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Turkish Adaptation of the Group Metacognitive Scale: Metacognition in Online Collaborative Group Activity

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Abstract

Group Metacognition Scale (GMS) developed by Biasutti and Frate (2018) was adapted into Turkish in this study. The original scale was a 20-item, 4-factor self-report scale measuring students' metacognitive group skills and addressing what generally happened in their group during online collaborative activities. The study was conducted with 208 university students who performed group activities and tasks in online collaborative learning environments. Purposive and convenient sampling method was used in the selection of the participants. According to the confirmatory factor analysis performed in the study, it was found that the fit indices indicated an acceptable fit of the data. It was seen that the factor loadings of the items in the scale vary between 0.51 and 0.82. Cronbach's alpha values for the factors in the scale were calculated as knowledge of cognition, 0.851, planning 0.851, monitoring 0.787 and evaluating 0.845. In this study, the differentiation status of group metacognition scores according to gender and perception of achievement was also examined. The subscales and total score mean of the group metacognition scale of the participants showed a significant difference according to gender and perception of achievement. Suggestions were made within the framework of the findings.

Key Words

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Concepts

The Covid-19 outbreak has made the implementation of remote distance learning mandatory. The prevalence of online learning in education has also highlighted the importance of students taking responsibility for their own learning. In this context, it has become more important for individuals to gain awareness about the ways of accessing information, how information is accessed, and what their learning paths are. Knowing, planning and controlling how the learning process takes place plays a role in the effective management of the learning process. In this context, it is important to focus on the concept of metacognition. Metacognition is defined as knowledge about the regulation of cognitive activities in learning processes (Flavell, 1979). According to Reeve and Brown (1985), metacognition is the ability of individuals to control their own cognitive processes and direct them when necessary. According to Martinez (2006), metacognition is the monitoring and control of thought. According to Brown (1981, 1987), unlike cognition, metacognition is the state of determining when and how to use information by controlling the cognitive processes of the individual. Metacognitive skills include the use of strategies for determining learning goals, planning, monitoring, controlling and evaluating by students (Schraw & Dennison, 1994; Zion et al., 2015).

Biasutti and Frate (2018) emphasized that in addition to examining metacognition at the individual level, attention should also be paid to group metacognition. According to Biasutti and Frate (2018), metacognition of group processes, reflecting the cognitive skills of the group during collaborative learning, thinking about the cognitive characteristics and potential of the group, selecting and organizing information, planning activities, assigning tasks, changing, improving and evaluating different aspects of the process. focuses on their awareness.

Active and appropriate coordination of group processes is important for collaborative learning to be successful (Kwon et al., 2013; Yildiz-Durak, 2021). Social metacognition distributes metacognitive demands among group members, increases the visibility of each other's metacognition, and improves individual cognition, providing mutual scaffolding and more motivation (Chiu & Kuo, 2010). It is suggested that in the collaborative problem solving process, groups should also include metacognitive factors in order to reflect organizational and cognitive factors that affect mathematical problem solving (Chalmers, 2009). Zheng et al. (2019) found that students with group metacognitive scaffolding outperformed students without a metacognitive scaffold in terms of knowledge generation and group product achievement.

Biasutti and Frate (2018) defined four factors for measuring group metacognition: (a) knowledge of cognition, (b) planning, (c) monitoring, (d) evaluating. According to Schraw and Moshman (1995), knowledge of cognition is individuals' knowledge about their own cognition. Accordingly, general knowledge of cognition about one's skills, abilities, or strategies falls within the scope of declarative knowledge, procedural knowledge of how to use these strategies, and conditional knowledge of when and why they are used (Basu & Dixit, 2022). When the knowledge of cognition is examined within the scope of group metacognition, it is defined as awareness about group learning strategies, information selection, material use and classification of new information (Bisautti & Frate, 2018). Planning, another factor in GMS, is the selection of the appropriate strategy and the right allocation of resources before executing a task (Schraw and Dennison, 1994). Within the scope of group metacognition, planning is related to the awareness of understanding the learning goals of the group, choosing cognitive strategies, and considering

time and workload management before starting the learning task (Bisautti & Frate, 2018). Monitoring is the individual's understanding of what he has learned and describing his performance (Schraw and Dennison, 1994). Monitoring includes processes such as monitoring collaborative progress and ensuring that the content is understood by colleagues (Rogat & Linnenbrink-Garcia, 2011). Socially shared monitoring supports collective information construction processes (Malmberg et al., 2017). The fourth factor in GMS is evaluating. Evaluating is defined as the students' comparison of the conformity of their products with the standards set during the planning phase (Panadero et al., 2013). Evaluating within the scope of group metacognition is the group's awareness of results, working methods, tools, and teamwork evaluation skills (Bisautti & Frate, 2018). As a result, it is important to determine the metacognitive skills of the students at the group level for a successful online collaborative group learning application. On the other hand, no Turkish scale has been found in the literature on this subject. This study is considered important to fill this gap in the literature.

In this context, the aim of the current research is to adapt the GMS developed by Biasutti and Frate (2018) into Turkish. In addition, it was aimed to compare the scores obtained from the GMS according to gender and perception of achievement. The following research questions were formulated in the study:

RQ1: How is the validity and reliability of the GMS adapted into Turkish?

RQ2: Do the GMS scores of female and male students differ significantly?

RQ3: How do the scores obtained from GMS differ according to university students' perceptions of achievement?

Method

Participants

The participants of the study are 208 university students studying at various universities in Turkey, selected by a convenient sampling method. University students included in the study consisted of 72.1% female and 27.9% male participants. Their ages range from 18 to 24, with an average of 20.6. Examining the distribution of university students by grade, it was seen that 60.6% were in the second grade, 22.6% were in the third grade, and 16.8% were in the fourth grade. When the distribution of the participants according to their perceptions of achievement regarding online courses was examined, it was determined that 47.1% were at moderate level, 37.5% at high level and 15.4% at advanced level. In order to evaluate whether the number of participants of the study is sufficient for confirmatory factor analysis, criteria in the literature were taken into account. Accordingly, it is suggested that five or ten times the number of items in the scale is sufficient (Bryman & Cramer, 2001). Considering that there are 20 items in the measurement tool, it can be concluded that the number of participants meets the criterion of ten times the number of items.

Research Instrument and Adaptation Process

The adaptation of the GMS, originally developed by Biasutti and Frate (2018), into Turkish was carried out in the context of this study. The scale is intended to determine the items related to metacognition levels in collaborative online group activities with the self-reported method. The original scale consists of four sub-dimensions and 20

items. These sub-dimensions are as follows: Knowledge of cognition, planning, monitoring, and evaluating. There are five items in the scale for each sub-dimension. These items are in a 5-point Likert structure as "strongly disagree", "disagree", "neutral", "agree" and "strongly agree". Within the scope of this study, the results regarding the adaptation process of the scale are presented in the findings section. The Cronbach' alpha coefficient of the scale calculated within the scope of this study is 0.936.

To adapt the scale to Turkish, permission was obtained from Michele Biasutti via e-mail. After the consent process, the steps suggested by Hall et al. (2003) for language validity were followed. Accordingly, two independent translators were used. After the first translator translated the scale into Turkish, another translator performed the back-translation without seeing the original scale. Then, the original form of the scale and the back-translated version were compared, and necessary adjustments were made. After this process, the final form of the scale was evaluated in terms of meaning and intelligibility by three experts who had experience with the subject area.

Data Analysis

In this study, the factorial validity of the group metacognition scale was tested with CFA. Since CFA is an analysis in which a predefined structure is tested as a model (Çokluk et al., 2016), it is suitable for testing an existing theory (Güngör, 2016). Therefore, in this study, the factorial structure was tested with CFA, since a scale with a previously defined factor structure was adapted to Turkish. Convergent and divergent validity findings were examined to provide evidence for construct validity.

The differentiation status of the scores obtained from the GMS according to gender was examined with the independent samples t-test. Cohen's d values were examined in the evaluation of the effect size. Accordingly, .20 is interpreted as weak, .50 medium and .80 large effect sizes (Cohen, 1988). One-way analysis of variance (ANOVA) was conducted to examine the differentiation status of the scores obtained from the GMS according to the participants' perceptions of achievement. In order to perform ANOVA analysis, Levene's test was performed to examine whether the variances were homogeneous or not. Accordingly, ($F_{(2, 205)}= 1.214$, $p> .05$) for the knowledge of cognition factor, $F_{(2, 205)}= 1.552$, $p> .05$) for the planning factor, $F_{(2, 205)}= 1.763$, $p> .05$) for the monitoring factor, $F_{(2, 205)}= 2.432$, $p> .05$) for the evaluating factor, and ($F_{(2, 205)}= 2.367$, $p> .05$) for the total score were obtained. These findings showed that the variances did not differ statistically significantly from each other.

Results

Confirmatory Factor Analysis

Confirmatory factor analysis was performed to test the factorial validity of the GMS in Turkish culture. The standardized findings of 20 items and four-factor structure as a result of CFA are given in Figure 1.
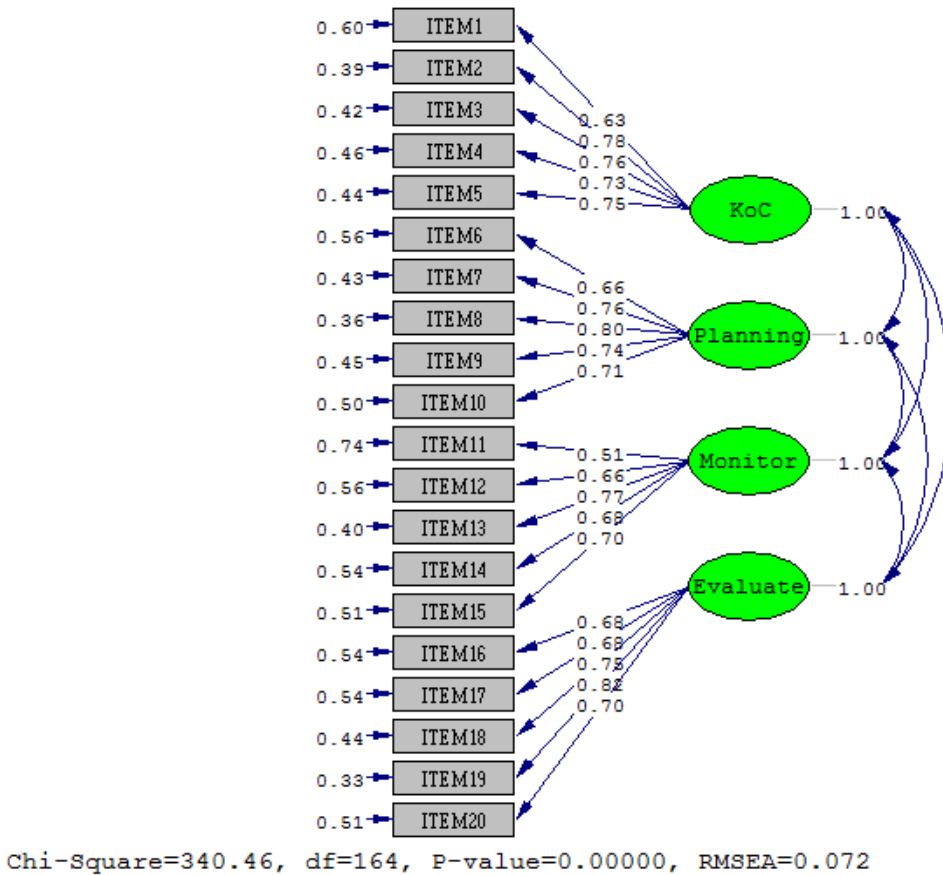
Figure 1. CFA results

When Figure 1 is examined, it is seen that the factor loadings of the items in the scale vary between 0.51 and 0.82. These values are statistically significant. In order to evaluate the model fit, Chi-square and degrees of freedom values $\chi2=340.46$, (df=164, p<.01) were examined. According to Bollen (1989), the $\chi2/df$ ratio should be below five, and below three indicates a good fit (Kline, 2005). In this study, the $\chi2/df$ ratio was calculated as 2.07 and it was concluded that it showed a good fit. In addition, Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) values were examined in the evaluation of the model. According to the DFA findings, the RMSEA value was calculated as 0.072 and the SRMR as 0.05. These values were found to indicate acceptable fit (Browne & Cudeck, 1993; Hu & Bentler, 1999). Other fit indices for the evaluation of model fit are Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Comparative Fit Index, Incremental Fit Index (IFI). The calculated values for these indices are 0.95 for NFI; 0.97 for NNFI; 0.97 for CFI; 0.97 for IFI. These calculated values show that the model has a good fit (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003; Tabachnick et al., 2001).

Construct Validity

Convergent and divergent validity methods were used for construct validity. According to Fornell and Larcker (1981), factor average variance extracted (AVE) values should be above 0.50. In addition, the AVE values should be

below the composite capability values. Table 1 presents the findings regarding the AVE, composite reliability values and Cronbach's alpha internal consistency coefficient of the factors in the scale.

Table 1

AVE, composite reliability and Cronbach's alpha values

Factor	AVE	Composite Reliability	Cronbach's alpha
Knowledge of cognition	0.535	0.852	0.851
Planning	0.541	0.854	0.851
Monitoring	0.448	0.800	0.787
Evaluating	0,532	0.850	0.845

When Table 1 is examined, it is seen that the AVE values of knowledge of cognition, monitoring and evaluating factors are above 0.50. The AVE value of the monitoring factor was calculated as 0.448, at the same time this value is below the composite durability value. However, it is stated that in cases where composite reliability is provided, it can be concluded that convergent validity can be reached by considering the conformity with the theoretical structure (Fornell & Larcker, 1981). As a result, it can be argued that sufficient results regarding the convergent validity of the scale have been reached. When the reliability findings are examined, it is seen that the composite and Cronbach's alpha values are above 0.70. These findings provide sufficient evidence for the reliability of the scale (Gefen et al., 2000; Hair et al., 1998).

The criteria proposed by Fornell and Larcker (1981) were considered to provide evidence of discriminant validity. Accordingly, the square roots of the AVE values should be above the correlation coefficients between the factors. Table 2 presents the findings regarding discriminant validity.

Table 2

Discriminant Validity

Factor	Knowledge of cognition	Planning	Monitoring	Evaluating
Knowledge of cognition	**0.731**			
Planning	0.684	**0.735**		
Monitoring	0.594	0.733	**0.698**	
Evaluating	0.560	0.705	0.678	**0.729**

The values highlighted in bold on the diagonals in Table 2 are the square roots of the AVEs. It has been determined that the correlations in each vertical column are below the square root AVE values. In conclusion, these findings provide evidence for discriminant validity.

Findings regarding the differentiation of group metacognition scores according to gender

The GMS scores of the participants according to gender are compared with the independent samples t test and the findings are given in Table 3.

Table 3

Independent sample t-test findings regarding the analysis of the scores obtained from the Group metacognition scale by gender

Factor	Gender	Mean	Standard Deviation	t	p	Cohen's d
Knowledge of Cognition	Female	19.0533	3.09532	2.261	0.025	0.327
	Male	17.8621	4.11437			
Planning	Female	20.3067	3.24388	3.696	0.000	0.528
	Male	18.2241	4.52689			
Monitoring	Female	19.8733	3.52802	2.576	0.011	0.386
	Male	18.4138	4.00015			
Evaluating	Female	20.4867	3.60971	2.886	0.004	0.421
	Male	18.7414	4.60572			
Total Scores	Female	79.7200	11.25430	3.324	0.001	0.476
	Male	73.2414	15.58937			

According to Table 3, it was found that the mean scores of females for group regulation sub-scales were higher than the males and this difference was statistically significant ($t(KoC)_{(206)}=2.261$, $p<.05$, $d\text{-}value=0.327$; $t(Planning)_{(206)}=3.696$, $p<.01$, $d\text{-}value=0.528$; $t(Monitoring)_{(206)}=2.576$, $p<.05$, $d\text{-}value=0.386$; $t(Evaluating)_{(206)}=2.886$, $p<.05$, $d\text{-}value=0.421$). A moderate level of effect for the factor of planning was calculated. A weak effect size for knowledge of cognition, monitoring and evaluating were founded. The t-test findings for the

total scores obtained from the scale show that there is a statistically difference between females and males and the difference has a weak effect ($t(Total)_{(49)}=3.324$, $p<.05$, d-value$=0.476$).

Findings on the differentiation of group metacognition scores according to the perception of achievement

ANOVA test was performed to examine the scores obtained from the GMS in terms of perception of achievement and the findings are given in Table 4.

Table 4

One-way analysis of variance findings regarding the examination of the scores obtained from the group metacognition scale in terms of perception of achievement

	Variance Source	Sum of Squares	df	Mean Square	F	p	LSD
Knowledge of cognition	Between Groups	293.400	2	146.700	13.933	.000	1-**2**; 1-**3**
	Within Groups	2158.427	205	10.529			
	Total	2451.827	207				
Planning	Between Groups	202.108	2	101.054	7.629	.001	1-**2**; 1-**3**
	Within Groups	2715.272	205	13.245			
	Total	2917.380	207				
Monitoring	Between Groups	94.757	2	47.379	3.518	.031	1-**2**; 1-**3**
	Within Groups	2761.007	205	13.468			
	Total	2855.764	207				

Evaluating	Between Groups	100.812	2	50.406	3.252	.041	1-**3**
	Within Groups	3177.188	205	15.498			
	Total	3278.000	207				
Total scores obtained from scale	Between Groups	2581.806	2	1290.903	8.296	.000	1-**2**; 1-**3**
	Within Groups	31898.636	205	155.603			
	Total	34480.442	207				

1: low-moderate, 2: moderate-high, 3: Advanced

According to Table 4, the mean scores of the participants obtainede from the sub-dimensions and total scores of the GMS showed a significant difference according to the perception of achievement. According to the results of the LSD test, the findings are summarized below:

- In the knowledge of cognition factor, it was determined that students with an advanced perception of achievement (M= 20,6563) had significantly higher group metacognition scores than students with a low-moderate level (M=17.5408). At the same time, the group metacognition scores of the students with a moderate-high perception of achievement (M= 19.4103) are significantly higher than those with a low-moderate level.
- It was determined that students with advanced perception of achievement (M=20.9688) had significantly higher group metacognition scores than students with low-moderate level (M=18.6939) for the planning factor. At the same time, the group metacognition scores of the students who have a moderate-high perception of achievement (M=20.5128) for the planning factor are significantly higher than those with a low-moderate level.
- It was determined that the students with an advanced perception of achievement (M= 20.2500) had a significantly higher group metacognition score than the students with a low-moderate level (M=18.7551) for the monitoring factor. At the same time, the group metacognition scores of the students who have a moderate-high perception of achievement (M= 20.0385) for the monitoring factor are significantly higher than those at the low-moderate level.

- In the evaluation factor, it was determined that students with an advanced perception of achievement (M= 20.6563) had significantly higher group metacognition scores than students with a low-moderate level (M=17.5408).

- When the differences between the groups were examined according to the scores obtained from the whole scale, it was determined that the group metacognition scores of the students with an advanced perception of achievement (M= 83.000) were significantly higher than the students with a low-moderate level (M=74.2959). At the same time, the group metacognition scores of students with a moderate-high perception of achievement (M=80.3718) are significantly higher than those with a low-moderate level.

Discussion, Conclusion & Suggestions

In this study, the group metacognition scale developed by Biasutti and Frate (2018) for university students who participated in online group studies was adapted into Turkish. The original scale consists of 4 sub-dimensions (knowledge of cognition, planning, monitoring and evaluating) and 20 items. The items of the scale provide a 5-point Likert-like evaluation as "strongly disagree", "disagree", "neutral", "agree" and "strongly agree". The four-factor structure in the scale was examined by confirmatory factor analysis. Model fit indices were found to indicate acceptable fit of the data. It was observed that the factor loadings of the items in the scale varied between 0.51 and 0.82 and these values were statistically significant. For the evaluation of model fit, Chi-square and degrees of freedom ratio, RMSEA, SRMR, NFI, NNFI, CFI, IFI were examined and it was concluded that findings indicate acceptable or good fit. Cronbach's alpha values calculated for the factors in the scale are above 0.7 for all sub-dimensions. AVE values range from 0.448 to 0.541, while composite reliability values range from 0.800 to 0.854. Based on these findings, it was concluded that the Turkish version of the scale was valid and reliable. In the literature, studies examining the subject of group metacognition are limited (Zion et al., 2015). On the other hand, Biasutti and Frate (2018) emphasized that metacognition is generally examined at the individual level. Therefore, it can be said that group metacognition is not emphasized enough in educational research based on collaborative group activities. However, according to Rapchak (2018), group metacognition is one of the key elements of successful collaborative learning. In this context, it can be said that the level of group metacognition is important in effective and successful collaborative learning activities. Based on these points, it is thought that the scale adapted in this study may be useful for researchers who want to study collaborative group studies. The adapted scale can be used in experimental studies to describe the existing situation.

In this study, the differentiation status of group metacognition scores according to gender and perception of achievement was also examined. The sub-dimension and total score averages of the GMS of the participants showed a significant difference according to gender and perception of achievement. In collaborative learning, group metacognition, social interactions between learners can be based on the theory of social constructivism (Vygotsky, 1978). Based on this theoretical basis in collaborative learning, it can be said that gender and perception of achievement may have affected one's interaction skills and thus the level of group metacognition. Liliana and Lavinia (2011) stated that female students have higher metacognitive skills than male students, and there are differences in

the metacognitive skills of male and female students. Nunaki et al. (2019) state that the findings in the literature regarding the differentiation of metacognition depending on gender and its causes are contradictory.

Future research can address the difference between male and female students' metacognitive skills in collaborative group work through qualitative research. On the other hand, in future studies, heterogeneous groups can be formed according to the level of academic achievement perception and the change in group metacognition in collaborative learning can be examined.

Ethic

In this study, all scientific ethical rules were followed.

Author Contributions

All stages of the study were organized and conducted by the authors.

Conflict of Interest

In addition, the authors declare that they have no conflict of interest.

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