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A Validation and Reliability Study of the Metacognition Scale in Turkey

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Abstract - The purpose of this study is to test the reliability and validity of Metacognition Scale (MS) developed by Demir (2012) with a view to identifying perceptions of Education Faculty students regarding metacognitive activities. The participants of the study are 250 randomly chosen students who attend three different departments in Kafkas University Education Faculty. The data were analysed through exploratory and confirmatory factor analysis to enhance the construct validity. Internal consistency (Cronbach Alpha) co-efficiency was evaluated for the reliability of the instrument. A 14-item instrument with "evaluation", "organization" and "planning" sub-dimensions was developed as a result of the analyses conducted. Cronbach Alpha internal consistency co-efficiency that explains 53.074% of the total variance was found .87 for the first factor, .65 for the second factor, .70 for the third factor, and .89 in total.

Keywords : *metacognition, reliability, confirmatory factor analysis.*

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A Validation and Reliability Study of the Metacognition Scale in Turkey

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Abstract - The purpose of this study is to test the reliability and validity of Metacognition Scale (MS) developed by Demir (2012) with a view to identifying perceptions of Education Faculty students regarding metacognitive activities. The participants of the study are 250 randomly chosen students who attend three different departments in Kafkas University Education Faculty. The data were analysed through exploratory and confirmatory factor analysis to enhance the construct validity. Internal consistency (Cronbach Alpha) co-efficiency was evaluated for the reliability of the instrument. A 14-item instrument with "evaluation", "organization" and "planning" sub-dimensions was developed as a result of the analyses conducted. Cronbach Alpha internal consistency co-efficiency that explains 53.074% of the total variance was found .87 for the first factor, .65 for the second factor, .70 for the third factor, and .89 in total.

Keywords : metacognition, reliability, confirmatory factor analysis.

I. Introduction

Learning is a lifelong process. In order for a person to learn completely and experience learning in different areas, it is necessary for him or her to know, apply, and reuse what is learned by recalling. Otherwise, learning will not be complete in situations that lack these three dimensions. Learning is a thinking process and the most comprehensive structure in this process is individuals' own learning and awareness of teaching process, in other words, metacognition.

Individuals who have metacognitive skills get into processes such as activating inner energy to solve a problem, developing positive attitudes for accomplishing a task, being motivated, and paying attention. This process requires self-awareness and self-control. Another dimension of metacognition is knowledge and control of the process. In this regard, learners evaluate what they know and what they should know, thus see where they are, and plan the things they should do with a view to fulfilling their aims. Some other important elements include reviewing the strategies that they developed, evaluating whether the strategies are appropriate for the aims, choosing new strategies if they are not appropriate, and being aware of ways of thinking and developing them. Metacognition starts with a process like this. However, in order for metacognition to take place, learners need to comprehend the meanings of phenomenon, concept and generalizations, which requires metacognitive skills.

With their perception capacity, learners will first come across phenomenon which is small information particles, then form concepts from the common distinguishing features, and reach the generalizations in the field by establishing relationships between the concepts. The role of metacognition is unquestionable in understanding the relationships between these. Hence, metacognition is a higher order thinking process; it will show up with the skills and become an element that can form base for other skills. Kluwe (1982 in Louca, 2003) describes metacognitive activities and addresses the dimensions of metacognition as 1) As a thinking topic, it is one's having information about his/her own thinking as well as others' thinking, 2) As a thinking topic, it is one's motioning and organizing his or her thinking processes as well as others'. Besides, Kluwe uses the term as an administrative process to show both monitoring and organizing strategies (in Louca, 2003, p.11). Brown's (1978) definition includes applied cognition dimensions such as individuals' planning, monitoring, and reviewing thinking (in Paris & Winograd, 1990, p. 16-17). Roll (2007) points that metacognition encompasses two basic skills: knowing about knowing (what do I know?), and organizing knowledge (How can I organize knowledge?) (in Roll, Aleven, McLaren & Koedinger, 2007, p.126).

Gaining metacognitive skills in teaching and learning processes helps learners to plan their work, to think flexibly, and to solve problems effectively. Therefore, learning metacognitive skills contributes to permanent learning. What forms learners' metacognitive skills are their various preferences developed by themselves in the learning process according to their abilities and characteristics. Some of these skills are planning, monitoring what to do and how to do it, and evaluating. Metacognition is a thinking process which takes place in every phase of learning and reflects on students' behaviours. Information gaining process requires planning, evaluating, observing, actively participating in the learning process, and taking control of one's own learning process (Doğanay, 1997, p.39).

Students themselves should choose, observe, and evaluate the topic they need as well as its depth and the way of learning. Learning is a way of inferring meaning. Thus, some evidence for the fact that

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metacognition is integrated with all thinking aspects is that individuals are aware of their own thinking in the things they are doing, they use this awareness in monitoring the things they are doing, they use cognitive processes such as memory, attention and imagination, and they use learning skills. Learning is a thinking process. Therefore, it becomes more permanent with the increase in the thinking skills involved in learning. Processes related to cognition and metacognition are integrated with each other in the learning process. Learning becomes more effective and permanent when learning strategies such as memory which involves repetition, interpretation which involves interpreting the stimulant, and organization which involves transfer are used together with metacognition.

In this regard, improving thinking processes and skills of Education Faculty students is closely associated with the active use of metacognition, organization, monitoring, organization, and self-evaluation skills. Individuals who are aware of learning to learn skills (planning, organization and evaluation) and develop these skills can take the responsibility in the learning process as well as actively experiencing the feeling of self-fulfilment with the responsibility they take. Thus, the main purpose of this study is to identify metacognitive skills of Education Faculty students in learning and teaching environments and to develop an instrument to identify the metacognitive skills of prospective teachers.

II. Method

a) Design of the Study

The present study aims to develop "Metacognition Scale" (MS) and test its validity and reliability at education faculty level. The process of preparing the items in the scale involves preparing the scale items, receiving expert opinions for content validity, conducting the pilot study, performing Exploratory Factor Analysis, Confirmatory Factor Analysis (CFA), and validity and reliability in the analysis of the data.

b) Target Population and the Participants

Features of Target Population and the Participants: Target population of the study is 250 prospective teachers who are enrolled in Kafkas University Education Faculty in 2011-2012 academic year. The participants of the study are 250 students (168 students-67,2% in normal education, 72 students-28,8% in evening education, and 10 students-4% who did not indicate their departments) enrolled in the three departments which were identified according to non-random cluster sampling method (Departments of Classroom Teaching, Psychological Counselling and Guidance, and Social Studies). Of all the students, 123 (49,2 %) are female, 123 (49,2%) are male and 4 (1,6%) did not indicate gender. Findings regarding the department variable shows that 10 students (4%) attend Social Science Department, 168 students (67,2 %) attend Psychological Counselling and Guidance Department (Pcg), 59 (23,6%) are enrolled in Classroom Teaching Department, and 13 students (5,2 %) did not indicate their departments.

c) The Process of Preparing Metacognition Scale (MS)

The Process of preparing *Metacognition Scale (MS)* included the following stages suggested by De Vellis (2003):

Preparing the Item Pool: The development of the Metacognition Scale (MS) started with preparing the item pool. Therefore, the related literature was reviewed with a view to improving metacognitive skills of prospective teachers and identifying information on the features of these practices. The draft for the first items was prepared in light of these identifications. Draft items were written in the framework of the "Metacognitive Skills" concept which is defined operationally and composed of learner behaviours that improve metacognitive skills as well as the practice setting aspects. These items were reviewed carefully so as to prepare a 100-item pool.

Expert Opinions for the Item Pool: The item pool was sent to three experts for their opinions. One of these experts currently works as a secondary school teacher and has received thinking education course in the master program. The second expert who is specialized on learning-teaching processes currently works in Çukurova University, Education Faculty, Department of Educational Sciences. The third expert specialized on learning-teaching processes works in Trakya University Education Faculty, Department of Educational Sciences and has instructed thinking education course.

Pilot Study for MS: The 100-item inventory draft was tested for its language and comprehensibility with a group of 30 students who are enrolled in the Social Studies teaching department. The items and the page layout were revised in light of the suggestions. Before the actual study was conducted, the revised 80 item inventory was piloted with 209 Education Faculty students from two different departments in one session in a classroom setting. The first efforts that aim to identify the factor structure of MS included examining Kaiser-Meyer-Olkin (KMO) coefficient and Barlett Sphericty factor analysis results with a view to identifying the appropriateness of the data for factor analysis. Results show that the values are statistically significant (KMO=0.879; Barlett Sphericty test $\chi 2$ =1.539 df =153 $p<.001$). Results of the pilot study for the Metacognition Scale (MS) which was conducted with 209 students show that the 18-item form has .89 Cronbach Alpha reliability level in total, .86 in the first sub-factor (evaluation) (5 items), .81 in the second sub-factor (organization) (5 items), .80 in the third sub-factor (organization) (5 items); and .58 in the fourth sub-factor (planning) (3 items).

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Table 1 displays factor analysis that is reached with eight iterations and results with four factors as well as factors, factor loads, and factor eigen values obtained from the reliability analyses, variance percentages and Cronbach Alpha values explained by the factors, revised item-total correlations in relation to the items, revised item-total correlations belonging to the items (r), common variances, and t values.

Table 1 : Factors, Factor Loads, Variance Percentages, and Item-Total Correlation Values (r) Explained by the Factors in the Metacognition Scale

Item Number	F 1	F 2	F3	F 4	$\bar{X}$	T	SS	r
24	.85				3.53	8.12	1.08	.56*
23	.84				3.72	7.11	1.10	.55*
25	.71				3.71	8.87	1.05	.63*
26	.70				3.44	9.23	1.07	.62*
27	.64				3.43	8.42	1.17	.55*
63		.77			3.52	7.46	1.05	.37*
75		.70			3.65	9.44	.93	.61*
76		.69			3.56	7.94	.89	.53*
77		.65			3.56	8.63	1.02	.60*
80		.63			3.66	7.13	.95	.58*
72			.80		3.76	6.63	.99	.51*
68			.74		3.85	7.04	.87	.44*
74			.65		3.82	7.22	1.06	.54*
70			.56		3.76	9.50	1.09	.63*
71			.55		3.55	8.41	1.09	.57*
3				.83	4.09	5.76	1.11	.39*
12				.66	3.92	8.87	1.15	.50*
48				.46	3.61	7.79	1.18	.41*
Range	.64-.85	.63-.77	.55-.80	.46-.83	3.43-4.09	5.76-9.50	.87-1.18	.37-.63
								Total
Variance %	36.69	10.24	7.44	6.08				60.46
Cronbach Alpha	.86	.81	.80	.58				.89

r: Item-total correlations: * indicates significance at .05 level

Note: Factor loads which are lower than .30 are not given in the table to make it easier to follow.

F1: Evaluation; F2: Monitoring; F3: Organization; and F4: Planning

Factor structure of MS was examined with Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Exploratory factor analysis aims to explore factor structure based on the relationships between variables. Confirmatory factor analysis which investigates model-data compatibility tests the hypothesis developed regarding the relationships between variables (Tabachnick & Fidell, 2001).

The first component obtained from the analyses is the "evaluation" dimension formed by the 24th, 23rd, 25th, 26th, and 27th items. Some of the items in this instrument are "I visualise what I have learnt with a view to monitoring my understanding", "I question my understanding while listening to the lesson", and "I sometimes review the topics with a view to understanding the important relations about the content of the topic". Factor loads of the 18 items in this sub-scale are between .64 and .85 and item-total correlations are between .55 and .63. Cronbach Alpha internal consistency coefficient is .86. Exploratory factor analysis results show that the second component in the MS are composed of ten items about the organization dimension of metacognition such as "I make guesses about the possible solutions to the problem in a topic that I do not know, and "I use different thinking techniques and strategies with a view to answering different questions about the content of the lesson" (Item pool numbers: 63, 75, 76, 77, and 80). Factor loads of the items in this factor called "Organizing" range between .63 and .77; item-total score correlations are between .37 and .61, and Cronbach Alpha internal consistency coefficient is .81. The third factor in MS according to the analysis results is the five items that include statements such as "I can identify the critical concepts of the lesson", "I can organize the information about the topic to be learned". This factor is called "organization". Factor loads of these items with .80 Cronbach Alpha internal consistency (Item Numbers: 72, 68, 74, 70 and 71) range between .55 and .80; and the item-total correlations are between .44 and .63. The fourth factor in MS according to analysis results is the one that deals with the planning dimension of metacognition: "I am aware of my own thinking", "Receiving support from the teacher about the content of the lesson helps me to become a successful student". This factor is called "Planning". Factor loads of these items in this sub-dimension with .58 Cronbach-Alpha internal consistency coefficient (Item numbers 3,

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12, and 48) range between .46 and .83, and item-total correlations between .39 and .50. Four sub-dimensions explain 60.46 % of the total variance. Cronbach Alpha Internal Consistency of the whole scale is .89. Guttman Split Half values which were performed with a view to finding out the stability or consistency between the two halves are .76 for the "Evaluation" sub-dimension, .76 for the "Monitoring" sub-dimension, .80 for the "Organization" sub-dimension , .43 for the "Planning" sub-dimension, and .81 for the whole scale. An analysis of Table 1 in terms of factor loads indicates that the factor loads range between .46 and .85. When analysed in terms of the items loaded on more than one factor, the items were found to be generally loaded on the related sub-scales with significant differences (generally .30 and over). In addition to these, total scores the participants got from the 18 items were grouped according to top and bottom 27% groups and examined whether the items distinguished these two groups. As a result of this analysis, all the items were found to distinguish the groups significantly ($p<.001$). Mean scores belonging to the remaining 18 items were found to range between 3.43 and 4.09, and the standard deviations between .87 and 1.18.

Confirmatory factor analysis was conducted with a view to testing the accuracy of the four-factor structure. Although there are many statistics for data accuracy, the most common indicators are $\chi 2$, $\chi 2/df$, RMSEA, NNFI, CFI and GFI values (Sümer, 2000; Çokluk, Büyüköztürk & Şekercioğlu, 2010). Confirmatory factor analysis conducted for reviewing the compatibility of the four-factor model of MS with the data collected and chi-square value performed for model-data compatibility were found to be significant ($\chi 2= 211.05$, $sd=129$, $p<.01$).

Examination of the four-factor model which was tested with CFA shows that fit indices values RMSEA=0.055 and $\chi 2/df=1.63$ value and RMR=0.050, STRMR=0.057, GFI=0.90, AGFI= 0.87, NFI=0.85, NNFI=0.92, CFI=0.93 values are suitable for the recommended criteria. Standardized coefficients that show the relationships of the factors with the items were found to range from 0.47 to 0.80, and all of them were significant at .01 level. A general analysis of the model fit indices indicates that the model reaches a medium level fit, but displays a good consistency with the RMSEA=0.055, $\chi 2/df=1.63$ values (Tabachnick and Fidell, 2001; in; Çokluk et al., 2010, 271)

d) Analysis of the Data

Reliability and validity analysis of the Metacognition Scale included performing Cronbach Alpha analysis for reliability, receiving expert opinions for content validity, and performing explanatory factor analysis and confirmatory factor analysis for construct validity. Besides, arithmetic means and standard deviation values of the items and item-total correlations were examined, and their item discrimination strength was calculated using t-test analysis. Mean scores, t-test, and one-way variance analysis techniques were used with a view to comparing the data in terms of gender, education type, and department variables.

III. Findings

a) Findings Regarding the Construct Validity and Reliability of the Metacognition Scale

The calculation of the skew and kurtosis coefficient of the items in each sub-scale, item-total score correlations, correlation matrix values of the items, their common variances, factor loads (at least .30), and the differences between the factor loads loaded on more than one factor (at least .20) were examined and found that four items should be excluded from the scale. These calculations were performed using principal components factor extraction and orthogonal (varimax) rotation. Kaiser-Meyer-Olkin (KMO) and Barlett Sphericty test results were examined for the factor structure of the gender sub-scale of the Metacognition Scale with a view to finding out whether the data are appropriate for factor analysis. These values were found to be statistically significant in the gender sub-scale (KMO =.914; Barlett Sphericty test $\chi 2 = 1.853$ df =153 $p<.001$). Results obtained from the student administration of the scale with 250 students show that Cronbach Alpha reliability value of the 14-item, three dimension form is .89, it is .87 in the first sub-factor , .65 in the second sub-factor and .70 in the third sub-factor.

The first results of the factor analysis show that the scale has three components over 1.00 eigen value. However, the items collected under the factors apart from the first three components with eigen value of over 2.00 were either too few in number (one or two items) or had factor loads of over .30 under other components as well, and the loads under the two components were found to be close to each other. Scree plot of the eigen values was analysed and found that the most significant skew occurred in the third factor. The most frequently used criteria in the process of identifying the total factor number included eigen value, percentage of contribution to the total variance, and scree plot (DeVellis, 2003; Kalaycı,2009). Cattel (in DeVellis, 2003) points that the factor number till the scree plot takes a horizontal shape can be used as a criterion in identifying the appropriate factor number. Beside these values, considering that the item pool was prepared under three main titles (F1: Evaluation, F2: Organization, F3: Planning), the factor analysis was reperformed limiting it with three components.

Table 2 displays factor analysis that is reached with two iterations and results with three factors as well as factors, factor loads, and factor eigen values obtained from the reliability analyses, variance percentages and Cronbach Alpha values explained by

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the factors; revised item-total correlations in relation to the items; revised item-total correlations belonging to the items (r), common variances, and t values.

Table 2 : Factors, Factor Loads, Variance Percentages explained by Factors, and Item-Total Score Correlation Values in the Metacognition Scale

Item Number	F 1	F 2	F 3	$\overline{X}$	T	SS	r*
4	.75			4.25	-8.337	1.01	.68*
9	.75			3.85	-11.076	1.04	.64*
3	.71			3.89	-10.003	1.03	.60*
5	.71			3.99	-10.135	1.08	.70*
11	.67			3.95	-9.158	1.11	.61*
1	.63			3.50	-10.471	.96	.56*
8	.62			4.20	-9.240	1.16	.63*
12		.66		3.69	-9.131	1.26	.49*
16		.65		3.67	-8.805	1.07	.48*
13		.58		3.76	-11.104	1.01	.61*
14			.70	3.61	-9.104	.94	.48*
17			.65	3.63	-7.879	.96	.46*
6			.61	3.63	-8.276	.98	.52*
18			.58	3.73	-7.211	1.04	.46*
Range	.62-.75	.58-.66	.58-.70	3.61-4.25	-7.211--11.076	.94-1.26	Total
Variance %	24.279	15.303	13.492				53.074
Cronbach Alpha	.87	.65	.70				.89

r: Item-total correlations: * indicates significance at .05 level
Note: Factor loads lower than .30 are not given in the table to make it easier to follow.
F1: Evaluation; F2: Organization; F3: Planning

Factor structure of MS was examined with Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Exploratory factor analysis aims to explore factor structure based on the relationships between the variables. Confirmatory factor analysis which investigates the model-data compatibility tests the hypothesis in relation to variables. (Tabachnick & Fidell, 2001). The first component obtained from the analyses is the "Evaluation" dimension formed by the 4th, 9th, 3rd, 5th, 11th, 1st and 8th items. Some items in this scale are "I visualise what I have learnt with a view to monitoring my understanding". Factor loads of 7 items in this sub-scale range between .62 and .75, and item-total correlations between .56 and .70; Cronbach Alpha internal consistency is .87. According to exploratory factor analysis results, the second component in the MS includes three items in relation to the organization dimension of metacognition such as: "While listening to the lesson, I sometimes review the topics with a view to understanding the important relationships regarding the content of the lesson" (Item numbers 12, 16 and 13). Factor loads of these items called "Organization" range between .58 and .66, and item-total correlation is between .48 and .61; Cronbach Alpha internal consistency coefficient is .65. Analysis results show that the third factor in MS is composed of four items regarding the planning dimension of metacognition: "I can create the necessary conditions so as to form the aims of the course" and "I can organize the information about the topic to be learned". This factor is called "Planning". Factor loads of the items in this sub-scale with .70 Cronbach Alpha Internal consistency coefficient (item numbers 14, 17, 6, and 18) range between .58 and .70; and the item-total correlations between .46 and .52. The three sub-scales explain 53.074 % of the total variance. Cronbach Alpha internal consistency of the whole scale is .89. Guttman Split Half values which were performed with a view to finding out the stability or consistency between the two halves are .84 for the "Evaluation" sub-scale, .50 for the "Organization" sub-scale, .58 for the "Organization" sub-scale , .58 for "Planning" sub-scale, and .82 for the whole scale. An analysis of Table 1 in terms of factor loads indicates that the factor loads range between .58 and .75. When analysed in terms of the items loaded on more than one factor, the items were found to be generally loaded on the related sub-scales with significant differences (generally .30 and over). Arithmetic means of the 14 items range from 3.61 to 4.25 while the standard deviations from .94 to 1.26. Besides, total scores the participants got from the 14 items were grouped according to top and bottom 27% groups and examined whether the items distinguished these two groups. As a result of this analysis, all the items were found to distinguish the groups significantly ($p<.001$). Arithmetic means of the remaining 14 items range from 3.61 to 4.25 while the standard deviations from 94 to 1.26.

Table 3 demonstrates correlation matrix, arithmetic mean, and standard deviation values in relation to the Metacognition Scale and its sub-scales.

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Table 3 : Correlation Matrix, Arithmetic Mean and Standard Deviation Values in relation to the Metacognition Scale Total Score and its Sub-scales

	1	2	3	x	sd
Evaluation	-	. 594**	. 546**	27,66	5,63
Organization	. 594**	-	. 549**	11,13	2,57
Planning	. 546**	. 549**	-	14,62	2,85
Total	.923**	.792**	.777**	53,42	9,46

N=259 **p<0.01, *p<0.05

As seen in Table 3, the first sub-scale in MS demonstrates significant relationships between the second and third total scores (p<0.01, p<0.05), and the second sub-scale between the first and third total scores (p<0.01, p<0.05). The third sub-scale displays significant relationships between the first and the third sub-scales and with the total score (p<0.01, p<0.05). The total dimension of the scale shows a positive significant relationship with all the sub-scales (p<0.01, p<0.05). Arithmetic mean values in relation to MS total and sub-scales range between 11.13 and 53.42 and standard deviations between 2.57 and 9.46.

Confirmatory Factor Analysis: There are a number of fit indices used in CFA with a view to testing the validity of the model. The most frequently used ones among these are chi-square conformance test, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit test (CFI), Normed Fit Index (NFI), the Non-normed Fit Index (NNFI), and Root Mean Square Error of Approximation (RMSEA).

It is indicated that if the (χ2/sd) proportion calculated with CFA is lower than 5, the model is compatible with the real data (Sümer, 2000). For model-data compatibility, GFI and AGFI values should be over .90, RMS or standardized RMS and RMSEA values lower than .05. On the other hand, some indicators showing the compatibility of the model with real data are that GFI and AGFI values are over 0.85, AGFI values over 0.80, and RMS value lower than 0.10 (Anderson and Gerbing, 1984; Cole, 1987; Marsh, Balla and McDonald, 1988; in, Gülbahar and Büyüköztürk, 2008: 151).

Confirmatory factor analysis was performed with a view to testing the validity of the three-factor structure identified. Although there are many statistics for data accuracy, the most common indicators are χ2, χ2/df, RMSEA, NNFI, CFI and GFI values (Sümer, 2000; Çokluk, Büyüköztürk and Şekercioğlu, 2010). Confirmatory factor analysis was performed with a view to testing the validity of the structure obtained from the exploratory factor analysis.

Confirmatory factor analysis conducted for reviewing the compatibility of the three-factor model with the data collected; and chi-square value performed for model-data compatibility were found to be significant (χ2=151.90, sd=74, p<.01). Some conformity statistics found using the same analysis are (χ2/sd)=2.05, RMSEA=0.064, RMR=0.045, GFI=0.92, AGFI=0.89, NNFI=0.91, NFI=0.87, CFI=0.93. With the first modification conducted (between M13 and M14), confirmatory factor analysis of the three-factor model and chi-square values for model-data compatibility were found to be significant χ2=116.68, sd =73, p<.01. Some conformity statistics found using the same analysis are (χ2/sd)=1.59, RMSEA=0.048, RMR=0.044, GFI=0.94, AGFI=0.91, NNFI=0.95, NFI=0.90, CFI=0.96. A general analysis of the model fit indices indicates that the model reaches a medium level fit, but displays a perfect consistency with the RMSEA=0.048, χ2/df=1.59 values (Tabachnick and Fidell, 2001; in; Çokluk et al., 2010, 271).

Table 4 displays t-test results of the students' answers given for evaluation, organization, and planning dimensions according to gender variable.

Table 4 : T-test Results of the MS Sub-dimensions according to gender variable

Sub-dimensions	Gender	N	X	S	Sd	t	p
Evaluation	Female	123	28,30	5,46	244	1.596	.112
	Male	123	27,05	5,76			
Organization	Female	123	11,59	2,28	244	3.132	0.02
	Male	123	10,58	2,77			
Planning	Female	123	14,73	2,57	244	,677	.499
	Male	123	14,49	3,08			
Metacognition Total	Female	123	54,53	8,79	244	2.018	.045
	Male	123	52,13	9,85			

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Analysis results show that the participants' metacognition perceptions significantly differ in organization [t(244)=3.132; p<.05] and total [t(244)=2.018; p<.05] dimensions in terms of gender.

Table 5 displays descriptive statistics regarding the participants' answers in relation to evaluation, organization, and planning sub-dimensions according to the departments they attend.

Table 5 : Descriptive Results in relation to the Department Variable according to the Sub-dimensions of the Metacognition Scale (MS)

Sub-dimensions	Departments			
Evaluation	Social Sciences	10	26,3	9,36
	Pcg	168	28,38	5,22
	Classroom Teaching	59	25,85	5,72
	Total	237	27,66	5,56
Organization	Social Sciences	10	10,7	2,94
	Pcg	168	11,47	2,4
	Classroom Teaching	59	10,36	2,66
	Total	237	11,16	2,52
Planning	Social Sciences	10	15,1	2,51
	Pcg	168	14,91	2,60
	Classroom Teaching	59	13,79	3,18
	Total	237	14,64	2,79
Metacognition Total	Social Sciences	10	52,1	12,60
	Pcg	168	54,77	8,54
	Classroom Teaching	59	50,01	10,13
	Total	237	53,47	9,33

Table 6 presents ANOVA results of the answers given for the evaluation, organization, and planning dimensions according to department variable.

Table 6 : ANOVA results of the answers given for the Metacognition Scale (MS) sub-dimensions according to Department Variable

Sub-dimensions	Source of Variance	KT	Sd	KO	F	P	Difference (LSD)
Evaluation	Intergroups	299,355	2	149,677	4,829	,009	Pcg-Class
	Intragroups	7252,909	234	30,995			
	Total	7552,264	236				
Organization	Intergroups	56,354	2	28,177	4,541	,012	Pcg-Class
	Intragroups	1451,948	234	6,205			
	Total	1508,301	236				
Planning	Intergroups	56,869	2	28,434	3,733	,025	Pcg-Class
	Intragroups	1782,280	234	7,617			
	Total	1839,149	236				
Total	Intergroups	1010,817	2	505,409	6,044	,003	Pcg-Class
	Intragroups	19566,915	234	83,619			
	Total	20577,733	236				

As seen in Table 6, the level of participants' metacognition skills differs significantly depending on the departments they are attending (evaluation: [F(2,236)=4.829; p<.05], organization: [F(2,236)= 4.541; p<.05]; planning: [F(2,236)=3.733; p<.05]; and total: [F(2,236)= 6.044; p<.05]. The results of LSD test performed with a view to finding out the departments that display differences indicate that there is a significant difference in favour of the Pcg department.

Table 7 presents t-test results for the participants' answers in relation to evaluation, organization, and planning dimensions according to type of education variable.

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Table 7 : T-test results for Sub-dimensions of the Metacognition Scale according to Type of Education Variable

Sub-dimensions	Type of Education	N	X	S	Sd	T	p
Evaluation	Normal	168	27,59	5,70	238	.-222	,825
	Evening	72	27,76	5,20			
Organization	Normal	168	10,87	2,64	238	-2,427	,016
	Evening	72	11,73	2,16			
Planning	Normal	168	14,31	2,89	238	-1,963	,051
	Evening	72	15,1	2,65			
Total	Normal	168	52,78	9,64	238	-1,394	,164
	Evening	72	54,60	8,19			

Analysis results show that the participants' metacognition perceptions differ significantly according to type of education in the organization dimension [t(238)=-2,427; p<.05].

IV. Discussion, Conclusion and Recommendations

MS process has included the use of many fit indices such as Chi-square Conformity Test ($\chi 2$), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit test (CFI), Normed Fit Index (NFI), the Non-normed Fit Index (NNFI), and Root Mean Square Error of Approximation (RMSEA) (Şimsek, 2007; Hoe, 2008).

Confirmatory factor analysis was performed with a view to testing the validity of the three-factor structure identified in the exploratory factor analysis. Confirmatory factor analysis conducted for reviewing the compatibility of the three-factor model of MS with the data collected and chi-square value performed for model-data compatibility were found to be significant $\chi 2=151.90$, sd=74, p<.01. Some conformity statistics found using the same analysis are($\chi 2$/sd)=2.05, RMSEA=0.064, RMR=0.045, GFI=0.92, AGFI=0.89, NNFI=0.91, NFI=0.87, CFI=0.93. The indicators showing the general compatibility of the factor structure are that the chi-square compatibility test is not significant; CFI, NNFI, NFI values are over .90; GFI and AGFI values are over .75; the ratio of $\chi 2$/df is 3 or lower; and RMSE significance level is 0,064.

With the first modification conducted (between M13 and M14) in DFA, confirmatory factor analysis of the three-factor model and chi-square value performed for model-data compatibility were found to be significant ($\chi 2=116.68$, sd=73, p<.01). Some conformity statistics found using the same analysis are ($\chi 2$/sd)=1.59, RMSEA=0.048, RMR=0.044, GFI=0.94, AGFI=0.91, NNFI=0.95, NFI=0.90, CFI=0.96. A general analysis of the model fit indices indicates that the model reaches a medium level fit, but displays a perfect consistency with the RMSEA=0.048, $\chi 2$/df=1.59 values (Tabachnick and Fidell, 2001; in; Çokluk et al., 2010, 271).Confirmatory factor analysis was performed with a view to testing the original factor structure of MS which was also supported by expert opinions; the 14 items in the scale were found to be valid for Education Faculty students. These values reveal that the data compatibility of the model is sufficient (Kline, 1998; Kelloway, 1998; Heubeck & Neill, 2000; Corral & Calvete, 2000; Lewis et al., 2002; Olivares et al., 2004; Ingles, Hidalgo & Mendez, 2005; Sanders et al., 2005; Kahn, 2006; Simsek, 2007; Hoe, 2008).

Klein (1998) and Wiersma (2000) define reliability as the consistency of the instrument in any measurement. The most commonly used reliability method in research is computing Cronbach Alpha value (Dorman & Knightley, 2006; Smolleck, Zembal-Saul & Yoder, 2006; Johnson, Stevens & Zvoch, 2007). The present study has developed a reliable, 14-item instrument in that Cronbach Alpha internal consistency level for the whole scale is .89; it is .87 in the evaluation sub-dimension, .65 in the second factor, and .70 in the third factor.

In line with the features of the items in factors, the first factor was identified as "evaluation", the second one as "organization", and the third one as "planning". This instrument, which is valid and reliable according to the results, is the first instrument in Turkey which was developed using confirmatory factor analysis with a view to identifying perceptions of education faculty students regarding metacognition.

Considering the results of the validity and reliability study conducted with education faculty students and considering that the instrument can measure perceptions of education faculty students regarding metacognition with a three-factor structure;

- The scale is valid and reliable;
- The results to be obtained from the real administration of the scale can provide feedback about students' perceptions regarding metacognition;
- The scale developed can be analysed in the future at meta-analytical level with various participants.
- It is thought that MS can be used in experimental and descriptive studies which aim to identify perceptions of education faculty students regarding metacognition.

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