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# The Effect of the Educational Game, Reading-Writing-Game, and Reading-Writing-Application Methods on Students' Social Skills, Attitudes Towards Science Courses, and School*

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**Abstract:** Research in the literature predominantly focuses on the academic development of students. However, the affective characteristics of students and their ability to work in different ways impact their learning. Therefore, it is crucial to examine the effects of various teaching methods on the development of affective factors. This study aims to investigate the impact of educational game (EG), reading-writing-games (RWG), and reading-writing-application (RWA) methods on students' attitudes towards science lesson, social skills, and attitudes towards school. A quasi-experimental design with pretest-posttest comparison groups was employed. The research involved 163 5th-grade students from middle school. Data collection utilized science course attitude scale, social skills scale, and attitude scale towards school. Dependent groups t-test and one-way ANOVA were employed for the analysis. The results indicated that EG, RWG, and RWA methods are statistically significant enhancing students' social skills, attitudes towards science courses, and attitudes towards school. EG, RWG, and RWA methods can be applied to improve the social skills and attitudes of students with low social skills and negative attitudes towards the course or school.

**Keywords:** Cooperative Learning; Educational Game; Social Skill; Attitude toward Course; Attitude toward School

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* Research Article

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## *El efecto del juego educativo, los métodos de lectura-escritura-juego y lectura-escritura-aplicación en las habilidades sociales de los estudiantes, actitudes hacia los cursos de ciencias y la escuela*

**Resumen:** La investigación en la literatura se centra predominantemente en el desarrollo académico de los estudiantes. Sin embargo, las características afectivas de los estudiantes y su capacidad para trabajar de diferentes maneras afectan su aprendizaje. Por lo tanto, es crucial examinar los efectos de varios métodos de enseñanza en el desarrollo de factores afectivos. Este estudio tiene como objetivo investigar el impacto del juego educativo (JE), los juegos de lectura-escritura (JLE) y el método de lectura-escritura-aplicación (LEA) en las actitudes de los estudiantes hacia la lección de ciencias, las habilidades sociales y las actitudes hacia la escuela. Se empleó un diseño cuasiexperimental con grupos de comparación preprueba-postprueba. La investigación incluyó a 163 estudiantes de quinto grado de una escuela intermedia. La recopilación de datos utilizó una escala de actitud hacia el curso de ciencias, una escala de habilidades sociales y una escala de actitud hacia la escuela. Se emplearon la prueba t de grupos dependientes y un análisis de varianza unidireccional (ANOVA) para el análisis. Los resultados indicaron que los métodos JE, JLE y LEA son estadísticamente significativos para mejorar las habilidades sociales de los estudiantes, las actitudes hacia los cursos de ciencias y las actitudes hacia la escuela. Los métodos JE, JLE y LEA pueden aplicarse para mejorar las habilidades sociales y las actitudes de los estudiantes con habilidades sociales bajas y actitudes negativas hacia el curso o la escuela.

**Palabras clave:** aprendizaje cooperativo; juego educativo; habilidad social; actitud hacia el curso; actitud hacia la escuela

## *O Efeito do Jogo Educacional, os métodos de leitura-escrita-jogo e leitura-escrita-aplicação nas habilidades sociais dos estudantes, atitudes em relação às disciplinas de ciências e à escola*

**Resumo:** A pesquisa na literatura se concentra predominantemente no desenvolvimento acadêmico dos estudantes. No entanto, as características afetivas dos estudantes e sua capacidade de trabalhar de diferentes maneiras afetam sua aprendizagem. Portanto, é crucial examinar os efeitos de vários métodos de ensino no desenvolvimento de fatores afetivos. Este estudo tem como objetivo investigar o impacto do jogo educacional (JE), dos jogos de leitura-escrita (JLE) e do método de leitura-escrita-aplicação (LEA) nas atitudes dos estudantes em relação à aula de ciências, nas habilidades sociais e nas atitudes em relação à escola. Foi utilizado um design quase experimental com grupos de comparação pré-teste e pós-teste. A pesquisa incluiu 163 alunos do quinto ano de uma escola intermediária. A coleta de dados utilizou uma escala de atitude em relação à disciplina de ciências, uma escala de habilidades sociais e uma escala de atitude em relação à escola. Foram empregados o teste t de grupos dependentes e uma análise de variância unidirecional (ANOVA) para a análise. Os resultados indicaram que os métodos JE, JLE e LEA são estatisticamente significativos para melhorar as habilidades sociais dos estudantes, as atitudes em relação às disciplinas de ciências e as atitudes em relação à escola. Os métodos JE, JLE e LEA podem ser aplicados para melhorar as habilidades sociais e as atitudes dos alunos com habilidades sociais mais baixas e atitudes negativas em relação à disciplina ou à escola.

**Palavras chave:** aprendizagem cooperativa; jogo educacional; habilidade social; atitude em relação à disciplina; atitude em relação à escola

## Introduction

Not all subjects in the curriculum capture the attention of students at the same level, and students do not approach each subject with an equal desire to learn. Particularly, the abstract and complex nature of subjects within the scope of the secondary school-level science courses makes understanding and challenging. This difficulty further diminishes the interests and desires of students who struggle with learning. Consequently, students tend to develop a negative attitude towards the course, teacher, and school (Karamustafaoğlu & Kaya, 2013; Kaya & Elgün, 2015). A negative attitude towards school and course can also adversely impact the learning process.

Problematic situations encountered by students during learning lead to false learning. Learning occurs through the connections students establish between new knowledge and existing knowledge (Hewson & Hewson, 1984), and problems experienced hinder the establishment of these connections in a healthy manner. When examining existing literature, it is evident that cognitive development is often emphasized, while affective development takes a back seat (Tuan, et al., 2005). Affective factors influencing mental processes in making sense of information should be considered as students learn concepts to ensure a robust healthy learning. Educators must employ diverse methods and techniques to foster the affective development of students (Ding, et al., 2007; Hazne & Berger 2007; Honey, 2009).

This approach not only facilitates lasting and meaningful learning but also supports the well-rounded development of students. One such method is educational games (EG), which, when well designed, imparts significant knowledge and skills through natural experiences. Another effective approach is the cooperative learning model, primarily designed to enhance students' knowledge levels, higher-order thinking skills, and social skills.

## Educational Game Method

Demirel et al. (2003) defined educational games as the use of game format to enable students to learn subjects or gain problem-solving skills. Varışoğlu, et al. (2013) defines educational games as activities that provide physical, spiritual, and psychological development, create a sense of fun and pleasure in learners, and promote positive behaviors and habits. Hamari and Koivisto (2015) refer to fun activities designed for specific purposes as educational games, while Chen and Hsu (2020) prefer a general definition, describing games designed for education and training purposes. According to Çakı (2008), since Educational Games (EG) can address more than one development area, it facilitates students' multi-directional development. As the classroom environment becomes enjoyable, the EG method reduces discipline problems, makes the course and the subject interesting, improves social skills such as sharing responsibility, self-expression, tolerance, respect for different ideas, thoughts, communication, and enables healthy thinking by reducing anxiety levels (Akandere, 2012; Bilen, 2002; Braude & Corey, 2006; Cady, 2005). Considering the stated benefits, it can be said that this method supports students' development in cognitive, affective, psychomotor, and social aspects. In the literature, learning with games includes digital games, video games, serious games, virtual reality games, etc., many of which are implemented. In this research, traditional games performed in real environments were used.

### *Cooperative Learning*

Cooperative learning is a learning model in which students form small, heterogeneous groups and help each other learn for a common purpose in the classroom and outside the classroom. It aims to develop communication, problem-solving, and critical thinking skills, increase self-confidence, and actively involve students in the learning process (Açıkgöz, 1992). Students working in groups in the classroom contribute to each other's learning. Reading - Writing -Application (RWA) supports students academically and affectively, representing one of the methods and techniques included in the cooperative learning model. RWA aims to develop students' skills such as problem-solving, research, questioning, sharing, and analyzing, kin addition to academic development (Fabian, Topping & Barron, 2018; Gillies, 2006; Hennessy & Evans, 2006; Huang, Huang & Yu, 2011; Kibirige & Lehong,

2016; Rabgay, 2018; Slavin, 1983, 1990, 1992). The RWA method is effective in situations such as students' respect for differences, expressing their ideas, listening, discussing, taking responsibility, solidarity, belonging, helping each other and tolerance, making decisions together, developing their practice skills, creating awareness of the group, developing a positive attitude towards the course, increasing their interest and motivation to learn (Açıkgöz, 1992; Hazne & Berger 2007; Hennessy & Evans, 2006; Huang, et al., 2011; Slavin, 1980, 1987, 1992). From this perspective, it can be concluded that the RWA method is benefical for students, educators, and researchers in various areas. Similarly, the Reading-Writing-Game (RWG) is created by integrating RWA and EG. For this reason, it combines the benefits of the cooperative learning model with the advantages of educational games (Yıldız, 2019).

*Background*

Upon reviewing the literature on Educational Games (EG) (Arıcı, 2017; Aymen-Peker, 2018; Boyce, 2016; Callaghan, et al., 2018; Can, 2017; Eltem, 2018; Espinoza-Morales, 2017; Gürpınar, 2017; Jefferson, 2015; Koka, 2018; Little, 2015; Martin, 2012; Martinez-Hernandez, 2010; Nunes, et al., 2018; Rouse, 2013; Stewart, 2013) and Cooperative Learning (Alghamdi, 2017; Avci, 2018; Barata-Aksoy, 2017; Fabian, et al., 2018; McCall, 2017; Rabgay, 2018; Wyman, 2018), it is evident that numerous studies have been conducted on both methods. However, the predominant focus of research in the literature has been on the impact of the EG and cooperative learning on academic development, with limited attention given to attitude and social skills.

Studies by Aymen-Peker (2018), Çelik (2017), Gürpınar (2017), and Serdaroğlu and Güneş (2020), examining students' attitudes towards the course at the secondary school level, concluded that the methods are effective in cultivating a positive attitude. In contrast, Zheng (2012) found that the EG method is not effective in developing attitude. An investigation by the Yıldız (2017) into the effect of the EG method on students' attitudes towards school and social skills revealed that the method is more effective than the current curriculum in fostering positive attitudes and increasing social skills. In a comparative study by Yazıcıoğlu and Çavuş-Güngören (2019) on the effects of integrating game activities into the current curriculum, it was found to be effective in developing attitude. In summary, when examining studies on the EG method's effect on attitude and social skills at the secondary school level, it can be concluded that the method is generally effective in developing both attitude and social skills.

Studies on the effect of cooperative learning on attitude, including those by Avcı (2015), Ballıel (2014), and Fabian, Topping, and Barron (2018) suggest that the methods and techniques in the cooperative learning model are effective in improving attitude. Notably, research method and integrating the EG method, one of the methods in the cooperative learning model, found that the combined use two methods is effective in enhancing students' attitudes towards school (Yıldız, et al., 2018) and social skills (Yıldız, et al., 2017).

In contrast to existing the literature, this study aims to compare the effects of the EG, Reading-Writing- Application (RWA), and Reading-Writing-Game (RWG) methods (combining these two methods) on students' attitudes towards the course and school, as well as their developing of social skills.

## Purpose and Problem Statement of the Research

The primary objective of this study was to investigate the effects of the EG, RWG, and RWA methods implemented in teaching 5$^{th}$-grade Matter and Exchange unit on students' attitudes towards science course, social skills, and attitudes towards school in both central and rural areas. The research problem was formulated as follows: "To what extend do the EG, RWG and RWA methods, when applied in the teaching of the Matter and Exchange unit, contribute to the improvement of students' social skills, attitudes towards the science course, and attitudes towards school?

Furthermore, which among EG, RWG and RWA methods is more effective in enhancing students' attitude in these areas, particularly in both central and rural settings?"

Within the research scope, the study aimed to address the following research questions:

What are the impacts of the EG, RWG and RWA methods, which methods on the enhancement of students' social skills?

Among the EG, RWG, and RWA methods, which methods proves to be more effective in terms of improving students' social skills?

To what extent do the EG, RWG and RWA methods contribute to the development of students' attitudes towards the science course?

Among the EG, RWG, and RWA methods, which methods demonstrates greater effectiveness in developing students' attitudes towards the science course?

What impact do the EG, RWG and RWA methods have on shaping students' attitudes towards school?

Among the EG, RWG, and RWA methods, which method is more effective in developing positive attitudes among students towards school?

By addressing these research questions, the study aimed to provide comprehensive insights into the comparative effectiveness of the EG, RWG, and RWA methods in fostering social skills and positive attitudes among 5th- grade students in both central and rural educational settings.

## Method

### *Research Design*

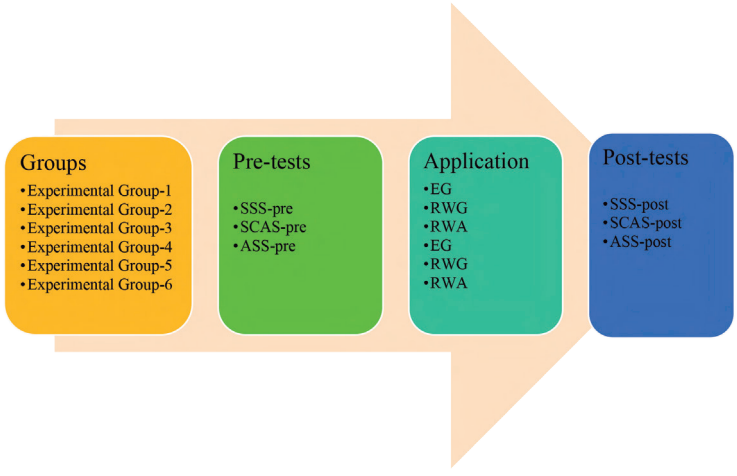
A quantitative research model was employed in this study, given that the data could be expressed in quantifiable and numerical terms, allowing for the determination and comparison of students' social skills, attitudes towards science course, and attitudes towards school. The research aimed to scrutinize and compare the effects of the EG, RWG, and RWA methods on the aforementioned variables, leading to the selection of a quasi-experimental design with a pretest-posttest comparison group.

The choice of a quasi-experimental design was deliberate, as it prove to be the most suitable design in situations where random assignment to groups is not feasible or when comprehensive control over all variables is practical (Mcmillan & Schumacher, 2006). This design allows for a structured investigation and comparison of the effects of the educational interventions.

#### *Plans of Quasi -Experimental Design with Pretest-Posttest Comparison Groups*

Refer to Figure 1 for an overview of the planned quasi-experimental design with pretest-posttest comparison groups, illustrating the sequential stages of the research process.

**Figure 1.** Plan of Quasi-Experimental Design with A Pretest-Posttest Comparison Group




**Source:** Own source.

The figure outlines the key steps of the research application, which was conducted in two separate regions - central and rural. At the outset of the application, the pretest phase included the administration of the Social Skills Scale (sss-pre), Science Course Attitude Scale (SCAS-pre), and Attitude Scale towards School (ASS-pre). The EG method was implemented in Experiment Group-1 and Experiment Group-4, the RWG method in Experiment Group-2 and Experiment Group-5, and RWA method in Experiment Group-3 and Experiment Group-6. Following the conclusion of the application, the posttest phase involved the administration of Social Skills Scale (sss-post), Science Course Attitude Scale (SCAS-post), and Attitude Scale towards School (ASS-post).

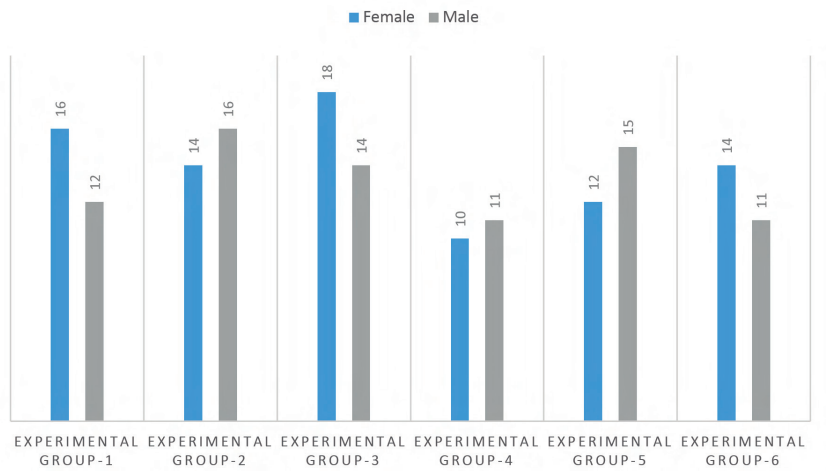
### *Study Group*

The study involved 163 fifth- grade students from middle schools in the central and rural areas of Erzurum during the 2019-2020 academic year. The selection of schools was based on specific criteria, including the presence of at least three different classes at the fifth grade and diverse composition of classes (taking into account factors such as achievement and gender). From the schools meeting these criteria, application schools were randomlt selected.

Both central and rural schools have six branches at the fifth-grade level, organized with a mixed structure considering the students' academic achievements and gender. It's noteworthy that all students attending the central school resided in the city center, while those in the rural school lived in villages near the school. The central school accommodated a total of 90 fifth grade students, and the rural school had 73 fifth grade students.

Experimental groups were determined through a random drawing among the branches within the schools. For a detailed breakdown of the students distribution among the experimental groups, refer to Figure 2.

**Figure 2.** Distribution of Students to Experimental Groups




**Source:** Own resource.

## Data Collection Tools

### *Social Skills Scale*

Developed by Kocayörük (2000), the Social Skills Scale is a four- point Likert-type instrument designed to assess the development of students' social skills. To ensure content validity, the opinions of five field experts were sought, confirming that the scale effectively measures the targeted social skill behaviors. In pilot applications involving 160 students, the scale demonstrated a Cronbach Alpha coefficient of .75. For this study, the reliability coefficient was calculated as .82. The scale has possible score range of 20 to 80.

### *Science Course Attitude Scale*

Crafted by Geban, et al. (1994), the Science Course Attitude Scale is a five-point Likert type scale comprising 15 items, including 10 positive and 5 negative statements. This scale gauges students' trust in learning science, interest in the subject, utilization of science concepts in comprehending natural phenomena, and their perception of science as a prospective career field. The reliability coefficient, as measured by Cronbach Alpha, was found to be .83 in its original form. For this study, the reliability coefficient was determined to be .80. The scale has a score range of 15 to 75.

### *Attitude Towards School Scale*

Developed by Coşkun (2004), the Attitude Towards School Scale is a three-point Likert- type instrument designed to assess the attitudes of students aged 11-15 towards school. Comprising 10 items, with an equal split between positive and negative statements, the scale underwent a pilot study involving 243 students, resulting in a Cronbach Alpha reliability coefficient of .74. For the purposes of this study, the reliability coefficient of the scale was determined to be .78. The scale has a scoring range from 10 to 30.

## Data Analysis

The normality distribution of the data was examined using central tendency measures, kurtosis-skewness coefficients, the Shapiro-Wilk normality test, and Levene tests. Given that the data exhibited suitability for analysis with parametric tests, the analysis employed dependent groups t-test and one-way ANOVA. Refer to table 1 for the values representing the normality distribution of the data.

**Table 1.** Normality Values

| Region | Test | Group | Kurtosis | Skewness | Minimum | Maximum | Median | Mean | sd | Shapiro-Wilk* |
|---|---|---|---|---|---|---|---|---|---|---|
| Central | SSS-pre | EG | -1.208 | .065 | 31.00 | 69.00 | 50.00 | 49.86 | 11.56 | .191 |
| | | RWG | -.0652 | .168 | 29.00 | 69.00 | 48.00 | 49.80 | 10.01 | .584 |
| | | RWA | -.802 | -.186 | 28.00 | 63.00 | 46.50 | 46.47 | 10.38 | .219 |
| | SSS-post | EG | -1.028 | -.114 | 44.00 | 76.00 | 65.00 | 66.36 | 12.01 | .366 |
| | | RWG | -1.099 | -.046 | 46.00 | 76.00 | 68.50 | 67.97 | 11.29 | .251 |
| | | RWA | -.155 | -.739 | 38.00 | 75.00 | 66.50 | 65.06 | 11.73 | .054 |
| | SCAS-pre | EG | -.776 | .005 | 27.00 | 70.00 | 47.50 | 47.57 | 11.51 | .446 |
| | | RWG | -1.354 | .025 | 30.00 | 70.00 | 50.00 | 48.80 | 12.32 | .079 |
| | | RWA | -1.221 | .071 | 30.00 | 66.00 | 50.00 | 47.44 | 11.13 | .075 |
| | SCAS-post | EG | -.211 | -.738 | 43.00 | 75.00 | 64.50 | 63.18 | 8.85 | .070 |
| | | RWG | -1.00 | -.476 | 45.00 | 75.00 | 65.50 | 62.33 | 8.60 | .052 |
| | | RWA | -1.116 | -.271 | 44.00 | 74.00 | 61.00 | 60.16 | 9.23 | .076 |
| | ASS-pre | EG | -.052 | -.673 | 10.00 | 25.00 | 19.50 | 19.29 | 4.13 | .106 |
| | | RWG | -.272 | -.433 | 13.00 | 24.00 | 19.50 | 19.63 | 2.99 | .157 |
| | | RWA | -.289 | -.421 | 12.00 | 25.00 | 19.50 | 19.72 | 3.43 | .248 |
| | ASS-post | EG | -.782 | -.168 | 17.00 | 30.00 | 24.00 | 24.89 | 3.92 | .058 |
| | | RWG | -.208 | -.678 | 16.00 | 27.00 | 24.00 | 23.00 | 3.03 | .068 |
| | | RWA | -.742 | -.377 | 15.00 | 27.00 | 22.00 | 22.06 | 3.33 | .079 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Rural | SSS-pre | EG | -.573 | -.499 | 24.00 | 66.00 | 49.00 | 48.14 | 12.07 | .410 |
| | | RWG | -.710 | -.085 | 27.00 | 66.00 | 46.00 | 46.78 | 10.59 | .794 |
| | | RWA | -.583 | -.292 | 34.00 | 60.00 | 48.00 | 47.92 | 7.44 | .314 |
| | SSS-post | EG | -1.172 | .111 | 52.00 | 78.00 | 66.00 | 66.38 | 9.30 | .435 |
| | | RWG | -1.327 | -.039 | 52.00 | 78.00 | 66.00 | 68.70 | 10.22 | .079 |
| | | RWA | 1.022 | -.686 | 44.00 | 80.00 | 67.00 | 65.12 | 7.83 | .591 |
| | SCAS-pre | EG | -.218 | -.619 | 32.00 | 60.00 | 51.00 | 48.48 | 7.37 | .349 |
| | | RWG | -.766 | -.713 | 26.00 | 63.00 | 50.00 | 48.93 | 8.23 | .358 |
| | | RWA | .176 | .605 | 33.00 | 69.00 | 48.00 | 48.28 | 8.84 | .256 |
| | SCAS-post | EG | -.525 | -.427 | 43.00 | 79.00 | 66.00 | 65.24 | 9.92 | .401 |
| | | RWG | -.918 | -.213 | 48.00 | 75.00 | 64.00 | 63.81 | 7.42 | .269 |
| | | RWA | .424 | .544 | 45.00 | 81.00 | 60.00 | 60.72 | 8.00 | .589 |
| | ASS-pre | EG | .577 | -.798 | 11.00 | 23.00 | 19.00 | 18.33 | 3.02 | .268 |
| | | RWG | -.973 | -.449 | 11.00 | 25.00 | 20.00 | 19.37 | 4.20 | .098 |
| | | RWA | -.552 | -.003 | 10.00 | 28.00 | 18.00 | 18.68 | 4.68 | .532 |
| | ASS-post | EG | .622 | -.836 | 18.00 | 30.00 | 26.00 | 26.00 | 3.26 | .082 |
| | | RWG | -1.115 | -.449 | 15.00 | 30.00 | 25.00 | 23.30 | 4.86 | .053 |
| | | RWA | -1.083 | .014 | 16.00 | 29.00 | 22.00 | 22.44 | 3.62 | .410 |

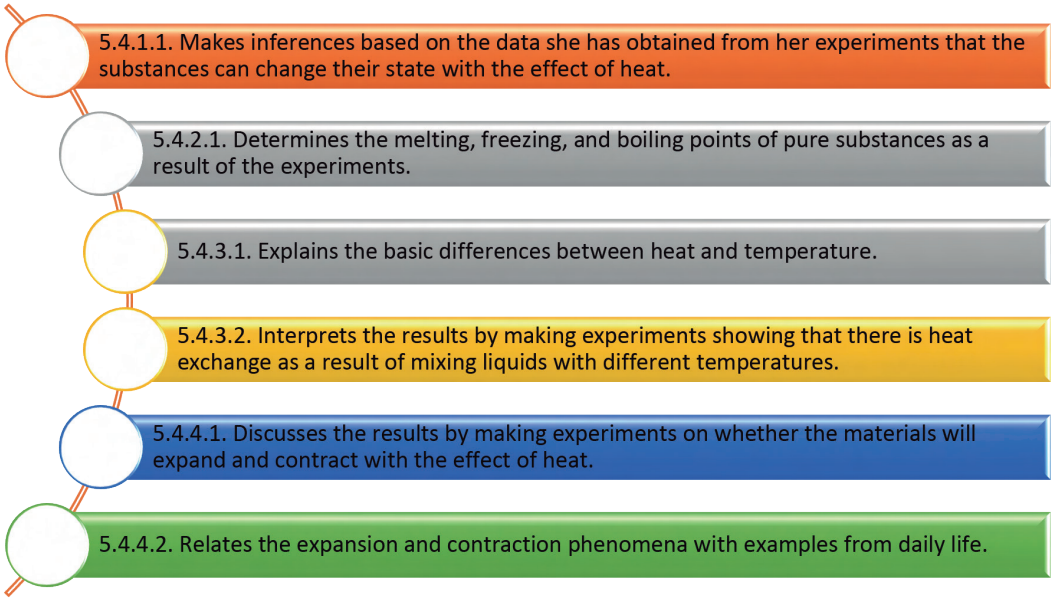
**Source:** Own source.

## Application

The Matter and Exchange unit comprises six outcomes, and the implementation of the methods aligned with the Ministry of National Education (MEB, 2018) recommendations required 26 lesson hours . The lessons were structured with a distribution of 2+2 lesson hours per week, and the researcher conducted the applications across all groups. The entire application, including the application of pre-tests and post-tests, was concluded within 30 lesson hours.

The unit encompasses topics such as State Change of Matter, Distinctive Properties of Matter, Heat and Temperature, and Effects of Heat Agents. Throughout the implementation process, the outcomes outlines in Figure 3 were systematically studied.

**Figure 3.** Matter and Exchange Unit Outcomes (MEB, 2018)




**Source:** Own source.

*Application of The EG Method*

In this method, educational games, namely Kutu Kutu Bilgi, Gen-Büz, Alın Yazısı, and Birleşen Harfler, designed by Yıldız (2019), were utilized. The students received detailed information about the process. Considering the students' prior knowledge and gender, mixed playgroups of four ( five students in rural areas) were formed. Efforts were made to ensure diversity within each group by selecting with different characteristics, aiming for equivalence across all groups. For each game, an introduction to the game was provided, rules were explained, a sample game application was provided, rules were explained, a sample game application was demonstrated, and finally the game was assessed. During evaluations, learning deficiencies and mistakes were emphasized, and corrective measures were implemented.

The Kutu Kutu Bilgi game was played for each segment of the unit to impart conceptual understanding. In this game, each group received flashcards of different colors, with information cards , were placed on the teacher's desks. The students took turns visiting the boxes, read the information cards to the class, and placed them into the corresponding boxes. The evaluation process began when all the cards were placed into the boxes. The teacher, taking cards one by one, read the information aloud, clarifying whether they were correctly placed. The group received 1 plus for each piece of information in the correctly placed and 1 minus for each incorrect placement. The group's overall score was determined by subtracting minus for pluses. At the conclusion of the evaluation, the group with the highest score revisited the boxes, repeating the information for each box. This game was conducted for all sections of the unit. Following the completion of the game, experiments suggested by the Ministry of National Education in the textbook were implemented using gamification.

In addition to Kutu k, the game Gen-Büz was played during the Heat Substances Effects section. A student from the class list was selected as a player, and the desks in the classroom were pushed

back to create ample space in the middle. The player stood in the center, with five players randomly selected players forming a circle around her. Since all students participated in the game, each student joined whenever a friend who was not in the circle was called. The player crouched down and stood up while shouting either ''Gen-Gen'' or ''Büz-Büz''. When the surrounding players shouted ''Gen-Gen'', they provided an example of expansion, and when ''Büz-Büz'' was shouted, they demonstrated contraction. If a player gave an incorrect example or repeated a previously given the example, they were removed from the game. The student who left the game was then replaced by another player from the class.

For the Alın Yazısı game, a dedicated four lesson hours were assigned. This game served the dual purpose of reinforcing conceptual understanding and identifying and addressing learning deficiencies among students. To facilitate the game, classroom desks were pushed to the back, creating a spacious area in the middle.

The prepared crowns were placed on the students' head, and a concept was discreetly conveyed to the cardholder on each crown without the students' awareness. Randomly wandering around the classroom, students posed questions to their peers to deduce the hidden concept. Each student had the privilege to ask one question, which had to be in form of Yes/No inquiry. Asking direct concept-revealing questions, such as ''Am I melting?'' or ''Am I related to heat?'' was strictly prohibited, resulting in the elimination of any student violating this rule. At the game's concluusion, each student ventured a guess at their concealed concept, with those making correct guesses declared as the game's winners.

In the last six lesson hours of the unit, the Birleşen Harfler game was employed to assess and reinforce the acquired concepts. Information envelopes were arranged on the teacher's desk to obscure the scores from view. Within a large box, cubes representing various concepts were thoroughly mixed. Groups took turns approaching the teacher's desk, collectively selecting an envelope. One group member opened the envelope and read its contents aloud for the entire class to hear. The 30 second countdown began immediately after information was read. is started. During this time, group members endeavored to assemble the concept using cubes. Successfully constructing the concept completely and accurately within 30 seconds earned the group the score indicated on envelope. The primary objective of this game was to evaluate the applications and reinforce the learned concepts.

### *Application of The RWA Method*

Students were grouped into sets of four (five students in rural areas), considering variables such as their prior knowledge and gender. Careful considerations was given to assembling diverses characteristics within each group, ensuring equivalence across all groups. A comprehensible explanation of the method was provided to the students. The comprehension of information was deepened through group discussions on the material read.

Following the reading phase, during the writing phase, groups created posters contain information solely derived from memory, without consulting any sources. The researcher evaluated the posters, providing consistent feedback to the groups regarding any learning deficiencies. The experiments recommended in the textbook were executed in the format of reading, writing and practical application, adhering to the principles of the method.

The time allocated for these activities mirrored that of the EG method. Similarly, the total time dedicated to reading studies equated to the time assigned to the Kutu Kutu Bilgi game in the EG method, and the time allocated to writing studies corresponded to the duration of the Alın Yazısı game. During the six lesson hours designated for the implementation phase, groups presented the posters created in the writing phase to the other groups, a timeframe equivalent to that of the Birleşen Harfler game.

### *Application of The RWG Method*

This method resulted from the integrated application of the EG and RWA methods. Students were grouped into set of four (two groups of five students in the center and one group of three students in the rural areas), accounting for factors such as their prior knowledge and gender. Similar attention was given to ensuring diversity within each group, while also guaranteeing

equivalence between groups. The students received detailed information about the method, with reading and writing exercises mirroring those of the RWA method. Additionally, experiments were conducted using by gamification, similar to the EG method. In the remaining six lesson hours at the conclusion of the unit, the Birleşen Harfler game, as employed in the EG method, was played .

## Results

The results of the first research question, which aims to determine the effects of the methods on developing students' social skills, are presented below. The analysis results of the dependent samples t-test conducted to assess the effects of the methods on students' social skills are provided in table 2.

**Table 2.** Dependent Samples t-test Analysis Results for Determining the Effect of Methods on Students' Social Skills

| Methods | Groups | Measurement | N | M | sd | df | t | p* |
|---|---|---|---|---|---|---|---|---|
| EG | Experimental-1 | Pre-test | 28 | 49.86 | 11.56 | 27 | -5.803 | .000 |
| | | Post-test | 28 | 66.36 | 12.01 | | | |
| | Experimental-4 | Pre-test | 21 | 48.14 | 12.07 | 20 | -5.416 | .000 |
| | | Post-test | 21 | 66.38 | 9.30 | | | |
| RWG | Experimental-2 | Pre-test | 30 | 49.80 | 10.01 | 29 | -6.204 | .000 |
| | | Post-test | 30 | 67.97 | 11.29 | | | |
| | Experimental-5 | Pre-test | 27 | 46.78 | 10.59 | 26 | -7.783 | .000 |
| | | Post-test | 27 | 68.70 | 10.22 | | | |
| RWA | Experimental-3 | Pre-test | 32 | 46.47 | 10.38 | 31 | -6.986 | .000 |
| | | Post-test | 32 | 65.06 | 11.73 | | | |
| | Experimental-6 | Pre-test | 25 | 47.92 | 7.44 | 24 | -9.610 | .000 |
| | | Post-test | 25 | 65.12 | 7.83 | | | |

***p<.05**
**Source:** Own source.

The analysis results presented in table 2, reveal that the EG method significantly enhances students' social skills in both central ($t(27)=-5.803$, $p<.05$, $\eta^2=.55$) and rural ($t(20)=-5.416$, $p<.05$, $\eta^2=.59$) regions. Eta-squared effect sizes are calculated at .55 in the central and .59 in the rural areas, classifying these values as very large effects according to Cohen (1988). Thus, it can be inferred that the EG method accounts for 55% of the variety in students's social skills in the central region and 59% in the rural areas.

Similarly, the RWG method exhibits statistically significance in improving students' social skills in both central ($t(29)=-6.204$, $p<.05$, $\eta^2=.57$) and rural ($t(26)=-7.783$, $p<.05$, $\eta^2=.70$) regions. Eta-squared effect sizes are calculated as .57 in the central and .70 in the rural areas, categorized as very large effects by Cohen (1988). Consequently, the RWG method contributes to 57% of the variability in the student's social skills in the central region and 70% in the rural areas.

Furthermore, the RWA method is statistically significant in enhancing students' social skills in both central ($t(31)=-6.986$, $p<.05$, $\eta^2=.61$) and rural ($t(24)=-9.610$, $p<.05$, $\eta^2=.79$) regions. Eta-squared effect sizes are calculated as .61 in the central and .79 in the rural, indicating very large effects as per Cohen (1988). Consequently, the RWA method contributes to 57% of the variability in student's social skills in the central region and 70% in the rural areas.

The findings of the second research question, aiming to determine which of the EG, RWG, and RWA methods is more effective in terms of improving students' social skills, are presented below.

Variations exist in the social skill scores of students. The results of one-way ANOVA performed to determine whether these differences are statistically significant are given in table 3.

**Table 3.** One-Way ANOVA Results of the Data Obtained from SSS

| Area | Measurement | Groups | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|---|---|
| Central | Pre-test | Between Groups | 232.703 | 2 | 116.351 | 1.028 | .362 |
| | | Within Groups | 9850.197 | 87 | 113.221 | | |
| | | Total | 10082.900 | 89 | | | |
| | Post-test | Between Groups | 130.830 | 2 | 65.415 | .480 | .620 |
| | | Within Groups | 11857.270 | 87 | 136.290 | | |
| | | Total | 11988.100 | 89 | | | |
| Rural | Pre-test | Between Groups | 18.443 | 2 | 9.222 | .090 | .914 |
| | | Within Groups | 7053.057 | 69 | 102.218 | | |
| | | Total | 7071.500 | 71 | | | |
| | Post-test | Between Groups | 166.780 | 2 | 83.390 | 1.004 | .372 |
| | | Within Groups | 5733.220 | 69 | 83.090 | | |
| | | Total | 5900.000 | 71 | | | |

**Source:** Own source.

According to the analysis results provided in table 3, there is no statistically significant difference among the students' social skill levels before the application in both the central ($F(2,87)=1.028$, $p>.05$) and rural areas ($F(2,69)=.090$, $p>.05$). At the end of the application, it was determined that there is no statistically significant difference among the social skills of the students in the central ($F(2,87)=.480$, $p>.05$) and rural ($F(2,69)=1.004$, $p>.05$).

The findings of the third research question, aiming to determine the effects of the methods in developing students' attitudes towards the science course, are present below. The dependent samples t-test analysis results determine the effects of the methods on students' attitudes towards science courses are provided in table 4.

**Table 4.** Dependent Samples t-test Analysis Results for Determining the Effect of Methods on Students' Attitudes to Science Course

| Methods | Groups | Measurement | N | M | sd | df | T | p* |
|---|---|---|---|---|---|---|---|---|
| EG | Experimental-1 | Pre-test | 28 | 47.57 | 11.51 | 27 | -5.242 | .000 |
| | | Post-test | 28 | 63.18 | 8.85 | | | |
| | Experimental-4 | Pre-test | 21 | 48.48 | 7.37 | 20 | -5.501 | .000 |
| | | Post-test | 21 | 65.24 | 9.92 | | | |
| RWG | Experimental-2 | Pre-test | 30 | 48.80 | 12.32 | 29 | -4.433 | .000 |
| | | Post-test | 30 | 62.33 | 8.60 | | | |
| | Experimental-5 | Pre-test | 27 | 48.93 | 8.23 | 26 | -7.566 | .000 |
| | | Post-test | 27 | 63.81 | 7.42 | | | |
| RWA | Experimental-3 | Pre-test | 32 | 47.44 | 11.13 | 31 | -4.394 | .000 |
| | | Post-test | 32 | 60.16 | 9.23 | | | |
| | Experimental-6 | Pre-test | 25 | 48.28 | 8.84 | 24 | -4.935 | .000 |
| | | Post-test | 25 | 60.72 | 8.00 | | | |

***p<.05**

**Source:** Own source.

According to the analysis results presented in table 4, the EG method was found to be statistically significant in improving the students' attitudes towards the science course in both central ($t(27)=-5.242$, $p<.05$; $\eta^2=.50$) and rural ($t(20)=-5.501$, $p<.05$, $\eta^2=.60$) regions. Eta-squared effect sizes were calculated as .50 in the central and .60 in the rural, and these values were classified as a very large effect by Cohen (1988). Accordingly, it can be said that the variability observed in students' attitudes toward the science course originates from the EG method at a rate of 50% in the central and 60% in the rural areas.

It was determined that the RWG method is statistically significant in improving students' attitudes toward the science course in both central ($t(29)=-4.433$, $p<.05$, $\eta^2=.51$) and rural ($t(26)=-7.566$, $p<.05$, $\eta^2=.69$) regions. Eta-squared effect sizes were calculated as .51 in the central and .69 in the rural, and these values were classified as very large effects by Cohen (1988). Accordingly, it can be said that the variability observed in students' attitudes towards science course is due to the RWG method at a rate of 51% in the central and 69% in the rural areas.

It was determined that the RWA method is statistically significant in improving students' attitudes toward the science course in both central ($t(31)=-4.394$, $p<.05$, $\eta^2=.38$) and rural ($t(24)=-4.935$, $p<.05$, $\eta^2=.50$) regions. Eta-squared effect sizes were calculated as .38 in the central and .50 in the rural, and these values were classified as very large effects by Cohen (1988). Accordingly, it can be said that the observed variability in students' attitudes toward the science course originates from the RWA method at a rate of 38% in the central and 50% in the rural areas.

The findings of the fourth research question, aiming to determine which of the EG, RWG, and RWA methods are more effective in developing students' attitudes toward the science course, are given below. There are differences among students' attitudes towards the science course. The results of one-way ANOVA performed to determine whether these differences are statistically significant are presented in table 5.

**Table 5.** One-Way ANOVA Results of Data Obtained from SCAS

| Area | Measurement | Groups | Sum of Squares | Df | Mean Square | F | p |
|---|---|---|---|---|---|---|---|
| Central | Pre-test | Between Groups | 34.068 | 2 | 17.034 | .125 | .882 |
| | | Within Groups | 11819.532 | 87 | 135.857 | | |
| | | Total | 11853.600 | 89 | | | |
| | Post-test | Between Groups | 148.163 | 2 | 74.081 | .934 | .397 |
| | | Within Groups | 6898.993 | 87 | 79.299 | | |
| | | Total | 7047.156 | 89 | | | |
| Rural | Pre-test | Between Groups | 7.908 | 2 | 3.954 | .058 | .944 |
| | | Within Groups | 4690.092 | 69 | 67.972 | | |
| | | Total | 4698.000 | 71 | | | |
| | Post-test | Between Groups | 303.614 | 2 | 151.807 | 2.192 | .119 |
| | | Within Groups | 4779.664 | 69 | 69.270 | | |
| | | Total | 5083.278 | 71 | | | |

**Source:** Own source.

According to the analysis results given in table 3, there is no statistically significant difference among the attitudes of students before the application in the central ($F(2,87)=.125$, $p>.05$) and in the rural areas ($F(2,69)=.058$, $p>.05$). At the end of the application, it was determined that there was no statistically significant difference among the students' attitudes towards science course in the center ($F(2,87)=.934$, $p>.05$) and rural ($F(2,69)=2.192$, $p>.05$).

The findings of the fifth research question, aiming to determine the effects of the methods in developing students' attitudes towards school are given below. The analysis results of the dependent samples t-test performed to determine the effects of the methods on students' attitudes towards school are presented in table 6.

**Table 6.** Analysis Results of Dependent Samples t-test for Determining the Effect of Methods on Students' School Attitudes

| Methods | Groups | Measurement | N | M | sd | df | t | p* |
|---|---|---|---|---|---|---|---|---|
| EG | Experimental-1 | Pre-test | 28 | 19.29 | 4.13 | 27 | -6.290 | .000 |
| | | Post-test | 28 | 24.89 | 3.92 | | | |
| | Experimental-4 | Pre-test | 21 | 18.33 | 3.02 | 20 | -9.769 | .000 |
| | | Post-test | 21 | 26.00 | 3.26 | | | |
| RWG | Experimental-2 | Pre-test | 30 | 19.63 | 2.99 | 29 | -4.428 | .000 |
| | | Post-test | 30 | 23.00 | 3.03 | | | |
| | Experimental-5 | Pre-test | 27 | 19.37 | 4.20 | 26 | -3.350 | .002 |
| | | Post-test | 27 | 23.30 | 4.86 | | | |
| RWA | Experimental-3 | Pre-test | 32 | 19.72 | 3.43 | 31 | -2.812 | .008 |
| | | Post-test | 32 | 22.06 | 3.33 | | | |
| | Experimental-6 | Pre-test | 25 | 18.68 | 4.68 | 24 | -3.557 | .002 |
| | | Post-test | 25 | 22.44 | 3.62 | | | |

**Source:** Own source.

According to the analysis results given in table 6, the EG method was found to be statistically significant in improving the students' school attitudes in both central ($t(27)=-6.290$, $p<.05$, $\eta^2=.59$) and rural ($t(20)=-9.769$; $p<.05$; $\eta^2=.83$) regions. Eta-squared effect sizes were calculated as .59 in the center and .83 in the rural, and these values are classified as very large effects by Cohen (1988).

Accordingly, it can be said that the variability observed in students' school attitudes is caused by the EG method at a rate of 59% in the center and 83% in the rural areas. It was determined that the RWG method is statistically significant in improving students' school attitudes in both central ($t(29)=-4.428$, $p<.05$, $\eta^2=.40$) and rural ($t(26)=-3.350$, $p<.05$, $\eta^2=.30$) regions. Eta-squared effect sizes were calculated as .40 in the center and .30 in the rural, and these values were classified as very large effects by Cohen (1988). Accordingly, it can be said that the variability observed in students' school attitudes is caused by the RWG method at a rate of 40% in the center and 30% in the rural areas. It was determined that the RWA method is statistically significant in improving students' school attitudes in both central ($t(31)=-2.812$, $p<.05$, $\eta^2=.20$) and rural ($t(24)=-3.557$, $p<.05$, $\eta^2=.34$) regions. Eta-squared effect sizes were calculated as .20 in the center and .34 in the rural, and these values were classified as very large effects by Cohen (1988). Accordingly, it can be said that the variability observed in students' school attitudes is caused by the RWA method at a rate of 20% in the center and 34% in the rural areas.

The findings of the sixth research question aiming to determine which of the EG, RWG, and RWA methods is more effective in developing students' attitudes toward school, are given below. The results of one-way ANOVA performed to determine whether these differences are statistically significant are given in table 7.

**Table 7.** One-Way ANOVA Results of Data Obtained from ASS

| Area | Measurement | Groups | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|---|---|
| Central | Pre-test | Between Groups | 3.073 | 2 | 1.536 | .123 | .884 |
| | | Within Groups | 1083.150 | 87 | 12.450 | | |
| | | Total | 1086.222 | 89 | | | |
| | Post-test | Between Groups | 122.569 | 2 | 61.284 | 5.204 | .007* |
| | | Within Groups | 1024.554 | 87 | 11.776 | | |
| | | Total | 1147.122 | 89 | | | |
| Rural | Pre-test | Between Groups | 12.075 | 2 | 6.037 | .358 | .701 |
| | | Within Groups | 1164.536 | 69 | 16.877 | | |
| | | Total | 1176.611 | 71 | | | |
| | Post-test | Between Groups | 154.246 | 2 | 77.123 | 4.673 | .012* |
| | | Within Groups | 1138.740 | 69 | 16.503 | | |
| | | Total | 1292.986 | 71 | | | |

***p<.05**
**Source:** Own source.

According to the analysis results presented in table 7, there is no statistically significant difference among students' attitudes towards school before the application in the central ($F(2,87)=.123$, $p>.05$) and in the rural areas ($F(2,69)=.358$; $p>.05$). At the end of application, it was found that there is statistically significant difference among students' attitudes towards school in the central ($F(2,87)=5.204$, $p<.05$, $\eta^2=.107$) and in the rural areas ($F(2,69)=4.673$; $p<.05$, $\eta^2=.119$). As a result of Scheffe, one of the multiple comparison tests conducted to determine which groups have a significant difference, it was established that there is a significant difference in favor of the students who were applied the EG method between the students who were applied the EG and RWA methods in both regions. The eta-squared effect size is calculated for the center as .107 and for the rural as .119, and these values are classified as medium effect by Cohen (1988). Accordingly, it can be said that the variability observed in students' attitudes towards school originates from the methods applied in the center with a rate of 10.7% and in the rural areas at 11.9%.

## Discussion and Conclusion

At the end of the application, it was determined, first of all, that the EG, RWG, and RWA methods were statistically significant in improving students' social skills in both central and rural regions. The reason for this situation is that students transform social skills into behaviors such as sharing their ideas, helping each other, supporting their friends, obeying the rules, expressing their thoughts freely, making friends, and developing friendship relations while playing games and working in groups. Similarly, studies conducted at the middle school level concluded that the EG method improves students' social skills (Yıldız, et al., 2017) and collaboration skills (Bressler, 2014). Fanetti (2011), working at the undergraduate level, concluded that the EG method is not effective in social skills development, contrary to the results of this research. The contradiction between the results of this research using real environment games and the results of the research samples and games types. It can be said that games played

in a real environment enable students to interact and communicate more with each other than video games, and therefore they are more effective in improving students' social skills.

The results obtained in the researches conducted within the scope of mathematics courses at middle school (Arisoy & Tarim, 2013) and primary school (Koç, 2015) levels, showing that cooperative learning practices improve students' social skills, are similar to the results of this study. In parallel with the results of this research, the integration of the EG method with the group research method, which is one of the methods in the cooperative learning model, is effective in improving students' social skills (Yıldız, et al., 2017). Similar results were obtained in studies using different cooperative learning methods and techniques and in studies using the EG method integrated with these different methods and techniques. Although there are some differences in their implementation, it can be said that this is due to the fact that all cooperative learning methods and techniques are based on the same basic principles (Açıkgöz, 1992; Johnson & Johnson, 2014).

It was determined that there is no statistically significant difference between the social skills of the students who were applied the EG, RWG, and RWA methods. In all methods applied within the scope of the research, it can be said that the methods are equally effective in social skill development since the students' activities of communication, self-expression, sharing, and cooperation are performed intensively in the process.

Secondly, it was found that the EG, RWG, and RWA methods are statistically significant in improving students' attitudes toward the science course. This improvement can be attributed to the stress-free atmosphere created by the EG method and the reduced anxiety resulting from shared responsibility in cooperative learning. Supporting each other's learning, and sharing achievement or failures among group members also contributed to this positive outcome. The results obtained align with prior research indicating the effectiveness of the EG method applied at the middle school level in enhancing students' attitudes toward the course (Aymen-Peker, 2018; Çelik, 2017; Eltem, 2018; Gürpınar, 2017; Nunes, et al., 2018). Conversely, findings from this study contradict research suggesting that digital games (Zheng, 2012) and video games (Shapiro, 2016) at the middle school and undergraduate levels, respectively, are ineffective in improving students' attitudes. This difference may be attributed to the limited interaction in video and digital games compared to real-world environment games. Similarly, research results indicate that various cooperative learning methods applied at the middle school level are effective in improving students' attitudes toward the science course (Avcı, 2015; Topuz, 2014).

In his study, Kılıç (2016) concluded that, contrary to the findings of this study, cooperative learning does not influence students' attitudes toward the science course. The difference in the duration of this research might explain this discrepancy, as this study was conducted over 26 lesson hours, while Kılıç (2016) research lasted only 20 lesson hours. Similar to the results of this research, the combination of the EG method with the group research method, a cooperative learning approach, has proven effective in enhancing students' attitudes toward the science course (Yıldız, et al., 2018). It was determined that there was no statistically significant difference between the attitudes of the students who were exposed to the EG, RWG, and RWA methods concerning the science course. Within the scope of the research, it can be argued that all applied methods are equally effective in cultivating students 'attitudes toward the course, given that students' active participation in the process and learning through hands on experience are at the forefront.

Lastly, it was established that the EG, RWG, and RWA methods are statistically significant in improving students' attitudes toward school. This positive shift in students' attitudes can be attributed to their distance from anxiety and stress, their enthusiastic and willing engagement in the process, and their heightened interest and desire for learning. Regarding students' attitudes toward school, it was determined that there is a statistically significant difference in favor of the students who used the EG method, compared to those who were applied EG and RWA methods, in both central and rural areas. Given that learning in the EG method is more enjoyable than other methods, and

students' desire to play games is higher, their attitudes towards school may have experienced a more substantial increase than with the RWA method.

## Recommendations

The EG, RWG, and RWA methods can be applied to enhance the social skills and attitudes of students with low social skills and negative attitudes toward the course or school. Since the duration of application may influence the effects of the methods on variables, conducting similar applications for extended periods could allow for a more in-depth examination of their effects. The effects of the EG method can be compared with various cooperative learning methods, and the impact of the EG method integrated into different cooperative learning methods can also be assessed. When implementing the educational game method, it is explained at the beginning, and students should be prepared by participating in a sample game. Game rules should be explained at the beginning, and students should be prepared by participating in a sample game. Interim evaluations should be conducted, and concepts should be reiterated to underscore those taught in the game. Feedback should be provided on the reasons for students losing the game, informing them about concepts they may not have learned correctly. Students should be educated on essential elements of cooperative learning, such as positive commitment, collaborative actions in every situation, collective wins or losses, and the process should be monitored to prevent situations that could undermine the spirit of cooperative learning. When preparing students for collaborative work, group names, roles, and transformational group leaders can established to foster group awareness. However, it is crucial to monitor cases where all group members participate in evaluating each other's opinion, and ultimately reaching a joint decision.

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### *Data availability*

The datasets generated and analyzed during the current study are not publicly available due to confidentiality issues but are accessible upon reasonable request by researchers.

### *Ethical approval*

Approval was obtained from the ethics committee of the university to which the author was affiliated, confirming adherence to ethical rules in the study.

### *Informed consent*

Approved permission to participate in the study was obtained from the parents of the students.

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