Exploring the relationship between metacognitive awareness and teachers' sense of efficacy through structural equation modelling

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Abstract

The aim of this study is to investigate the relationship between metacognitive awareness and beliefs of pre-service teachers' sense of efficacy. The research has been designed within a relational survey model. The sample of the research consists of 312 pre-service teachers. In the research, metacognitive awareness inventory and teachers' sense of efficacy scale were used as data collection tools. The correlation between variables was examined using structural equation modelling. The results showed that there was a positive and significant correlation between metacognitive awareness and teachers' sense of efficacy. This result interprets that an individual with high metacognitive awareness has a high teacher's sense of efficacy.

Keywords: Metacognitive awareness, teachers' sense of efficacy, structural equation modelling, pre-service teachers.

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1. Introduction

Individuals should be able to use information, acquired in cognitive, emotional or psychomotor dynamic ways, effectively in the solutions of the problems they encounter. Therefore, individuals should have knowledge in the field of social sciences, science, mathematics and technology in line with their interests. An interdisciplinary relationship should be established in order to link the information in this field with other fields. Students cannot establish this interdisciplinary relationship on their own. Teachers should guide students in this regard. Teachers should create the teaching environment for students and maintain order (Moore, 1998). In order to ensure that students are successful in the learning environment, teachers should start by motivating students in activities that will improve students' metacognitive awareness and by developing self-efficacy perceptions.

Metacognition is defined as the process of memorising entries, configuring them in the mind, selecting the information needed by scanning the information and controlling the information in the memory (Flavell, 1979). In addition, metacognition is the control of the individual by thinking how much of something is learned (Schraw & Dennison, 1994) and it is the ability to use and regulate metacognitive activities in the mind (Akin, 2006). Metacognitive awareness is basically the awareness of the individual's own knowledge, how and when to use it. In other words, it is the knowledge of the individual about his thinking, learning, cognitive strategies and products (Senemoglu, 2005). Individuals need to know how to learn something, remember what they have learned when needed and how to effectively control and direct their learning. These competencies are defined as the ability of individuals to control their own metacognitive process and direct them, i.e., metacognitive awareness (Reeve & Brown, 1985).

Self-efficacy is described as the beliefs of individuals about their abilities to successfully complete an action (Tschannen-Moran & Woolfolk Hoy, 2001). Self-efficacy beliefs emerge as an important affective variable. Self-efficacy beliefs are defined as a person's belief in his or her own abilities to successfully complete a job (Bandura, 1994). It is the judgment of the individual about herself or himself in order to cope with the difficult situations that she or he may face in the future (Senemoglu, 1997). Self-efficacy is important because people often believe in doing things they can successfully complete and do not try what they think will fail (Bandura, 1994). Students who have high self-efficacy beliefs aim for new tasks, do not quail against the difficulties they face in doing these tasks and achieve success (Britner, 2008; Zeldin & Pajares, 2000). Self-efficacy beliefs have a strong effect on the achievement level of individuals, which they themselves can also recognise. A strong sense of self-efficacy beliefs increases the level of individuals in many areas, such as success (Pajares & Schunk, 2001). The aim of this study was to examine the relationship between the knowledge of cognition, i.e., metacognitive awareness, and the beliefs of one's abilities to successfully finish a job, i.e., teachers' sense of efficacy, with a structural equation model (SEM).

2. Method

In this study, the relational survey model was used. Relational survey is a model that enables us to examine the relationship between two or more variables (Fraenkel, Wallen & Hyun, 2012). The aim of this study was to examine the metacognitive awareness and beliefs of pre-service teachers' sense of efficacy, and to determine the relationship between these variables.

2.1. Sampling

The sample of this research study consists of 312 pre-service teachers attending the faculty of education in a public university in Turkey. 78.5% of the pre-service teachers were female and 21.5% were male (Table 1).

Table 1. Characteristics of sampling			
		f	**%**
Gender	Female	245	78.5
	Male	67	21.5
Discipline	Chemistry	183	58.7
	Science	124	39.7
	Mathematics	5	1.6
Class	1st class	52	16.7
	2nd class	163	52.2
	3rd class	34	10.9
	4thclass and above	63	20.2

2.2. Data collection tools

In the research, the metacognitive awareness inventory and teachers' sense of efficacy scale were used as data collection tools. The metacognitive awareness inventory was developed by Schraw and Dennison (1994) and adapted to Turkish by Akin, Abaciand Cetin (2007). The scale consisted of 52 statements on a 5-point Likert-typescale having eight dimensions. These dimensions are declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, evaluation, debugging and information management. Cronbach's alpha reliability coefficient and test-retest reliability coefficient for the whole scale were 0.95.

Teachers' sense of efficacy scale was developed by Tschannen-Moran and Woolfolk Hoy (2001). The Turkish adaptation of the scale was made by Capa, Cakiroglu and Sarikaya (2005). The scale comprises three sub-dimensions: efficacy in student engagement, efficacy in instructional strategies and efficacy in classroom management. The scale consisted of 24 statements on a 5-point Likert–type scale. Cronbach's alpha reliability coefficient for the whole scale was 0.93, for efficacy in student engagement it was 0.82, for efficacy in instructional strategies it was 0.86 and for efficacy in classroom management it was 0.84.

2.3. Data Analysis

The analysis of the data obtained from the study was carried out with Statistical Package for the Social Sciences 23 and AMOS23 programmes were used. Descriptive statistics and correlations were calculated for the variables. SEM was used to establish the model of relationships between variables.

3. Results

All assumptions required for SEM were justified before analysing data. Whether the dataset was normally distributed was examined. For this, skewness, kurtosis, minimum, maximum and 5% trimmed mean values were checked. The analysis results are given in Table 2.

Table 2. Descriptive statistics for the observed variables.

Observed variables	Mean	5% Trimmed mean	SD	Min	Max	Skew.	Kurt.
Declarative knowledge (1)	3.95	3.96	0.48	2.00	5.00	−0.647	1.524
Procedural knowledge (2)	3.78	3.79	0.53	1.50	5.00	−0.445	1.258
Conditional knowledge (3)	3.96	3.98	0.53	1.20	5.00	−0.927	2.777
Planning (4)	3.81	3.84	0.52	1.86	4.86	−0.744	1.261
Monitoring (5)	3.80	3.82	0.50	2.00	5.00	−0.490	1.047
Evaluation (6)	3.85	3.87	0.53	1.50	5.00	−0.523	1.198
Debugging (7)	4.00	4.03	0.58	1.20	5.00	−0.836	1.825
Information management (8)	3.93	3.95	0.48	1.22	4.89	−1.058	2.678
Efficacy for student engagement (9)	7.24	7.28	0.84	4.38	9.00	−0.590	0.229
Efficacy for instructional strategies (10)	7.28	7.31	0.87	4.63	9.00	−0.669	0.255
Efficacy for classroom management (11)	7.31	7.37	0.99	3.63	9.00	−0.819	0.405

Skew. = Skewness; Kurt. = Kurtosis.

When Table 2 is examined, it can be seen that kurtosis and skewness values are within the accepted limits and data are normally distributed (Tabachnick & Fidell, 2013). Then, the multivariate normality and extreme values were investigated, and for this the mean and the trimmed mean were compared. In the data set, a few outliers were observed when means were compared to 5% trimmed means. Then, Mahalanob is distance value was controlled. In order to meet the multivariate normality assumption, some data were excluded from the analysis and the remaining 312 data met the multivariate normality assumption.

To examine the relationship between the latent variables of metacognitive awareness and teachers' sense of efficacy, the SEM was used. SEM was used to establish the model of relationships between these variables.

Correlation analysis was used to determine the level of relationship between variables. The obtained findings are presented in Table 3.

Table 3. Correlation between sub-dimensions

	1	2	3	4	5	6	7	8	9	10	11
1	1	0.668[a]	0.762[a]	0.691[a]	0.688[a]	0.674[a]	0.591[a]	0.643[a]	0.323[a]	0.337[a]	0.230[a]
2		1	0.670[a]	0.677[a]	0.744[a]	0.615[a]	0.505[a]	0.612[a]	0.212[a]	0.254[a]	0.116[b]
3			1	0.636[a]	0.664[a]	0.639[a]	0.589[a]	0.625[a]	0.256[a]	0.259[a]	0.182[a]
4				1	0.746[a]	0.730[a]	0.608[a]	0.682[a]	0.254[a]	0.275[a]	0.166[a]
5					1	0.722[a]	0.595[a]	0.643[a]	0.331[a]	0.314[a]	0.221[a]
6						1	0.575[a]	0.625[a]	0.246[a]	0.237[a]	0.153[a]
7							1	0.633[a]	0.223[a]	0.222[a]	0.142[b]
8								1	0.202[a]	0.160[a]	0.091
9									1	0.791[a]	0.732[a]
10										1	0.729[a]
11											1

[a]Correlation is significant at the 0.01 level (two-tailed).
[b]Correlation is significant at the 0.05 level (two-tailed).

The correlations between all variables are given in Table 3. From Table 3, it can be seen that some correlations are significant and one is not significant. The model obtained from the SEM is shown in Figure 1.
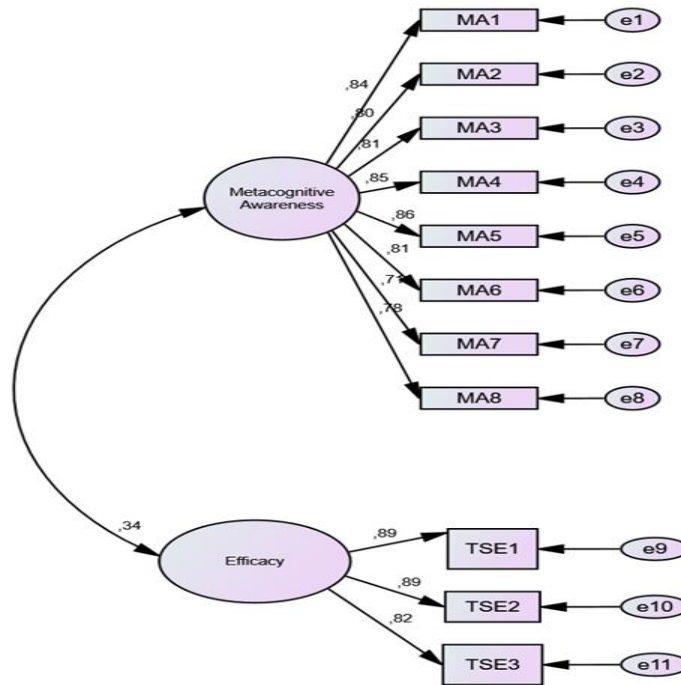
Figure 1. SEM model for metacognitive awareness with teachers' sense of efficacy

When Figure 1 is examined, there is a significant correlation between metacognitive awareness and teachers' sense of efficacy. The path coefficients and *t*-values obtained from the path diagram are given in Table 4.

Table 4. Results of SEM for metacognitive awareness with teachers' sense of efficacy

Observed variables	Path coefficient	*T*-values	R^2
MA1	0.84	18.01	0.70
MA2	0.80	16.81	0.64
MA3	0.81	17.03	0.65
MA4	0.85	18.43	0.72
MA5	0.86	18.79	0.74
MA6	0.81	17.26	0.66
MA7	0.71	14.15	0.50
MA8	0.78	16.06	0.60
TSE1	0.89	19.33	0.80
TSE2	0.89	19.23	0.79
TSE3	0.83	16.98	0.67

When Table 4 is examined, we can say that all values are significant. According to the model, the fit indices are given in Table 5.

Table 5. Criteria of SEM

	Well fitness	Acceptable fitness	Result
χ^2/df	0≤ χ^2/df≤3	3≤ χ^2/df≤5	2.753 Well
RMSEA	0<RMSEA<0.05	0.05<RMSEA<0.08	0.075 Acceptable
NFI	0.95≤NFI≤1	0.90≤NFI≤0.95	0.97Well
NNFI	0.97≤NNFI≤1	0.95≤NNFI≤0.97	0.98 Well
CFI	0.97≤CFI≤1	0.95≤CFI≤0.97	0.98 Well
GFI	0.95≤GFI≤1	0.90≤GFI≤0.95	0.94Acceptable
AGFI	0.90≤AGFI≤1	0.85≤AGFI≤0.90	0.90Well

Adapted from Schermelleh-Engel, Moosbrugger and Muller (2003).

When Table 5 is examined, it can be seen that the fit indices from the model (χ^2/df = 2.753; RMSEA = 0.075; NFI = 0.97; NNFI = 0.98; CFI = 0.98; GFI = 0.94; AGFI = 0.90) indicated well and acceptable fit indices.

4. Discussion and Conclusion

In this study, the relationship between metacognitive awareness and teachers' sense of efficacy using different statistical tools has been examined. A model with sub-scales of metacognitive awareness and teachers' sense of efficacy with SEM was also created. According to the SEM results, a statistically significant model has been obtained. The results of the SEM indicated that the fit indices of the model are in well fitness. It can be concluded that there is a significant positive relationship between metacognitive awareness and teachers' sense of efficacy.

If an individual follows his/her own learning process, realises what he/she has learned and cannot learn and can give feedback to him/herself, he/she is carrying out the informatic processes (Cakiroglu, 2007). It is easier for individuals to learn new things if they are aware of their own metacognitive skills. Individuals with high metacognitive awareness are more confident and as a result of this trust, success is positively affected. There is a positive relationship between metacognitive awareness and academic achievement (Young & Fry, 2008). Self-efficacy is a person's expectations of him/herself about what his/her level of success will be when he/she encounters a new situation (Tschannen-Moran & Woolfolk Hoy, 2001). According to the literature, teachers' sense of efficacy belief firstly increases students' motivation to learn, and then improves their perception of personality (Midgley, Feldlaufer & Eceles, 1989). Individuals with high metacognitive awareness also have high self-efficacy perception. Self-efficacy perceptions also develop in understanding the reading of individuals with metacognitive awareness (Bagci & Unveren, 2020). It is determined that self-efficacy skills are a predictor of metacognition, i.e., metacognitive awareness in children (Bozgun & Pekdogan, 2018). Using metacognitive strategies improves teacher candidates' metacognitive awareness and self-efficacy beliefs (Yildiz & Akdag, 2017).

The positive, meaningful relationship between metacognitive awareness and teachers' sense of efficacy obtained in the research is supported by other research studies. In another study, a significant, positive and high correlation was observed between the metacognitive awareness levels and self-efficacy beliefs of students (Yelgec & Dagyar, 2020). In a study with prospective teachers, a significant and positive relationship between metacognitive learning strategies and their academic self-efficacy beliefs was found (Tunca & Alkin Sahin, 2014). It has been determined that metacognitive reading strategies improve self-efficacy beliefs (BektasBedir & Dursun, 2019). In another study, a positive, high and significant relationship between metacognitive awareness and self-efficacy belief was revealed (Lindsay, 2010). There was a significant relationship between metacognitive awareness and self-efficacy of teacher candidates. When activities are added to develop metacognitive awareness in education programmes, metacognitive awareness is also developed. Thus, the importance of metacognitive awareness is understood (Bars& Oral, 2017).Individuals who use metacognitive strategies in the learning environment, connect information and are aware of difficult

situations. As a result, self-efficacy perceptions can be developed (Kirbulut & Uzuntiryaki-Kondakci, 2017). Education programmes included in metacognitive awareness skills develop students' metacognitive awareness, self-efficacy perceptions and problem-solving skills (Mohamed, Mohamed & Abdeen, 2020). Variables such as pedagogical attitude and self-efficacy affect metacognitive skills (Thienngam, Provat & Thongsaard, 2020). There is a statistically meaningful relationship between high school students' academic motivations and metacognitive awareness (Alkan, 2016), and a significant positive relationship between metacognitive awareness and attitudes toward chemistry lessons (Alkan & Altundag, 2017). Students' metacognitive awareness can be improved by applications in teaching areas such as laboratories (Cakir & Guven, 2019) and metacognitive learning strategies can be developed in the laboratory by experiments in which the experiential learning model is applied (Alkan, 2017). In future studies, the change of the metacognitive awareness with other variables can be examined, the levels of high school students can be determined instead of pre-service teachers and the effect of appropriate methods and techniques on this variable can be revealed.

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