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## The Level of Metacognitive Awareness of Primary School 4th Grade Students Predicting Their Academic Achievement

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## The Level of Metacognitive Awareness of Primary School 4th Grade Students Predicting Their Academic Achievement\*

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### Abstract

This study was conducted to reveal the role of 4th grade students' level of metacognitive awareness in predicting their academic achievement. The Relational Survey Method, one of the quantitative data collection methods, was used in the study. The study group was selected through random sampling method. It consists of 526 fourth grade students working in five different primary schools affiliated to the Directorate of National Education in the province of Niğde during the 2021-2022 academic year. The "Metacognitive Awareness Scale for Children (MCAS-C) A-form, the personal information form and the academic achievement test were used as data collection tools of the study. The Construct Validity of the Metacognitive Awareness Scale was examined, and the Exploratory Factor Analysis (EFA) was applied. When the data analyzed based on selected variables, the SPSS 25 program was used for the Quantitative Data Analysis. In the study, the Mann Whitney U-test was used for the variables of gender, the pre-school education status, and the Kruskal Wallis test was used for the variables of the parental education status, the economic status and the number of siblings. In terms of the variables of the study, a significant difference was found between the level of metacognitive awareness and gender, the pre-school education status, the parental education status, the economic status of the family and the number of siblings. A Structural Equation Model (SEM) was created to test the academic achievement model and analyses were performed with the IBM AMOS 23 programme. According to the findings of the study, metacognitive awareness, which was assessed through the Metacognitive Awareness Scale, has a moderate, positive and direct effect on academic achievement.

**Keywords:** Academic achievement, Metacognitive Awareness Scale, Structural Equation Modelling.

### Introduction

The faster development of science and technology compared to the past causes a change in the skills expected from individuals. During the education process, missions that can keep pace with developments are imposed. During this development process, individuals are expected not only to learn the information they need, but also to be aware of their own learning, to find the information they need within the knowledge, to use this information in different areas, to understand what and how much they know, to discover how to learn best for themselves, to be open to innovations, to be productive and creative (Akgündüz, Aydeniz, Çakmakçı, Çorlu, Öner ve Özdemir, 2015). Metacognitive Awareness Skills are needed to raise individuals in accordance with the requirements of the age in education and to achieve the goals.

Today, the rapid developments in science and technology compared to the past have necessitated a change in the skills expected from individuals. This situation has imposed new missions on the education and training process and raising individuals with skills appropriate to the human profile of our age has become the main objective. Individuals are expected not only to learn the information they need, but also to be aware of their own learning, to discover the information they need among the knowledge, to use this information in appropriate areas, to be aware of what and how much they know, to discover how they learn best for themselves, to be open to innovations, to be productive and creative (Akgündüz et al., 2015). In the related literature, these characteristics are generally expressed as Metacognitive Awareness Skills. In educational systems, Metacognitive Awareness Skills are needed to raise individuals in accordance with the requirements of the era and to achieve the goals.

For the realisation of 21st century learnings, Metacognition, which is accepted as a basic skill (Horvathova, 2019), appears as a driving force in the formation of students' self-regulated learning behaviours in the

\* This study is a part of the doctoral thesis prepared by the first author under the supervision of the second author.

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education and training process (Winne & Perry, 2000). For this reason, students should be active during the education and training process. To support the Metacognitive development of students, an education process should be followed in which students can acquire problem solving skills, critical thinking, communication skills and the qualities of being open to co-operation and having responsibility and leadership.

According to Williams, Atkins, and Otero (2009), the concept of Metacognition; started with Flavell's study on children's intelligence in 1976 by including the term "Metamemory" for the first time about children's cognitive abilities. Metacognition, which is described as thinking about one's own thinking, is defined as the awareness and organisation of thinking processes that students use in planned learning and problem-solving situations (Flavell, 1976; Brown, 1978). Flavell used the concept of metacognition for social cognition, problem solving, memory, attention, language acquisition, writing, reading comprehension, verbal persuasion and verbal transfer of information (1979). According to Shanahan (1992), it is the understanding and control of cognitive activity; according to Butterfield, Albertson and Johnston (1995), it is the understanding of variables affecting cognition and controlling cognition with small examples. Metacognition skills and academic achievement are interrelated concepts. To improve the learning levels of individuals in school environments, it increases their cognitive and motivational motivation related to problem solving strategies during the reading, writing and problem-solving process, and enables them to think and gain awareness.

Metacognition has become a subject of study in different areas in the literature. It is seen that there are some studies on metacognition in the literature like The effect of metacognition on individuals' attitude (Ataalkın, 2012), Metacognitive knowledge and skills (Nişan & Temel, 2023), Self-efficacy perception (Açıkgül & Tuhan, 2023; Kurtuluş & Öztürk, 2017; Mandıracı, 2023; Oğuz & Kutlu Kalender, 2018; Şahin, Kırmalı, & Kayır, 2022; Türkben, 2022), Effects on achievement in different fields and problem solving skills (Arslan & Çelik, 2022; Çulha, 2022; Karakelle, 2012), Awareness levels (Ayar, 2022; Çalgıcı & Ogan Bekiroğlu, 2021; Doğan & Tuncer, 2017; Göçer, 2014; Kaplan & Aykut, 2022; Kapucu & Öksüz, 2015; Konaş, Özcan, Yıldız, & Kardaş, 2023; Mert & Baş, 2019; Özdil & Demir, 2022). It was observed that studies on metacognitive awareness were mainly conducted on teacher education (Kallio, Kallio, Virta, K., Iiskala, & Hotulainen, 2021; Whitebread & Neale, 2020), for primary school students (Çini, Malmberg, & Jarvela, 2020; Teng, 2022), for second level of primary education students (Bağçeci et al., 2011; Kaya, 2019; Nerse, 2021; Özkaya, 2022; Varlı & Sağır, 2019; Premachandran & Jaleel, 2016), for secondary education level students (Bektaş Bedir & Dursun, 2019; Hong-Nam et al., 2014; Kallio et al., 2018; Rapchak, 2018) and for university students (Alkan & Açıkyıldız, 2020; Hughes, 2019; Özturan Sağırlı, Baş, & Bekdemir, 2020; Öztürk & Açıl, 2020; Kaplan & Aykut, 2022). However, rapidly changing technology and conditions reveal the necessity of developing metacognitive skills in students from an earlier age (Özcan, 2007). According to the studies, it is seen that the studies on the primary school level are limited and the studies on predicting academic achievement are insufficient (Ayar, 2022; Bakkaloğlu, 2020; Yurtbakan, 2023).

It is important for individuals to know how to learn as well as what to learn (Çakıroğlu, 2007). When we look at the PISA exam conducted internationally, it is seen that it helps to determine the self-learning levels of students and to carry out studies on raising the determined levels (Preliminary National Report of the Programme for International Student Assessment, 2010). For this purpose, the countries participating in the PISA exams project are expected to provide students with metacognitive awareness skills and enable them to adapt to the developing and changing conditions in society as individuals. Because individuals with Metacognitive Awareness are more successful in the problem-solving process and can easily reach the result (Zorbozan, 2021). Since international examinations are becoming more and more important with the development of science and technology, it is necessary to pay attention to strategies and studies in which metacognition and metacognitive awareness are formed. When the studies conducted were examined, it was revealed that there was a significant relationship between Metacognitive Awareness Skills and academic achievement (Güleç, 2023; Memiş & Arıcan, 2013; Sawhney & Bansal, 2015; Vosniadou, Darmawan, Lawson, Van Deur, Jeffries, D., & Wyra, 2021). Students being aware of when to act strategically and when not to act strategically and being conscious in the process for learning to be effective will lead them to be successful (Özsoy, 2008).

There is a need to increase the studies in which metacognitive skills of primary school students influence predicting academic achievement. In this study, the level of students' metacognitive awareness skills predicting academic achievement is examined. It is aimed to increase the level of academic achievement by analysing the variables affecting academic achievement. In the study in which the metacognitive awareness skills of fourth grade primary school students are examined in terms of different variables (gender, whether they have pre-school education or not, paternal and maternal education, economic status and number of siblings); metacognitive awareness is emphasised and the answers to the following questions are sought to investigate the effect of metacognitive awareness on the level of academic achievement. Does the Metacognitive Awareness of fourth grade primary school students.

1. Differ significantly in terms of gender, pre-school education, parental education, economic status and number of siblings or not?

2. Predict their general academic achievement level?

3. Predict their achievement levels in Turkish, mathematics, science and technology, and Social Sciences Courses?

### Method

In this part of the study, information about the participants included in the study, the scales used to collect data, data collection and analysis are presented. The ethics committee permission for this study was obtained from the Student Affairs Department of the Necmettin Erbakan University Rectorate dated 30/12/2021 and numbered 134738 with the decision number E-61900286-20-40519417. In addition, the application permissions of the scales used were obtained from the authors.

### Study Model

This study, in which the effect of metacognitive awareness skills on the prediction of students' academic achievement in primary school fourth grades was examined, was conducted with the Correlational Research Model, one of the quantitative types of research. The purpose of the Correlational Research Model is generally to describe the situation related to the study topic, usually collecting information from large masses. In this study, it was tried to determine the effect of metacognitive awareness skills on students' gender, whether they had pre-school education or not, parental education status, economic status of the family and number of siblings, and the effect of Metacognitive Awareness Skills on students' academic achievement in terms of courses (Turkish, mathematics, science and technology, social studies). Since this study aims to reveal possible relationships among selected variables, a Correlational Research Model was used.

### Study Group

The study consists of 526 primary school fourth grade students affiliated to the Ministry of National Education in the province of Niğde during the 2021-2022 academic year. In this study, the Simple Random Sampling Method was used. The reason why the Simple Random Sampling Method was preferred in the study is that in determining the sample, representing the universe, everyone has an equal probability of being included in the selection. While there is an independent and equal chance for all units existing in the universe to be selected for sampling, it is also economical in terms of saving resources and time for the researcher (Büyüköztürk et al. 2021).

### Data Collection Tools

In line with the purpose and design of the study, "the Personal Data Inventory, the Metacognitive Awareness Scale and the Academic Achievement Test" were used by the researcher as data collection tools throughout the study.

### Metacognitive Awareness Scale

The "Metacognitive Awareness Scale", which was developed by Sperling, Howard, Miller, and Murphy (2002) for the third and ninth grade levels and whose validity and reliability study was conducted by Karakelle and Saraç (2007) was used to measure the students' metacognitive skills. During the factor analysis conducted for the "Metacognitive Awareness Scale Form A", two dimensions have emerged. The first of these dimensions was formed as a triple Likert type which includes the dimensions of organisation of cognition (3,6,7,8,8,9,10,11) and knowledge of cognition (1,2,4,5,12). The items of MA1, MA6, MA7, MA8, MA9, MA10, MA11 constitute the first dimension and the items of MA1, MA2, MA4, MA5, MA12 constitute the second dimension.

To determine the reliability of the scale, the Cronbach's Alpha reliability test was applied. According to Fornell and Larcker (1981), the Combined Reliability (CR) coefficient should be 0.70 and above, and in another study, the Cronbach's Alpha (CA) coefficient, which measures internal consistency in social sciences, is higher than 0.70, indicating that it is reliable (Gürbüz & Şahin, 2014). The Cronbach's Alpha value of the Metacognitive Awareness Scale was calculated as 0.745. The Cronbach's Alpha value of the first factor in the scale was 0.653 and the Cronbach's Alpha value of the second factor was 0.615. In the studies, it was emphasised that to use a Likert-type scale, the reliability coefficient should be as close to 1 as possible (Tezbaşaran, 1997) and the factor common variance of the items being close to 1 or above 0.66 indicates that it is a good solution for the study, but it is generally difficult to meet these values in practice (Büyüköztürk, 2002). According to the statistical analyses conducted for this study, the reliability of the scale was found to be at a good level, and it was considered safe to use it.

Table 1. Confirmatory Factor Analysis (CFA) Fit Values Related to the Metacognitive Awareness Scale

Indices	Model value	Acceptable limits	Result
$\chi^2 / df$	2,591	$\leq 5$ Acceptable Fit, $\leq 3$ Perfect Fit <0	Perfect Fit
RMSEA	0.056	$\leq 0.10$ Poor Fit, $\leq 0.08$ Good Fit, $\leq 0.05$ Excellent Fit	Perfect Fit
GFI	0.97	0.85-0.89 Acceptable Fit, $\geq 0.90$ Good Fit	Good Fit
AGFI	0.96	0.85-0.89 Acceptable Fit, $\geq 0.90$ Good Fit	Good Fit
CFI	0.96	$\geq 0.90$ Acceptable Fit, $\geq 0.95$ Good Fit, $\geq 0.97$ Excellent Fit	Good Fit
IFI	0.97	$\geq 0.90$ Acceptable Fit, $\geq 0.95$ Good Fit, $\geq 0.97$ Excellent Fit	Good Fit
TLI(NNFI)	0.95	0.90 Acceptable Fit, $\geq 0.95$ Good Fit	Good Fit

The  $X^2/df$  value obtained in the study was found to be 2.591. This result indicates that the model is statistically significant. An IFI value of 0.95 and above, which considers both the sample size and the complexity in the model, indicates a good fit (Şimşek, 2007). The model fit indices (CMIN/df= 1.87, CFI=0.96, TLI=0.95, IFI=0.97, RMSEA= 0.056) of the scale confirmed by the factor analysis of the metacognitive awareness scale show that the proposed two-factor model is compatible and acceptable with the data. These results showed that the predicted organisational structure (two-factor model) of the metacognitive awareness scale was confirmed.

### Personal Data Inventory

To compare the students in this study, a personal information questionnaire was used, and questions were asked about the gender of the students, whether they attended kindergarten or not, their parents' education level, the number of siblings, and the economic status of the family.

### Academic Achievement Test

In the study, to determine the effect of students' metacognitive awareness skills on academic achievement and to evaluate the effectiveness of the subjects determined by the Ministry of National Education, an academic achievement test prepared by considering the gains of November in the fourth grade of primary education was used. A 90-question essay exam prepared in line with the gains in November from the essays in the Ministry of National Education question pool consisting of questions from the fourth-grade science and technology, mathematics, social studies and Turkish lessons was applied. With the expert opinion, some questions were removed from the test, considering the attention span of the students. In line with the suggestions of the experts, 40 questions were selected as 10 questions in Turkish language, 10 questions in mathematics, 10 questions in science and 10 questions in social studies and the academic achievement test was applied. The correct answer given by the participants to each item was entered as 1 point, the wrong answers were entered as 0, and each correct question was calculated as 2.5 points in the achievement score and the statistical processing was performed. The average KR21 reliability value of the academic achievement test was found to be 0.901. A KR21 value between 0.70 and 0.99 is considered high in terms of reliability (Büyüköztürk et al. 2021). As a result of the analysis of the academic achievement test, the item difficulty index was 0.65 and the questions were at an easy level (0.60 - 0.79). The average discrimination index was found to be very good ( $\geq 0.40$  very good) with a value of 0.48. The fact that the discrimination power of the test is very good can be said to be successful in distinguishing between the students who know and those who do not know.

### Data Collection

The necessary permissions were obtained from the researchers who developed and adapted the scale for the use of it in the study. Before collecting the data required for the study, the necessary permission was obtained for the documents to be used in the study according to the decision of the Research and Publication Ethics Committee of the Necmettin Erbakan University Institute of Educational Sciences. The data collection was carried out face-to-face in the province of Niğde during the 2021-2022 academic year between April and June in accordance with the determined sample. During the data collection, the participants were informed about the purpose and content of the study and were told that participation in the study would be voluntary. It was stated that the study was conducted in accordance with the principle of confidentiality.

### Data Analysis

Before conducting the analyses in the study, the skewness and kurtosis values were calculated to determine whether the data obtained from the scales met the normality assumption and it was determined that the distribution of the scores related to the metacognitive awareness scale was not normal ( $p < 0.05$ ), but when the skewness and kurtosis values calculated according to the total scores were examined, it was found that the kurtosis and skewness coefficients were between +2 and -2, emphasising that the scores showed a normal

distribution (Pallant, 2001). Therefore, it was decided to use the T-test and variance analysis from the parametric measures in the analysis of the data.

In the study, the metacognitive awareness of fourth grade primary school students was analysed according to gender and whether they were educated in kindergarten or not. When the normal distribution table was analysed, the sig value was below 0.05. Since metacognitive awareness skills did not show normal distribution according to gender and whether they received education in kindergarten or not, the Mann Whitney U-Test was applied.

Table 2. The Mann Whitney U-Test Table Showing the Metacognitive Awareness of Fourth Grade Primary School Students According to Gender and Whether They Receive Education in Kindergarten or Not

		N	Mean Rank	Sum of Rank	U	p
Gender	Girls	259	276,08	71505,00	31318,00	0,060
	Boys	267	251,30	67096,00		
Education Level	Educated in kindergarten	472	271,18	127998,50	9117,500	0,001
	Not educated in kindergarten	54	196,34	10602,50		

The analysis presented in the table 2 shows that the metacognitive awareness of primary school fourth grade students does not show statistically significant difference according to gender ( $U=31318,00$ ;  $p<0,05$ ), but it shows statistically significant difference according to the status of attending kindergarten. ( $U=9117,500$ ;  $p<0,05$ ). When the mean ranks are analysed, it is seen that the students who attended kindergarten (mean rank=271,18) are higher than the students who did not attend kindergarten (mean rank=196,34).

According to the normal distribution table of the metacognitive awareness skills of primary school fourth grade students, parental education status, economic status of the family and the number of siblings in the family, the sig value is below 0.05, so it does not show a normal distribution. In addition, the Kruskal Wallis Test was applied because there were more than two categories.

Table 3. The Kruskal Wallis Table of Fourth Grade Primary School Students' Metacognitive Awareness Skills According to Parental Education Status, Family Economic Status and Number of Siblings in the Family

	Item	N	Mean Rank	df	$\chi^2$	p
Mother's Education Status	Literate	40	215,29	4	25,348	0,000
	Primary School	63	202,34			
	Secondary School	77	238,79			
	High School	122	269,88			
	University	223	293,29			
Father's Education Status	Literate	34	227,60	4	15,312	0,004
	Primary School	44	233,45			
	Secondary School	58	218,79			
	High School	101	251,90			
Economic Status of the Family	Poor	13	162,04	2	22,153	0,000
	Middle	199	232,33			
	Good	314	287,46			
Sibling Order in the Family	First	38	252,67	3	8,214	0,042
	Second	247	273,45			
	Third	175	258,80			
	More	59	211,96			

It was determined that the metacognitive awareness of primary school fourth grade students showed a statistically significant difference according to their mother's education status ( $X^2=25,348$ :  $p < 0,05$ ) and the difference was between the secondary school-university groups. When the metacognitive awareness skills of primary school fourth grade students were analysed according to their father's education status, it was determined that there was a statistically significant difference ( $X^2=15,312$ :  $p < 0,05$ ) and the difference was between the secondary school-university groups according to their father's education status. When the metacognitive awareness skills of fourth grade primary school students were analysed according to their economic status, it was determined that there was a statistically significant difference ( $X^2=15,312$ :  $p < 0,05$ ) and that the difference was between the medium-good and poor-good groups. When the metacognitive awareness skills of primary school fourth grade students were analysed according to the number of siblings in the family, it was determined that there was a statistically significant difference ( $X^2=8,214$ :  $p < 0,05$ ) and that the difference was between 2-4 and 3-4 groups according to the number of siblings in the family. In the study, structural equation modelling (SEM) analyses were performed to test the model established for the prediction of academic achievement by metacognitive awareness skills. To check whether the fit values of the model tested within the scope of the study are at the desired levels, it is necessary to check whether the fit values are among the values accepted in the literature (Schumacker & Lomax, 2004).

Figure 1. Structural Equation Modelling of the Effect of Students' Metacognitive Awareness Skills on Academic

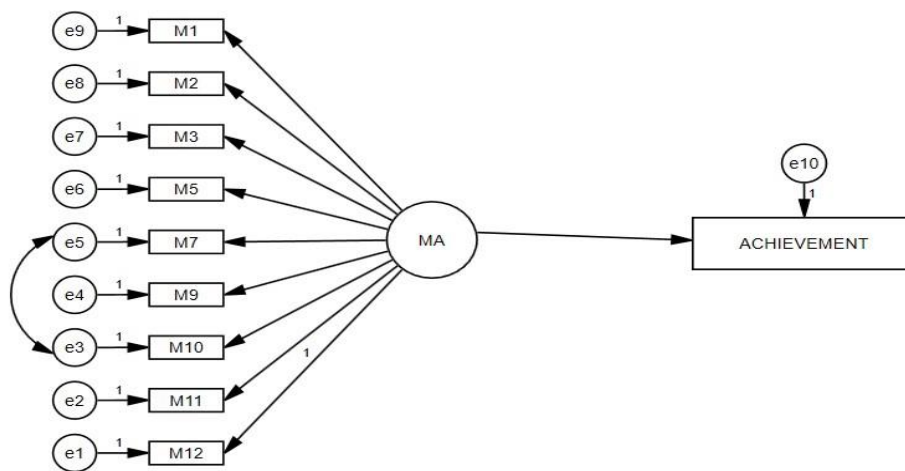


Table 4. Goodness of Fit Values for the Model

Indices	Model value	Acceptable limits	Result
$\chi^2 / df$	1.89	$\leq 5$ Acceptable Fit, $\leq 3$ Perfect Fit $< 0$	Perfect Fit
RMSEA	0.041	$\leq 0.10$ Poor Fit, $\leq 0.08$ Good Fit, $\leq 0.05$ Excellent Fit	Perfect Fit
GFI	0.97	0.85-0.89 Acceptable Fit, $\geq 0.90$ Good Fit	Good Fit
AGFI	0.96	0.85-0.89 Acceptable Fit, $\geq 0.90$ Good Fit	Good Fit
CFI	0.96	$\geq 0.90$ Acceptable Fit, $\geq 0.95$ Good Fit, $\geq 0.97$ Excellent Fit	Good Fit
IFI	0.96	$\geq 0.90$ Acceptable Fit, $\geq 0.95$ Good Fit, $\geq 0.97$ Excellent Fit	Good Fit
TLI(NNFI)	0.95	0.90 Acceptable Fit, $\geq 0.95$ Good Fit	Good Fit

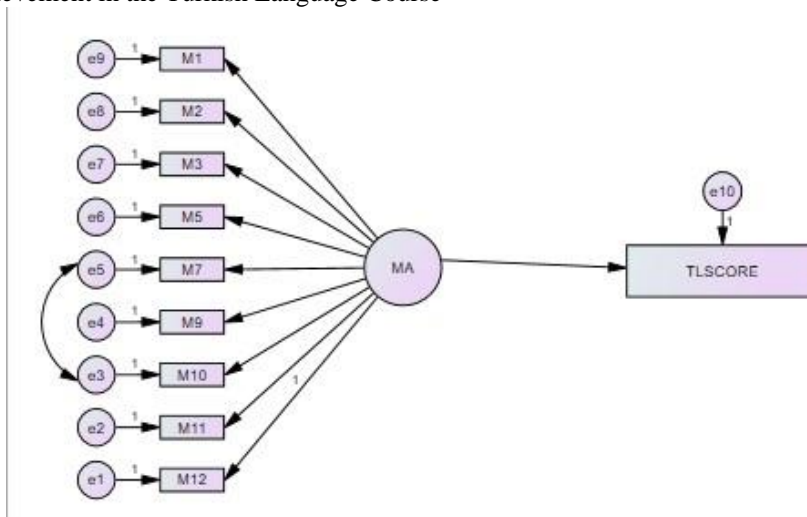
In the structural equation analysis conducted for the prediction of academic achievement by metacognitive awareness skills, the Model Fit Indices were found as  $\chi^2/df=1,89$ ,  $RMSEA=0.041$ ,  $GFI=0.97$ ,  $AGFI=0.96$ ,  $CFI=0.96$ ,  $IFI=0.96$   $TLI=0.95$ . As a result of the structural equation analysis conducted for this study, the goodness of fit values obtained in the analyses were found to be between good and excellent.

Table 5. The Effect of Students' Metacognitive Awareness Skills on Academic Achievement

	Estimate	$\beta$	Standard Error	T	p
MA---ACHIEVEMENT	41.50	0.35	7.40	5.61	***

According to Table 5, when the effect level between the MA and ACHIEVEMENT variable was examined, the standardised path coefficient was found to be  $\beta = 0.35$  ( $p < 0.05$ ) and the effect was at a medium level. A one unit increase in the metacognitive awareness skill level causes a 0.35-unit increase in the ACHIEVEMENT score.

Figure 2. A Structural Equation Modelling of the Effect of Students' Metacognitive Awareness Skills on Academic Achievement in the Turkish Language Course



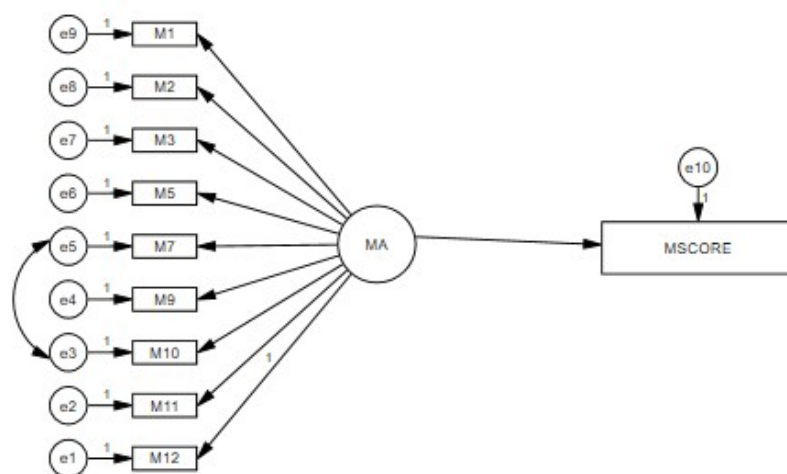
In the structural equation analysis in which metacognitive awareness skills of fourth grade primary school students predicted the level of academic achievement in the Turkish Language Course, the model fit indices of the scales were found as  $\chi^2/df=1.89$ , RMSEA= 0.041, GFI=0.98, AGFI=0.96, CFI=0.96, IFI= 0.96 TLI=0.95. As a result of the structural equation analysis conducted for this study, the goodness of fit values obtained in the analyses were found to be good and excellent.

Table 6. The Effect of Students' Metacognitive Awareness Skills on Academic Achievement in the Turkish Language Course

	Estimate	$\beta$	Standard Error	T	p
MA---TLSCORE	41,50	.35	7.40	5.61	***

When the level of impact between the MA and the TLSCORE variable was examined, the standardised path coefficient was found as  $\beta = 0.35$  ( $p < 0.05$ ) and the effect of the MA level on the TLSCORE (Turkish Language Score) was found to be at a moderate level. A one unit increase in the Metacognitive Awareness Skill level causes a 0.35-unit increase in achievement in terms of Turkish Language score.

Figure 3. A Structural Equation Modelling of the Effect of Students' Metacognitive Awareness Skills on Academic Achievement in the Mathematics Course





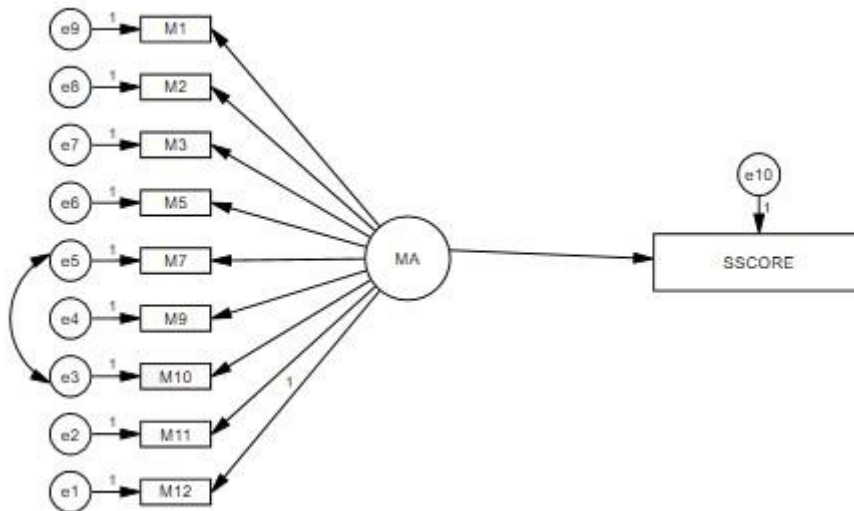
In the structural equation analysis in which metacognitive awareness skills of fourth grade primary school students predicted the mathematics course achievement level, the model fit indices of the scales were found as  $\chi^2/df=1.85$ ,  $RMSEA=0.040$ ,  $GFI=0.98$ ,  $AGFI=0.96$ ,  $CFI=0.96$ ,  $IFI=0.96$ ,  $TLI=0.95$ . When the goodness of fit values obtained in the analyses because of the structural equation analysis conducted for this research are examined, it is seen that the values are good and excellent.

Table 7. The Effect of Students' Metacognitive Awareness Skills on Academic Achievement in the Mathematics Course

	Estimate	$\beta$	Standard Error	T	p
MA---MSCORE	10,80	0.31	2.13	5.04	***

Analysing the level of effect between the MA and the MSCORE variable, the standardised path coefficient was found as  $\beta = 0.31$  ( $p < 0.05$ ), and the level of MA was found to have a moderate effect on the MSCORE (mathematics score). A one unit increase in metacognitive awareness skill level causes a 0.31-unit increase in achievement in terms of maths score.

Figure 4. Structural Equation Modelling of the Effect of Students' Metacognitive Awareness Skills on Academic Achievement in the Science and Technology Course



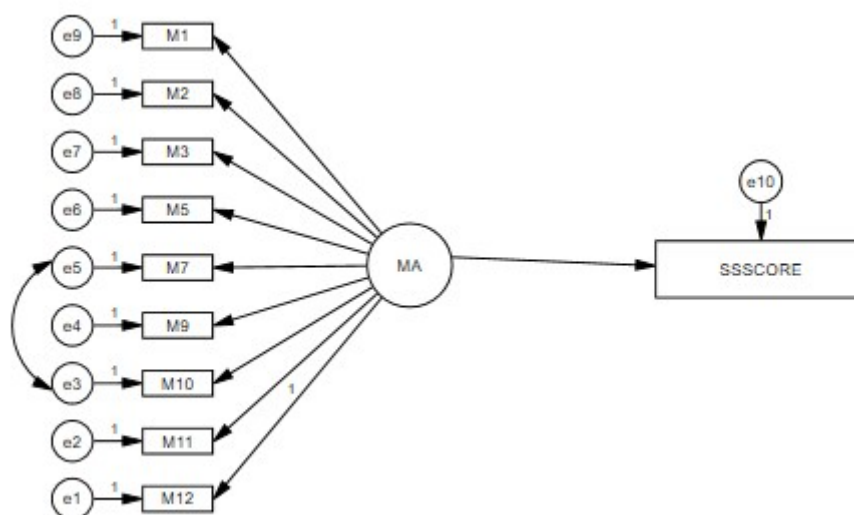
In the structural equation analysis in which metacognitive awareness skills of fourth grade primary school students predicted the achievement level of science and technology course, the model fit indices of the scales were found as  $\chi^2/df=1.69$ ,  $RMSEA=0.036$ ,  $GFI=0.98$ ,  $AGFI=0.97$ ,  $CFI=0.97$ ,  $IFI=0.97$ ,  $TLI=0.96$ . When the goodness of fit values obtained in the analyses because of the structural equation analysis conducted for this study are examined, it is seen that the values are good and excellent.

Table 8. The Effect of Students' Metacognitive Awareness Skills on Academic Achievement in the Science and Technology Course

	Estimate	$\beta$	Standard Error	T	p
MA----SSCORE	8.96	0.23	2.19	4.07	***

When the level of effect between the MA and the SSORE variable was examined, the standardised path coefficient was found as  $\beta = 0.23$  ( $p < 0.05$ ), and the effect of the MA-level on the SSORE (Social Sciences Score) was found to be moderate. A one unit increase in the metacognitive awareness skill level causes a 0.23-unit increase in achievement in terms of science and technology score.

Figure 4. Structural Equation Modelling of the Effect of Students' Metacognitive Awareness Skills on Academic Achievement in Social Sciences Course



In the structural equation analysis in which metacognitive awareness skills of fourth grade primary school students predicted the achievement level of the Social Sciences Course, the model fit indices of the scales were found as  $\chi^2/df=1,61$ ,  $RMSEA=0.034$ ,  $GFI=0.98$ ,  $AGFI=0.97$ ,  $CFI=0.97$ ,  $IFI=0.97$ ,  $TLI=0.96$ . When the goodness of fit values obtained in the analyses because of the structural equation analysis conducted for this research are examined, it is seen that the values are good and excellent.

Table 9. The Effect of Students' Metacognitive Awareness Skills on Academic Achievement in the Social Sciences Course

	Estimate	$\beta$	St. Hata	T	p
MA----SSSCORE	.11	.30	2.13	5.006	***

When the level of effect between the MA and the SSSCORE variable was examined, the standardised path coefficient was found as  $\beta = 0.30$  ( $p < 0.05$ ) and the level of MA was found to have a moderate effect on the SSSCORE (Social Sciences Score). A one unit increase in the metacognitive awareness skill level causes a 0.30-unit increase in achievement as the Social Sciences Score.

## Results and Discussion

The analysis presented in the previous section shows that the Metacognitive Awareness Skills of fourth grade primary school students did not show a statistically significant difference according to Gender. Among the studies in the literature; Akdağ (2014), Alkan and Açıkyıldız (2020), Aydın (2022), Bağçeci et al. (2011), Kandal and Baş (2021), Sarpkaya, Arık and Kaplan (2011), Şahin, Kırmalı and Kayır (2022) and Zorbozan (2021) stated that the Gender factor did not have a significant difference on Metacognitive Awareness Skills. In contrary to these studies, when the studies of Baltacı (2018), Bakioğlu, Küçükaydın, and Karamustafaoğlu (2015), Dilci and Kaya (2012), Khan and Panth (2017), and Yenice, Özden, and Hiğde (2017) are examined, it is seen that they support the finding that the gender variable is affected. According to the studies, there is no common opinion on the change in Metacognitive Awareness Skills according to Gender. While evaluating the data because of the analyses and examining whether the gender distribution of the students participating in the study affected this process, it was seen that the gender distribution was balanced (259 girls, 267 boys). It is thought that the fact that the Gender factor does not affect this process may be since primary school fourth grade students are not aware of Metacognitive Awareness Skills or that this skill has not developed due to not being supported by in-class activities.

Another conclusion of the study is that the Metacognitive Awareness Skills of fourth grade students who attended kindergarten before starting primary education were better than those of students who did not attend kindergarten. Based on this result, it can be stated that kindergarten education positively affects Metacognitive Awareness Skills. In the literature, it is believed that Metacognitive Awareness develops in individuals from a

very young age (Chatzipanteli, Grammatikopoulos, & Gregoriadis, 2014). There are studies showing that individuals' knowledge about metacognitive strategies develops metacognitive strategies especially during the early childhood and the primary education period (Hong, Peng, & Rowell, 2009). In the study conducted by Gürefe (2015), it was determined that the Metacognitive Awareness Skills of primary school students who received pre-school education were better than those who did not receive pre-school education. For this reason, it is thought that the education received by individuals may affect their Metacognitive Awareness levels.

In the study, it was determined that the Metacognitive Awareness of students whose mother and father education levels were secondary school and above was higher than those who were primary school and only literate. Kaya and Fırat (2011) examined the metacognitive skills of fifth and sixth grade students in terms of parental education level and found that there was a significant difference in favour of mothers with university and high school education level and fathers with university and secondary school education level. In another study, Atay (2014) examined the metacognitive awareness of secondary school students according to their parents' education level. As the data of the study showed, there was a significant difference in metacognitive awareness in favour of the university graduate mother and the high school and university graduate father. Another study supporting these results was conducted by Ocağ, Karakuyu and Küçükçınar (2023) and it was found that when the attitudes of secondary school students towards the English course were examined in terms of metacognitive awareness levels, the difference was in favour of students whose mother's educational status was primary school and whose father's educational status was university.

When the metacognitive awareness skill levels of fourth grade primary school students were analysed according to the economic status of the family, it was found that the metacognitive awareness of students with "good" economic status of their families was higher than those with "medium and poor" level. Similarly, Balcı (2007) found that the metacognitive awareness of students at lower socio-economic level was lower than that of students at a medium and higher socio-economic level. However, there are also studies in which the economic status of the family does not statistically affect the level of metacognitive awareness (Arslan & Çelik, 2022; Karşlı, 2015).

When the Metacognitive Awareness Skill levels of primary school fourth grade students were examined according to the number of siblings variable, it was statistically determined that the Metacognitive Awareness levels of students with 2 and 3 siblings were statistically significant and higher than the students with more siblings or single siblings. According to the result obtained, it can be said that the decrease in the interest shown by families to their children as the number of siblings increases also affects Metacognitive Awareness. In the literature, it is seen that there are studies in which similar findings are obtained with this research. In the study conducted by Yaşar Ekici and Balcı (2018), it was found that in the sub-dimension of the need to control thoughts in the metacognition scale, the metacognition levels of students with more than one sibling were higher than those with 1 sibling.

The analyses conducted for the study revealed that Metacognitive Awareness Skills predicted students' general academic achievement by 35%. In summary, Metacognitive Awareness Skills were found to predict academic achievement positively. In the literature; Ataalkın (2012), Alkan and Açıkıldız (2020), Bağgeci et al. (2011), Ekici, Ulutaş and Atasoy (2019), Çalgıcı (2018), Çakır and Yaman (2015), Ghonsooly, Khajavy and Mahjobi (2014), Sökmen and Kılıç (2016) examined the effect of metacognitive awareness on academic achievement in their studies and, they found that it affected positively.

Another conclusion drawn from the analysis is that Metacognitive Awareness Skills predicted Turkish course achievement by 26%. According to this result, it can be said that students with high metacognitive awareness will also have high achievement scores in the Turkish course. It was seen that the cognitive awareness strategy positively increased students' cognitive awareness skills, reading comprehension success and students' attitudes towards the course during the Turkish Language Course. Faridah, Setyaningrum, and Falakha (2022) examined whether the metacognitive strategy instruction "CALLA" affects students' reading comprehension and reading awareness, and it was observed that students to whom the metacognitive strategy method was applied had significantly higher scores. In the study of Aktaş (2013), in which the effect of attitude and metacognitive skills on the academic achievement level of the Turkish Language Course of students studying in the Primary Education Department of Classroom Teaching at the Faculty of Education was examined, it was revealed that the academic achievement level of the Turkish Language Course was positively affected.

It can be stated that the effect of Metacognitive Awareness Skills on the mathematics course achievement is 25%, and accordingly, it can be said that students with high metacognitive awareness skills also have high mathematics course achievement scores. In Eke's (2019) study to examine secondary school students' mathematics-oriented risk-taking behaviours, their metacognitive awareness levels and their relationship with

mathematics achievement, it was found that the metacognitive awareness level predicted academic achievement by 24.3%; In Topçul's (2019) study examining the effect of metacognitive awareness levels and logical thinking skills of secondary school students on academic achievement in mathematics courses, there were significant and positive relationships between the metacognitive awareness levels and the logical thinking skills of secondary school students and academic achievement. In Kaplan and Duran's (2015) study examining the use of metacognitive strategies by secondary school students with different academic achievement levels in the process of studying mathematics, all sub-dimensions of metacognition were analysed. In the study conducted by Kurtuluş and Öztürk (2017) to determine the effect of metacognitive awareness level of secondary school students and mathematics self-efficacy perception on mathematics achievement, it was found that the metacognitive awareness level of secondary school students differed significantly according to the Gender, the Grade Level and the Mathematics School Report Score variable and that it affected the mathematics achievement by 47%.

The effect of metacognitive awareness skills on science and technology course achievement was found to be 25%. Accordingly, it can be said that students with high metacognitive awareness skills may also have high science and technology course achievement scores. Özkaya (2022) examined the effect of teaching with the STEM Framework on students' creativity, metacognitive awareness and academic achievement and concluded that Metacognitive Awareness Skills increased academic achievement. As a result of the study conducted by Aydın (2022) to prepare the basis for an effective learning environment for motivation and metacognitive awareness in the science course, it is seen that students' motivation to learn science varies significantly according to Gender, the Experimentation Status, the Participation in the Science Project, the Use of Science in Daily Life, the Grade Level and the Mean Score of the Science Course. To assess the metacognitive awareness of secondary school students and understand its correlation with their learning levels, Çalgıcı and Ogan-Bekiroğlu (2021) conducted a study. They aimed to unveil the relationship between science achievement scores, general weighted grade point averages, and TEOG exam scores. The findings of their research indicated that the metacognitive awareness of secondary school students is notably high, exerting a significant influence on their learning outcomes. They also concluded that students with high metacognitive awareness use some metacognitive skills more while learning, and that students who know their mental processes and control their cognition can learn better and that activities for the development of metacognition can increase academic success. Ataalkın (2012) examined the effects of metacognitive strategies on students' metacognitive awareness, metacognitive skills, academic achievement and attitudes towards science and technology course when metacognitive strategies are used, especially for students (5th grade) who have just entered the third semester (the period when metacognitive strategies can be developed and used). As a result of the research, it was seen that the use of strategies that enable the development of metacognitive skills during the science and technology course improved students' metacognitive skills and increased their attitudes towards the science and technology course and increased their academic achievement.

The effect of Metacognitive Awareness Skills on the Social Sciences Course achievement was found to be 25%. Based on this result, it can be said that students with high metacognitive awareness may also have high Social Sciences achievement scores. Because the Social Sciences Course is a verbal course, which is boring for some students and easily forgotten by them, Kuru (2022) stated in his studies; in which he aimed to make teaching during Social Sciences Courses colourful, to ensure that individuals are responsible for their own learning, to help them see their deficiencies and to help them make inferences about how they can learn better; that teaching practices using metacognitive strategies increased students' awareness and their competence to use metacognitive strategies. Pullu and Kazu (2023) examined the effect of using strategies that develop metacognitive skills on the acquisition of values and attitudes towards the fourth grade Social Sciences Course in primary school and concluded that the use of strategies that develop metacognitive skills has a positive effect on the academic sense of the Social Sciences Course.

## Recommendations

Considering the results obtained from our study, it is seen that many factors affect Metacognitive Awareness Skills. Determining these factors as Metacognitive Awareness Skills will positively affect both cognitive and academic development of individuals.

- This study revealed that metacognitive awareness skills contribute to the academic achievement of primary school fourth grade students. Therefore, to increase the academic achievement of primary school students, it is necessary to focus on factors affecting metacognitive awareness and factors affecting metacognitive awareness.
- Many factors should be taken into consideration when designing activities to develop metacognitive awareness skills for primary school students. Although gender does not appear to be an important

factor for children, can be done by since they attend kindergarten, that their parents have received education, the economic status of the family, and the number of siblings in the family.

- For disadvantaged students in regions where the education level of parents is low, the interaction between teachers and parents can be increased and families can be closely involved in their children's education. In designing activities to develop or increase the metacognitive awareness skills of primary school students, can be done by considering the economic situation.
- In this study, only the effect of metacognitive awareness on academic achievement in primary school 4th grades was examined and data were collected accordingly. It can be analysed whether the metacognition levels differ between the grade levels in the same school. The study is a quantitative study and the extent to which metacognitive awareness predicts academic achievement was examined. This study can be transformed into a mixed-method study by supporting it with interviews with families, students or teachers. There are much fewer qualitative studies on metacognitive awareness. For this reason, data can be collected and evaluated by using the qualitative research design.
- In this study, the effect of metacognitive awareness on academic achievement in primary school 4th grades was examined and data were collected accordingly. The study can be carried out among different grade levels, and it can be benefited from different provinces and schools.
- It can also be converted into a longitudinal study by working with the same students from the first to the fourth grades of primary school, considering the changes in metacognitive awareness skills.

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### Author (s) Contribution Rate

This study was produced END doctoral dissertation and IK was her adviser of doctoral studies.

### Conflicts of Interest

The authors declared no conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Ethical Approval (only for necessary papers)

Ethical permission (November 12, 2021, date and 2021/532 number) was obtained from the Ethics Committee of Social and Humanity Science Research of Necmettin Erbakan University for this research.

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