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Investigation of the Relationship of Self-Efficacy, Self-Regulation and Metacognitive Awareness with Academic Performance through Artificial Neural Networks*

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Abstract

Metacognition is defined as individuals having knowledge and control over their own cognitive systems. Self-efficacy for teacher candidates is defined as a teacher's belief in the capacity or ability of his students to create the desired learning outcomes. Self-regulatory learning, on the other hand, is defined as thoughts, feelings and actions that are planned and applied cyclically to achieve an individual goal. In this study, it was aimed to examine the relationship between self-efficacy, self-regulation and metacognitive awareness scores and academic performance. In other studies, in the relevant literature, the relationship between academic performance and three variables, whose relationship with academic performance is examined separately, will be examined as a whole. At the same time, it will be checked whether there is a significant difference between the groups in three variable scores according to various variables. Since the aim of the research is to examine the relationship between the factors affecting the self-efficacy, self-regulation and metacognitive awareness scores of teacher candidates and the variables in question and academic performance, the relational screening model suitable for these purposes was used. The population of the research consists of teacher candidates studying in the 2022-2023 academic year at the faculty of education at a state university in the Aegean Region. The appropriate sampling method was used for data collection. Teacher Self-Efficacy Scale adapted to Turkish by Çapa, Çakıroğlu and Sarıkaya (2005), Self-regulatory Learning Skills Scale developed by Turan (2009), and Metacognitive Awareness Scale developed by Fırat Durdukoca and Arıbaş (2019) were used as data collection tools. As a result of the research, no significant difference was found in the variables of gender, department, quality of the family residence. It was determined that there was no significant relationship between family and student income variables and scale scores. In the class variable, it was found that there was a significant difference in favor of upper classes according to the three scale scores. In addition, it was determined that the three scale scores explained 47% of the total variance in academic performance..

Keywords: Artificial Neural Network, Metacognitive Awareness, Self-Efficacy, Self-Regulation, Teacher Candidate

Introduction

The concept of self-efficacy is defined as a person's personal belief in the ability to plan and carry out the actions necessary in the process of achieving the determined goals (Bandura, 1997). In other words, it can be defined as one's belief in individual competencies and potential (Sakız, 2013). Self-efficacy belief is the most important predictor of individual behaviors. In cases where individuals have the belief that they have the ability and control to perform a task, they are more willing to choose this task, express their determination in this regard, and exhibit the necessary behaviors (Sharp, 2002). Determining the self-efficacy beliefs of individuals can help explain and understand their behaviors. Based on the self-efficacy beliefs of teachers as an individual, it is possible to understand

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and explain their behaviors (Korkut and Babaoğlan, 2012). It can be said that teachers with high self-efficacy successfully carry out the basic subjects in the teaching process and are different from other teachers in this regard (Kiremit, 2006). Teachers with high self-efficacy beliefs believe that they can control and at least influence student success and motivation (Tschannen-Moran, Woolfolk-Hoy, and Hoy, 1998). It can also be said that thanks to self-efficacy belief, teachers tend to struggle when faced with difficulties and to address the problem until they reach a solution (Gibson and Dembo, 1984; Ashton and Webb, 1986; Ross, 1992). When the results of the research are evaluated, it is seen that self-efficacy perception is an important factor within the scope of success in the field of education.

Self-regulation emerges as a concept related to the degree to which students actively participate in their own learning processes in terms of metacognition, motivation, and behavior (Zimmerman, 1989). According to Kauffman (2004), self-regulation is "the learner's effort to control and manage complex learning activities". Pintrich (2000) defines self-regulatory learning as an effective and positive process that involves students setting their own learning goals, controlling their cognitive, behavioral, and psychomotor characteristics, and being willing to make changes and adjustments when necessary, and being guided by their goals and environmental characteristics. Individuals who grow up in an environment where self-regulation skills are supported and developed will start their lives one step ahead. Self-regulated learning has become increasingly important in our age of rapidly increasing knowledge. It is very important for individuals to develop their own knowledge and skills day by day and to acquire information that will carry them further (Yılmaz, 2016). In this respect, it is quite a job for the teachers who regulate the teaching-learning environment. Teachers need to organize the teaching-learning environment in a way that improves students' self-regulation skills (Aybek and Aslan, 2017). This situation reveals the importance of determining the self-regulation levels of teachers while they are studying at the undergraduate level and informing teacher candidates about self-regulation skills. It is thought that the fact that teacher candidates have self-regulation skills will make it easier for students to gain this skill in their professional lives.

Flavell (1976) defined metacognition as an individual's knowledge of their own cognitive processes. Metacognition can also be defined as the processes in which individuals have knowledge about their own cognitive activities and cognitive strategies (Boekaerts, 1997). It is the individual's consciously monitoring and supervising the cognitive processes by running the prediction and planning stages (Brown, 1980). Breed, Mentz, and Westhuizen (2014) define metacognitive awareness as being aware of how the individual will learn, how to plan his/her own learning process, and the processes of organizing, structuring, and producing information. In line with this view, Schraw (2002) states that students with metacognitive awareness can plan their own learning, use more strategies and techniques in the learning process, and therefore students are more successful. It is seen that strategies consisting of three main dimensions are put to work in the development of metacognitive awareness. These are the creation of activities related to metacognition, the execution of the metacognitive process by teachers and the basis of an approach that spreads not only to the result but also to the process. In this respect, it is thought that teachers should have awareness of metacognition (Aydın, 2022). As a matter of fact, the teacher should organize the process for this situation by creating metacognitive-based learning environments in order to organize the learning process more quality. In this respect, it can be stated that it is important for teacher candidates to develop these skills and to have metacognitive awareness in order to increase learning efficiency and activity (Kalemkuş, 2021). For this reason, it can be said that it is necessary to determine the metacognitive awareness of teachers and thus teacher candidates in order to improve the metacognitive skills of students in educational environments.

When the literature is examined, it is seen that there are relationships between self-efficacy and metacognition (Nosratinia, Saveiy and Zaker, 2014; Tunca and Alkın-Sahin, 2014), between self-efficacy and self-regulation (Dağyar and Şahin, 2020), between metacognition and self-regulation (Kaya, 2019). It is also possible to see the findings in the literature showing the relationship between self-efficacy (Britner and Pajares, 2001; Coutinho and Neuman, 2008; Dağyar and Şahin, 2020), self-regulation (Bozpolat, 2016; DiBenedetto and Zimmerman, 2010; Lindner and Harris, 1993) and metacognition (Al Huseini, 2015; Coutinho and Neuman, 2008; Çıkrıkci and Odacı, 2013) variables and academic performance. The effect of these three variables, which are related both to each other and to academic performance, on academic performance needs to be investigated as a whole. It is thought that this research will make an original contribution to the literature by determining how much the three variables together predict academic performance. In this context, in this study, based on these relationships, it was tried to determine the extent to which these three variables predicted academic performance together. In this context, this study aims to examine the relationship between self-efficacy, self-regulation and metacognitive awareness scores and academic performance. At the same time, it was checked whether there was a significant difference between the groups in three variable scores according to various variables. For these purposes, the problems of the research are as follows:

1. Do the self-efficacy, self-regulatory learning and metacognitive awareness scores of the teacher candidates differ according to the variables of gender, department, class, and quality of family residence?

2. Is there a significant relationship between teacher candidates' self-efficacy, self-regulatory learning and metacognitive awareness scores and family and student income?

3. To what extent do self-efficacy, self-regulatory learning and metacognitive awareness scores explain teacher candidates' academic grade points averages?

Method

Study Pattern

This research was conducted according to the correlational research design, which is one of the quantitative research methods. The relational research model is a research model that serves to determine the existence of the relationship between more than one variable or the power of the relationship (Karasar, 1999). In this study, two types of relational research, which can be classified as predictive and exploratory (Fraenkel and Wallen, 2006), were used within the scope of this research since both inter-variable relationships and predictive levels of variables were investigated.

Population and Sampling

The population of the research consists of teacher candidates (Classroom, Preschool, Turkish and Social Studies Teaching) studying in the fall semester of the 2022-2023 academic year at a state university in the Aegean Region. The sampling method consists of the appropriate sampling method. A total

of 342 teacher candidates were included in the sample after removing the forms with outliers and filled in incompletely. Demographic data on teacher candidates are presented in Table 1.

Table 1. *Demographic Variables*

Demographic Features	Groups	f	%
Grade Points Averages*	2-2.5	46	13.5
	2.51 – 3.5	267	78.1
	3.51 - 4	29	8.5
	Total	342	100.0
Gender	Female	251	73.4
	Male	91	26.6
	Total	342	100.0
Department	Preschool	129	37.7
	Classroom Education	66	19.3
	Social Studies	68	19.9.
	Turkish Education	79	23.1
	Total	342	100.0
Class	2nd Grade	108	31.6
	3rd Grade	113	33.
	4th Grade	121	35.4
	Total	342	100.0
Family Income*	Up to 5500	89	26.
	5501 and above	233	68.1
	Total	322	94.2
Student Revenue*	850	114	33.3
	851 and above	195	57
	Total	309	90.4
Quality of Family Residence	Village	42	12.3
	District	62	18.1
	Province	100	29.2
	Metropolitans	137	40.1
	Total	341	99.7

*Relevant variables were not grouped during the analysis, but they are shown in this table as a group in order to give an idea about the data.

Data Collection Tools

In the selection of the scale, attention was paid to the fact that the scales were developed with the participation of a similar sample (teacher candidates and university students), and that the internal reliability coefficients were 70% and above. Teacher Self-Efficacy Scale (Cronbach's Alphas .93 for original scale) adapted to Turkish by Çapa, Çakıroğlu and Sarıkaya (2005), Self-regulatory Learning Skills Scale (Cronbach's Alphas .91 for original scale) developed by Turan (2009), and Metacognitive Awareness Scale (Cronbach's Alphas .75 for original scale) developed by Fırat Durdukoca and Arıbaş (2019) were used as data collection tools. The general grade point averages of the teacher candidates were collected from the teacher candidates through forms. The Teacher Self-Efficacy Scale consists of 24 items. The lowest 24 points and the highest 120 points can be obtained from the scale. The Self-regulatory Learning Skills Scale consists of 41 items. The lowest score of 41 and the highest score of 205 can be obtained from the scale. The Metacognitive Awareness Scale consists of 18 items. The lowest score can be obtained from the scale and the highest score can be obtained from 90 points.

Data Analysis

As a result of the data being close to normal distribution, parametric statistical techniques were used in the analysis of the data. Data on the normality assumption are presented in Table 2. For the assumption of normality, kurtosis and skewness values were also checked (Table 3). Accordingly, independent groups t-test was used for the gender, one-way analysis of variance (ANOVA) was used for the variables of the quality of the family residence, department, and class, Pearson correlation coefficient was used for the variables of family and student income, and artificial neural network analysis was used for the estimation of the general grade average according to the scale scores. In addition, Scheffe test was used to interpret ANOVA results because the number of samples was not equal, and it made it possible to compare all possible combinations that could be created between the groups (Gündoğdu, 2014; Kayri, 2009).

Table 2. *Values Obtained for Normality Assumption*

The scales	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistical Value	df	p	Statistical Value	df	p
Self-efficacy	.060	342	.005	.994	342	.225
Self-Regulatory Learning	.050	342	.039	.995	342	.335
Metacognitive Awareness	.048	342	.054	.995	342	.290

According to Table 2, the data showed normal distribution according to the Shapiro-Wilk test, while the data obtained from the self-efficacy and self-regulation scale did not show normal distribution according to the Kolmogorov-Smirnov test.

Table 3. *Kurtosis and Skewness Values*

The Scales	For the Whole Sample	Statistical Value	S.E.	Calculated Value
Self-efficacy	Skewness	-.118	.132	.893
	Kurtosis	.071	.263	.269
Self-Regulatory Learning	Skewness	-.046	.132	-.348
	Kurtosis	.004	.263	.015
Metacognitive Awareness	Skewness	-.084	.132	636
	Kurtosis	.123	.263	.467

When Table 3 is examined, it is seen that the values calculated by dividing the statistical value by the standard error are in the range of ± 1.96 and are close to the normal distribution. The artificial neural network, which is another analysis used in the study, was established with feed-forward back propagation, single hidden layer, 27 hidden cells, momentum weights slope drop adaptation learning and Levenberg-Marquardt learning algorithm.

Validity and Reliability

The reliability of the data obtained was examined by calculating the internal consistency coefficient (Cronbach's Alphas for self-efficacy .90, for self-regulatory learning .91 for metacognitive awareness .80). The internal consistency coefficient of 70 and above indicates that the data are sufficient for reliability in general (Büyüköztürk, 2016). In addition, it was paid attention that the measurement tools used in the research were developed with the contributions of a similar sample (teacher candidates, university students). Since the volunteering of the participants is also a variable that can affect reliability and validity (Yıldırım and Şimşek, 2008), data were collected only from volunteer teacher candidates. Forms showing extreme value quality, which is another situation that may affect the results, were not included in the study.

Findings

In the findings section, descriptive statistics of teacher candidates' self-efficacy, self-regulatory learning and metacognitive awareness are presented. Then, the results of the analysis of demographic variables are given. Finally, findings related to the artificial neural network are presented.

The general distribution of the scores obtained by the teacher candidates from self-efficacy, self-regulatory learning and metacognitive awareness scales is presented in Table 4.

According to the level ranges obtained by dividing the difference between the lowest score that can be obtained and the highest score that can be obtained by 5 (very low, low, medium, high, very high) and starting from the lowest score that can be obtained, it can be said that teacher candidates' self-efficacy, self-regulatory learning and metacognitive awareness are at a high level. Table 5 presents the t-test results for the independent samples made to look at the significant difference between the groups for the gender variable.

When Table 5 is examined, it is seen that there is no significant difference between the groups according to the scores of the scales for the gender variable. The results of the one-way analysis of variance conducted to examine the significant difference between the groups for the department variable are presented in Table 6.

When Table 6 is examined, it is seen that there is no significant difference between the groups according to the scores of the scales for the department variable. The results

Table 4. *General Distribution of Scores*

The scales	Lowest Score	Maximum score	Average	Standard Error	Standard Deviation
Self-Efficacy (SQ)	24	120	92.9035	.56320	10.41539
Self-Regulatory Learning (SR)	41	205	157.4123	.99250	18.35451
Metacognitive Awareness (MA)	18	90	66.5819	.52749	9.75495

Table 5. *Analysis Results for Gender Variable*

Score	Group	N	M	Sd	$S.E._M$	t-test		
						t	df	p
SQ	Female	251	92.5936	10.35230	.65343	-.914	340	.362
	Male	91	93.7582	10.59805	1.11098			
SR	Female	251	158.3347	18.54140	1.17032	1.547	340	.123
	Male	91	154.8681	17.67937	1.85330			
MA	Female	251	66.4582	9.49870	.59955	-.389	340	.698
	Female	91	66.9231	10.47667	1.09825			

Table 6. *Analysis Results for Department Variable*

	Values				ANOVA Results				
P.	Group	N	M	Sd		Sum of Squares	df	Mean Square	F	p
SQ	Pre-school	129	91.2713	10.458	Between	699.481	3	233.160	2.171	.091
	Classroom	66	93.424	11.884	Inside	36292.335	338	107.374		
	Social	68	95.102	9.132	Total	36991.816	341			
	Turkish	79	93.240	9.821						
SR	Pre-school	129	155.007	19.371	Between	1592.820	3	530.940	1.584	.193
	Classroom	66	160.727	17.129	Inside	113286.048	338	335.166		
	Social	68	158.750	15.347	Total	114878.868	341			
	Turkish	79	157.417	19.741						
MA	Pre-school	129	65.279	9.436	Between	463.090	3	154.363	1.631	.182
	Classroom	66	67.636	9.704	Inside	31986.118	338	94.633		
	Social	68	68.161	9.453	Total	32449.208	341			
	Turkish	79	66.4684	10.426						

of the one-way analysis of variance conducted to examine the significant difference between the groups for the class variable are presented in Table 7.

When Table 7 is examined, it is seen that there is a significant difference between the groups according to the scores of the scales for the class variable. Scheffe test results performed to determine which groups differ according to the grade variable are presented in Table 8.

When Table 8 is examined, it is seen that there is a significant difference in self-efficacy scores between 3rd grades and 2nd grades in favor of 3rd graders. It is seen that there is a significant difference in self-regulatory learning scores between 4th grades and 2nd grades in favor of 4th grades. In metacognitive awareness scores, it is seen that there is a significant difference between 3rd and 4th grades and 2nd grades in favor of 3rd and 4th grades. The results of the one-way analysis of variance conducted to examine the significant difference between the groups for the quality of the place where the family lives are presented in Table 9.

When Table 9 is examined, it is seen that there is no significant difference between the groups according to the scores of the scales for the quality of the place where the family lives. The Pearson correlation coefficient results to examine the relationship between the family income variable and the scores of the scales are presented in Table 10.

Table 7. *Analysis Results for the Class Variable*

	Values				ANOVA Results					
P.	Group	N	M	Sd		Sum of Squares	df	Mean Square	F	p	η^2
SQ	2	108	91.129	11.229	Between	853.482	2	426.741	4.003	.019	.023
	3	113	95.000	10.618	Inside	36138.334	339	106.603			
	4	121	92.528	9.136	Total	36991.816	341				
SR	2	108	153.351	19.976	Between	2633.124	2	1316.562	3.976	.020	.023
	3	113	158.911	18.066	Inside	112245.745	339	331.108			
	4	121	159.636	16.580	Total	114878.868	341				
MA	2	108	63.342	10.084	Between	1680.089	2	840.044	9.255	.000	.051
	3	113	68.407	9.040	Inside	30769.119	339	90.764			
	4	121	67.768	9.457	Total	32449.208	341				

Table 8. *Scheffe Test Results*

Score	Groups (i)	Groups (j)	M_i - M_j	$S.E._M$	p
SQ	3rd Grade	2nd Grade	3.87037	1.38941	.022
SR	4th Grade	2nd Grade	6.28451	2.40879	.034
MA	3rd Grade	2nd Grade	5.06449	1.28204	.000
	4th Grade	2nd Grade	4.42600	1.26116	.002

Table 9. *Analysis Results for the Variable of the Quality of Family Residence*

	Values				ANOVA Results				
P.	Group	N	M	Sd		Sum of Squares	df	Mean Square	F	p
SQ	Village	42	91.785	8.469	Between	467.522	3	155.841	1.445	.230
	District	62	93.354	11.003	Inside	36357.305	337	107.885		
	Province	100	91.520	11.124	Total	36824.827	340			
	Metropolitans	137	94.146	10.065						
SR	Village	42	157.785	16.503	Between	228.129	3	76.043	.225	.879
	District	62	158.983	19.054	Inside	114003.062	337	338.288		
	Province	100	156.570	18.945	Total	114231.191	340			
	Metropolitans	137	157.386	18.221						
MA	Village	42	65.928	7.930	Between	41.898	3	13.966	.145	.933
	District	62	66.161	10.915	Inside	32404.800	337	96.157		
	Province	100	66.780	10.029	Total	32446.698	340			
	Metropolitans	137	66.839	9.624						

Table 10. *Analysis Results for Family Income Variable*

Score	Statistics	Family Income
SQ	Pearson Correlation Coefficient	.026*
SR	Pearson Correlation Coefficient	-.033*
MA	Pearson Correlation Coefficient	-.049*

p>.05, *N*=322

When Table 10 is examined, it is seen that there is no significant relationship between the family income variable and the scores of the scales. The results of the Pearson correlation coefficient to examine the relationship between the student income variable and the scores of the scales are presented in Table 11.

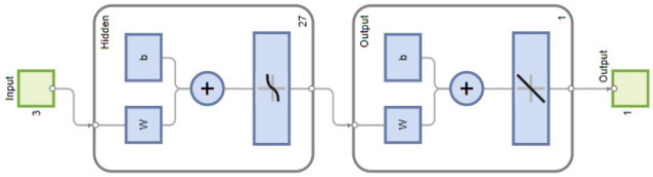
Table 10. *Analysis Results for Student Income Variable*

Score	Statistics	Student Income
SQ	Pearson Correlation Coefficient	.101*
SR	Pearson Correlation Coefficient	.003*
MA	Pearson Correlation Coefficient	-.029*

p>.05, *N*=309

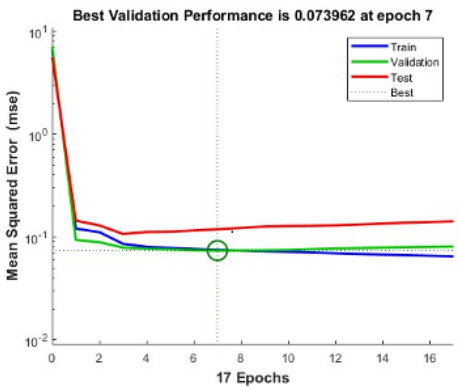
When Table 11 is examined, it is seen that there is no significant relationship between the student income variable and the scores of the scales. The artificial neural network model used in the research is shown in Figure 1.

Figure 1. *Artificial Neural Network Model*



When Figure 1 is examined, it is seen that the artificial neural network model established with the Levenberg-Marquardt learning algorithm has a structure with feed-forward back propagation, single hidden layer, 27 hidden cells, 3 inputs and one output. The performance graph showing the best mean square error (MSE) value obtained for the artificial neural network created is shown in Figure 2.

Figure 2. *Performance Values of Artificial Neural Network*



When Figure 2 is examined, it can be seen that the best verification performance is the one reached in the 7th epoch .073962. The learning status graph of the created network is presented in Figure 3 and the distribution of error values is presented in Figure 4.

Figure 3. *Learning Status Chart*

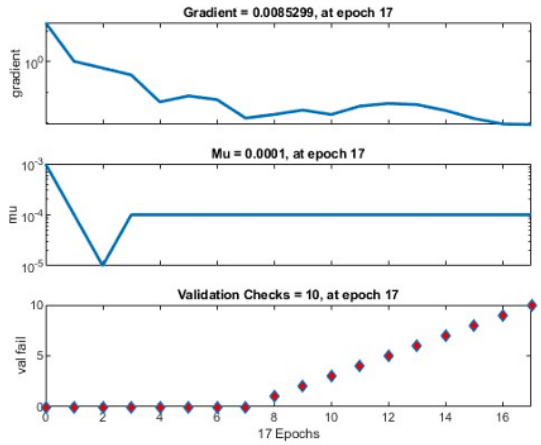
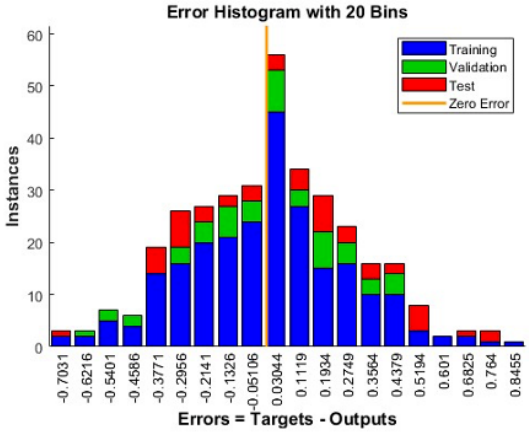
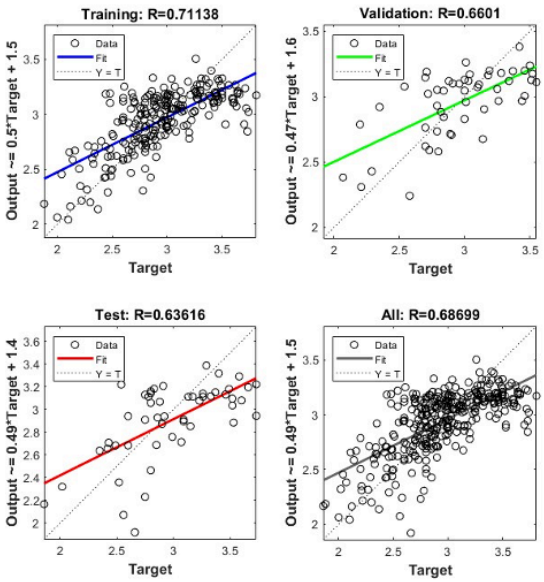


Figure 4. *Distribution of Errors*



When Figure 3 is examined, it is understood that the slope line continuously decreases, but the error in the verification control starts to increase after the 7th epoch, so the best performance is achieved at this point. When Figure 4 is examined, it is seen that the majority of the error values consisting of the difference between the actual data and the estimation data 03044. The estimated values of the established artificial neural network are shown in Figure 5.

Figure 5. *Artificial Neural Network Correlation Chart*



When Figure 5 is examined, it is seen that the single hidden layer, 27 hidden cell artificial neural network model for education .71, for verification .66, for the test .64 for the whole model .69 correlation value. When the correlation values of the validation and test data and the proximity of the total correlation value are examined, it can be said that the model created is a balanced model. MSE values of the model were found to be .075, for verification .074, for testing .12 and for the whole model .082. According to the model, self-efficacy, self-regulatory learning, and metacognitive awareness scores explain approximately 47% of the total variance of academic performance.

Conclusion and Discussion

As a result of the research, it was concluded that the self-efficacy, self-regulatory learning, and metacognitive awareness scores of the teacher candidates did not change statistically significantly according to the gender variable. When the literature is examined in the context of the gender variable, it is seen that there are studies supporting the finding obtained in this study within the scope of metacognitive awareness (Al Huseini, 2015; Bakioğlu, Alkış Küçükaydın, Karamustafaoğlu, Uluçınar Sağır, Akman, Ersanlı and Çakır, 2015; Çikrıkci and Odacı, 2013; Deniz, Küçük, Cansız, Akgün and İşleyen, 2014; Ekici and Uslu, 2020; Hashempour, Ghonsooly and Ghanizadeh, 2015; Özsoy and Günindi, 2011; Öztürk and Açıl, 2020; Jaleel and Premachandran, 2016; Rahman, Jumani, Chaudry, Chisti and Abbasi, 2010; Sezgin Memnun and Akkaya, 2009; Vianty, 2007; Zakaria, Yazid and Ahmad, 2009; Zulkiply, 2006), within the scope of self-regulation (Gömleksiz and Demiralp, 2012; Hashempour, Ghonsooly and Ghanizadeh, 2015; Karaoğlu and Pepe, 2020; Saracaloğlu, Karademir, Dursun, Altın and Üstündağ, 2017), and within the scope of self-efficacy (Dagar and Gill, 2019; Hampton and Mason, 2003; Kumar and Lal, 2006). However, contrary to this study, there are also studies showing that gender is effective within the scope of metacognitive awareness (Belet and Güven, 2011; Bidjerano, 2005; Bulut, 2018; Öztürk and Serin, 2020; Tunca and Alkın-Şahin, 2014), self-regulatory learning (Bidjerano, 2005; Bozpolat, 2016; Güler, 2015; Zimmerman and Martinez-Pons, 1990), and self-efficacy (Demirtaş Cömert and Özer, 2011; Huang, 2013; Saracaloğlu, Karademir, Dursun, Altın and Üstündağ, 2017; Tømte and Hatlevik, 2011). Observing different results in the gender variable in the context of dependent variables may be due to the fact that the sociocultural structure (Huffman, Whetten and Huffman, 2013; Jain, Tiwari and Awasthi, 2018; Vatandaş, 2007), in which the sample in which the research was conducted has a different personal and characteristics (Pintrich, 2004) or the cultural prejudices (Pajares, 2002) of women and men on the gender basis. In addition, as Huang points out (2013) in the example of self-efficacy, it should be taken into consideration that differences occur according to gender depending on different life periods.

When the literature is examined in the context of the department variable, it is seen that there are studies supporting the finding obtained in this study within the scope of metacognitive awareness and its sub-dimensions (Bakioğlu, Alkış Küçükaydın, Karamustafaoğlu, Uluçınar Sağır, Akman, Ersanlı and Çakır, 2015; Bedir, 2017; Özturan Sağırlı, Baş and Bekdemir, 2020), within the scope of self-regulation and its sub-dimensions (Aybek and Aslan, 2017) and within the scope of self-efficacy (Çakır, Kan and Sünbül, 2006). However, contrary to this study, there are also studies showing that the department variable is effective within the scope of metacognitive awareness and its sub-dimensions (Bedir, 2017), within the scope of self-regulation and its sub-dimensions (Aybek and Aslan, 2017; Gömleksiz and Demiralp, 2012), and within the scope of self-efficacy (Çakır, Kan and Sünbül, 2006; Demirtaş Cömert and Özer, 2011; Gürbüztürk and Şad, 2009; Ilıman, Arslan and Aslan, 2019). As a result of this research, it was concluded that self-efficacy, self-regulatory learning, and metacognitive awareness scores of teacher candidates did not change statistically significantly according to the department variable.

As a result of the research, it was concluded that the self-efficacy, self-regulatory learning, and metacognitive awareness scores of the teacher candidates did not change statistically significantly according to the quality of family residence. When the literature is examined in the context of the place variable experienced with the family, it is seen that there are studies supporting the finding obtained in this study within the scope of metacognitive awareness (Balasubramanıam, 2017; Jagadeeswari and Chandrasekaran, 2014; Jaleel and Premachandran, 2016), within the scope of self-regulatory learning (Chen and Wu, 2021) and within the scope of self-efficacy (Turan, Karaoğlu, Kaynak and Pepe, 2016). However, contrary to this study, there are also studies showing that the settlement variable is effective within the scope of metacognitive awareness (Bakkaloglu, 2020), within the scope of self-regulatory learning (Güler, 2015), and within the scope of self-efficacy (Arslan, 2019; Ilıman, Arslan and Aslan, 2019; Korkut and Babaoğlan, 2012; Sezer, İşgör, Özpolat and Sezer, 2006).

It was determined that there was no significant relationship between family and student income variables and self-efficacy, self-regulatory learning, and metacognitive awareness scores. When the literature is examined in the context of income variable, it is seen that there are studies supporting the finding obtained in this study within the scope of metacognitive awareness (Jagadeeswari and Chandrasekaran, 2014; Sarpkaya, Arık and Kaplan, 2011), within the scope of self-regulatory learning (Güler, 2015; Ülker, 2019) and within the scope of self-efficacy (Arslan, 2019; Dönmez and Uslu, 2014). However, contrary to this study, there are also studies showing that the income variable is effective within the scope of metacognitive awareness (Karaduman and Erbaş, 2017; Saban, 2008), self-regulatory learning (Ülker, 2019), and self-efficacy (Ilıman, Arslan and Aslan, 2019).

Within the scope of this research, it was observed that self-efficacy, self-regulatory learning, and metacognitive awareness scores changed significantly in favor of upper classes only in the class variable. Considering that metacognitive awareness makes the learning process better in strategic decisions and planning for students (Victor, 2004), and that academic performance increases with the development of metacognitive skills (Al Huseini, 2015; Çikrıkci and Odacı, 2013), it can be interpreted that students make more strategic decisions and plan better as the grade level increases. When the literature is examined in the context of the class variable, it is seen that there are studies similar to the findings obtained in this study within the scope of metacognitive awareness (Belet and Güven, 2011; Ekici and Uslu, 2020; Kurtuluş and Öztürk, 2017; Mert and Baş, 2019; Özsoy and Günindi, 2011; Özturan Sağırlı, Baş and Bekdemir, 2020; Sezgin Memnun and Akkaya, 2009), self-regulatory learning (Aybek and Aslan, 2017; Çelik Ercoşkun and Gündoğdu, 2020; Güler, 2015; Özturan Sağırlı, Çiltaş, Azapağası and Zehir, 2010; Taşkapı, 2015) and self-efficacy (Çelik Ercoşkun and Gündoğdu, 2020; Saracaloğlu, Karademir, Dursun, Altın and Üstündağ, 2017). In addition, when the findings are examined in detail, it is observed that in some of the mentioned studies (Çelik Ercoşkun and Gündoğdu, 2020; Taşkapı, 2015) the scores differ significantly

in favor of lower classes. However, contrary to this study, there are also studies showing that the class variable is not effective within the scope of metacognitive awareness (Çikrıkci and Odacı, 2013; Deniz, Küçük, Cansız, Akgün and İşleyen, 2014; Öztürk and Açıl, 2020; Saban, 2008), self-regulatory learning (Karaoğlu and Pepe, 2020; Saracaloğlu, Karademir, Dursun, Altın and Üstündağ, 2017), and self-efficacy (Palavan and Açar, 2015). The differences in the literature with the findings obtained in this study may be due to the possible mediating or regulatory role of variables such as age (Huang, 2013), academic climate (Abd-Elmotaleb and Saha, 2013), effort regulation, deep processing strategies and goal orientation (Honicke and Broadbent, 2016).

In the context of the relationship between self-efficacy, self-regulatory learning and metacognitive awareness variables and academic grade point average, it is possible to see the studies in which metacognitive awareness (Al Huseini, 2015; Coutinho and Neuman, 2008; Çikrıkci and Odacı, 2013; Kurtuluş and Öztürk, 2017; Maqsud, 1997; Mert and Baş, 2019; Özturan Sağırlı, Baş and Bekdemir, 2020; Öztürk and Açıl, 2020; Rahman, Jumani, Chaudry, Chisti and Abbasi, 2010), self-regulatory learning (Bozpolat, 2016; DiBenedetto and Zimmerman, 2010; Lindner and Harris, 1993; Turan and Demirel, 2010; Ülker, 2019; Üredi and Üredi, 2005) and self-efficacy (Britner and Pajares, 2001; Coutinho and Neuman, 2008; Dağyar and Şahin, 2020; Hampton and Mason, 2003; Honicke and Broadbent, 2016; Üredi and Üredi, 2005) are determined by academic performance. However, it is also possible to see studies in the literature showing that metacognitive awareness (Belet and Güven, 2011; Chisholm, 1999; Ekici and Uslu, 2020), self-regulatory learning (Çetin, 2015; Karaoğlu and Pepe, 2020) and self-efficacy (Ünlü, Kaşkaya and Kızılkaya, 2017) are not related to academic performance. In this study, it was determined that a balanced artificial neural network model could be created as a result of artificial neural network analysis and a model was formed in which self-efficacy, self-regulatory learning and metacognitive awareness variables explained 47% of the total variance in academic performance. As a matter of fact, it can be inferred from this result that self-efficacy, self-regulatory learning, and metacognitive awareness have significant effects on academic performance.

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