six factors, small declines are observed. When pattern matrix is scanned, 8 factor loadings do not make sense in addition to very small number of items per some of the factors that might decrease the reliability values of the factors. In the pilot EFA, 5 factors had been generated and two of them had been integrated. By considering all, a 5 factor extraction was performed to be consistent with the theoretical framework. It was found that these factors explain 45.83 % of variance. The most contributing factor is the first one (see Table 2). After the fifth factor, contributions move very slightly. A six-factor solution was also run, but some of the factors had small numbers of items. Since goodness of fit value is significant

($\chi^2 (295) = 499, p < .001$), it can be interpreted that the overall model fits well. In addition, when Velicer's MAP and parallel analysis tests were run, the results also point the 5-factor structure. The smallest average squared partial correlation is .0946 placed at five factor. Moreover, the Eigenvalues that are greater than 1 of actual data were found all greater than the Eigenvalues of the random data. The comparison of these values was listed in Table 2.

Table 1. Factor Correlation Matrix

Factor	1	2	3	4
1	1.00			
2	-.15	1.00		
3	-.29	.18	1.00	
4	-.42	-.02	.14	1.00
5	.43	-.002	-.21	-.42

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

Table 2. Number of Factors

Factor	Actual Data Eigenvalues	% of Variance	Cumulative%	Random Data Eigenvalues	Velicer's Average Squared Correlation
1	7.341	24.470	24.470	1.890	.309
2	2.272	7.572	32.042	1.579	.310
3	1.526	5.086	37.128	1.506	.270
4	1.340	4.466	41.594	1.140	.152
5	1.270	4.234	45.828	1.078	.095*

* The smallest average squared partial correlation is .0946 & The Number of Components According to the Original (2000) MAP Test is 5

Table 3 summarizes factor loadings of the items. The findings indicate that there are no considerable close loadings, except for item 13. The range of loadings is between .38 and .85. According to Hair et al. (2005), unless the sample size and the number of variables are large, smaller loadings can be acceptable. In this case, there are 273 sample and 30 observed variables, which means that factor loadings greater than .35 are significant. There were no items below this range.

Table 3. *Factor loadings*

Items	Factors				
	1	2	3	4	5
7. I deeply examine the contents of the sites that are found after Internet search.	.62				
10. After completing my homework, I check for correctness of my expressions.	.57				
13. I take some notes about examined Web sites.	.52				
5. After completing the search, I think of the steps that I have followed.	.50				
18. If different Web sites include inconsistent information about the same topic, I think of its reasons.	..49				
3. I complete my homework by adding reflections of my own.	..44				
12. After finishing my Internet search, I think about whether found information is adequate for my homework.	..41				
4. I know that Internet search is just a part of my homework.	..38				
9. While searching on the Internet, instead of clicking on each found site, I prefer to select the ones that make sense.		.70			
2. While examining the sites, I check for relatedness of found information with my homework.		.62			
19. The time that I spend for Internet search depends on the topic of my homework.		.51			
6. While examining the sites, I easily distinguish between related and unrelated information.		.50			
26. When I find important information, I start to examine more deeply and carefully.		.48			
29. While examining the sites, I realize how much I understood so far.		.43			
27. While examining the sites, I try to link the new information with my previous knowledge.		.42			
30. While examining a site, I easily distinguish the information that can be used in my homework.		.39			
21. When I did not find any related site on my first attempt, I try other key words.			.85		
20. Before starting Internet search, I generate certain questions about the topic.			.55		
16. Before starting to search, I examine my homework's content.			.49		
1. Before starting the Internet search, I determine my exact goals.			.42		
8. Before starting the Internet search, I decide on basic key words.			.39		
15. During the examination of sites related to my homework, I check my e-mails.				.62	
22. During the examination of sites related to my homework, I chat with my friends.				.51	

25. If I find the whole information in one site that I search for, I do not need further search of more sites.	.49
17. The Internet search is the most time consuming part of my homework.	.42
14. If I do not find any related site, I give up searching any more.	.38
11. I know approximately how much time to spend on Internet search.	.66
28. While integrating different information, I generate my own strategies.	.59
24. While searching, I quickly scan the sites.	.56
23. While examining the sites, I generate special strategies to understand easily.	.48

Extraction Method: Principal Axis Factoring.
 Rotation Method: Oblimin with Kaiser Normalization.
 a. Rotation converged in 53 iterations.

The main aim of the instrument is to explore the pattern of self-ratings of 7th graders in terms of metacognition experienced throughout an Internet search. The first dimension that included items 3, 4, 5, 7, 10, 12, 13, and 18 was entitled “reflection and regulation”. The second dimension involved items 2, 6, 9, 19, 26, 27, 29, and 30, all of which related to monitoring skills. Therefore, it is entitled “monitoring”. The third dimension includes items 1, 8, 16, 20, and 21 which are all representative of planning the search, thus it was named “planning”. Items 14, 15, 17, 22, and 25 loaded to “control of attention” factor. “Generating strategies” is the last factor consisting of items 11, 23, 24, and 28.

Reliability coefficients for factors were calculated. Cronbach’s alpha values for the first three factors are above the lower limit that is .70 (Hair et al., 2005) ($\alpha_{\text{factor1}} = .78$, $\alpha_{\text{factor2}} = .76$, and $\alpha_{\text{factor3}} = .76$). The fourth and fifth factors are below this cut-off, nevertheless, they are still within acceptable range ($\alpha_{\text{factor4}} = .64$, and $\alpha_{\text{factor5}} = .62$). Overall reliability of the scale was found to be .83 which is quite acceptable.

Results for Confirmatory Factor Analysis

The results of the analysis showed significant χ^2 value (χ^2 (df = 394) = 920. $p < .001$). However, due to its sensitivity to the sample size, other fit indexes were investigated to decide on goodness of fit. χ^2 / df ratio was calculated to be 2.34. According to Hair et al. (2005), when sample size is large and the number of observed variables is equal to or greater than 30, chi square test is likely to produce significant p values. Then, exploring at least one absolute and one incremental fit index is recommended. Within absolute fit indexes, root mean square error of approximation index (RMSEA = .052, LO90 = .040, HI90 = .057, <.06) and standardized root mean square residual index (SRMR = .06, < .08) indicated satisfactory values. Although goodness of fit index is slightly below the cut-off point (GFI = .89, <.90), adjusted goodness of fit index suggested an acceptable fit (AGFI = .91, >.90). Within incremental fit indexes, normed fit index (NFI = .92, > .90) and comparative fit index (CFI = .95, >.90) confirmed the goodness of the model fit. According to Hair et al. (2005), if the number of cases are greater than 250 and the number of observed variable are greater than or equal to 30, then RMSEA values below .07 with CFI values higher than .90 can be acceptable for model fit.

All items except for item 13 were tested under the factors that were previously found in EFA. Item 13 were defined under generating strategies factor because it conveys the closest meaning for that category. Standardized loadings of the latent variables range from .51 to .74 (see Figure 2). All loadings were above the suggested cutoff value that is .50 (Hair et al., 2005). Moreover, their standardized and unstandardized loadings were found significant ($p < .001$). Internal consistencies of each dimension and the instrument were assessed by Cronbach’s alpha. The values were listed in Table 4. Overall reliability of the scale was computed .83.

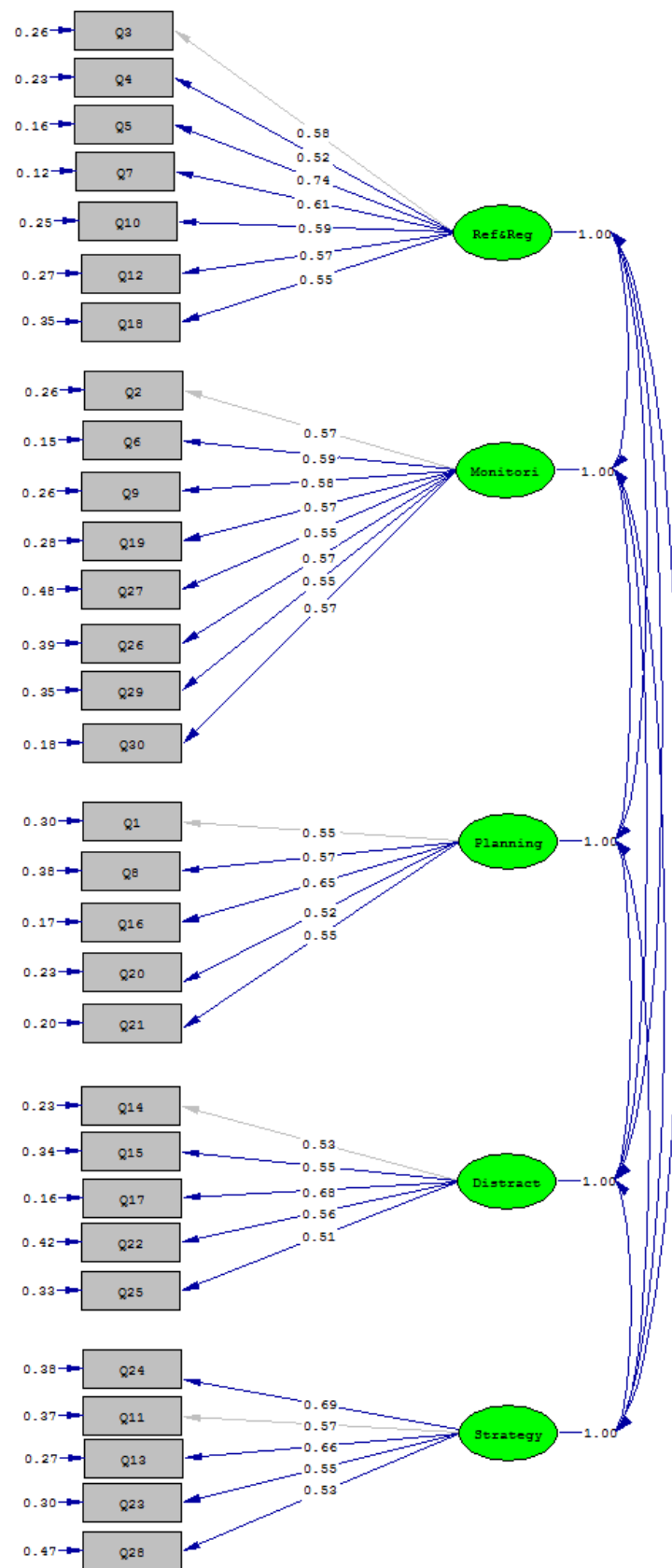


FIGURE 2. Standardized Loadings of Each Item of MSIIS

Results for Reliability

In order to explore how reliable the instrument across a certain time interval, test-retest reliability was performed. Pearson correlation coefficient (r) was used to calculate the relations. Correlation between the results of first administration of the whole scale and the second administration, after 4 weeks, was found to be significant ($r_{\text{MSIIS}} = .84$, $p < .01$). Correlation coefficients for factors were also significant. The summary of test-retest results can be examined in Table 4.

Table 4. Reliabilities, Correlation Coefficients, and Test-Retest Reliabilities

Factors	Cronbach α for EFA	Cronbach α for CFA	4 weeks interval Test-Retest (r)
(1) Reflection and Regulation	.76	.74	.87**
(2) Monitoring	.78	.76	.90**
(3) Planning	.76	.75	.93**
(4) Coping with Distracters	.64	.70	.89**
(5) Generating Strategies	.62	.68	.86**
Instrument	.83	.83	.84**

**Correlation is significant at the 0.01 level.

The same data set was split into two to find the correlation between two halves. SPSS 15.0 was used to calculate the Spearman-Brown coefficient. The results revealed that there is a correlation between forms ($r = .593$), and the Spearman-Brown coefficient was within acceptable range ($r_{\text{SB}} = .80$).

Results for Validity

In order to explore the content validity, 7 experts reviewed the first item pool, which contains 57 items. After all dropped, revised or split items, there were 39 items before the cognitive interview. Each expert separately worked on items, and advised which one should be revised or deleted completely. Taking all comments together, content validity indexes were calculated for both items and the inventory. Items having a content validity index less than $I\text{-CVI} = .78$, which is the appropriate cut-off value according to Lynn (1986) were deleted. There were 11 items having considerably low $I\text{-CVI}$ values (2 items with $I\text{-CVI} = .14$; 6 items with $I\text{-CVI} = .29$; 3 items with $I\text{-CVI} = .57$). 8 items having moderate $I\text{-CVI}$ values were also removed from the pool (5 items with $I\text{-CVI} = .67$; 3 items with $I\text{-CVI} = .71$). The rest of the items were above the cut-off, but not all of them reached the full agreement of experts. In other words, some items needed small revisions and one item was split into two statements. Finally, the scale content validity was calculated as $S\text{-CVI} = .89$, which is acceptable.

DISCUSSION and CONCLUSION

The MSIIS instrument was developed and piloted with 251 7th and 8th graders. An EFA of the 37 items revealed a 5-factor solution. However, two factors were combined because of their similarities with respect to metacognitive skills. In that study, 7 items were removed due to their low loadings and 4 items were revised due to close loadings. After the revisions, the first version of the scale was administered to 273 7th graders. Again a 5-factor solution was decided as appropriate through EFA. The loadings and reliability coefficients showed that the scale was reliable and items fit factors within an acceptable range. Finally, to prove the consistency of the constructs, the inventory was distributed to 321 7th graders. In addition, a 4-week interval test-

retest reliability was also administered with 101 6th graders. The results confirmed the consistent structure of MSIIS.

The nature of measured constructs is very complex because the phenomenon is completely internal. What is supposed to be achieved with MSIIS is to rely on self-ratings of individuals, which makes the measurement very complex. For this study, only one instrument was used to measure metacognition since the aim is just to develop and confirm constructs, but it would be safer including various types of data collection. Literature reveals various facets of metacognitive skills. Therefore, deciding on consistent definitions and categorization of constructs is not so easy. Despite these limitations, the generated and confirmed factors were found meaningful.

Items in the *reflection and regulation* category convey some typical attributes. According to Kluwe (1982), allocation of resources, ordering the steps, deciding on the intensity, and speed of the studying are some characteristics of regulation. In addition, this skill is needed whenever the task requirements change (Ross, Salisbury-Glennon, & Tollefson, 2006). Item 4 is an example for allocation of resources because the item refers to that Internet search is just a means to complete the homework, so s/he knows that s/he should go further by other actions such as interpreting the found information. Item 7 exemplifies how intense should be the work at that time. In their metacognitive model of reflection, Mcalpine, Weston, Beauchamp, Wiseman, and Beauchamp (1999) define reflection as “a process of thinking about teaching and learning by monitoring cues for the extent to which they are within a corridor of tolerance and making decisions to adjust teaching as appropriate to better achieve teaching and learning goals.” (p. 110). Considering that kids in our study aim to achieve a learning goal, items 3, 5, 10, 12, and 18 can be included into reflection category. Item 3 and item 12 are about the reflection of the content whereas item 10 is about the reflection of the meanings. Item 5 focus on the evaluation of the followed steps. Finally, item 18 evaluates the inconsistencies between new upcoming information.

Monitoring is a crucial skill to deal with online information (Mason, Boldrin, & Ariasi, 2010). It has generally the following parts (Dunlosky & Metcalfe, 2009 & Kluwe, 1982): identifying the current task, checking and evaluating the current progress, and predicting the outcome. Items 2, 6, 27, and 30 relate with checking the relatedness of the content. Items 9 and 19 are clear examples of task understanding. Item 26 can be interpreted as either regulation or checking the upcoming information. Distinguishing important information among a large amount of information can be defined as checking the current progress while the second part of the item 26 refers to some sort of regulation. Item 29 exemplifies the evaluation of current understanding.

Planning can be assumed one of the regulatory skills. It involves a series of decisions about resources, strategies, and order of steps (Dunlosky & Metcalfe, 2009 & Woolfolk, 2004). *Strategies* can be defined as the “cognitions or other behaviors employed to achieve them (goals)” (Flavell, 1979, p. 907). The utilization of metacognitive strategies is related to the satisfaction of the learners (Choi, 2016), and they are valuable for learning. In our inventory, two subcategories named planning and generating strategies, therefore, are highly related to each other. They might be combined under one factor. Items in the planning category refer basically goal setting, but only item 21 can be fall into strategy category. All items in generating strategies category relate with some kind of strategy use for the ease of Internet search. In this study, these two categories were used separately, but for further research purposes, they can be combined, too.

The last sub-dimension is about *control of actions or attention*. “Control involves self-regulative processes that direct and modify one’s behavior, such as processes that govern the selection of strategies for accomplishing tasks.” (Cary & Reder, 2002, p.64). Items 14 and 25 refer to giving up the search easily because of searching for or finding ‘all in one’ information. Control might be considered as the reverse actions of monitoring. In the Internet search cases, if the user give up the search easily, it might refer to inadequate control of actions resulted from inadequate monitoring or reflection. Items 15, 17, and 22 indicate distractions from the task. Checking the e-mails or chatting online might inhibit the other metacognitive skills such as monitoring or regulation.

In this study, a 5 factor solution was found meaningful, but for different samples, it might not be necessarily the same. In other words, various variations or distribution of items are also possible. In that case, the way to interpret the overall pattern is important. There is still some

room for further development of the scale. It needs to be validated across middle school students within different places varying in such variables as socio-economic-status, computer access, school type, and so forth. Because of the attempt to externalize the internal phenomenon, the pure utilization of this scale might not be helpful at all. Instead, this scale can be used as an exploratory tool to discover all possible facets of metacognitive skills associated with Web searching. In addition to this instrument with various subcomponents, students' logs, reflective journals, performance works, and some other indicators can be included with appropriate tasks in order to reveal the possessed metacognitive skills.

Use of metacognitive skills is essential for a successful information search on the Internet (Lazonder & Rouet, 2007; Tu, Shih, & Tsai, 2008), as well as to interpret the search results. Considering online search context as an informal learning environment, learners' performance can be affected by the way they utilize metacognitive skills as epistemic tools (Mason et al., 2010). In that respect, MSIIS can help identify the potential low performing students especially within the context of conducting Internet searches. In any online learning environment, the issues related to metacognition should be considered as a key aspect of design (Choi, 2016) because the design of interaction can lead to extraneous cognitive load. That is why the interdependence of metacognitive skills with cognitive load should guide the teachers/designers (Seufert, 2018). For example, high MSIIS scores can point automated use of metacognitive strategies, which can bring about less cognitive overload. Despite being a sophisticated process, the learner may not be able to activate metacognitive skills during the Internet search, and thus may just stay within behavioral or procedural zone (Tsai, 2009). The scale can be a starting point to decide on the level of Internet search literacy, which seems very crucial to deal with the high density of information in a deep and sophisticated maze. Analysis of MSIIS can also establish a basis for the design of metacognitive training or scaffolding. Students with low scores might need Internet search scaffolding besides metacognitive scaffolding since the constructs of MSIIS combined both dimensions. Although the main aim of the inventory is to decide on the metacognitive skills during a search performance, it can also help teachers to observe either the epistemic development or the information literacy levels of learners. MSIIS was distributed a limited sample, therefore for further studies it can be administered to a wide range of samples. This can allow multiple comparisons of samples having different technological and educational backgrounds.

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