Full research paper

THE RELATIONSHIP BETWEEN HIGH SCHOOL STUDENTS' PERCEPTIONS OF ROLE MODELING AND SELF-REGULATION FOR SCIENCE

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ABSTRACT

Role models are key to the development of self-regulation skills. The study aimed to develop a model that shows the relationship between high school students' role-modeling perceptions and self-regulation skills. In the study, the predictive correlation design of the quantitative research method was used. The study sample consisted of 362 high school students studying at a public high school and agreeing to participate in the research. The research data were collected with the "Perceived Role Models Scale" and the "Self-regulation Scale for Science". As a result, a model was developed showing that the reproduction, retention, and motivation dimensions of high school students' role modeling perceptions were statistically significant predictors of science self-regulation. This result proved that role models were important in developing high school students' self-regulation skills. Therefore, it could be argued that the development of self-regulation that begins at an early age is a lifelong process. The results of the study can be a reference point for research that will examine the relationship between the sub-dimensions of self-regulation and role modeling perception in depth.

KEYWORDS

Role model, self-regulation, science education, high school, structural equation model

HOW TO CITE

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Highlights

- *There is a significant relationship between high school students' role models and their self-regulation skills.*
- *Role models are important for the development of self-regulation skills in high school students.*
- *The sub-dimensions of the role model for high school students are also important for the development of self-regulation skill.*

INTRODUCTION

The framework of social cognitive theory includes understanding and changing human behavior. The theory asserts that individuals learn by using their cognitive characteristics as well as observing their environment (Bandura, 1986). Perhaps the greatest contribution of social cognitive theory to understanding human behavior and personality is indirect or observing learning, which is one of the basic principles of the theory. Bandura argues that learning is not limited to classical or operant conditioning. Learning can occur by observing, reading, or hearing other people's actions (Rutledge, 2000). According to Bandura, observers learn five things from the model: cognitive, affective, psychomotor skills, and value and belief systems. By observing others, individuals can learn new cognitive skills, such as decision-making and problem-solving, and psychomotor skills, such as dancing and riding a bicycle. Individuals' beliefs and value judgments can be strengthened or weakened as a result of observing the model. Observers can gain new values, beliefs, and ways of thinking as a result of modeling. They can also learn how to react to new situations encountered, as well as how the environment and property can be used. By observing the way, the model expresses their emotions, observers can learn to explain their emotions similarly.

The social cognitive theory argues that people can self-regulate their emotions, thoughts, and behaviors. Starting from this idea, the concept of self-regulation becomes an important concept. In the self-regulation process, mechanisms of control and management are put into action. The individual perceives his environment as the main source to realize his purpose (Locke & Latham, 2006).

Albert Bandura's social cognitive theory has led to the emergence of the concept of self-regulation. Based

on the therapy studies conducted by Bandura in 1977 with individuals having various phobias, the concept of self-regulation was developed (Berry & West, 1993). This is a cognitive and affective structure that includes skills such as self-regulation, symbolization, learning from others, strategy planning, self-regulation, and evaluation. This system functions as self-regulation by providing individuals with the ability to change their environment and control themselves (Pajares, 1996).

Learners with advanced self-regulation skills are individuals who have internalized the constructivist approach, who can analyze cognitive, behavioral, and environmental factors well in the process of reaching their own goals, identify situations that can help them reach their goals, adapt to changing conditions, and take an active role in the process. From this point of view, determining the effective and related situations in an individual's development of self-regulation skills and consciously organizing educational environments such as social environment and school according to these variables will contribute positively to the increase in the number of self-regulated learners.

Contrary to popular opinion, the process of acquiring self-regulation is not an internal process isolated from the social environment. The "self" used here refers to a process that requires personal initiative, perseverance, and harmony rather than an internal situation isolated from the social environment. According to social cognitive theory, individuals can learn through modeling by observing their environment (Bandura, 1977). Learning by modeling occurs as a result of interaction with role models that more individuals take as an example and identify with (Adesola et al., 2019). As a result of this interaction, people convey their attitudes, values, perspectives, and thoughts to each other and gain skills and competence (Rutledge, 2000). Role models are people whose specific goals, behaviors, and strategies are modeled by individuals. Also, role models are people who have a profound and significant impact on a person's life (Pell et al., 2022). Selected role models can be effective in the formation of the individual's cognitive, affective, or psychomotor skills (Dix et al., 2010).

Learning from role models may not always occur consciously. On the other hand, individuals living in the same environment may or may not see the same people as role models. The basis of this preference lies in individual perception. In terms of social learning, the model must be perceived correctly by the learner as well, and the right role model must be chosen. For example, while individuals at the beginning of their academic careers determine positive, close, and full-fledged role models, those in the middle or end of their careers tend towards specific and more negative role models (Gibson, 2003). In addition to the social status, psychological status, socioeconomic level of the role model, individual goals, and experiences obtained from the individual's previous life, reinforcements will affect the perception of role modeling (Hurd et al., 2011). Individuals with a developed perception of role modeling consciously prefer role models that will guide and assist them, especially in the process of achieving academically determined goals (Hackett et al., 1989). They do not always approve of all the features of the role model they have chosen as a result of this preference. Individuals with a developed perception of role modeling decide whether or not to take that behavior as an example after critically evaluating the behavior they observe according to their internal criteria (Hackett et al., 1989). Individuals choose, perceive, evaluate, interpret, decide, and implement the learned behavior when necessary. In summary, there is a dynamic relationship between individuals and the environment (Elkjaer, 2004).

Role models are an important resource for the individual's self-regulation development (Mueller et al., 2011; Urban et al., 2010). Exposure of learners to the right role model, knowingly or unknowingly, contributes to the development of self-regulation skills (Wirthwein et al., 2020). Therefore, if the relationship between the theoretically envisaged role model and self-regulation is understood more thoroughly, the models devised to develop self-regulation skills can be enriched. Following Zimmerman's self-regulated learning development model (2002), learners begin to learn by modeling and imitation, so they are still dependent on feedback from the environment. We can say that the students who can manage their self-learning have higher development characteristics than others. In these phases, some learners independently have metacognitive thinking about which strategy to use when, and how (Zimmerman, 2002). The purpose of this study is to reveal the importance of role models in meeting this need.

There are field studies examining the role model and self-regulation together (Acar et al., 2022; Augustine et al., 2022; Cai et al., 2022; Fung & Chung, 2021; Karaca & Bektas, 2021; Kurtoviç et al., 2021; Leslie, 2021; Ringoot et al., 2021; Vitiello et al., 2022; Xie & Li, 2022; Zielinska et al., 2022). Augustine et al. (2022) showed that family adjustment behavior enriched with self-regulation helps reduce anxiety problems. Karaca and Bektas (2021) applied the data collection tools used in this study to secondary school students. In the structural equation model the authors developed, they proved that the reproduction and retention dimensions of the perception of role modeling are important predictors of the development of students' self-regulation for science. In addition to these models, field studies state that self-regulation skills should be supported from an early age (Thomas et al., 2022; Xie & Li, 2022). Dignath and Büttner (2008) report that younger learners get more out of self-regulation training compared to high school and college students. On the other hand, it should not be overlooked that self-regulation is a lifelong process, even if the pace of development decreases (Kuhn, 1999). Learning is not limited to the school environment; the world has become a small village, and students need to develop their inner characteristics to make the right choices. Nevertheless, in our education system, affective features are not as important as cognitive features. Therefore, the purpose is to show high school students that it is important to set the right role model so that students can develop their self-regulation skills, regardless of their age. From this point of view, this study aims to develop a model that proves the relationship between high school students' role-modeling perceptions and self-regulation. Structural Equation Model (SEM) has a wide framework that takes into account the effect of latent variables, through which we can examine relational situations in depth and in multiple ways (Raykov & Marcoulides, 2006).

One of the SEM strategies is the model development strategy, in which the selected model is developed and supported by the data, considering that it best explains the relationship structure between the variables (Schermelleh-Engel & Moosbrugger, 2003). This study tried model probabilities until the model that expresses the possible relationship between self-regulation and role modeling perception most significantly and the latent variables that constitute them are obtained.

MATERIALS AND METHODS

Research Design

This study was conducted using the predictive correlation design of the quantitative research method. In predictive correlation studies, the relationships between variables are examined, and one of the variables is tried to be explained by the other (Fraenkel & Wallen, 1996). In this study, this design was preferred because high school students' perceptions of role modeling and self-regulation variables for science explain each other.

Population and Sample

The accessible population of the study was high school students studying in state high schools in Kayseri. Purposive sampling type of non-random sampling was used in the study. Purposive sampling is the selection of information-rich situations suitable for the study. It is preferred when it is desired to work with individuals with certain characteristics (Fraenkel & Wallen, 1996). In this study, high school students were preferred because the relationship between high school students' perception of role modeling and their self-regulation for science will be investigated. The study sample consisted of 362 high school students studying at a public high school and agreeing to participate in the research (Table 1). Turkish national education is based on the 4+4+4 system. At the end of their high school education, students prepare for university exams that greatly affect their future careers. Thus, they enter an intensive course of study at the 11th and 12th-grade levels. Therefore, the number of 11th and 12th-grade students participating in the study was less than that of 9th and 10th-grade students. There were 26 and 30 items in the scales used in the study. To contribute to the validity of the study results, it was tried to reach 10 times the number of items in the scale. CN (critical sample size) was also used to evaluate the adequacy of the sample size beyond model fit (Jöroskog & Sörbom, 1993). As a result of the SEM analyses developed in this study, the critical sample number for the study was CN = 154.31. Due to the pandemic, the application was made on the online platform, and sufficient sample numbers were reached.

Grade Level		Total	Gender
9	123	362	**Girl:** 216 **Boy:** 146
10	115		
11	81		
12	43		

Table 1: Sample of the study, 2017-2018, (source: own calculation)

Data Collection Tools

In order to check the validity and reliability of the data collection tools, a sample different from the research sample was used. In addition, data from different samples were used for EFA and CFA. The data relating to the scales used in the study were collected with the "Perceived Role Models Scale" and "Self-Regulation Scale for Science", which were developed during the first author's doctoral dissertation study, and validity and reliability checks were performed (Karaca & Bektas, 2022). To determine the scale items, the authors created a pool of questions based on the literature (Eker & İnce, 2018; Ilgaz & Gül, 2014; Kayan Fadlelmula, 2011; Zimmerman & Martinez-Pons,1986). Karaca and Bektas (2022) created self-regulation scale items based on Zimmerman's (1986) self-regulation model and strategies. Authors created role model scale items by taking into account the modeling processes (attention, retention, reproduction, motivation) and definitions (Malone, 2002; Rutledge, 2000) of Bandura's (1971) social learning theory, which forms the theoretical basis of the concept of role model. There were 51 items on the self-regulation draft scale for science and 49 items on the draft scale for determining the perception of role modeling. A pilot study was conducted with ten times the number of items in the draft scales (Mertens, 2019). In this context, draft scales were applied to 500 students (125 students in the fifth grade, 132 in the sixth grade, 127 in the seventh grade, and 116 in the eighth grade) studying in three secondary schools in the Melikgazi district of Kayseri in the spring term of 2017-2018 academic year. As a result of the application, the data, which were checked for completeness and objectivity, were entered into the SPSS 25 package program to conduct validity and reliability studies. After the data entry was completed, the authors assigned an average value to the items that were left blank because the missing data entry was below 5%. Reverse-coded items in the scale were recoded. The normal distribution of the scores obtained from the items prepared for analysis was checked. As a result of the reliability analysis, Cronbach's Alpha reliability coefficient of the self-regulation draft scale was .950. The Cronbach's Alpha reliability coefficient of the role modeling perception draft scale was calculated as .910. In addition, the authors decided which items should remain in the scale by checking the reliability coefficients of each item in the draft scales and the effect of the coefficient on the whole scale if they were removed from the scale. After examining the content validity of the draft scales, they calculated the item difficulty and discrimination indexes. After the content validity analysis, the authors checked the construct validity for both draft scales. Construct validity is the theoretical basis of the measurement tool (Cronbach & Meehl, 1955). Construct validity can be checked with factor analysis. After the explanatory factor analysis for both draft scales using the SPSS.25 program, the authors applied the relevant draft scales to a different sample from the sample in which the pilot study was conducted. Confirmatory factor analysis was performed using the LISREL 8.80 program with the obtained data. Within the scope of construct validity, the KMO value for the "Science-Oriented Self-regulation

Scale" was .952 and .922 for the "Perceived Role Models Scale". Since this value meant that factor analysis could be carried out, that the data were normally distributed, and that there was a sufficient sample, the authors switched to exploratory factor analysis (Pallant, 2020). As a result of repetitive factor analysis, items with overlapping extraction values below .30 or excluded in any factor were removed from the scales. Afterward, the authors continued the factor analysis with the remaining items in the "Self-Regulation Scale for Science". They determined that the remaining 26 items on the scale were grouped under three significant factors. When the distribution of the items to the factors using the Direct Oblimin vertical rotation technique was considered, the authors observed that the Eigenvalue was gathered in three factors greater than 1, and all the items had acceptable loading values in the factor they entered (the lowest item load value was .339; the highest item load value was .820). Similarly, they determined that the remaining 30 items in the "Perceived Role Models Scale" were grouped under three significant factors.

As a result, the "Self-regulation Scale for Science" was obtained, which explained 48% of the variance, had a reliability coefficient of .940, and consisted of 26 questions and three factors. The factors, names, and sample items of the scale are given in Table 2. Similarly, the "Perceived Role Models Scale" consisting of 30 questions and three factors, with a reliability coefficient of .911, explaining 41.96% of the variance was obtained. The factors were renamed, taking into account the item contents under the factors and the literature-supported factors initially predicted theoretically (Table 3).

Factors	Number of Items	Reliability Coefficient	Sample Items
Learning Strategies	2, 9, 11, 19, 25, 26, 32, 33, 34, 39, 40, 41, 44, 51	.905	I list and memorize important information related to the science course.
Critical Thinking	8, 17, 18, 20, 28, 35, 36	.808	I try to develop my ideas about what I learned in science class.
Regulating time and effort	14, 15, 31, 37, 43	.780	I use my study time efficiently for the science course.

Table 2: "Self-regulation Scale for Science" reliability values and sample items, 2017-2018, (source: own calculation)

Factors	Number of Items	Reliability Coefficient	Sample items
Reproduction	30, 13, 10, 5, 20, 16, 45, 24, 1, 42, 33,47	.876	I like it when my parents learn from the mistakes they've made in the past.
Retention	25, 9, 12, 15, 49, 36, 11, 8, 4, 19	.838	My friends' studies summarizing in science class attract my attention.
Motivation	41, 29, 35, 18, 26, 43, 23, 27	.752	I find it unnecessary to reward celebrities for their achievements.

Table 3: "Perceived Role Models Scale" reliability values and sample items, 2017-2018, (source: own calculation)

The accuracy of the factor structure revealed by the EFA was checked by confirmatory factor analysis (CFA) (Mertens, 2019) using LISREL 8.80 software. To obtain CFA data, again following the rule of 10, a total of 308 students studying at each level of a different secondary school from the pilot study in the seventh region of Melikgazi District of Kayseri in the 2018-2019 academic year were selected, a 26-item "Self-regulation Scale for Science" and the 30-item "Perceived Role Models Scale" were applied simultaneously. After the research data were complete and objective, they were transferred to the computer environment. Considering the factor structure determined by EFA, syntax commands were written, and CFA was performed. The authors examined the t values obtained as a result of the CFA, the factor loading value of each item, and the model fit indices (Jöroskog & Sörbom, 1993). The authors confirmed the factor structures obtained as a result of EFA with CFA.

Data Collection Process

Both scales used in the study were adapted to the Google Form format by the authors. The form consisted of three parts: demographic information, "Perceived Role Models Scale" and "Self-regulation Scale for Science". For the participants to answer each question and not leave it blank, the "required" tab was marked. After reaching a sufficient number of samples, the data obtained were transferred to the Excel program. After the demographic information was converted into numerical codes, participant answers were prepared for analysis. The normality of the data was checked with the SPSS 25 program. LISREL 8.80 program was used for SEM analysis.

Data Analysis

In the study, SEM's model development strategy was used to determine the relationship between high school students' role-modeling perceptions and their self-regulation levels toward science. SEM is a combination of factor analysis and regression analysis techniques applied to test causal and reciprocal relationships between variables (Raykov & Marcoulides, 2006). In this study, the SEM model development strategy was preferred since the possible relationship between the erception of role modeling and self-regulation variables and their sub-dimensions was investigated.

RESULTS

SEM Assumptions

In this section, it was primarily examined whether the data obtained from the self-regulation and role-modeling perception scales applied to the sample met the assumptions of SEM. To analyze the data of this study with SEM, independence of observations, random sampling of participants, linearity of the relationship between variables, univariate and multivariate normality, appropriate measurement level, and sufficient sample size were assumed (Reisinger & Turner, 2003; Tabachnick & Fidell, 1989). The independence of observations, which means that each observation or measurement is independent of the other, emerges as a basic requirement for almost every hypothesis testing (Gravetter & Wallnau, 2007). This study assumed that each participant answered both scales used in the research independently of each other.

The random sampling assumption, in which the participants are determined without a specific selection criterion, is important in terms of representativeness and generalizability (Gravetter & Wallnau, 2007). This study randomly selected participants studying at a public high school based on voluntariness.

In SEM analysis, there should be an assumption of linearity between both latent and observed variables. Violation of this assumption may indicate that the model fit and standard estimates are biased. One of the ways to check assumptions such as outlier, linearity, covariance, and independence of residuals is to check normality values (Pallant, 2020: 176). In SEM analysis, it is very important to control univariate and multivariate normality assumptions to determine the estimation method to be used during hypothesis testing. In the LISREL program, the generally preferred method is the Maximum Likelihood (EO) estimation (Jöroskog & Sörbom, 1993). To use this method, the variables must have a normal distribution. The multivariate normality assumption states that all univariate distributions are normal, each variable is normally distributed with the other, all bivariate graphs are linear, and residuals are covariate (Kline, 2011: 60). The LISREL program provides univariate and multivariate normality, which shows the skewness and kurtosis values for all variables measured in the model, with the chi-square test (Kunnan, 1998). The univariate normality test result is shown in Table 4.

Variables	Mean	Median	Minimum	Maximum	Skewness	Kurtosis
Learning strategies	56.60	56.00	28.00	70.00	-.41	-.30
Critical thinking	27.19	27.00	14.00	35.00	-.12	-.46
Regulation time and effort	18.36	18.00	7.00	25.00	-.06	-.54
Reproduction	47.87	48.00	20.00	60.00	-.71	.37
Retention	38.09	39.00	15.00	50.00	-.39	-.29
Motivation	29.83	31.00	12.00	40.00	-.88	1.13
Role model	115.78	117.50	61.00	150.00	-.40	-.02
Self-regulation	102.15	102.00	55.00	130.00	-.11	-.51

Table 4: The univariate normality test result, 2017-2018, (source: own calculation)

Findings Related to the Research Model

After the SEM assumptions were checked, model development studies were started. According to the results of exploratory and confirmatory factor analysis, three factors of role modeling perception (reproduction, retention, motivation) and three factors of self-regulation for science (learning strategies, critical thinking, time and effort regulation) were defined as latent variables, a structure consisting of a total of six latent variables, 56 indicator variables and 362 observations was studied. While developing the model, first of all, the χ^2/df ratio was checked, and then other fit indices were examined. In the first experiment, a model was studied in which three sub-dimensions of the role model predicted the three sub-dimensions of self-regulation. Although all of the t values obtained in this model were shown with black arrows, it was determined that the standardized coefficients were not in the desired range. The possible reason for this situation was multicollinearity. When the correlation coefficients of both scales within their dimensions were examined, it was determined that the correlation between the sub-dimensions of the self-regulation scale was high. To solve the multicollinearity problem, self-regulation was made into a single variable. The model in which the three dimensions of the perception of role modeling predicted the self-regulation variable was tested, and it was found that there was no red arrow in the t values (Figure 1), and the standardized coefficients were in the range of -1/+1 (Figure 2).

We reported the fit of the model in Table 5 by utilizing the goodness of fit indices commonly used in the literature (Jöroskog & Sörbom, 1993). According to Kline (2011), it is good if the ratio of the Chi-square value to degrees of freedom is less than five; if it is below three, it means perfect harmony. In this case, we can assert that the developed model has an acceptable fit.

In the SEM obtained as a result of the study, it was found that each of the three sub-dimensions of role modeling perception predicted high school students' self-regulation skills (25% reproduction, 44% retention, and 11% motivation) and explained 46% of the variance.

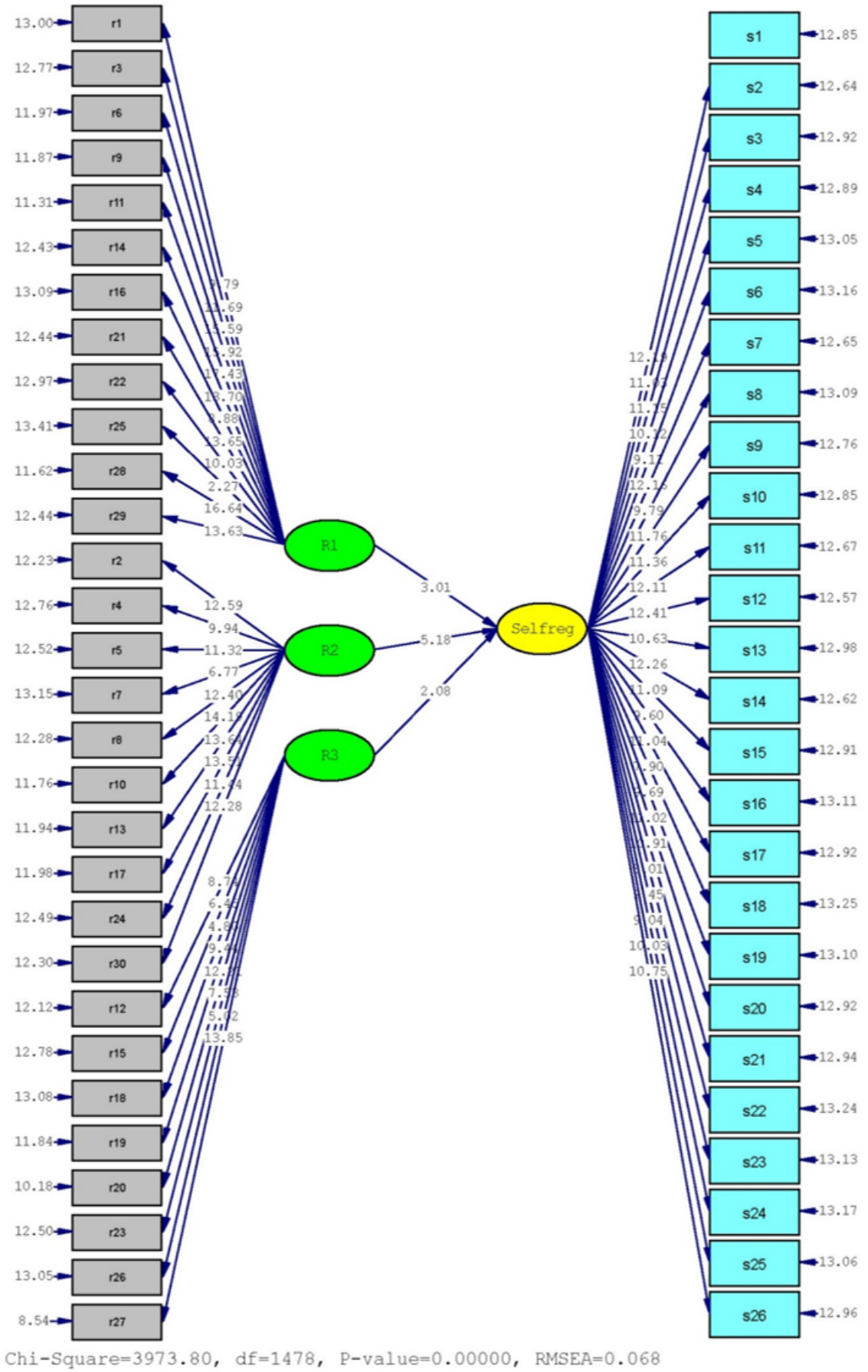

Figure 1: SEM t values, 2017-2018, (source: own calculation)

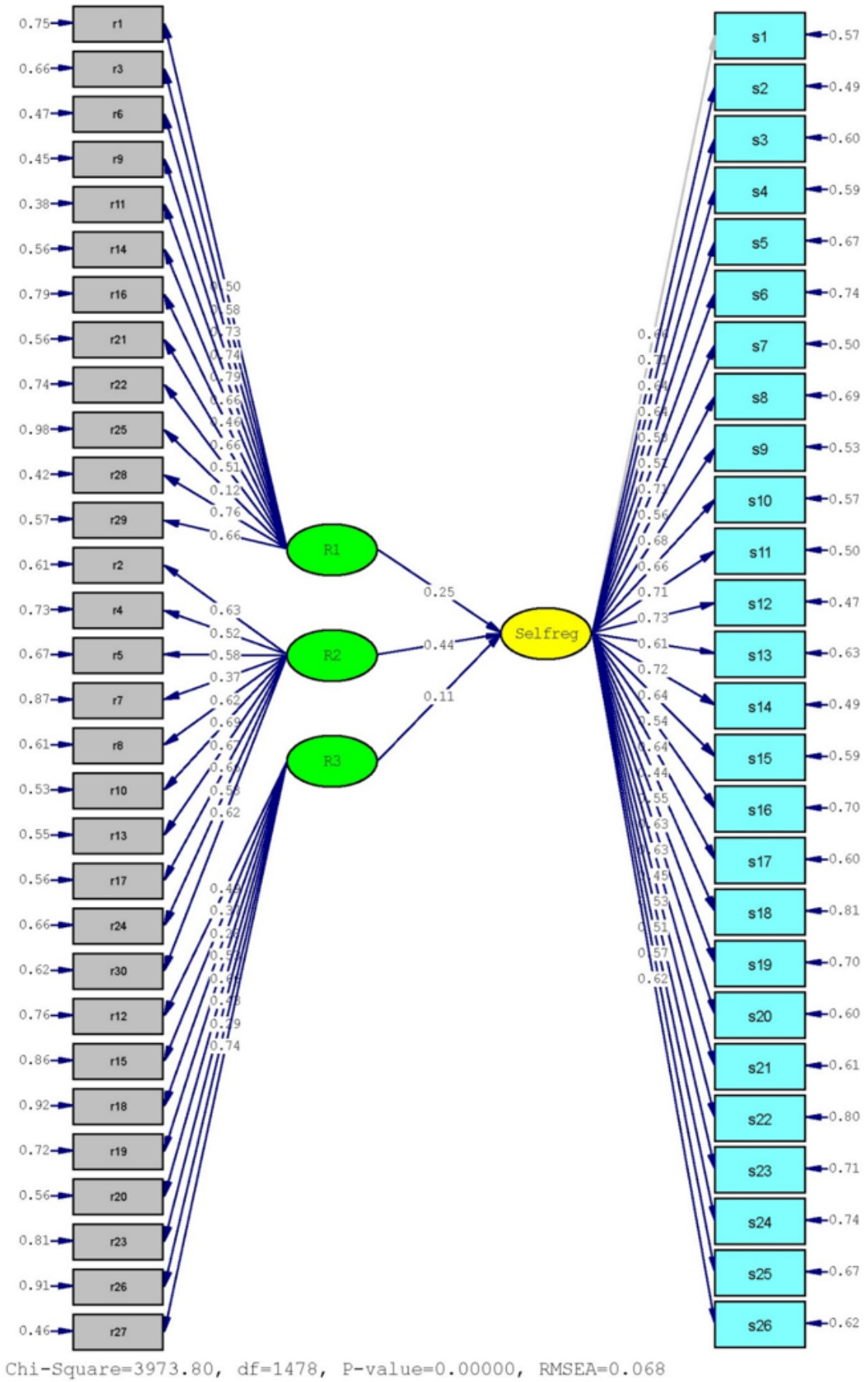

Figure 2: SEM standardized coefficient values, 2017-2018, (source: own calculation)

Fit indices	Acceptable	Excellent	Value on the scale	The fit of the scale
	χ^2/df		2.68	Excellent
NFI	.90 and above	.95 and above	.91	Acceptable
NNFI	.90 and above	.95 and above	.94	Acceptable
IFI	.90 and above	.95 and above	.94	Acceptable
RFI	.90 and above	.95 and above	.91	Acceptable
CFI	.95 and above	.97 and above	.94	Reject
GFI	.85 and above	.90 and above	.72	Reject
AGFI	.85 and above	.90 and above	.70	Reject
SRMR	Between = .05 and = .08	Between = .00 and < .05	.080	Acceptable
RMSEA	Between = .05 and = .08	Between = .00 and < .05	.068	Acceptable

Table 5: Structural equation model goodness of fit indices, 2017-2018, (source: own calculation)

DISCUSSION

Motivation and education programs are very effective in the development of children's self-regulation skills (Montroy et al., 2016). As mentioned before, the perceived social environment has an important place for the development of self-regulation skills (Bronson, 2000). As competence levels of learners increase, the role model builds a kind of scaffolding (Wood et al., 1976) by transferring the responsibility to them and slowly withdrawing their support. These scaffolds are more robust in situations such as environments where the active participation of the learner is ensured (Kangas, 2016) and seen as a stakeholder (Flekkøy & Kaufman, 1997), which is important for the development of self-regulation skills, including the learner in assessment processes (Dinsmore & Wilson, 2016). On the other hand, it is known that children start and continue their learning processes as they reach higher levels, and adult support decreases (Lundy, 2007; Smith et al., 2002). It is also known that the development of self-regulation in individuals is not directly proportional to their biological age. Therefore, the reason why the sub-dimensions of the role model could not explain the sub-dimensions of self-regulation in the first model tried in this study may be that high school teachers do not use the necessary strategies for the development of students' affective characteristics and do not show sufficient support. The reason why high school teachers have such an attitude may be that they believe students' affective characteristics are like adults because they are at the age to go to university after a few years, they often ignore that they are still children, and they are not aware that self-regulation skill development will continue throughout life even if the pace slows down. Teachers should be role models for their students to gain self-regulation skills (Siddiqui & Habib, 2021). Teachers should realize that they are role models in raising students with skills such as questioning, debating, logical inference, and problem-solving (Ashton, 1988; Wilks, 2018).

The combined use of motivation and self-regulation strategies helps to create self-regulated learning (Pintrich, 2000). One of the reasons for the differences in the results of these two studies, in which the same scales were used, maybe the age of the students who made up the sample. Self-regulation includes reflexive and learned responses, whether desired or not (Strauman, 2017). It is known that younger ages are more important for the development of these skills (Ringoot et al., 2021; Thomas et al., 2022). On the other hand, studies report that older children exhibit higher self-regulation skills than younger children (Vitiello et al., 2022; von Suchodoletz et al., 2013). In addition, experience is also an important variable for the development of self-regulation skills (Alexander et al., 1998). Moreover, children often find it difficult to generalize the use of experienced strategies to new contexts (Alexander et al., 1998). Therefore, another reason for the difference in the results of these two studies conducted in the same socioeconomic and sociocultural region may be students' different individual experiences regarding self-regulation development. Therefore, looking at these two models, it could be argued that self-regulation skills, which include internal and external processes, continue to develop throughout life, even if the pace changes depending on different variables.

Although self-regulation skills are defined as an individual process, research has documented that the social dimension is undeniably effective (Ijaz et al., 2022). By its nature, the relationship between the perception of role modeling and self-regulation is intertwined with the environment. This relationship has an important role in lifelong learning (Broda et al., 2020; Lenes et al., 2020; Lerner et al., 2021). Lerner et al. (2021) stated that role models can help learners develop their character traits and increase their awareness, especially during adolescence. Fung and Chung (2021) stated that the role model parent response is important in the self-regulation development of preschool children. There are many studies in the literature proving that role models are especially effective in the development of children's self-regulation (Acar et al., 2022; Augustine et al., 2022; Broda et al., 2020; Cai et al., 2022; Fung & Chung, 2021; Karaca & Bektas, 2021; Kurtovic et al., 2021; Lenes et al., 2020; Lerner et al., 2021; Leslie, 2021; Ringoot et al., 2021; Vitiello et al., 2022; Xie & Li, 2022; Zieli'nska et al., 2022).

CONCLUSION

In this study, reproduction, retention, and motivation dimensions of high school students' role modeling perceptions did not predict the sub-dimensions of self-regulation learning strategies, critical thinking, and time-effort management for science.

In light of the analyses, another model in which the dimensions of the perception of role modeling predicted the whole self-regulation was tried and statistically verified. Karaca and Bektas (2021) developed a model by applying the scales used in this study to secondary school students. As a result of their study, the authors confirmed the model showing that

secondary school students' reproduction and retention skills predicted self-regulation skills for science. This model proved that as the number of positive role models in a student's social environment increases, it becomes easier for them to develop self-regulation skills. On the other hand, the same model shows that motivation does not predict self-regulation. In the model, the authors developed in light of the data obtained from high school students that all three dimensions of the perception of role modeling predicted self-regulation separately.

The model developed as a result of this research enriched the results obtained from field studies by revealing that role models are important for the development of self-regulation skills of adolescent high school students. Therefore, being aware of the fact that they are role models, high school teachers need to use strategies to develop students' self-regulation skills, ensure active participation, and support students effectively until they reach a sufficient affective level. Enrichment of education and training programs with self-regulation will facilitate the work of program practitioners. The model obtained in this study also shows that individuals in the social environment should be aware that they are candidate role models for the learners around them. As this awareness matures, the social learning network that Bandura foresees will become widespread, and it will become easier and faster for children to gain self-regulation skills.

The limitations of the study and the suggestions put forward in the light of the results are listed below.

1. The sample of this study is limited to students studying at a public high school in Kayseri, Türkiye. Since self-regulation is affected by environmental factors, this research can be conducted with high school students studying in different regions. The results can be expanded by conducting this study, which was carried out in an Anatolian high school, with high school students at different academic levels studying in private high schools, vocational high schools, and science high schools.
2. This study was conducted based on the quantitative research method. Especially with the extreme values in the research, it is possible to interview by using the qualitative research method. Thus, the opportunity to examine the possible causes of the results in more detail is obtained.
3. The model developed in this study can be extended by including demographics (gender, class level, education levels of mother and father), socioeconomic, and sociocultural characteristics.
4. In the study, the sub-dimensions of the perception of role modeling predicted the whole self-regulation but did not predict the sub-dimensions of self-regulation. The possible reasons for this result can be investigated in detail using the qualitative research method.

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