

INVESTIGATING THE DIFFERENTIAL RELATIONSHIP BETWEEN THE
BIG FIVE DOMAINS OF SOCIAL AND EMOTIONAL SKILLS AND
MATHEMATICS ACHIEVEMENT USING OECD'S SSES

by

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*Dedicated to the strongest woman I have ever known, my lovely
grandmother, for all her love and support.*

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ABSTRACT

INVESTIGATING THE DIFFERENTIAL RELATIONSHIP BETWEEN THE BIG FIVE DOMAINS OF SOCIAL AND EMOTIONAL SKILLS AND MATHEMATICS ACHIEVEMENT USING OECD'S SSES

The goal of the study is to investigate the differential relationship between the social and emotional skills measured by the “big five” skill domains and mathematics achievement for socioeconomic status, gender, and level of SEL evaluation groups. For this purpose, the study used the OECD 2019 Survey data on social-emotional skills from Turkey. The OECD conceptual framework combines and integrates skills from different applied frameworks (Kankaraš & Suarez-Alvarez, 2019). Big five model of social and emotional skills consists of *task performance, emotional regulation, engaging with others, collaboration, and open-mindedness* (Kankaraš & Suarez-Alvarez, 2019). In the current study, the participants are 9th grade, 10th grade, and 11th grade students in Istanbul, Turkey. The results indicated that 8% of the variance in mathematics achievement ($R^2=0.077$) was explained by the social and emotional skills domains, especially with open mindedness, emotional regulation and engaging with other domains. Also, there is a differential relationship between mathematics achievement and social and emotional skills for boys and girls. The relationship between social and emotional skills and mathematics achievement is stronger for girls ($R^2=0.092$) than boys ($R^2=0.056$). On the other hand, the results showed that while for low level SES students this model explains 13% of the variance in mathematics achievement ($R^2=0.130$), for medium level SES students, it explains 9% of the variance in mathematics achievement ($R^2=0.091$). Furthermore, for high level SES group, the model explains 6% of the variance in mathematics achievement ($R^2=0.056$). Therefore, it can be stated that there is differential relationship between social and emotional skills and mathematics achievement for different levels of SES. Lastly, there is a differential relationship between the five domains SSES model and mathematics achievement for non-evaluated ($R^2=0.062$), informally evaluated ($R^2=0.080$) and formally evaluated ($R^2=0.091$) SEL groups. Overall, the findings suggest that grouping variables need to be taken into consideration to understand the relationship between the mathematics achievement and emotional skills.

ÖZET

OECD’NİN SSES ARAŞTIRMASI KAPSAMINDA ELE ALINAN SOSYAL VE DUYGUSAL BECERİLER VE MATEMATİK BAŞARISI ARASINDAKİ İLİŞKİNİN FARKLI GRUPLAR İÇİN İNCELENMESİ

Bu çalışmanın amacı, “büyük beşli” beceri alanı tarafından ölçülen sosyal ve duygusal beceriler ile matematik başarıları arasındaki farklı ilişkiyi sosyoekonomik statü, cinsiyet ve sosyal duygusal öğrenme değerlendirme grupları için araştırmaktır. Bu amaçla çalışmada, OECD 2019 sosyal duygusal becerileri ölçme anketinin Türkiye verileri kullanılmıştır. OECD kavramsal çerçevesi, farklı uygulamalı çerçevelerdeki becerileri birleştirir ve bütünleştirir (Kankaraş & Suarez-Alvarez, 2019). Büyük beşli sosyal ve duygusal beceri modeli, görev performansı, duygu düzenleme, başkalarıyla etkileşimde olma, iş birliği ve açık fikirlilikten oluşur (Kankaraş ve Suarez-Alvarez, 2019). Bu çalışmanın katılımcıları İstanbul’da bulunan 9, 10 ve 11. sınıf öğrencilerinden oluşmaktadır. Sonuçlar, matematik başarılarındaki varyansın %8’inin ($R^2=0.077$) sosyal ve duygusal beceri boyutları ile, özellikle açık fikirlilik, duygusal düzenleme ve başkalarıyla etkileşimde olma ile açıklandığını göstermiştir. Ayrıca, erkek ve kız çocuklarında matematik başarıları ile sosyal ve duygusal beceriler arasında farklı bir ilişki bulunmaktadır. Sosyal ve duygusal beceriler ile matematik başarıları arasındaki ilişki, kızlarda ($R^2=0.092$) erkeklere göre ($R^2=0.056$) daha güçlüdür. Diğer bir yandan, kullanılan model düşük sosyoekonomik statüdeki öğrencilerin matematik başarılarındaki varyansın ($R^2=0.130$) %13’ünü açıklarken, orta sosyoekonomik statüdeki öğrencilerin matematik başarılarındaki varyansın %9’unu açıklamaktadır ($R^2=0.091$). Ayrıca, kullanılan model yüksek sosyoekonomik statüdeki öğrencilerin matematik başarılarındaki varyansın %6’sını açıklamaktadır ($R^2=0.056$). Dolayısıyla farklı SES düzeyleri için sosyal ve duygusal beceriler ile matematik başarıları arasında farklı bir ilişkinin olduğu söylenebilir. Son olarak, değerlendirilmeyen ($R^2=0.062$), informal olarak değerlendirilen ($R^2=0.080$) ve formal değerlendirilen ($R^2=0.091$) sosyal duygusal öğrenme grupları için beş boyutlu SSES modeli ile matematik başarıları arasında da farklı bir ilişki bulunmaktadır. Genel olarak, bulgular matematik başarıları ile duygusal beceriler arasındaki ilişkiyi anlamak için gruplama değişkenlerinin dikkate alınması gerektiğini göstermektedir.

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LIST OF ACRONYMS/ABBREVIATIONS

CASEL	The Collaborative for Academic, Social, and Emotional Learning
CFA	Confirmatory Factor Analysis
OECD	Organization for Economic Cooperation and Development
SEL	Social and Emotional Learning
SEM	Structural Equation Modelling
SES	Socioeconomic Status
SSES	Study on Social and Emotional Skills

1. INTRODUCTION

In the recent decades, digitalization and globalization of the world has been accelerated with the increased demands of the population. This process brings with the development in the potentials individually and collectively. On the other hand, by means of the same factors, world has become more complicated, more unclear and more confusing. People require a balanced combination of cognitive skills, and social and emotional abilities in order to be successful in today's changing, and unpredictable environment. Therefore, education should not only provide instruction to students, but also need to equip them with a reliable and consistent guide, and the skills in order to confidently navigate this world (OECD, 2021). In this respect, development of both social and emotional skills and academic performance have been emphasized in many studies in recent years (CASEL, 2022; Durlak et al., 2011; Eroglu et al., 2021; Göl-Güven, 2022; OECD, 2021; Poropat, 2009; Sklad et al., 2012; Taylor et al., 2017; Uşaklı, 2017). The present study focuses on the differential relationship between the big five domain of students' social and emotional skills and mathematics achievement for socioeconomic status groups, gender groups, and level of SEL evaluation groups.

1.1. Social and Emotional Learning

In the history of social and emotional learning, first formal definition of emotional intelligence was provided by Salovey and Mayer (1990, p.189) as “The ability to monitor one's own and others' feelings, to discriminate among them, and to use this information to guide one's thinking and action.”. After the description of Salovey and Mayer, Goleman's (1995) Emotional Intelligence book and theory is accepted as the basis of the studies in the field of social and emotional learning (Elias 2004; Elias et al., 1997; Elias & Moceris, 2012; Vadeboncoeur & Collie, 2013). According to Goleman (1995), emotional intelligence (EQ) is defined as the ability to motivate oneself, persevere, delay gratification, regulate emotions, control stress in case of problems, empathize, and be optimistic. Also, EQ was classified into five components as self-awareness, self-regulation, motivation, empathy, and social skills (Goleman, 1995).

In the following years, the model of Mayer and Salovey was redefined with four branches: perceiving, understanding, using, and managing emotions (Mayer & Salovey, 1997). Their studies and definitions are accepted as the foundations of emotional learning and many theories in the field of social and emotional learning (Uşaklı, 2017). With the increasing importance about emotional intelligence theories and studies in digitalizing, changing and complexing world, the social and emotional skills (SES) and social and emotional learning (SEL) have been highlighted by researchers from almost three decades.

Social and emotional skills have been defined from many perspectives in the literature. As one of the major definition, Elias et al. (1997) described social and emotional skills as the characteristics required for people to adapt to social life, understand and control their emotions, and express themselves in accordance with these characteristics. From the point of view of Gueldner, Feuerborn, and Meller (2010), social and emotional skills are the framework to develop and integrate the skills like positive self-development, prevention of violence, character education, protective mental health, etc.

Moreover, SEL is seen as an integral piece of the educational and social development. In recent studies, one of the most widely used definition was made by the Collaborative for Academic Social Emotional Learning (CASEL, 2020, p.1) as follows: "Social-emotional learning is the process through which all young people and adults acquire and apply the knowledge, skills, and attitudes to develop healthy identities, manage emotions and achieve personal and collective goals, feel, and show empathy for others, establish and maintain supportive relationships, and make responsible and caring decisions."

Researchers suggest that SEL is also crucial to individuals' long-term progress in and out of school, and to prepare them for today's diverse and complicated world, and it demands careful, continuous attention throughout their educational careers (Bridgeland et al., 2013; DePaoli et al., 2017; Weissberg et al., 2015). Also, CASEL accepted SEL as the most crucial part of educational and individual development and provided a CASEL wheel with five model (CASEL, 2022).

1.1.1. CASEL's Five Model

CASEL's model inscribed five interrelated and broad areas of social and emotional skills which are self-consciousness, self-management, relationship abilities, social consciousness, and responsible decision-making (CASEL, 2022). It is claimed that these abilities will enhance students' academic success, positive social behaviors, and social relations by preparing them to successful college, business, family and society lives during their educational career while decreasing mental stress and behavioral issues (Elias, 2014; Jones & Kahn, 2017). Also, expression and improvement of social and emotional skills over the years are SEL's some of the developmental approaches in the model.

In the light of school, family, and community cooperation, SEL improves equality and quality in education in order to create collaborative and reliable learning environments, meaningful, reflective, and appropriate instruction and curriculums (CASEL,2022). It also helps to address different forms of inequality and direct individuals to make contributions to create a healthy, safe, and fair community.

1.1.1.1. SEL in Classroom Environment. According to studies by CASEL (2022), social and emotional skills can be developed by means of different classroom-based approaches. Explicit teaching methods in which social and emotional competencies are covered and practiced in developmental, contextual and cultural, ways are the first strength of SEL in the classroom environment (CASEL, 2022; Uşaklı, 2017). Secondly, cooperative and project-based teaching practices are accepted as effective classrooms. Lastly, academic curriculum of subject areas combined with SEL is another classroom-based approach. In this respect, four components of well-qualified SEL education are defined by CASEL (2022) as sequenced, active, focused and explicit.

1.1.1.2. SEL in School Environment. Efficient SEL integration throughout the school requires progressive planning, application, assessment, and sustained development by all participants of school society. Successful SEL applications not only contribute to all members of school community but also rely on the respectful, supportive, and engaging school climate. Therefore, by means of SEL programs and practices, schools can create an environment that supports students socially, emotionally, and academically with sense of belongings (CASEL, 2022; Eroglu et al., 2021; OECD, 2021; Usaklı, 2017).

1.1.1.3. SEL in Family Environment. First of all, individuals start to gain insights into the culture, facts, behaviour, attitude and experiences in their families (Bandura, 1969; Vygotsky, 1978). Therefore, their perspectives and backgrounds are crucial to support and collaborate with SEL programs. It was indicated that the efficiency of SEL programs is getting higher when school-family partnership exists with compatible values, norms, and cultures (CASEL, 2022; Uşaklı, 2017).

1.1.1.4. SEL in Community. Community partners frequently offer secure and developmentally rich environments for learning and development. Also, they have a profound understanding of the cultural needs and values, and relationships with alternative supports and services that schools and families' demand. In order to combine SEL programs both in and out of school, community partners and schools need to work with collaboratively and coordinately (CASEL, 2022).

1.1.2. Importance of Social and Emotional Learning and Skills

In today's globalized and digitalized era, the whole world including the countries and people has been connected to increase the potential of humankind individually and collectively. Therefore, in such a complex, ambiguous, and diverse world, education serves not only for teaching students about specific subject areas academically but also for improving abilities to fulfil life expectations and success in the long term (OECD, 2021). It is argued that focusing only on the cognitive skills of students is not sufficient for the required and desired individual behaviour and labour market expectations. Thus, Elias et al. (1997) suggested that social and emotional skills provide mainly required behaviours like emotional control, empathy, responsibility, caring, stress resilience, and risk taking for

students. In the light of the changes made in education systems, particularly since the 2000s, it is apparent that the importance of social and emotional skills that enhance academic capabilities has increased (Candeias, Cristovao, & Verdasca, 2020).

Social and emotional skills support students in various aspects with multidimensional benefits. Various significant life outcomes, including academic achievement, profession, health, and individual well-being, are strongly influenced by social and emotional skills, as indicated by a considerable body of evidence (Kankaraš, 2017; OECD, 2015). A study about social and emotional skills examined the significance and advantages of these skills in different parts (Eroglu, Suna, Taskırec, & Yasaran, 2021). According to the report of Eroglu, Suna, Taskırec, and Yasaran (2021), the parts which represent the importance and benefits of social and emotional skills in learning are listed as facilitating learning, adaptation to innovations, supporting disadvantaged students, reducing behaviour problems, and responding to changing employment demands.

1.1.2.1. Facilitating Learning. According to researchers, social and emotional skills have a direct impact on the learning-teaching process (CASEL, 2022). For instance, McCollow and Hoffman (2019) demonstrated that the delays in the social and emotional development of the students have negatively affected all their cognitive skills. Also, according to studies, students who cannot interact with their environment, struggle to articulate their emotions, and lack empathy and a decision-making mechanism, have difficulty in developing cognitively and adapting to their environment (Horan, 2020).

Similarly, it is emphasized that when these skills are not compensated for, students who show insufficient social and emotional development may reduce their academic success, their well-being may be adversely affected and they will not be able to adapt to the classroom adequately (McCollow & Hoffman, 2019; Schoeps et al., 2018). In addition, it becomes difficult for learning to be permanent in case of insufficient social and emotional skills (Ashdown & Bernard, 2012). In this respect, it is clear that social and emotional skills have a significant influence on facilitating learning.

1.1.2.2. Adaptation to Innovations. Today's socio-economic climate provides a series of challenges that require individuals to manage complexity and diversity in their private, work, and social lives (Eroglu et al., 2021). According to OECD (2021), these challenges are likely to be met by people with extensive cognitive, social, and emotional skills. Moreover, Cristovao et al. (2020), argued that today's students will need to be able to adapt to an unpredictable future, collaborate with individuals from diverse backgrounds, solve issues cooperatively, and come up with creative solutions to new difficulties. Therefore, individuals with developed social and emotional skills are more flexible and more open to interactive processes, able to better adapt to rapidly changing business and life conditions.

1.1.2.3. Supporting Disadvantaged Students. Studies demonstrated that individuals with developed social and emotional competencies are more likely to have better academic performance and professional opportunities (Cristovao, Candeias, & Verdasca, 2020; Jones, Greenberg, & Crowley, 2015). Additionally, they are less likely to commit violence or crime, more likely to be pleasant, and generally more willing to be active members of society (Metzger et al., 2018; OECD, 2021). On the other hand, students with poor social and emotional abilities are more inclined to be involved in antisocial behaviours, have learning difficulties, and drop out of school (Hukkelberg et al., 2019; Wang et al., 2016). Students from disadvantaged backgrounds may not have sufficient opportunity to acquire these abilities, as they are frequently less likely to receive adequate support from their environment. Therefore, the statement was supported with that there is a significant relationship between student academic success and the level of education, profession and income level of the family, known as socioeconomic status (Heyneman & Loxley, 1983; Savaş et al., 2010).

Moreover, students from more advantageous background are generally more successful in school, while children from poor families are more at risk of academic failure (Sirin, 2005). Furthermore, there are limited possibilities for socializing in a low socioeconomic status environment. Young people in this environment are more vulnerable to the stresses of low SES and experience more academic and social difficulties (Kabakcı & Korkut, 2008). This is an indication of a significant problem in education equality and has the potential to increase existing disadvantages. Therefore, social and emotional skills

needed to be organized and developed more by authorities for low SES in order to support disadvantages students.

1.1.2.4. Reducing Behaviour Problems. Studies showed that behavioural problems that occurred during school years might be related to students' social and emotional skills as well as their academic skills (Dymnicki, Sambolt, & Kidron, 2013; Moreira, et al., 2014). According to their arguments, social and emotional skills serve as a protective factor in case of risky situations like substance use, violent behaviour, and school dropout. It is believed that students with these abilities would be able to better analyze the threat posed by the circumstances to themselves and their peers, avoid risky situations, and take the required actions to prevent such risks from reoccurring. Therefore, skills such as sense of responsibility, empathy, and emotional regulation skills play a significant role in keeping students away from such risky situations.

1.1.2.5. Responding to Changing Employment Demands. In recent years, as a result of the rapid development in automation technologies and production technologies based on artificial intelligence, the definition of professions has been changing and professions whose existence was not predicted until a short time ago are emerging (OECD, 2019). Today's employment demands involve more cooperation to provide services to more heterogeneous groups of people. Therefore, cognitive skills have become insufficient to manage all these processes. In today's business environment, in addition to cognitive skills, social and emotional skills play an effective role to fulfil employment demands (Deming, 2015).

A recent study focusing on employment strategies in labour markets revealed that cognitive and social skills are more effective than education time in estimating the production capacity of individuals (Acosta & Muller, 2018). In the same study, it was provided that cognitive skills are more strongly associated with salaries, although social skills are more crucial in terms of labour force participation. Thus, social and emotional skills have a critical impact on an individual's employability.

1.2. Measuring SEL

In order to develop effective teaching strategies and learning outcomes of social and emotional skills, assessment and evaluation of SEL is a significant part of developing these skills because assessment is an integral part of understanding a construct (Agliati et al., 2020). Researchers, instructors, and policymakers from various nations believe that a comprehensive assessment system in SEL should be implemented in order to promote student success and performance. According to Agliati et al. (2020), like the other areas of learning, social and emotional competencies needed to be assessed to promote student learning at school. They argue that appropriate assessment procedures may help learners in tracking their own development, provide them with feedback on their performance, and guide teachers on which teaching strategies should be implemented.

CASEL (2019) asserted that the assessment in SEL can be beneficial for schools and communities to;

- Create common understanding and language for social and emotional learning.
- Enhance comprehension of the development in SEL capabilities of students over time.
- Enhance SEL education and program application constantly.
- Assess the efficacy of SEL programs and approaches.
- Provide equitable results in education.

Assessment of SEL can be conducted by a variety of respondents and in a variety of ways to have valid and reliable results about the social and emotional skills of students (Sutton, 2021).

Sutton (2021) argued that SEL assessment can be conducted by the combination of four perspectives as student-reported, teacher-reported, parent-reported, and direct-reported. Student-reported assessment means that students provide a self-reflection about their well-being sense and their own skills. In teacher-reported assessment, teachers provide a report about their students' social and emotional competencies since instructors' perceptions and reports may critically predict students' skills and long-term outcomes. On the other hand, parents' reports about their children provide a good opportunity to learn and assess the

students' skills outside the school environment. Another method to assess these abilities is direct-reported assessment in which students complete the number of different activities or interact with a game or application that may be used to assess their social and emotional abilities. Students are not asked about their social and emotional abilities, but their responses to tasks are indicative of their social and emotional skills (Sutton, 2021).

All in all, in the combination of different forms of assessment about SEL, learning and teaching programs and strategies can be developed to improve social and emotional skills of students and provide better and more successful academic lives, careers, and life outcomes. Despite the significance of assessment of SEL, there are currently few large-scale worldwide research on social and emotional abilities. However, researchers, authorities, and practitioners have paid more attention to this area because of increasing awareness of its significance, particularly in future living and working settings (Kankaraš & Suarez-Alvarez, 2019). In recent years, The Organization for Economic Co-operation and Development (OECD) which mainly conduct the international comprehensive assessment of cognitive abilities like literacy and numeracy has attached importance to assessment of social and emotional skills, too (Kankaraš & Suarez-Alvarez, 2019).

1.2.1. Organization for Economic Co-operation and Development (OECD)

After World War II, in 1948, for the reconstruction and recovery of Europe, The Organisation for European Economic Co-operation (OEEC) was established to manage the financial support coming from America and Canada to Europe called as Marshall Plan. In 1961, OEEC was transformed into OECD with the aims of contributing to economic expansion and the world economy by increasing living standards, maximum sustainable development of the economy, and employment with financial stability in member as well as non-member countries (OECD, 2022). The OECD works with governments, international organizations, policy makers, authorities, labour, and civil community to create international standards to the individuals and providing solutions to the global issues such as well-being, education, equality, agriculture, and climate change, etc.

According to the current data of OECD (2022), 38 countries, Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia,

Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, have worked together as the member countries of OECD organization. Also, Brazil, China, India, Indonesia, and South Africa are the key partners of OECD organization.

Educational studies conducted by the OECD, containing the Programme for International Student Assessment (PISA), the International Early Learning and Child Well-being Study (IELS), and the Survey of Adult Skills (PIAAC) are mainly concerned with cognitive skills, such as literacy and numeracy. In recent years, The OECD recognizes the significance of social and emotional competencies and is extending the measurements beyond traditional academic fields such as reading and writing (Kankaraš & Suarez-Alvarez, 2019).

1.2.2. OECD's Study on Social and Emotional Skills

Social and emotional skills are defined by OECD as: “...*individual capacities that can be (a) manifested in consistent patterns of thoughts, feelings and behaviours, (b) developed through formal and informal learning experiences, and (c) important drivers of socio-economic outcomes throughout the individual's life*” (OECD, 2015, p. 35).

The OECD's study on social and emotional skills is the most comprehensive international study in the field of SEL with 10 cities from 9 countries. The aim was to develop and offer a conceptual structure for the Social and Emotional Skills' Study, which attempts to shed lights on personal, family, and school factors that promote or prevent the development of these skills across diverse student demographics and contexts (Kankaraš & Suarez-Alvarez, 2019). The current conceptual framework of Kankaraš and Suarez-Alvarez (2019) contains the merged and integrated competencies from other applied frameworks, focusing on the Big Five model's underlying skills that are indicative of positive life consequences. To ensure that the sub-dimensions of social and emotional skills are comprehensively addressed, 15 skills were included in the five domains of Big Five Model.

In the OECD's SSES, in order to investigate the factors that encourage or prevent the development of these essential skills, an international survey which examines the skills of two age groups (10- and 15-years old students) in 10 cities, "*Bogota, Daegu, Helsinki, Houston, Istanbul, Manizales, Moscow, Ottawa, Sintra, and Suzhou*", from various countries is used (OECD, 2021, p.12). In addition to measuring these skills of students, OECD's study investigates a various environmental factor, such as students' socio-demographic structure, family, school and social environment, and broader sociocultural surroundings by means of context-specific surveys from students, parents, teachers, and school principles (OECD, 2021).

1.2.2.1. Big Five Model of OECD's SSES. The structure of OECD's study on social and emotional skills is called as Big Five model. Main domains of the model are "*task performance, emotional regulation, engaging with others, collaboration, and open-mindedness*" (Kankaraš & Suarez-Alvarez, 2019, p.17). In the assessment framework of the OECD's study on social and emotional skills, these five domains are defined as below:

- **Task-performance:** Task performance, also known as conscientiousness, is defined as the ability to be self-controlled, responsible to others, persistent, motivated to achieve, confident, organized, and principled (Kankaraš & Suarez-Alvarez, 2019). It has three subdimensions which are self-control, responsibility, and persistence. Definition of self-control is provided as "*ability to control impulses, delay gratification and maintain concentration*"; responsibility is decided as "*following through with promises to others*"; and persistence is stated as "*persevere in tasks and activities, hard to distract*" (Kankaraš & Suarez-Alvarez, 2019, p. 34).

- **Emotional regulation:** "*The ability to deal with negative emotional experiences and stressors and is central to managing emotions*" (Kankaraš & Suarez-Alvarez, 2019, p. 36). Subdimensions of emotional regulation are defined as stress resistance which is "*effectiveness in modulating anxiety and response to stress*", and emotional control which is "*keeping the emotions and temper under control*", and optimism which is "*positive expectations for self and life*" (Kankaraš and Suarez-Alvarez, 2019, p. 36).

- Engaging with others: Engaging with others known as extraversion was defined as *“the ability of enjoying and excelling in the company of others”* (Kankaraš & Suarez-Alvarez, 2019, p. 37-38). In the sub-dimensions of engaging with others, energy means the tendency of an individual to pursue daily tasks with enthusiasm, energy, and spontaneity. Assertiveness refers to tendency to have leadership role, dominance, and self-confident behaviours. Last sub-dimension of the skill is sociability which is the ability to sustain social interactions (Kankaraš & Suarez-Alvarez, 2019, p. 37-38).

- Collaboration: *“The ability to collaborate with others translates into stronger relationships, more pro-social behaviours and, among children, fewer behavioral problems.”* (Kankaraš & Suarez-Alvarez, 2019, p. 39.). Collaboration consists of three subdimensions which are empathy, cooperation, and trust. Empathy is defined as *“perspective taking and empathic concern for others well-being”* (Kankaraš & Suarez-Alvarez, 2019, p. 39). In the OECD’s assessment framework of SSES (2019), cooperation is described as the peaceful co - existence with others and the meaning of trust is provided as tendency to have good intentions and assumptions about others’ acts and beliefs in a trustful way.

- Open-mindedness: *“The ability to explain and understand the behaviour of individuals in settings characterised by high levels of uncertainty and change”* (Kankaraš & Suarez-Alvarez, 2019, p. 40). Curiosity, creativity, and tolerance are classified as the subdimensions of open-mindedness domain. Curiosity includes the passion for ideas and learning, and intellectual discovery. Creativity represents generating innovative ways to come up with a solutions and products. Another subdimension tolerance is defined as openness to different perspectives, diverse values and embracing individuals from different cultures and backgrounds (Kankaraš & Suarez-Alvarez, 2019).

1.3. The Relationship Between SEL and Mathematics Achievement

Mathematics is an essential component of human thought and reasoning, as well as the fundamental part of our attempts to comprehend the environment and ourselves. It provides an efficient strategy for improving mental discipline and logical reasoning. Moreover, in the process of comprehending the content of other academic disciplines,

including science, social studies, music, etc., mathematical understanding have an essential role. Therefore, mathematics achievement is highly prioritized all around the world. In order to provide effective instructional strategies, increase the achievement in mathematics and create positive attitudes and perspectives toward mathematics, various programs have been developed in many countries (Bhoumick & Saha, 2020; Göl-Güven, 2021). Promoting Alternative Thinking Strategies (PATHS), Incredible Years (IY), Lions Quest Life Skills (LQLS), Second Step, My Teaching Partner (MTP), I Can Problem Solve (ICPS), Conjoint Behavioral Consultation, Parent-Teacher Action Research Team, Family Check-Up with School Intervention, and Caring School Community are some of the applied SEL programs all around the world (Bayındır, 2021; Göl-Güven, 2021; Özgünlü, 2021). In Turkey, mostly “*Second Step*” and “*Lions Quest Life Skills*” programs are utilized by some of the private schools. It is reported that SEL programs provide improvement in social and emotional skills, less behavior problems, higher academic performance, increase in life-satisfaction, more cooperative behavior, and more self-efficacy on students (CASEL, 2015; Durlak et al., 2016; Frey et al., 2005; Grossman et al., 1997; Özgünlü, 2021).

Researchers argued that integration of SEL programs into mathematics education and teaching practices provide effective instructional strategies and a supportive classroom environment (Jennings & Greenberg, 2009). Such a supportive environment during the learning process develops interactive discussions, inquiry-based learning which foster academic success (Ottmar, RimmKaufman, Larsen, & Berry, 2015). The quasi-experimental study of Bhoumick and Saha (2020) revealed that students who received SEL in their mathematics instruction demonstrate considerably developed learning performance in mathematics and attitude towards mathematics. Moreover, Poropat (2009) conducted a meta-analysis about the relationship between academic performance and five factor model of personality. He reported that correlations with academic achievement and five personality factors were significantly moderated by grade levels, and participants’ age levels (Poropat, 2009). With the exception of conscientiousness, correlations of student achievement with each of the five component measures (agreeableness, extraversion, emotional stability, and openness) is found to be decreased as educational level and age increased (Poropat, 2009). However, he could not provide findings about the correlation between mathematics achievement and big five domain of social and emotional skills because academic performance data of his study derived from general GPA of the participants. Also, his

findings mostly highlighted the correlations between the differences in age levels and academic performance with respect to five factor model.

The relationship between SEL and math achievement might be different for various groups. Especially factors related to achievement might moderate the relationship between SEL and math achievement. Socioeconomic status is found to be related with mathematics achievement in many studies. Some researchers conducted the studies about the relationship between the socioeconomic status and academic performance of Turkish students in Program for International Student Assessment (PISA) data (Arıkan, 2018; Alacacı & Erbas, 2010; Dolu, 2020; Sarı, Arıkan & Yıldızlı, 2017; Arıkan, Van de Vijver & Yagmur, 2017). Arıkan (2018) stated that in countries with low and medium levels of development, socioeconomic status positively predicted problem-solving skills according to PISA 2012 data. Similarly, Alacacı and Erbaş (2010) stated that students' socioeconomic background has positive relationship with mathematics performance. Also, Sirin (2005) found that family income and parents' education level have an impact on students' performance. Moreover, immigrant students with high socioeconomic status index have better achievement scores in PISA 2009 reading test and PISA 2012 mathematics tests (Arıkan, Van de Vijver & Yagmur, 2017). All in all, they all argue that there is a statistically significant correlation between socioeconomic background and achievement level, however, their investigations do not include social and emotional skills variables.

Moreover, gender is found to be related with mathematics achievement. Therefore, gender differences in mathematics performance have been examined in various studies (Alacacı & Erbas, 2010; Hyde et al., 1990; Sirin, 2005). They argued that gender makes differences in the favour of boys in mathematics achievement. Therefore, investigation of the relationship between the SSES scores measured by big five domain model and mathematics achievement for boys and girls may provide valuable insights in this study.

However, there is a lack of study in the field of the differential relationship between the mathematics achievement and social emotional skills and learning for different groups of SES and gender. Therefore, the study aims to make contributions to the field by examining differential relationship between the mathematics achievement and SSES scores for different groups of SES and gender.

1.4. Significance of the Study

This study aimed to investigate the differential relationship between social and emotional skills scores measured by the big five domain and mathematics achievement in Turkey. The differential relationship was investigated for socioeconomic status groups, gender groups, and level of SEL evaluation groups.

In recent years, the relationship between social and emotional skills and academic success have been investigated in many studies from different aspects (Durlak et al., 2011; Poropat, 2009; Sklad et al., 2012; Taylor et al., 2017). They all argue that well-organized and implemented social and emotional learning programs provide better social and emotional skills and academic performance. However, their findings depend on the meta-analyses of various studies derived from different countries except Turkey. Therefore, the current study focuses on the data from Turkey analyzed the differential relationship between the social and emotional skills and mathematics performance of students.

In the OECD report, the relationship between the fifteen subdimensions of the big five domain and school performance were provided by using regression analysis (OECD, 2022). However, in the current study, big five domain skills were analyzed to predict the mathematics achievement by means of confirmatory factor analysis and structural equation model focusing on the differential relationship for various groups.

All in all, the current study is unique because it is one of the pioneer studies which investigate the differential relationship between social and emotional skills scores measured by the big five domain and mathematics achievement for socioeconomic status groups, gender groups, and level of SEL evaluation groups in Turkey. Investigating and reporting the differential relationships for SES groups is significant to identify whether the relationship holds for all groups or shows different pattern for some groups. For instance, findings of differential relationship for disadvantaged students might guide stakeholders to propose specific policies. Thus, the results may help authorities to take necessary actions for the differentiated needs of boys and girls. Moreover, the results may help policymakers to explain the importance of SEL evaluations in school environment to provide better academic success with developed social and emotional skills.

1.5. Rationale and Theoretical Framework of the Study

The relationship between personality characteristics and academic achievement has been a subject of discussion throughout the 20th century. Preliminary studies focused on the relationship between academic success and a broad personality attribute known as perseverance of motives (Webb, 1915). In time, studies have examined the connections between academic success and the personality dimensions described by Cattell (1973) and Eysenck (1970) in their various theories of personality structure. The most current theoretical approach in the field of academic success and personality characteristics is Five Factor Model of personality which were comprised of “Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness” (O’Connor & Paunonen, 2007). Most of the recent studies about the relationship between personality skills and academic achievement have conducted within the framework of Five Factor Model (O’Connor & Paunonen, 2007; Poropat, 2009). These studies and many meta-analyses have provided that Five Factor Model of personality traits predict the academic performance in some levels (Ashton, 2001; O’Connor & Paunonen, 2007; Poropat, 2009). Therefore, theoretical framework of the current study depends on Five Factor Model of personality which is improved by OECD as the “Big Five Factor of Social and Emotional Skills”.

In this context, the current study suggested an argument to investigate in the field of the relationship between big five factor of social and emotional skills and academic performance. If subdimensions of big five factor of social and emotional skills predicts the mathematics performance (CASEL, 2022; Eroğlu et al. 2021; OECD,2021), big five factor of these skills can also predict mathematics achievement in various levels for different groups which are gender, socioeconomic status. Many research stated that there is a gender difference in mathematics achievement (Erdoğan, 2002; Kabakçı, 2006; Yurdakavuştu, 2012). Also, individuals from different socioeconomic background have different levels of academic success and social and emotional skills (Alacacı & Erbaş, 2010; Arıkan, 2016; Aslanargun et al., 2016; Dolu ,2020; Erkan. 2011; Heyneman & Loxley, 1983; Sirin, 2005). Therefore, there may be differential relationship between big five factor of SSES and mathematics achievement for gender and socioeconomic status groups.

On the other hand, assessment of SEL can promote student success and performance by developing effective learning environment and strategies (Agliati et al., 2020; CASEL, 2019; Kankaraš & Suarez-Alvarez, 2019). Therefore, another argument of the current study is to examine the relationship between social and emotional skills and mathematics achievement for different level of SEL evaluation groups.

1.6. The Purpose of Study

Scholars reported that students' social and emotional skills have a relationship with academic performance (CASEL, 2022; Eroglu et al., 2021; OECD, 2021). Also, studies reported that different levels of socioeconomic status are related with students' mathematics achievement (Alacacı & Erbas, 2010; Arıkan, 2018; Dolu, 2020). Moreover, in accordance with the collected data of OECD, it can be stated that while some schools do not evaluate social and emotional skills, others provide informal or formal evaluation of these skills to monitor students' development (OECD, 2019). Therefore, evaluation levels of social and emotional skills as non-evaluated, informally evaluated and formally evaluated may differentiate the relationship between SEL and math achievement. Thus, the purpose of this study is to investigate the differential relationship between the social and emotional skills measured the "big five" domains and mathematics achievement for different levels of socioeconomic status, gender groups, and level of SEL evaluation groups.

1.7. The Research Questions

The research questions of the study:

- (i) To what extent the big five domains of SSES- task performance, emotional regulation, engaging with others, collaboration, open-mindedness-could predict mathematics achievement?
- (ii) Is there any differential relationship between the SSES scores measured by big five model and mathematics achievement for boys and girls?
- (iii) Is there any differential relationship between the SSES scores measured by big five model and mathematics achievement when socioeconomic status is taken for low, medium, and high levels?

- (iv) Is there any differential relationship between the SSES scores measured by the big five model and mathematics achievement for students who are not evaluated, informally evaluated, formally evaluated in social and emotional skills at their school?

2. LITERATURE REVIEW

2.1. Social and Emotional Learning Studies

With the increasing demand to develop social and emotional skills as well as cognitive skills in today's complicated world, SEL programs have already been carried out in many schools to fulfil the demand (Humphrey, 2013; Weissberg & Cascarino, 2013). Therefore, the efficiency of SEL programs and their consequences have been investigated by the studies of educators and policy makers (Mahoney et al., 2018).

In the meta-analysis of Durlak, Weissberg, Dymnicki, Taylor, and Schellinger (2011), results from 213 school-based and universal SEL programs containing the data provided by 270,034 K-12 students were examined. Their findings were highlighted in two major parts: development in social and emotional skills and higher academic performance. On the contrary of control students, students involved in SEL programs demonstrated considerably higher positive outcomes with developed social and emotional skills, positive and social attitudes and behaviours, and decreasing levels of emotional problems and psychological stress (Durlak et al., 2011). Also, according to the meta-analysis of Durlak, Weissberg, Dymnicki, Taylor, and Schellinger (2011), students involved in SEL programs increased their achievement gains as 11 percentile points which means that SEL programs provide higher academic performance.

After the first meta-analyses, researchers conducted more meta-analyses to evaluate the efficiency of SEL programs (Sklad et al., 2012; Taylor et al., 2017). Sklad, Diekstra, Ritter, and Ben (2012) examined data from 75 studies of school-based universal programs which were published between 1995 and 2008. 72 of these studies were published in journals with peer review, and three of them were progress reports. The reported average group size for interventions was 543 participants, the lowest intervention group included 13 students (one classroom), and the biggest intervention group included 8,280 students (Sklad et al., 2012). Key findings indicated that global school-based programs investigated in 75 experimental or quasi-experimental research over these 13 years have generally positive impacts on a variety of desired outcomes which comprise social and emotional skill

development, positive self-esteem, social attitudes and behaviours, decrease or avoidance of aggressive behaviour, mental problems, and diseases, and enhancement of school performance (Sklad et al., 2012).

Taylor, Oberle, Durlak, and Weissberg (2017) conducted a meta-analysis of follow-up effects in order to promote Positive Youth Development (PYD) by means of school-based interventions of social and emotional skills. In the meta-analysis, results from 82 school-based and universal SEL programs containing the data provided by 97,406 K-12 students were evaluated. The student body was culturally, socioeconomically, and geographically varied. 41 interventions took place in urban school districts, 8 in suburban school regions, 9 in rural areas, and 5 in a mixture of these settings. Fourteen of the programs primarily involved children from low-income and working-class households; in nine research, the majority of the children were from middle- and upper-class households, but in the remaining 28 studies, the sample of the students were socioeconomically mixed with no prevalent socioeconomic status. There were five significant key findings in the evaluation of this meta-analysis. First of all, students who participated in school based SEL programs demonstrated considerable positive improvements in seven outcomes gathered between 56 and 195 weeks after program participation, on average. The dual effects of SEL treatments on both positive and negative aspects of well-being reflected as a second key discovery. Thirdly, the social and emotional competencies fostered by SEL can promote the positive impact of children from diverse family and geographic backgrounds. Fourth finding is that developing diverse social and emotional skills relates to a substantial improvement in the long-term adjustment of students. The last finding included the favourable impacts on several additional crucial developmental consequences such as enhancing future social relations and, improving the rate of high school graduation (Taylor et al., 2017).

With respect to the findings, their studies all agreed that well-organized and applied SEL programs provide higher social and emotional skills and academic performance (Mahoney et al., 2018).

2.2. Five-Factor Personality Model and Academic Achievement

Poropat (2009) implemented a meta-analysis of studies demonstrating relationships between personality and academic performance depending on Five Factor Model (FFM) of personality which consists of agreeableness, conscientiousness, emotional stability, extraversion, and openness. In this meta-analysis, at the end of searching and inclusion process of databases, 80 study reports (63 of them is published articles and 17 of them is unpublished dissertations) including comprehensive sample size with over 70,000 students were used to analyze. This meta-analysis has a strong predictive capacity for academic success on a statistical level (Poropat, 2009). Sample sizes of the studies were derived from the levels of primary, secondary, and tertiary education. In the coding process of the meta-analysis, academic performance of participants was represented by GPA scores of them. Also, American College Test and Scholastic Aptitude Test (SAT) scores were coded as the measure of intelligence. Effect size of *Cohen's d* was used to make the results of the study meaningful (Poropat, 2009). Cohen's *d* effect size can be defined as small around 0.2, medium around 0.5, and large around 0.8 (Cohen, 1988). Therefore, according to the results, correlation between the academic performance and conscientiousness can be accepted as medium effect size ($d=0.46$).

On the other hand, relationship between the academic achievement and openness ($d=0.24$) and agreeableness ($d=0.14$) can be seen as small-effect size while emotional stability (0.03) and extraversion (-0.02) had minor effects. However, the considerable interaction between academic level and age created complicated patterns of personality-academic achievement correlations. One possible reason for such differences was argued as the validity of personality and academic achievement measurements due to the inconsistency of young children's self-reports. Therefore, in the meta-analysis (Poropat, 2009), it was claimed that the correlations between the academic achievement and FFM is directly associated with the age and education levels. All in all, in the study of Poropat (2009), it was clearly stated that personality is related to academic achievement. Therefore, in this study, investigation of the relationship between the big five domains of social and emotional skills defined by OECD (2019) and mathematics achievement may provide broader analysis and implications in Turkey in which studies in the field are scarce.

2.3. Socioeconomic Status

There are several factors that influence the academic achievement of students. In order to comprehend which variables are responsible for these differences in educational achievement, researchers determine which variables have the most effect on achievement and produce studies to guide policymakers. In one of the earliest studies on educational equity, *Equality of Educational Opportunity*, Coleman (1966) demonstrated that in the United States, family characteristics had a significantly greater influence on academic achievement than school resources. Following its publication, the Coleman's report provided a base for several instructional initiatives. Following the Coleman's Report, Heyneman and Loxley (1983) conducted a similar study covering 29 high- and low-income countries in Africa, Asia, Latin America, and the Middle East. While eight of these countries were classified as low income, nine of them were classified as a middle income, and twelve of them were defined as high income. Their study suggested that as the income level of the country decreased, the effect of school resources on academic achievement increased, and that education is consistently linked to income level. According to the authors, this was due to the limited educational opportunities in developing countries and the large disparities between schools (Heyneman & Loxley, 1983).

However, the theory of Heyneman and Loxley Effect was tested by the data of 1994's Third International Mathematics and Science Study (TIMSS) in a study (Baker et al., 2002). It was found that family background explains the observed variance in academic achievement. Similarly, it was underlined that the socioeconomic status (SES) of the family has a similar impact in all countries, regardless of the level of development in the meta-analysis of Van Ewijk and Sleegers (2010). In another World Bank report (2010), about one-third of the variation in PISA performance was associated with family background opportunities which is caused by inequality.

2.3.1. SES And Academic Achievement

A meta-analysis conducted by Sirin (2005) examined journal articles on SES and academic performance published between 1990 and 2000. 75 independent samples formed the sample, which included 101,157 students, 6,871 schools, and 128 school districts

(Sirin,2005). According to Sirin's study (2005), family income as an index of SES represents the student's potential access to social and economic resources. Parental education, the second basic component of SES, is regarded as one of the more consistent parts of SES since it is often developed at a young age and remain relatively constant throughout time. The third typical SES variable, profession, is classified according to the required education and income for a certain occupation. Home resources, as a fourth measure, is used less frequently than the other three primary indicators. Also, GPA or composite achievement test were used to measure academic achievement level in most of the studies (Sirin,2005). In the analysis, effect size of Pearson's correlation coefficient SES variables in mathematics achievement was provided as .35 which is statistically significant (Sirin, 2005). Therefore, the overall conclusion of this analysis revealed that parents' socioeconomic status has a significant impact on students' achievement.

According to the research conducted on the socioeconomic status and academic achievement, there is a considerable correlation between these two factors (Aslanargun et al., 2016). Research in this field suggests that students from advantaged groups are more likely to succeed in school, but children from disadvantaged groups are at a greater risk of academic failure (Sirin, 2005). According to the research findings (Aslanargun et al., 2016), the socioeconomic status of the family is also a significant factor influencing the student's preparation. In addition, an important difference was observed between the parental education level and the students' readiness levels (Erkan. 2011). This condition supports the influence of socioeconomic factors and parental education on student performance. Moreover, the data of Aslanargun, Bozkurt and Sarioglu (2016) suggests that students with high academic success also come from high socioeconomic status.

2.3.2. Socioeconomic Status and Mathematics Achievement Relationship in Turkey

Internal and external factors influence student progress in mathematics (Papanastasiou, 2000). External influences include the social status and educational background of the family, the school atmosphere, the linguistic background, and the students' attitudes toward mathematics. Berberoglu and Yayan (2004) revealed that as parental education and the number of books in the home increased, eighth grade mathematics achievement improved as well. Also, findings of Duru, Savaş and Taş (2010) supported that there is a statistically

significant correlation between parental income and mathematics achievement of students. In the study conducted by Duru et al., (2010), 275 analyses were conducted with the students from 6th, 7th, and 8th grade to decide the factors predicting the mathematics achievement. They concluded that students from higher socioeconomic backgrounds performed better than those from lower socioeconomic backgrounds. In addition, the study of Duru et al., (2010) demonstrated a positive relationship between students' mathematics performance and their participation in private courses.

Alacacı and Erbaş (2010) provided the similar arguments in their study which examines the relationship between mathematics achievement of students and school factors in the PISA 2006 while controlling for demographic and socioeconomic characteristics, and family background. Their data depended on Turkish students participated in PISA 2006. The sample included 4942 15-years-old students with 2290 girls and 2652 boys from grade 7 to grade 11 classes across from seven geographical regions (Alacacı & Erbaş, 2010). According to OECD (2007a, p. 333), in their study, the index of economic, social and cultural status of PISA (ESCS) referred to the socioeconomic background of students. By means of the analysis of two-level regression, the impacts of school social capital indicators on students' mathematics achievement while controlling for students' family background and socioeconomic status in Turkey were investigated. The results of their study demonstrated that 55 percent of the variance is associated with differences between-schools and 45 percent with individual factors. According to Alacacı and Erbaş (2010), about two-thirds of the 55 percent variance may be attributed by admissions criteria, time spent studying mathematics, students' socioeconomic status, gender, and geographic province. The PISA indicator ESCS of the student, the student's gender, and the school's mean ESCS are major background characteristics that positively affect student mathematics performance (Alacacı & Erbaş, 2010).

From another perspective, Arıkan (2016) conducted a study which investigates the relationship between learning opportunities and mathematics performance in Turkey using PISA 2012 dataset. According to Arıkan's findings (2016), average mathematics performance of students from high socioeconomic status is 81 points higher than students from low socioeconomic status. This difference corresponds to approximately 2 years of schooling. In other words, although students with high socioeconomic status and students

with low socioeconomic status received education for the same period, the opportunities of students with high socioeconomic status brought them 2 years ahead. Therefore, it can be stated that differences between the socioeconomic status create a considerable gap on the mathematics achievement of advantageous and disadvantageous students.

Similarly, Dolu (2020) conducted research to investigate the effects of socioeconomic factors on educational performance using PISA 2015 Turkey data. In the study, by means of the hierarchical linear model (HLM), data were analyzed in the field of science achievement. At the end of the analysis, it has been found that students whose families have a high ESCS value, who attend regular secondary education in schools with high ESCS value, particularly Science and Anatolian high schools, and who attend schools with higher socioeconomic status have higher academic achievement (Dolu, 2020). In addition, it was found that male students and students living in the western part of the country, especially in West Marmara, achieved higher results in terms of gender (Dolu, 2020). Therefore, in the light of these studies, it can be argued that socioeconomic status can affect the achievement level of students.

2.3.3. SES and SEL Relationship

Due to the novelty of the SEL, the number of studies on social and emotional learning, which is believed to be merged with emotional intelligence studies throughout time, has expanded significantly since 2000. In addition, there are also studies investigating the relationship between various skills that can be evaluated under social emotional learning skills, such as and socioeconomic level of participants. In this respect, Kabakçı and Korkut (2008) investigated the differential relationship between the SEL competencies and gender, grade level, and socioeconomic status (SES) for 6th, 7th, and 8th grade in Turkey. They found that students with lower socioeconomic status have higher mean scores on the factor of coping with stress than students with higher socioeconomic status (Kabakçı & Korkut, 2008). In this respect, more challenging living environment and a variety of pressures connected to environment may enhance the development of coping with stress strategies. In addition, this may be related to the fact that children from families with a higher SES are more protective in stressful situations, whereas children from families with a lower SES exhibit a less protective behavior (Kabakçı & Korkut, 2008).

Moreover, OECD (2021) reported that all domains and subdimensions are correlated with students' socioeconomic status, and socioeconomically advantaged students have higher average scores. Empathy, creativity, sociability, assertiveness, self-efficacy, and motivation to succeed are the subdimensions where the greatest differences were observed (Eroğlu et al., 2021; OECD, 2021). Various research demonstrated that self-efficacy and success motivation are closely associated with educational achievements (Ahmad & Safaria, 2013; Lane & Lane, 2001; Steinmayr et al., 2019).

2.4. Gender

2.4.1. Gender Impact on Academic Achievement

All around the world, gender differences and its effects on academic achievement have been investigated in many studies (Alacacı & Erbas, 2010; Dolu, 2020; Hyde et al., 1990; Sirin, 2005). According to Alacacı and Erbas (2010), gender seems to provide a difference in mathematics achievement since the dominance of boys on girls in Turkey data was greater than the OECD average. On the PISA math scale, boys score 16.43 points higher than girls, while the gap between boys and girls was 11 points (OECD, 2007a). Similarly, in the study of Dolu (2020), the difference between the science performances of girls and boys reveals a negative picture for girls in terms of PISA achievement when controlling the other variables such as the economic status of their families or which grade level. Therefore, in the study, investigating the differential relationship between the social and emotional skills measured the “big five” skill domains and mathematics achievement for boys and girls may provide meaningful results to make inferences about the effects of gender differences.

2.4.2. Gender Impact on SEL

The research of Memiş and Memiş (2013) investigated whether the social skills of 4th and 5th grade elementary school students differed by gender, and achievement, using a random sample of 223 students from the elementary school during the spring semester of the 2010-2011 academic year. There were 110 female students and 113 male students in the sample. Kocayörük's (2000) Social Competence Scale was utilized to measure the social skill levels of primary students. A considerable difference was discovered between

the social skill levels of female (68.90) and male (65.76) students as a result of the investigation (Memiş & Memiş 2013). While there was a strong relationship between the school grades of girls and their social skill levels (0.58), this correlation was moderate among boys (0.37) (Memiş & Memiş 2013).

Moreover, Durualp (2014) aimed to explain the social emotional learning skills of 6th, 7th and 8th graders and investigate the effects of gender and grade level on those skills. The sample for this study consisted of 521 students (girls:265, boys:256) from a secondary school in Cankiri (Durualp, 2014). The "Social Emotional Learning Skills Scale" prepared by Kabakçı (2006) was used to collect data. In the study of Durualp (2014), considerable gender gap in communication, problem-solving, stress management, and self-esteem abilities was revealed in favor of girls. In addition, girls demonstrate better social-emotional learning skills than boys ($p < 0.05$). This finding shows that gender is effective in increasing social emotional learning skills. Also, in many scholars, it was determined that social-emotional skills have a differential relationship with gender, and girls showed higher social-emotional skills than boys (Erdoğan, 2002; Kabakçı, 2006; Yurdakavuştu, 2012).

2.5.Assessment of SEL

SEL programs have been implemented in many countries to meet the social and emotional needs of students and prepare them to the life in a well-qualified way. Assessment of SEL programs is one of the most significant parts in order to develop effective teaching strategies and learning outcomes of social and emotional skills. Therefore, by the researchers and authorities who implement these programs, some of the SEL programs are evaluated in terms of their outcomes.

First of all, "Lions Quest Life Skills" (LQLS) program is one of the most inclusive SEL program with its scope starting from early childhood education and continue to university (Özgünlü, 2021). LQLS program is applied by the instructors who are certificated with the interactive and comprehensive training sessions and materials. During the training sessions of instructors, learning experiences provided by LQLS are implemented as individually or groups (Durlak et al., 2016). Evaluation of LQLS program was conducted by many scholars to see the changes and developments in students (Göl-Güven, 2016; Lion

Quest, 2019). They found out that there is an incredible change with developed social relationships, increase in understanding and expressing the emotions, improvement in problem solving skills, less behavior problems, increase in academic achievement.

Another SEL program applied in Turkey is “Second Step” which provides the effective tools and materials for instructors and parents who have active role in the improvement of social and emotional skills of students. Therefore, second step is a holistic and inclusive program to provide healthy societies (CASEL, 2019; Committee for Children, 2019; Second Step, 2019). Target population of second step is from 4 years to 14 years. Studies about the outcomes of the second step programs indicates developed social skills, improved academic success, less behavior problems, increase in life-expectations, increase in cooperation, and more controlled emotions (Erey et al., 2005; Holsen et al., 2008; Heyman et al., 2017). Overall, with the light of the previous studies, it is seen that evaluation of SEL programs needs to be taken into consideration to provide development in social and emotional skills.

3. METHODOLOGY

The methodology of the study is described in the following parts as the design, the population and sample, the instrument, collection of data and the data analysis.

3.1. The Design of this Study

The main purpose of the study is to investigate the differential relationship between the social and emotional skills scores and mathematics achievement for socioeconomic status, gender, and level of SEL evaluation groups. According to Creswell (2012), a correlational design is conducted to evaluate the relationship between two or more variables. Therefore, in the currently study, correlational design is implemented to investigate the relationships between the variables stated above.

3.2. The Population and Sample

3.2.1. Participants of OECD's SSES

The OECD's SSES study (OECD, 2021) is a survey based two groups: 10-year-old participants studying in grade 2 or more and 15-year-old participants studying in grade 7 or more. In the OECD's main study on social and emotional skills, 10 cities from different countries involved in the data collection process (OECD, 2021). Participated cities and countries in the data collection process of SSES study are “*Bogota, Colombia; Daegu, Korea; Helsinki, Finland; Houston, Texas, United States; Istanbul, Turkey; Manizales, Colombia; Moscow, Russian Federation; Ottawa, Ontario, Canada; Sintra, Portugal; and Suzhou, People's Republic of China*” (OECD, 2021, p.12).

According to technical report of OECD's SSES (2021), the sampling procedure was two-stage stratified random sampling method. The first step of the OECD's sampling procedure (2021) was to divide each cohort's cities into specific divisions based on their similar characteristics. Institutions were sampled individually by cohort and specific strata

using a probability proportionate to their size (PPS), indicating that schools with larger student populations had a greater chance of being selected. In the second stage, students from each participating school were selected according to the Target Cluster Size (TCS) with an equal probability sample. If an institution has less suitable students than the TCS, then participants were selected from all eligible students (OECD, 2021).

In each participating city, around 3000 students from each group were selected at random to participate in the OECD study. Therefore, around 6000 students equally represented male and female students in each participating city from both age groups.

Table 3.1. Detailed information of sample sizes by city and by domain (OECD, 2021).

	All Students			Younger			Older		
	students sample size	school sample size	Within- School Sample size	students sample size	school sample size	Within- School Sample size	students sample size	school sample size	Within- School Sample size
Bogota	6771	154	43.97	3415	87	39.25	3356	82	40.93
Daegu	6334	132	47.98	3008	77	39.06	3326	78	42.64
Helsinki	5482	97	56.52	3034	83	36.55	2448	55	44.51
Houston	6434	102	63.08	3333	74	45.04	3101	45	68.91
Manizales	6757	85	79.49	3226	83	38.87	3531	70	50.44
Moscow	6792	78	87.08	3363	77	43.68	3429	77	44.53
Ottawa	5440	123	44.23	3250	89	36.52	2190	58	37.76
Sintra	3860	49	78.78	2224	48	46.33	1636	29	56.41
Suzhou	7246	122	59.39	3633	76	47.80	3613	75	48.17
Istanbul	5869	101	58.11	2701	91	29.68	3168	80	39.60

3.2.2. The Target Population and Sample of Current Study

With 15 million people, Istanbul is the most crowded city in Turkey. Istanbul has already become a large metropolitan city due to immigration from all areas of the country and other countries. As it is seen in the Table 3.2, 5869 students from 101 schools in which 2701 students, and 2841 teachers from the younger cohort and 3168 students, and 3373 teachers from the older cohort were selected to represent 3,103,439 students in İstanbul in 2017/2018 (OECD, 2021).

Table 3.2. Sample size of Istanbul, Turkey.

	Younger Cohort			Older Cohort		
	Students	Parents	Teachers	Students	Parents	Teachers
Eligible Participants	2701	1974	2841	3168	2033	3373
Total Participants	2796	2095	2903	3184	2155	3416
Current Participant Rate	96.60	94.22	97.86	99.50	94.34	98.74

In this study, data of grade 9, 10 and 11 students are used because older students can provide the more consistent results in self-assessment reports (Poropat, 2009). Moreover, Rice and Pasupathi (2010) stated that older students might have a more constant and clear sense of self compared to younger individuals. Therefore, it is decided to evaluate the relationship between socio emotional learning and mathematics achievement for older cohort. Below Table 3.3 represents the sample size of this study.

Table 3.3. Sample size of this study.

	Older group (Grade 9, 10 and 11 students in Istanbul)	
	Students	Teachers
Eligible Participants	3168	3373
Total Participants	3184	3416

Table 3.3. Sample size of this study (cont.).

Current Participant Rate	99.50	98.74
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3.3. The Instrument

This study utilized SSES 2019 survey questionnaires and data on social-emotional skills from Turkey provided by OECD. The OECD SSES gathered data by four contextual surveys designed for students, parents, teachers, and administrators (Kankaraš & Suarez-Alvarez, 2019). The purpose in the background of improving contextual questionnaires was to discover the aspects which influence students' social and emotional skills in their environments like community, school, and family. Therefore, previous studies in the field and OECD studies, especially Program for International Student Assessment (PISA) studies were examined to provide questions which carefully developed. After the adapted and new questions were evaluated in item trial and field test, the number of questions was decreased as much as possible while still including the most significant elements of students' environmental influences on the skill development (Kankaraš, Suarez-Alvarez, 2019).

There were mainly two types of questionnaires:

- o Part A: Scales for assessing the social and emotional skills of students
- o Part B: Contextual questionnaires - designed to gather information on the family, school, and peer environments of students.

According to assessment framework of OECD SSES, the social and emotional abilities of students were evaluated using three distinct report sources: student self-assessment reports, parents' and teachers' reports about students (Kankaraš & Suarez-Alvarez, 2019). The agree/disagree response scale for the survey items is a 5-point Likert scale, with responses through 1 - strongly disagree to 5 - strongly agree. All 15 skill scales contain both positively and negatively expressed items (Kankaraš & Suarez-Alvarez, 2019).

3.3.1. Measuring Big Five Domain and Related Subdimensions

According to Chernyshenko, Kankaras and Drasgow (2018), the SSES theoretical framework was established through the basis of the 'Big Five Model' (John, Naumann & Soto, 2008) with the purpose of evaluating young people's social and emotional skills. The SSES scaling study focused on a theoretical identification of 15 possible subdimensions that were organized in five main domains: “Task performance, Emotional regulation, Collaboration, Open-mindedness, and Engaging with others” (Kankaraš & Suarez-Alvarez, 2019, p.17). The 5 domains and 15 subdimensions are listed in Table 3.4 and explained in the next section.

Table 3.4. Domains and subdimensions of the SSES in OECD study (OECD, 2021).

Domains	Subdimension	Label
Collaboration	Empathy	EMP
	Trust	TRU
	Cooperation	COO
Emotional regulation	Emotional control	EMO
	Optimism	OPT
	Stress resilience	STR
Engaging with other	Assertiveness	ASS
	Energy	ENE
	Sociability	SOC
Open-mindedness	Creativity	CRE
	Curiosity	CUR
	Tolerance	TOL
Task performance	Persistence	PER
	Responsibility	RES
	Self-control	SEL

3.3.1.1. Collaboration. Collaboration domain was described as the combination of the skills of empathy, trust, and cooperation in the survey on social and emotional skills of OECD (OECD,2021). According to the assessment framework of the OECD;

- Empathy is the ability of understanding and caring the other people and their well-beings.
- Trust is the ability to assume that people generally act with good intentions and to forgive the wrong behaviours.
- Co-operation is the ability to live together peacefully with others and respects the interdependence of all individuals (Kankaraš & Suarez-Alvarez, 2019).

3.3.1.2. Emotional Regulation. Emotional regulation domain was stated as emotional stability with the combination of the skills; stress resilience, optimism, and emotional control in the survey on social and emotional skills of OECD (OECD,2021). According to the assessment framework of the OECD;

- Stress resilience was defined as the ability to modulate anxiety effectively and solve problems calmly.
- Optimism was described as the ability to have hopes for life positively and optimistically.
- Emotional control is the ability to apply effective methods for controlling anger, aggression, and irritation in case of frustration (Kankaraš & Suarez-Alvarez, 2019).

3.3.1.3. Engaging with other. Engaging with other domain was defined as extraversion with the combination of the skills; sociability, assertiveness, and energy in the survey on social and emotional skills of OECD (OECD,2021). According to the assessment framework of the OECD;

- Sociability is the ability to initiate and sustain social interactions with people.
- Assertiveness is the ability to articulate thoughts, needs, and emotions with confidence and create social impact.
- Energy is the ability to engage daily life with enthusiasm, energy, and spontaneity (Kankaraš & Suarez-Alvarez, 2019).

3.3.1.4. Open-mindedness. Open-mindedness domain was defined as openness to experience with the combination of the skills; curiosity, tolerance, and creativity in the survey on social and emotional skills of OECD (OECD,2021). According to the assessment framework of the OECD;

- Curiosity is the ability to have passion for learning, comprehension, and intellectual investigation.
- Tolerance is the ability to be open to different perspectives and to appreciate the diverse values and cultures.
- Creativity is the ability to generate innovative ways by means of vision, explorations, and learning from failure (Kankaraš & Suarez-Alvarez, 2019).

3.3.1.5. Task Performance. Task performance domain was defined as conscientiousness with the combination of the skills; responsibility, self-control, and persistence in the survey on social and emotional skills of OECD (OECD,2021). According to the assessment framework of the OECD;

- Responsibility is the ability to fulfill the commitments, as well as being punctual and trustworthy.
- Self-control is the ability to resist disturbances and spontaneous desires and concentrate on the present task to reach a particular objective.
- Persistence is the ability to persevere until a task or activity is completed (Kankaraš & Suarez-Alvarez, 2019).

3.3.2. Assessment of Students' Social and Emotional Skills

According to the assessment framework of the SSES study, in order to create assessment instruments of students' skills, the great majority of 20 items were chosen from International Personality Item Pool (IPIP) for every 19 skills (Kankaraš & Suarez-Alvarez, 2019). After the feedbacks of the Technical Advisory Group (TAG), cognitive interviews, item trials, and the field test, the number of the skills was reduced to 15. Also, the number of items per skill was decreased to 8 in the main study. All in all, in the study, 120 items with 5-point Likert type response scale were used to measure social and emotional skills of

students (Kankaraš & Suarez-Alvarez, 2019). In Table 3.5, some of these items were provided as the examples from student questionnaire. Also, all of the items are demonstrated in the attached link <https://www.oecd.org/education/ceri/social-emotional-skills-study/data.htm> by OECD.

Table 3.5. Examples from item scale of the students' social and emotional skills.

Domains	Subdimension	Items' examples
Collaboration	Empathy	I can sense how others feel. I know how to comfort others.
	Trust	I think most of my classmates keep their promises. I believe that my friends can keep my secrets.
	Cooperation	I am ready to help anybody. I get along well with others.
Emotional regulation	Emotional control	I am not easily upset. I keep my emotions under control.
	Optimism	I believe good things will happen to me. I am always positive about the future.
	Stress resilience	I am relaxed and handle stress well. I do not get nervous easily.
Engaging with other	Assertiveness	I like to be the leader of a group. I know how to convince others to do what I want.
	Energy	I maintain high energy throughout the day. I show a lot of enthusiasm.
	Sociability	I like to spend my free time with others. I make friends easily.
Open-mindedness	Creativity	I have a good imagination.

Table 3.5. Examples from item scale of the students' social and emotional skills (cont.).

Domains	Subdimension	Items' examples
		I sometimes find a solution other people don't see.
	Curiosity	I am curious about many different things. I like learning new things.
	Tolerance	I love to learn about other countries and cultures. I am willing to be friends with people from other cultures.
Task performance	Persistence	I finish things despite difficulties in the way. I do not give up easily.
	Responsibility	I keep my promises. I am a responsible person.
	Self-control	I can control my actions. I think carefully before doing something.

3.3.3. Mathematics Achievement and Grouping Variables

The variables of the research questions and related measurement instruments are provided in detail in this section.

3.3.3.1. Mathematics achievement. In the study, mathematics achievement was determined by the standardized school grade for mathematics courses at school with the code of Sgrade_Math. OECD transformed all grades to a scale from 1 to 50, since participating cities have different grading systems (OECD, 2021).

3.3.3.2. Socioeconomic Status (SES). Socioeconomic status (SES) index derived from the data about parental education in accordance with the International Standard Classification of Education scheme (ISCED), parental employment situation accordingly international socio-economic index of occupational status (ISEI), and household possessions (HOMEPOS). Both the parent and student surveys had open-ended questions for the collection of occupational, educational and home possession information. Some examples of the variable items from the questionnaires are provided below. Also, OECD demonstrated all the items of parent questionnaire in the following link <https://www.oecd.org/education/ceri/social-emotional-skills-study/data.htm>.

- (i) “What is the highest level of formal education COMPLETED by your mother (or female guardian) and father (or male guardian)?” (OECD, 2021, p.24).
- (ii) “What is your mother (or female guardian)’s main job?
(*e.g. school teacher, kitchen-hand, sales manager*)” (OECD, 2021, p.26).
- (iii) “What does your mother (or female guardian) do in her main job? (*e.g. teaches high school students, helps the cook prepare meals in a restaurant, manages a sales team*)” (OECD, 2021, p.26).
- (iv) “How many of these are there at your home?
 - a. Televisions
 - b. Cars
 - c. Rooms with a bath or shower
 - d. [cell phones] with internet access (*e.g. smartphones*)
 - e. Computers (desktop computer, portable laptop or notebook)” (OECD, 2021, p.25).

3.3.3.3. Evaluation of social and emotional skills in schools. Another variable to examine the question is that evaluation of students' achievement in social and emotional skills in schools. In the study, each teacher contributed to dataset with indirect assessment questionnaire and contextual questionnaire. In the indirect assessment test, teachers provided their responses for each of the students. Therefore, evaluation of students' social and emotional skills in school environment variable were derived from the teacher contextual questionnaire with the items provided below. Also, full items of teacher contextual questionnaire are provided by the OECD in the following link <https://www.oecd.org/education/ceri/social-emotional-skills-study/data.htm>.

“Is students' achievement in social and emotional skills evaluated in your school? (Please select one response.)” (TCQM02001) (OECD, 2021, p.12)

- No, we don't evaluate these skills
- Yes, using informal evaluation (e.g. oral reports to students or parents, etc.)
- Yes, using formal evaluation (e.g. written reports, grades, etc.)

3.3.4. Scale Validity

First, the International Contractors and the OECD Council reviewed the literature identified 31 subcategories of the Big Five Domain that were appropriate to the framework (OECD, 2021). In order to provide content validity, the items received six cycles of changes and were rated by the expert group stated above according to reading level, language characteristics, intercultural comparison, and sensible topics and wordings (OECD, 2021). According to the feedbacks, the number of items was decreased to 15 items for each skill for the older group of students.

For predictive validity, subdimensions were ranked from low to moderate to high moderate. The number of these skills was decreased from 19 to 15 in accordance with predictive validity scales derived from field trial and technical advisory group feedback. The eliminated scales did not fulfill the required psychometric criteria for inclusion (OECD, 2021).

Moreover, with the data triangulation, which is the indirect assessments from parents and teachers, construct validity of the instruments by giving information on students' behaviors in various contexts was provided (OECD, 2021).

3.3.5. Scale Reliability

Reliability of the scales were reported by Cronbach's alpha coefficients in the technical report. Cronbach's alpha coefficients which are higher than 0.7 is acceptable, higher than 0.8 is the good, and higher than 0.9 is excellent in all studies (George & Mallery, 2003). Cronbach's alpha coefficients are given in Table 3.6 below (OECD, 2021). Overall, the reliability coefficients of the subdimensions are mostly acceptable and good.

Table 3.6. Scale reliability in the student assessment in İstanbul (OECD, 2021).

Domains	Subdimensions	Cronbach's Alpha
Collaboration	EMP	0.70
	TRU	0.77
	COO	0.72
Emotional Regulation	EMO	0.74
	OPT	0.86
	STR	0.84
Engaging with other	ASS	0.88
	ENE	0.76
	SOC	0.70
Open-mindedness	CRE	0.76
	CUR	0.77
	TOL	0.80
Task performance	PER	0.84
	RES	0.77
	SEL	0.75

3.4. Data Analysis

In the study, the data derived from the official website of OECD. In order to provide answers to the research questions of the current study, confirmatory factor analysis (CFA) and structural equation modelling (SEM) was conducted using Mplus. Mplus can take the sample weights into consideration in the analysis process (Muthén & Muthén, 2012). Sampling weights, confirmatory factor analysis (CFA), and structural equation model (SEM) and the current study's analysis procedure with CFA and SEM are explained in the next section.

3.4.1. Sampling Weights

Using the whole population of a study is almost impossible due to the limited time and inadequate financial resources, therefore the purpose of the large-scale assessments is that generalization of the findings to the entire population by means of the most representative sample (Arıkan, Ozer, Şeker, & Ertaş, 2020, Rutkowski, Gonzalez, Joncas, & von Davier, 2010). Also, Rutkowski et al. (2020) stated that the effectiveness of the selected sample is proportional to its ability to estimate the characteristics of the population. In this process, using sampling weights provides each student's contribution to statistical estimates to be proportional to the total number of students who are represented in the population (Arıkan, Ozer, Şeker, & Ertaş, 2020; Gonzales, 2012; OECD, 2017). Therefore, by means of sampling weights, more accurate estimations are estimated (Arıkan et al., 2020). In the study of social and emotional skills of OECD (2021), two stage stratified sampling model was used to select the sample which requires weighting the sample to prevent the bias and have the best proportion for representativeness. Therefore, in the analyses of the study, students' weights were taken into consideration.

3.4.2. Confirmatory Factor Analysis (CFA)

The main goal of confirmatory factor analysis is to statistically evaluate the significance of a hypothesized factor model, in other words, whether the sample data support hypothesized model (Schumacker & Lomax, 2004). Therefore, in CFA, the number of factors and the variables used to measure each factor are specified. In CFA model, there are

five steps to follow: specification of model, identification of model, estimation of model, model testing, and modification of model (Schumacker & Lomax, 2004).

3.4.2.1. Model Specification. Model specification is the first and most essential step in CFA. It is necessary to specify a model that will be investigated or verified by implementing appropriate theory, research, and available data. Therefore, in this section, it is determined which variables are involved in the analysis and how they are connected by defining their relationships (Arıkan, 2010; Schumacker & Lomax, 2004). Specification error, which happens when an insignificant variable is used or a significant variable is removed from the model, is a significant potential issue at this stage. The model with specification error called as a misspecified model which provides skewed parameter estimates that are systematically distinct from the model's true parameter values. In case of misspecified model, data will probably not be fitted with the model (Arıkan, 2010; Schumacker & Lomax, 2004).

3.4.2.2. Model Identification. After a confirmatory model is specified, determining the identification of the model is the next step. Identification of the model is accomplished, if there is a unique and original solution for each model parameter based on the sample data that generate the sample covariance matrix S and the theoretical model represented by the population covariance matrix Σ (Arıkan, 2010; Schumacker & Lomax, 2004). In order to get unique solution, the model must be “overidentified” which has more values in sample covariance matrix S than parameters to be estimated. If the number of estimated parameters and values in the matrix S are equal, the model will be “just-identified” which cannot test the adequacy of the model. Lastly, if the value of sample covariance matrix S is less than parameters to be estimated, “underidentified” model occurs in which parameters cannot be predicted (Arıkan, 2010; Schumacker & Lomax, 2004).

3.4.2.3. Model Estimation. In this section, estimating the parameter is provided by the data of the sample and specified model. It is intended to get predictions that result in an inferred covariance matrix Σ that closely approximates the sample covariance matrix S . Various estimation techniques such as maximum likelihood (ML), weighted least squares (WLS), and generalized least squares (GLS) are used (Arıkan, 2010; Schumacker & Lomax, 2004).

3.4.2.4. Model Testing. After a model estimated, determining whether the fit of the model is “good” is the next crucial step. A good model is one in which the difference between the sample and population covariance matrices is minimum. This indicates that these matrices have a good fit and sample data supports the specified model (Schumacker & Lomax, 2004). Various fit indices are improved to investigate the model fit.

One of the fit indices is the which is mostly recommended to compare estimated and independence model is comparative fit index (CFI) (Schumacker & Lomax, 2004). The range of CFI is between 0 and 1. If the CFI values more than 0.95, this indicates a good fitting model (Ullman, 2001).

Tucker-Lewis index (TLI) is one of the fit index which is not significantly influenced by the size of sample. TLI is called as incremental and non-normed fit index. In TLI, while values more than 0.95 represent better model fitting (Schumacker & Lomax, 2004).

Another fit index is the root mean square error of approximation (RMSEA). By using degrees of freedom, RMSEA measures the inadequacy of fit with the comparison of estimated and perfect model (Ullman & Bentler, 2012). Large degrees of freedom and smaller RMSEA values indicate better model fitting (Ullman & Bentler, 2012). If the value of RMSEA is less than or close to 0.06, it implies a good fitting model (Ullman & Bentler, 2012). On the other hand, values of RMSEA more than 0.10 means poor fitting models (Browne & Cudeck, 1993).

The equation of the comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA) equation are provided by Schumacker and Lomax (2004) as

$$CFI = 1 - [(X_{model}^2 - df_{model}) / (X_{null}^2 - df_{null})] \quad (3.1)$$

$$TLI = [(X_{null}^2 / df_{null}) - (X_{model}^2 / df_{model})] / [(X_{null}^2 / df_{null}) - 1] \quad (3.2)$$

$$RMSEA = \sqrt{[X_M^2 - df_M] / [N - 1]df_M} . \quad (3.3)$$

3.4.2.5. Model Modification. If the specified model is evaluated as unsatisfactory with various fit indices, the model is required to be modified to provide a model fitting better (Schumacker & Lomax, 2004). One of the significant parts of modification is supporting the process by a theory to make reasonable changes. One of the methods is that insignificant parameter for both model and theory can be eliminated. Another method is using CFA software's indices for modification which demonstrates the impacts of expected differences in the model fit when a given parameter modification is made (Arikan, 2010; Schumacker & Lomax, 2004).

3.4.3. CFA in the Current Study

In the present study, first of all, confirmatory factor analysis was applied to statistically test whether the sample data confirms the measurement model with five domains (task performance, emotional regulation, engaging with others, collaboration, and open-mindedness) and fifteen subdimensions (empathy, trust, self-control, cooperation, emotional control, optimism, stress resilience, assertiveness, energy, sociability, creativity, curiosity, tolerance, persistence, responsibility, and self-control). In the current study, maximum likelihood estimation method was used to estimate the model. The measurement model of the current study is shown in Figure 3.1 below.

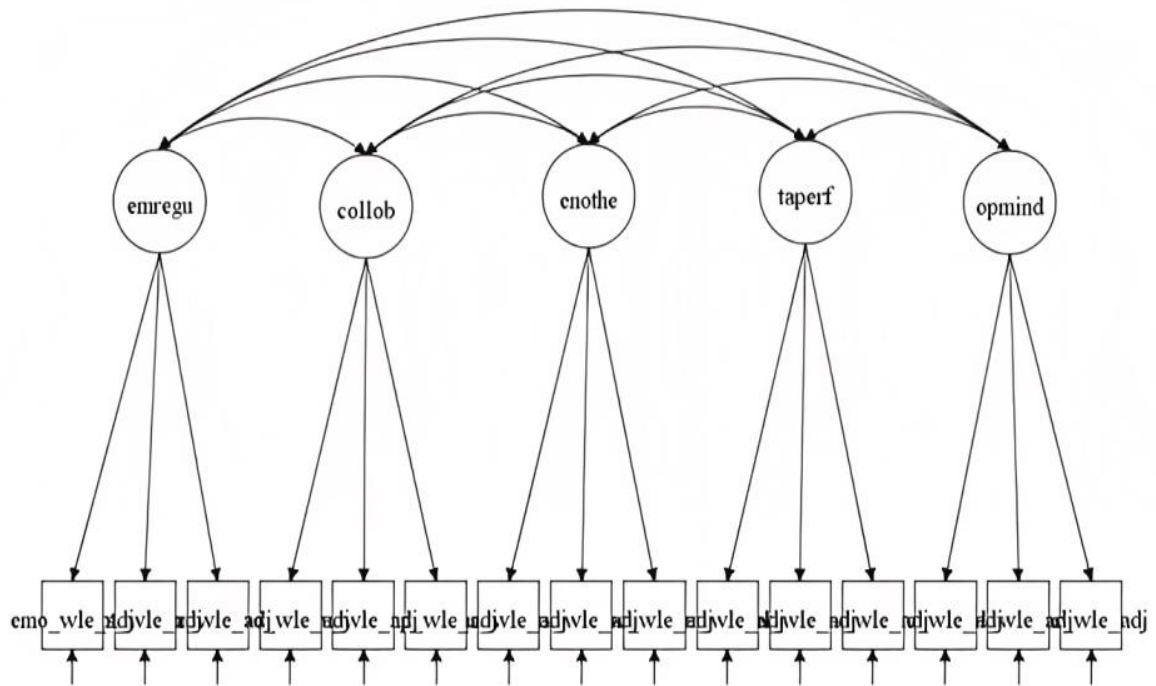


Figure 3. 1. Confirmatory factor analysis model of the study.

3.4.4. Structural Equation Model (SEM)

Structural equation model is a statistical modelling method that can integrate sophisticated path models with factors (latent variables). SEM provides a comprehensive and practical framework to make statistical analyses which contain various multivariate procedures, such as factor analysis and regression analysis (Hox & Bechger, 1998). Path diagrams are frequently used to demonstrate structural equation models.

3.4.5. SEM in the Current Study

By means of the SEM, significance, directions and explained variance of the relationships between the five domains and mathematics achievement was reported in results section. Also, SEM was used to predict the power of the relationships between the five domains and mathematics achievement (Schumacker & Lomax, 2004; Ullman & Bentler, 2012).

In the analysis of the study, the structural equation modelling was used to provide an answer for which of the five domains (collaboration, open-mindedness, task performance, emotional regulation, and engaging with others) predicts the mathematics achievement of students. For the second research question, the measurement model was used to examine the differential relationship between the five domains and mathematics achievement for genders groups of boys and girls to investigate gender differences. For the third research question, SEM analysis was used to investigate which of the five domains predicts the mathematics achievement for different SES groups as low, medium, and high levels. For the fourth research question, analysis of SEM was used to investigate the differential relationships between the big five domains the mathematics achievement for the levels of SEL evaluation groups defined as non-evaluated, informally evaluated, and formally evaluated. Figure 3.2 demonstrates the path diagram of the SEM model of the analysis.

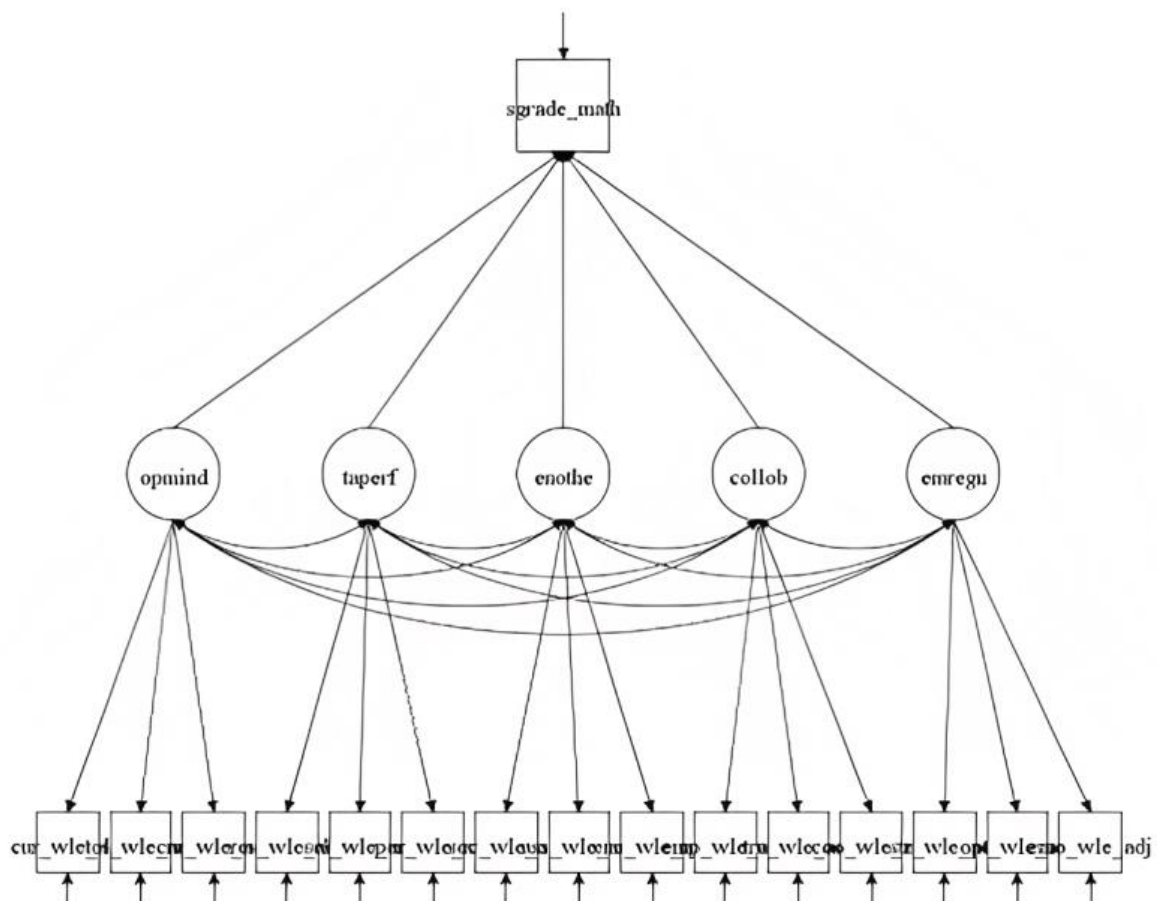


Figure 3.2. Structural equation model of the study.

4. RESULTS

The main purpose of the study is to investigate the differential relationship between the social and emotional skills scores and mathematics achievement for various groups such as socioeconomic status, gender, and level of SEL evaluation groups. In order to achieve this goal, confirmatory factor analysis (CFA) and structural equation modelling (SEM) was conducted for Turkish sample. The differential relationships between the social and emotional skills scores and mathematics achievement for socioeconomic status groups, gender groups, and level of SEL evaluation groups were investigated.

4.1. Preliminary Analysis

4.1.1. Mathematics Achievement and Fifteen Subdimensions

In this section, descriptive statistics of social and emotional skill subdimensions and mathematics achievement were provided to indicate the key characteristics of the data.

Table 4.1. Descriptive statistics of subdimensions and mathematics achievement.

Subdimensions	Mean	Median	Std.	Skewness	Kurtosis
Mathematics achievement	29.15	28.86	10.52	-.031	-.864
Collaboration by					
Empathy	638.55	625.66	93.53	.784	1.004
Trust	502.27	504.64	84.69	-.376	2.231
Cooperation	627.54	617.99	85.54	.610	.608
Emotional regulation by					
Emotional control	512.30	510.40	88.72	.135	3.516
Optimism	535.73	537.08	93.39	.066	3.020
Stress resilience	512.09	514.62	111.85	-.129	2.061

Table 4.1. Descriptive statistics of subdimensions and mathematics achievement (cont.).

Subdimensions	Mean	Median	Std.	Skewness	Kurtosis
Engaging with others by					
Assertiveness	521.59	514.14	110.77	.426	.848
Energy	561.97	555.38	93.08	.700	2.319
Sociability	583.52	575.32	91.54	.745	1.442
Open mindedness by					
Creativity	605.36	592.15	98.10	.881	1.220
Tolerance	621.04	605.37	111.15	.797	.780
Curiosity	628.48	614.18	91.13	.594	.185
Task performance by					
Persistence	608.48	600.16	102.15626	.610	.518
Responsibility	588.50	578.72	96.22337	.696	1.155
Self-control	607.07	603.97	95.05298	.656	1.155

4.1.2. Testing the Assumptions

4.1.2.1. Sample Size. In order to estimate the satisfactory size of the sample, MacCallum, Brown, and Sugawara (1996) provided tables for minimum needed sample size for goodness of fit tests. Sample size estimates were based on degrees of freedom and effect size in tables. According to tables, minimum sample size should be 186 participants for the level of degrees of freedom of 80. In the current study, degrees of freedom was determined as 80 for 3140 participants. Also, all groups of gender, socioeconomic status, and SEL evaluation groups have a much bigger number of participants. Therefore, this assumption is not violated.

4.1.2.2. Multivariate Normality. Multivariate normality is assumed by most of the estimation techniques in SEM. Therefore, histogram of subdimensions were given below separately. The assumption is not violated because mathematics scores and subdimension scores distributed normally.

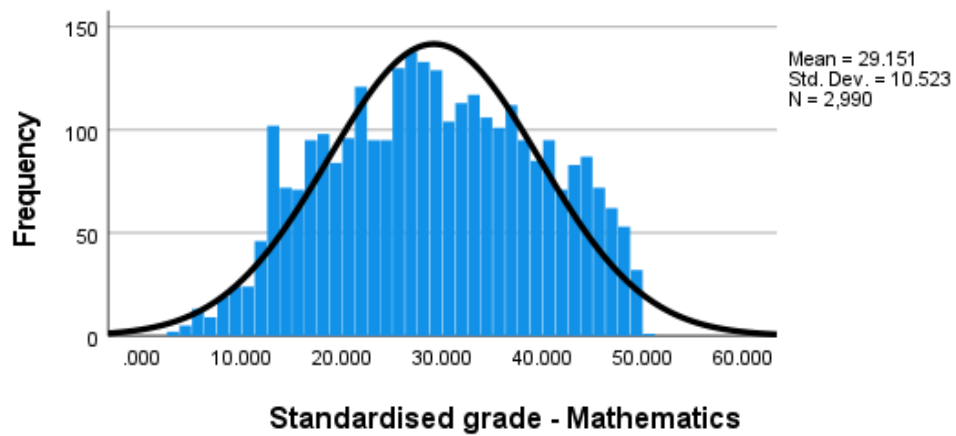


Figure 4.1. Histogram of mathematics achievement.

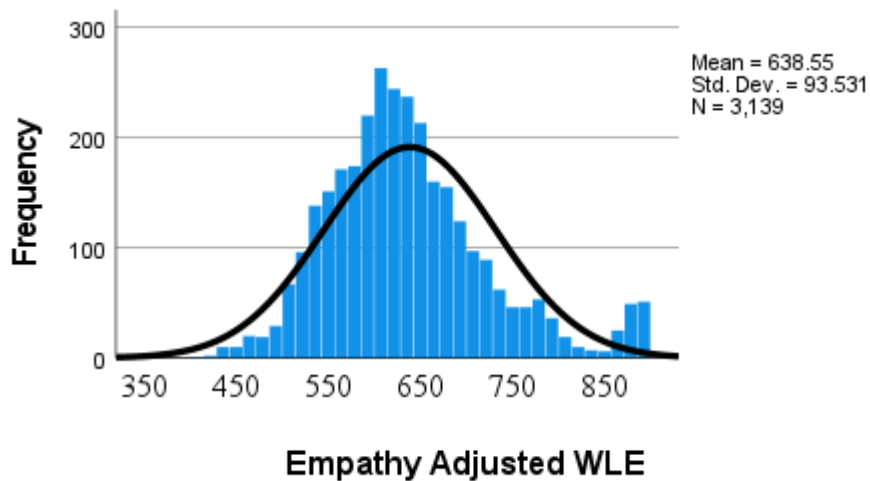


Figure 4.2. Histogram of empathy.

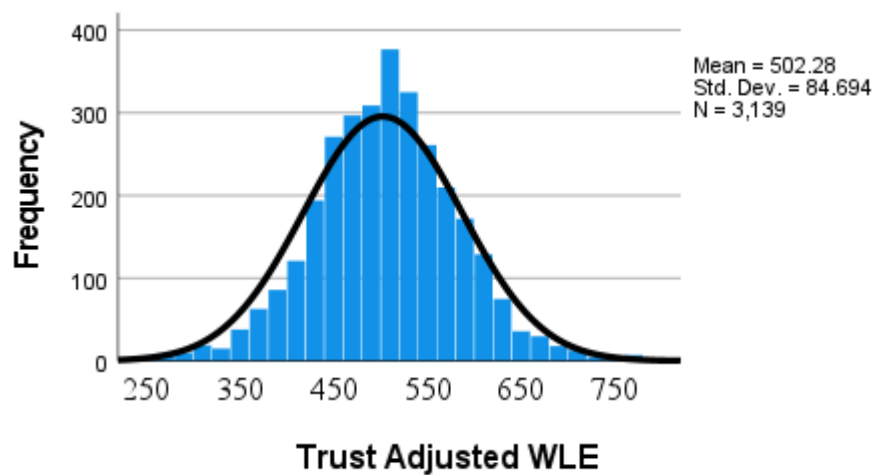


Figure 4.3. Histogram of trust.

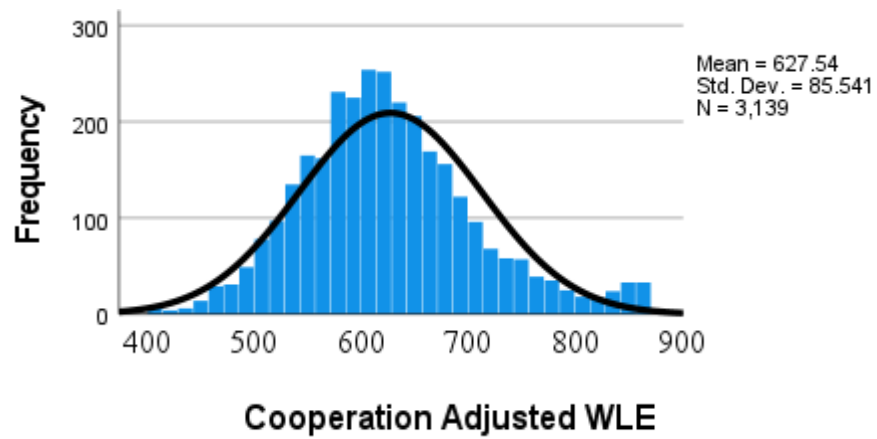


Figure 4.4. Histogram of cooperation.

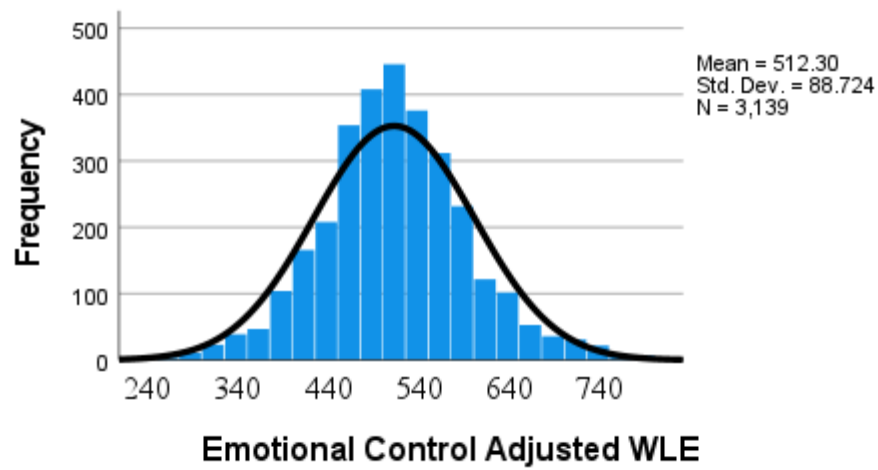


Figure 4.5. Histogram of emotional control.

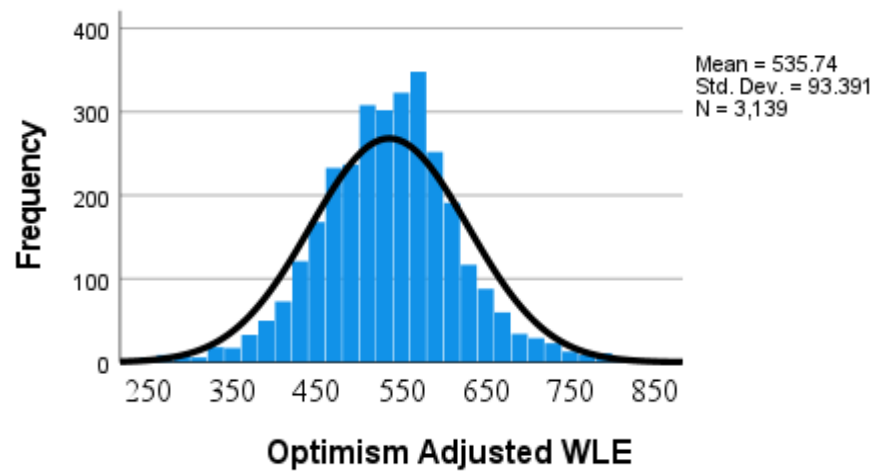


Figure 4.6. Histogram of optimism.

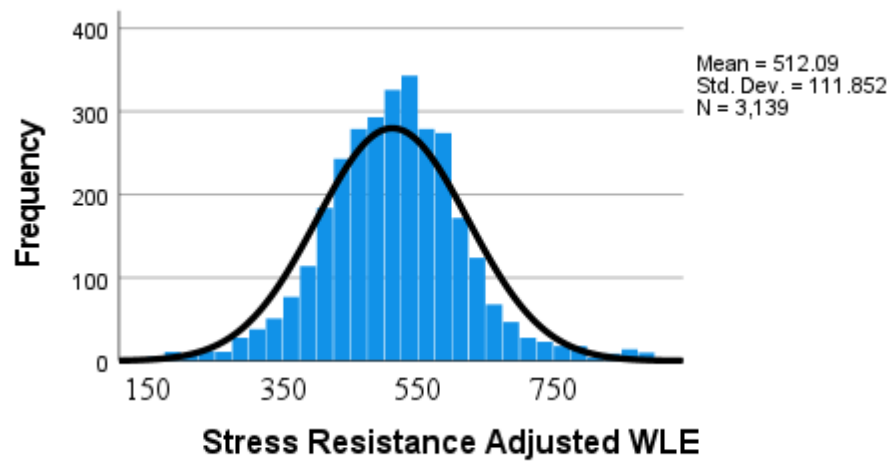


Figure 4.7. Histogram of stress resistance.

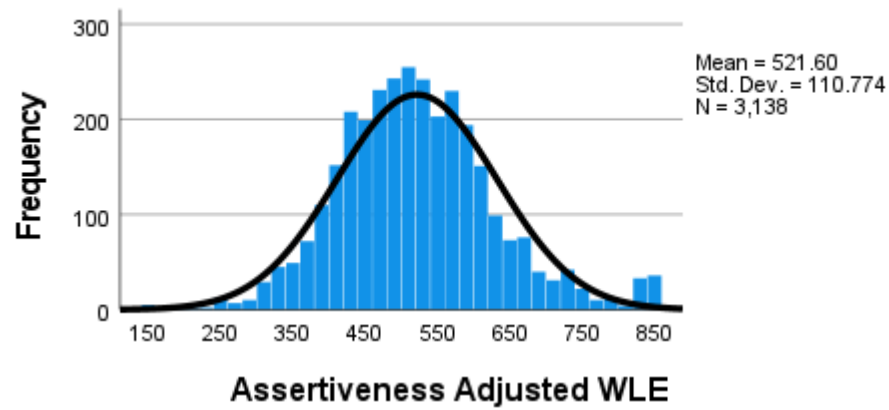


Figure 4.8. Histogram of assertiveness.

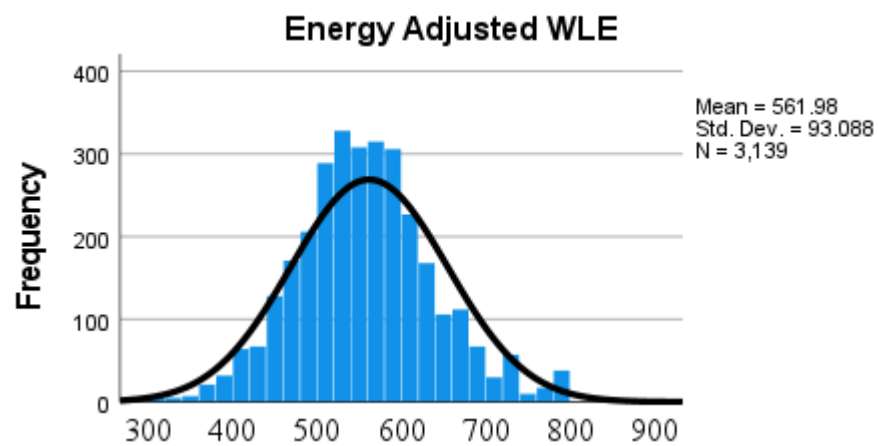


Figure 4.9. Histogram of energy.

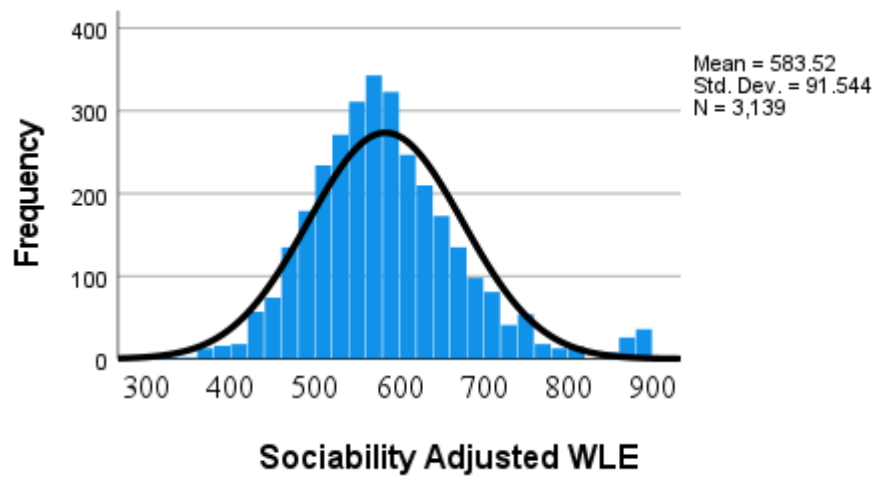


Figure 4.10. Histogram of sociability.

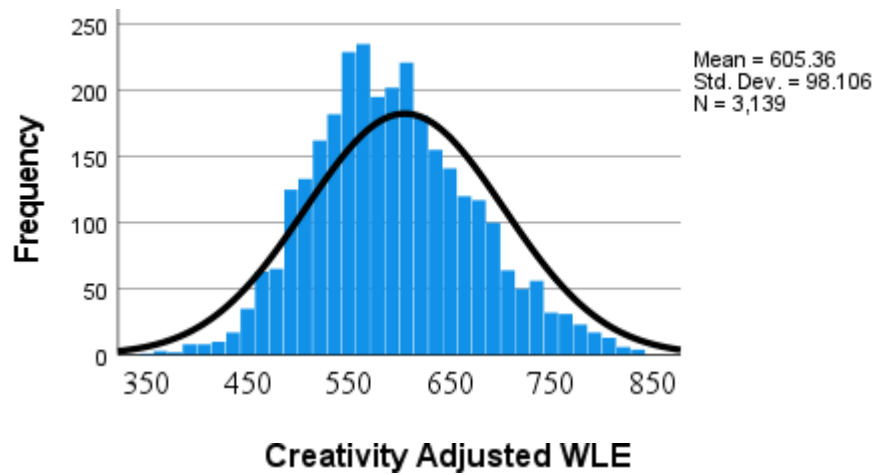


Figure 4.11. Histogram of creativity.

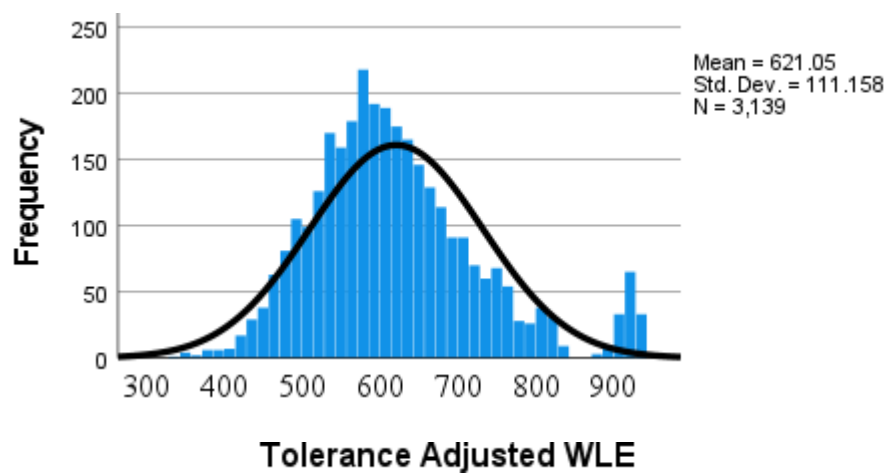


Figure 4.12. Histogram of tolerance.

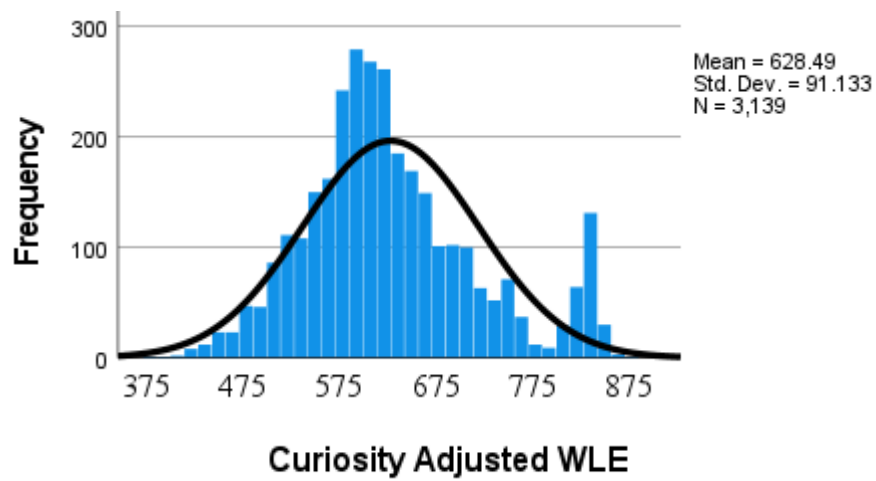


Figure 4.13. Histogram of curiosity.

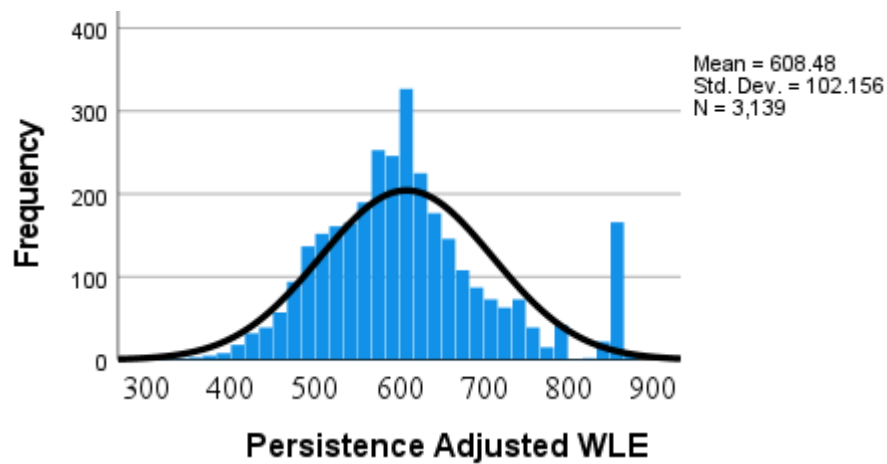


Figure 4.14. Histogram of persistence.

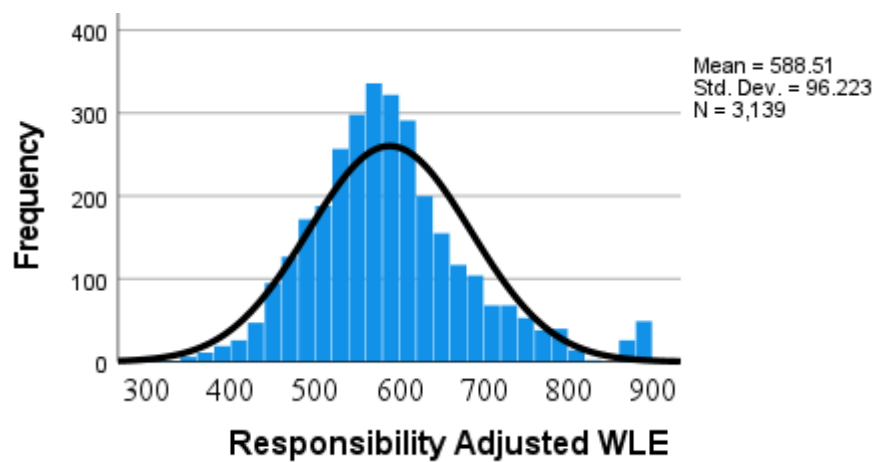


Figure 4.15. Histogram of responsibility.

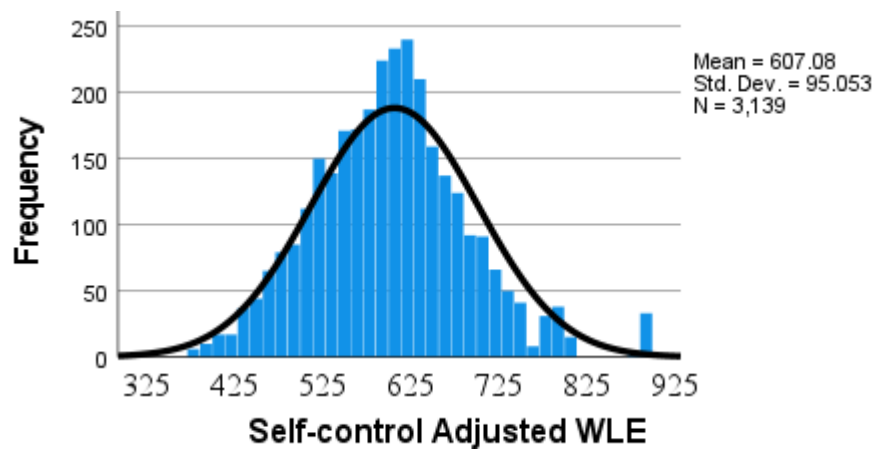


Figure 4.16. Histogram of self-control.

4.1.2.3. Linearity. Tabacknick and Fidell (2013) suggested drawing scatterplots in order to assess the linear relationship among the variables. Therefore, scatterplots of each factor were provided below. According to the scatterplots, there is a linear relationship among the subdimensions in each factor. Therefore, linearity assumption is not violated.

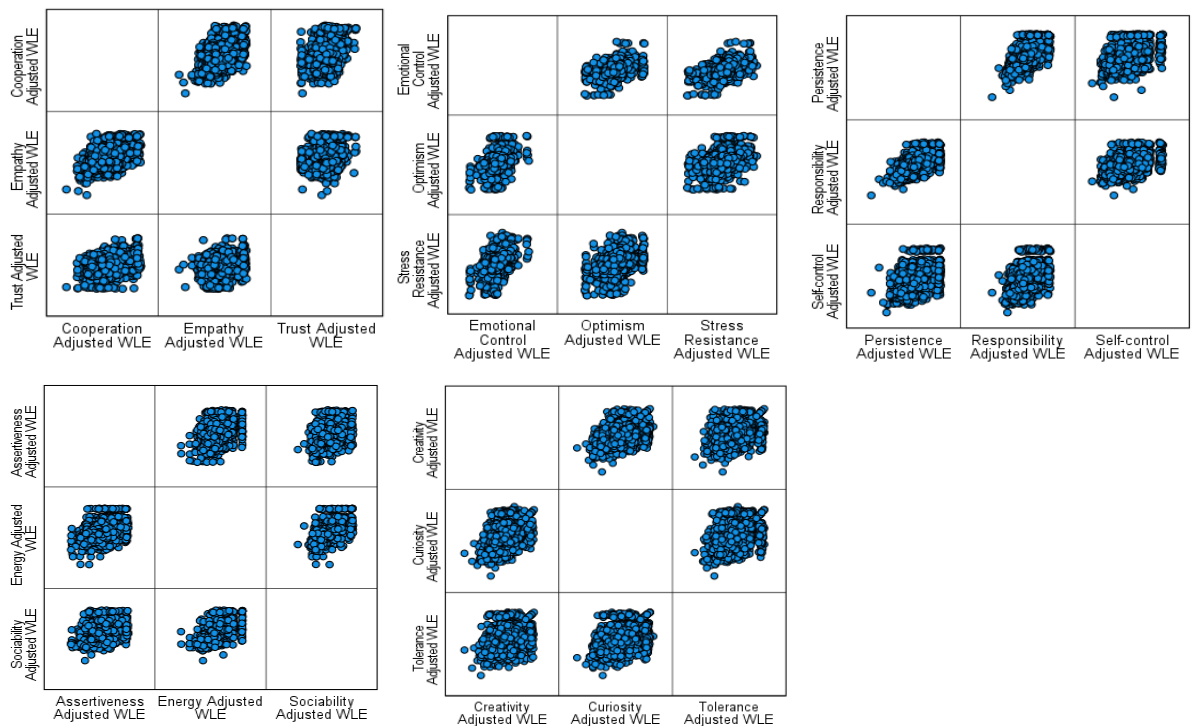


Figure 4.17. Linearity of each factor.

4.1.2.4. Multicollinearity. Tabacknick and Fidell (2013) suggested inverting the covariance matrix to determine the linear combination of the variables. Therefore, for each factor, multicollinearity was investigated. According to Table 4.2, multicollinearity assumption is not violated.

Table 4.2. Correlation among each factor.

Factors	Correlations	
Collaboration by	Empathy	Trust
Empathy	-	-
Trust	.144**	-
Cooperation	.584**	.299**
Emotional regulation by	Emotional control	Optimism
Emotional control	-	-
Optimism	.472**	-
Stress resilience	.496**	.438**
Engaging with others by	Assertiveness	Energy
Assertiveness	-	-
Energy	.334**	-
Sociability	.310**	.546**
Open mindedness	Creativity	Tolerance
Creativity	-	-
Tolerance	.431**	-
Curiosity	.521**	.416**
Task performance	Persistence	Responsibility
Persistence	-	-
Responsibility	.670**	-
Self-control	.549**	.536**

4.1.3. Gender, SES and SEL Groups Statistics

In order to show the sample size of different groups, frequency table (see Table 4.3) and bar chart of gender, SES, and level of SEL evaluation is demonstrated below. Overall, the number of girl students in this study is more than the number of boys. On the other hand, informally evaluated SEL group has more participants than formally evaluated and non-evaluated groups. Also, missing values of SEL groups is higher than other groups.

Table 4.3. Frequencies of groups.

Groups		N	%
Gender	Girls	1841	58.6%
	Boys	1299	41.4%
SES	Low	1046	33.3%
	Medium	1047	33.3%
	High	1045	33.3%
	Missing	2	0.1%
	Total	3140	100.0%
SEL Evaluation	No, we don't evaluate these skills	542	17.3%
	Yes, using informal evaluation	1392	44.3%
	Yes, using formal evaluation	855	27.2%
	Missing	351	11.2%
	Total	3140	100.0%

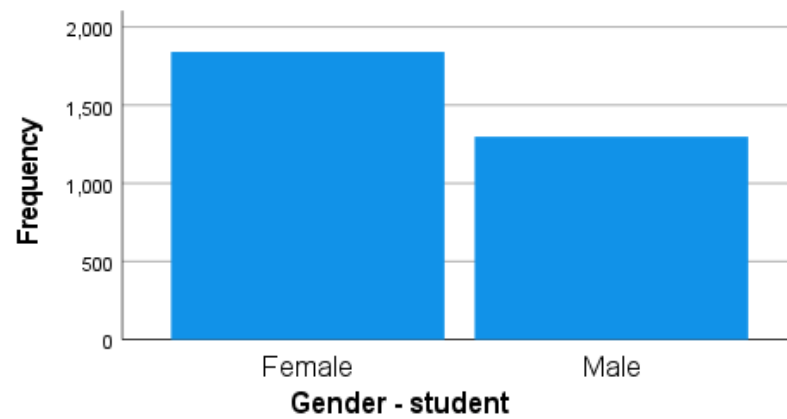


Figure 4.18. Gender distribution.

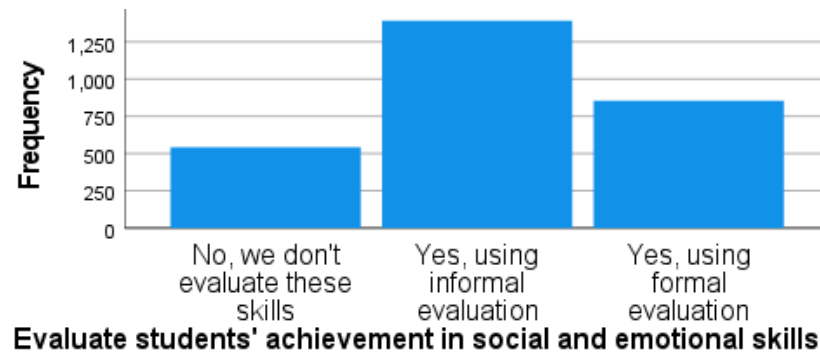


Figure 4.19. Evaluation of SEL groups distribution.

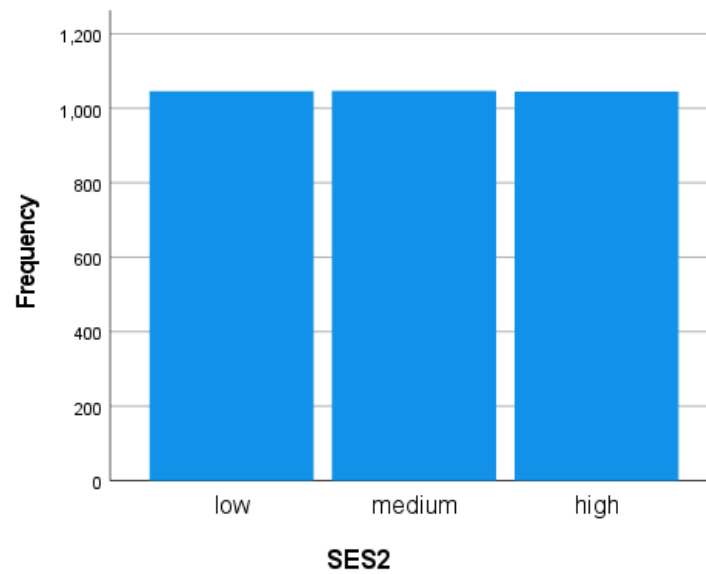


Figure 4.20. SES distribution.

4.2. Mathematics Achievement with Big Five Domain Model of SSES

4.2.1. Model Testing by Confirmatory Factor Analysis (CFA)

First of all, the measurement model with five domains (task performance, emotional regulation, engaging with others, collaboration, and open-mindedness) and fifteen subdimensions (empathy, trust, self-control, cooperation, emotional control, optimism, stress resilience, assertiveness, energy, sociability, creativity, curiosity, tolerance, persistence, responsibility, and self-control) were used to test whether the sample data confirmed the factor structure. In this study, in order to estimate the model, maximum likelihood (ML) method was utilized. If there was a multivariate normality and interval scale on observed variables, it can be stated that standard errors, maximum likelihood estimates, and χ^2 test can be called as appropriate.

In this study, CFI, TLI, and RMSEA values for the big five domain model were reported to determine the model fit. CFI and TLI of this model are 0.832 and 0.779 respectively (see Table 4.4). Since CFI and TLI values were lower than 0.950, the big five domain model had poor fit to the data. Also, RMSEA value of the model was 0.111 which was more than 0.100 representing poor fitting model (90% percent of the confidence interval for RMSEA value is 0.107 and 0.114). Also, large sample sizes significantly boost chi-square result, thus, χ^2 / df values were provided in the Table 4.4 in order to minimize the effects of sample size.

Table 4.4. Confirmatory factor analysis of big five domain model.

Model	χ^2	<i>df</i>	χ^2 / df	CFI	TLI	RMSEA	
						Value	90%
Big five domain model	3147.119***	80	39.34	0.832	0.779	0.111	0.107, 0.114

* $p < .05$; ** $p < .01$; *** $p < .001$

Modification indices were investigated to improve the model by identifying the subdimensions which would develop the model fit. However, suggestions of modification indices didn't provide a meaningful and acceptable fit. Also, suggested modification indices put some of the subdimensions under one of the other factors, which is not appropriate with the theoretical background of big five model. As the fit indices for big five domains model indicated poor fit to the data, a modified model was tested by decreasing number of subdimensions according to the lowest factor loadings. Table 4.5 demonstrates the factor loadings of the big five domains measurement model.

Table 4.5. Standardized coefficients of measurement model with five domains.

Big five domains Model	Standardized Coefficients	S.E.
Collaboration by		
Empathy	0.707***	0.012
Trust	0.314***	0.018
Cooperation	0.825***	0.011
Emotional regulation by		
Emotional control	0.619***	0.014
Optimism	0.777***	0.012
Stress resilience	0.624***	0.014
Engaging with others by		
Assertiveness	0.393***	0.017
Energy	0.845***	0.011
Sociability	0.656***	0.013
Open mindedness by		
Creativity	0.703***	0.013
Tolerance	0.501***	0.016
Curiosity	0.790***	0.012
Task performance by		
Persistence	0.809***	0.009
Responsibility	0.804***	0.009
Self-control	0.695***	0.011

* $p < .05$; ** $p < .01$; *** $p < .001$

The subdimensions with the lowest factor loadings were eliminated from the big five model. Therefore, tolerance ($\beta = 0.501$), self-control ($\beta = 0.695$), assertiveness ($\beta = 0.393$), trust ($\beta = 0.314$), and emotional control ($\beta = 0.619$) were removed with the lowest correlations in this model. Therefore, the model was modified as five domains and ten subdimensions.

Fit indices of the modified model indicated acceptable model fit with better CFI, TLI and RMSEA values which are shown in Table 4.6. Overall, the model provided an acceptable fit (CFI=0.938, TLI= 0.888, RMSEA=0.097).

Table 4.6. Confirmatory factor analysis of modified five domains model.

Model	χ^2	df	χ^2 / df	CFI	TLI	RMSEA	
						Value	90%
Modified model	769.905***	25	30.80	0.938	0.888	0.097	0.092, 0.103

* $p < .05$; ** $p < .01$; *** $p < .001$

4.2.2. Predicting Mathematics Achievement with Modified Five Domains SSES Model

The modified five domains SSES model was used to predict the mathematics achievement of students. According to the results, open-mindedness ($\beta = 0.258$) and emotional regulation ($\beta = 0.398$) domains have statistically significant positive relationship with mathematics achievement of students. On the other hand, engaging with others ($\beta = -0.516$) domains has statistically significant and negative relationship with mathematics achievement while task performance and collaboration domains do not have a statistically significant relationship. Overall, this model explains 8% of the variance in mathematics achievement ($R^2 = 0.077$). Among these variables, engaging with others has the most important role in the prediction.

Table 4.7. Standardized regression coefficients in the model.

Mathematics Achievement	Standardized Coefficients	S.E.
Open mindedness	0.258***	0.053
Task performance	-0.049	0.056
Engaging with others	-0.516***	0.141
Collaboration	0.033	0.067
Emotional regulation	0.398**	0.127

* $p < .05$; ** $p < .01$; *** $p < .001$

4.3. Mathematics Achievement with Big Five Domains Model of SSES for Gender Differences

4.3.1. The Modified Measurement Model Testing and Model Fit by CFA for Boys and Girls

To determine if the data from boys and girls independently supported the factor structure, the modified measurement model was utilized. As reported in Table 4.8, overall, the modified model provided a good fit for boys (CFI=0.950, TLI= 0.909, RMSEA=0.088 with 90% of the confidence interval of 0.079 and 0.098). Also, the model had an acceptable fit with the girls' data (CFI=0.936, TLI= 0.885, RMSEA=0.098 with 90% of the confidence interval of 0.091 and 0.106).

Table 4.8. Confirmatory factor analysis of the modified model for boys and girls.

Gender	Model	χ^2	df	χ^2 / df	CFI	TLI	RMSEA	
							Value	90%
Boys	Modified model	276.223***	25	11.05	0.950	0.909	0.088	0.079, 0.098
Girls	Modified model	471.107***	25	18.84	0.936	0.885	0.098	0.091, 0.106

* $p < .05$; ** $p < .01$; *** $p < .001$

4.3.2. Predicting Mathematics Achievement with Modified Five Domains SSSES

Model for Genders Groups of Boys and Girls

For the second research question, the modified five domains SSSES measurement model was used to predict the mathematics achievement for genders groups. The results showed that while this model explained the 6% of the variance in mathematics achievement ($R^2=0.056$) for boys, it explained 9% of the variance of girls in mathematics achievement ($R^2=0.092$). Therefore, the modified model explained more variance in mathematics achievement for girls than boys.

According to Table 4.9, although open-mindedness domain has statistically significant positive relationship with mathematics achievement for both boys and girls, the relationship between the open-mindedness domain and mathematics achievement was stronger for boys ($\beta = 0.320$) than girls ($\beta = 0.246$).

On the other hand, while engaging with others and emotional regulation domain does not have a statistically significant relationship for boys, girls have statistically significant negative relationship with engaging with others ($\beta = -0.419$), and statistically significant positive relationship with emotional regulations ($\beta =0.412$). Moreover, task performance and collaboration domain does not have a statistically significant relationship with mathematics achievement for both boys and girls.

Table 4.9. Standardized regression coefficients in the model for boys and girls.

	Mathematics Achievement	Standardized coefficients	S.E.
Boys	Open mindedness	0.320***	0.089
	Task performance	-0.138	0.090
	Engaging with others	-0.348	0.214
	Collaboration	0.028	0.113
	Emotional regulation	0.185	0.194
Girls	Open mindedness	0.246***	0.063
	Task performance	0.012	0.068

Table 4.9. Standardized regression coefficients in the model for boys and girls (cont.).

	Engaging with others	-0.419**	0.152
	Collaboration	-0.064	0.075
	Emotional regulation	0.412**	0.134

* $p < .05$; ** $p < .01$; *** $p < .001$

4.4. Mathematics Achievement with Big Five Domains Model of SSES for Different Socioeconomic Status Groups

4.4.1. The Modified Measurement Model Testing for Low, Medium, and High Level of SES

The modified measurement model was used to test whether data of low, medium, and high SES confirmed the factor structure. As reported in Table 4.10, the modified model had an acceptable fit for low level SES group (CFI=0.930, TLI= 0.874, RMSEA=0.094 with 90% of the confidence interval of 0.094 and 0.114.). For the medium level SES group, the modified model had also an acceptable fit (CFI=0.932, TLI= 0.877, RMSEA=0.091 with 90% of the confidence interval of 0.091 and 0.112). Moreover, for high level SES group, the model provided a good model fit (CFI=0.955, TLI=0.920, RMSEA= 0.084 with 90% confidence interval is 0.073 and 0.094).

Table 4.10. Confirmatory factor analysis of modified model for low, medium and high-level SES.

SES	χ^2	df	χ^2 / df	CFI	TLI	RMSEA	
						Value	90%
Low Level	306.714***	25	12.27	0.930	0.874	0.104	0.094, 0.114
Medium Level	292.198***	25	11.69	0.932	0.877	0.101	0.091, 0.112
High Level	207.999***	25	8.32	0.955	0.920	0.084	0.073, 0.094

* $p < .05$; ** $p < .01$; *** $p < .001$

4.4.2. Predicting Mathematics Achievement with Modified Five Domains SSES Model for Socioeconomic Status

The modified five domains SSES model was used to predict predicts the mathematics achievement for different SES groups as low, medium, and high levels. The results showed that while for low level SES students this model explains 13% of the variance in mathematics achievement ($R^2=0.130$), for medium level SES students, it explains 9% of the variance in mathematics achievement ($R^2=0.091$). Furthermore, for high level SES group, the model explains 6% of the variance in mathematics achievement ($R^2=0.056$). Therefore, the model explains more variance in mathematics achievement for low SES students, compared to medium SES, and high-level SES.

According to Table 4.11, while open-mindedness domain had a statistically significant positive relationship between the mathematics achievement for low level ($\beta=0.507$) and high level of SES groups ($\beta =0.170$), the relationship was stronger for low level SES groups than high level SES groups. Low level ($\beta = -0.606$) and high level ($\beta = -0.471$) of SES groups have statistically significant negative relationships between the engaging with others and mathematics achievement. Lastly, emotional regulation domain ($\beta =0.341$) and mathematics achievement have a statistically significant positive relationship for only high level of SES groups. For medium level of SES groups, none of the domains was significantly related to math achievement.

Table 4.11. Standardized regression coefficients in the model for low, medium, and high-level SES.

	Mathematics Achievement	Standardized Coefficients (β)	S.E.
Low SES	Open mindedness	0.507***	0.120
	Task performance	-0.166	0.145
	Engaging with others	-0.606*	0.279
	Collaboration	-0.089	0.105
	Emotional regulation	0.520	0.283
Medium SES	Open mindedness	0.073	0.126
	Task performance	-0.108	0.239
	Engaging with others	-0.955	0.769
	Collaboration	0.399	0.406
	Emotional regulation	0.691	0.640
High SES	Open mindedness	0.170*	0.082
	Task performance	0.104	0.080
	Engaging with others	-0.471**	0.174
	Collaboration	-0.031	0.076
	Emotional regulation	0.341*	0.149

* $p < .05$; ** $p < .01$; *** $p < .001$

4.5. Mathematics Achievement with Big Five Domains Model of SSES for Different Levels of SEL Evaluation Groups

4.5.1. The Modified Measurement Model Testing for Different Levels of SEL Evaluation Groups

The modified measurement model was used to test whether the data of different levels of SEL evaluation groups confirmed the factor structure. As reported in Table 4.12, the modified model provided an acceptable fit for non-evaluated SEL groups (CFI=0.910, TLI= 0.838, RMSEA=0.117 with 90% of the confidence interval of 0.103 and 0.132). For informally evaluated SEL group, the good model fit was obtained (CFI=0.944, TLI= 0.900, RMSEA=0.093 with 90% of the confidence interval of 0.084 and 0.102). Moreover, for formally evaluated SEL group, the model was indicated as an acceptable fit (CFI=0.942, TLI= 0.896, RMSEA=0.095 with 90% of the confidence interval of 0.083 and 0.106).

Table 4.12. Confirmatory factor analysis of modified model for levels of SEL evaluation groups.

SEL evaluation groups	χ^2	df	χ^2 / df	CFI	TLI	RMSEA	
						Value	90%
Non-evaluated	211.099***	25	8.44	0.910	0.838	0.117	0.103, 0.132
Informally evaluated	324.804***	25	12.99	0.944	0.900	0.093	0.084, 0.102
Formally evaluated	216.263***	25	8.65	0.942	0.896	0.095	0.083, 0.106

* $p < .05$; ** $p < .01$; *** $p < .001$

4.5.2. Predicting Mathematics Achievement with Modified Five Domains SSES Model for Levels of SEL Evaluation Groups

The modified five domains SSES model was used to predict the mathematics achievement for the levels of SEL evaluation groups defined as non-evaluated, informally evaluated, and formally evaluated. The results showed that while this model explains 6% of the variance in mathematics achievement ($R^2 = 0.062$) for non-evaluated SEL groups, it explains 8% of the variance in mathematics achievement ($R^2 = 0.080$) for informally evaluated SEL groups of data. Furthermore, for formally evaluated SEL group, the model explains 9% of the variance in mathematics achievement ($R^2 = 0.091$). Therefore, explained variance in the model for mathematics achievement for formally evaluated groups is more than informally evaluated, and non-evaluated SEL groups.

According to Table 4.13, for all level of SEL evaluation groups, open-mindedness ($\beta_{non} = 0.240$, $\beta_{informally} = 0.233$, $\beta_{formally} = 0.359$) had a statistically significant positive relationship with mathematics achievement. However, this relationship is getting stronger from non-evaluated groups to formally evaluated groups. Therefore, it can be stated that formal evaluation of the social and emotional skills has a positive relationship with mathematics achievement of students in these schools.

On the other hand, while non-evaluated and informally evaluated groups do not have statistically significant relationship between engaging with others domain and mathematics achievement, formally evaluated groups of students have statistically significant negative relationships with engaging with others ($\beta = -0.482$). Thus, engaging with others domain had a relationship with mathematics achievement of students in negative direction in schools which formal evaluation of SEL is conducted.

Table 4.13. Standardized regression coefficients in the model for levels of SEL evaluation groups

	Mathematics Achievement	Standardized Coefficients (β)	S.E.
Non-evaluated	Open mindedness	0.240*	0.121
	Task performance	-0.192	0.261
	Engaging with others	-0.588	0.683
	Collaboration	0.101	0.284
	Emotional regulation	0.547	0.657
Informally evaluated	Open mindedness	0.233**	0.080
	Task performance	-0.011	0.078
	Engaging with others	-0.550	0.293
	Collaboration	0.058	0.130
	Emotional regulation	0.396	0.265
Formally Evaluated	Open mindedness	0.359**	0.126
	Task performance	-0.097	0.116
	Engaging with others	-0.482**	0.179
	Collaboration	0.017	0.106
	Emotional regulation	0.343*	0.168

* $p < .05$; ** $p < .01$; *** $p < .001$

5. DISCUSSION

In the revisions made in education systems, it is seen that more emphasis is devoted to social and emotional skills due to the increased awareness of 21st century skills. The importance attributed to these skills has also increased over time, since they can support students' learning processes, reduce behavioral problems, develop social relations and their tendency to take responsibility, respond to changing labor demands and support disadvantaged students (CASEL, 2022; Dymnicki, 2013; Eroğlu et al., 2021; Metzger et al., 2018; OECD, 2021). In 2019, the OECD conducted the most comprehensive international study on social and emotional skills with big five domains in the field of SEL. However, the number and the scope of the studies conducted in the field of social and emotional skills and mathematics in Turkey is scarce. Therefore, the study aimed to investigate the differential relationship between the modified big five domains of SSES and mathematics achievement for socioeconomic status, gender, and level of SEL evaluation groups using the OECD 2019 SSES data of 9th, 10th, and 11th grades of Turkey.

5.1. Mathematics Achievement with Big Five Domains Model of SSES

In this study, one of the main goals was to predict the mathematics achievement of students using big five domains model of SSES which includes fifteen subdimensions. However, when the fit indices were reported by CFA, big five domains measurement model of SSES indicated poor fit to the sample data. Therefore, the model was modified with five domains and ten subdimensions (curiosity, creativity, responsibility, persistence, sociability, energy, empathy, cooperation, stress resilience, and optimism).

According to the results of modified model, 8% of the variance in mathematics achievement ($R^2=0.077$) was explained by the social and emotional skills domains, especially with open mindedness, emotional regulation and engaging with other variables. It is consistent with the arguments in the literature as academic skills have become more developed when they are supported by the social and emotional skills (Alzahrani, et al.,

2019; Chernyshenko, Kankaras & Drasgow, 2018; McCormick et al., 2015; OECD, 2015, 2021).

Open mindedness and emotional regulation domains have significantly positive relationship with students' mathematics achievement. Thus, the model indicates that students with developed open-mindedness and emotional regulation skills tend to have higher grades on mathematics courses. The findings are consistent with OECD's SSES report for all participating cities (OECD, 2021). Open-mindedness domain which was defined in the study as openness to experience with the combination of skills, curiosity, and creativity has significantly positive relationship with students' mathematics performance (Eroğlu et al, 2021; OECD, 2021). Therefore, students who described themselves as highly creative and curious also identified themselves as willing to develop new information which results in higher academic achievement (OECD, 2021). Moreover, emotional regulation domain which was stated as emotional stability with the combination of the skills; stress resilience, and optimism has positive relationship with mathematics achievement (CASEL, 2020; Eroğlu et al, 2021). Therefore, students with developed skills to regulate their emotions have more likelihood for better mathematics performance.

On the other hand, engaging with others has the most important role in the prediction of mathematics achievement in Turkey sample data. The result is consistent with the SSES findings of OECD for the older cohort of all the data. OECD (2021) reported that 15 years old students who are more sociable have lower mathematics grades. Individuals experience physiological and physical changes and are impacted by their peers during adolescence (Ahmetoğlu, 2009; Gander & Gardiner, 2007). In this period, the priorities of teenagers are to be accepted by their peers (Durualp, 2014). Therefore, the findings of this study can be related to the fact that the priority of teenagers is their social connections and relationships at the expense of their school achievement (OECD,2021).

Moreover, although some research findings in the literature about the relationship between the social and emotional skills and mathematics achievement is consistent with the present study's findings, the consistency extent is too limited due to the differences in methodology, sample, and social and emotional skill domains (Durlak et al., 2011; İşeri, 2016; Kabakcı & Korkut, 2008; Mahoney et al., 2018; Poropat, 2009).

5.2. Mathematics Achievement with Big Five Domains Model of SSES for Gender Differences

In the present study, one of the aims was to predict the mathematics achievement for gender groups of boys and girls separately to investigate differential relationship using big five domains model of SSES.

According to the modified big five domains model results, while the explained variance is indicated as 6% in mathematics achievement for boys, it is stated as 9% for girls. This means that, girls' explained variance in mathematics achievement is more than boys. Therefore, the relationship between improved social and emotional skills and mathematics achievement is stronger for girls than boys. Previous research supports the findings of this study that gender differences have a substantial role in the improvement of social and emotional skills in a favor of girls than boys (Durualp, 2014; Kabakçı & Korkut, 2008; Memiş & Memiş, 2013). It is stated that girls demonstrate better communication skills and activities such as initiating a conversation, adapting, maintaining interaction, and awareness of emotions compared to boys (Durualp, 2014; Kabakçı & Korkut, 2008).

Moreover, when each domain considered separately, open mindedness predicts mathematics achievement in a positive direction for both boys and girls. However, boys' open mindedness domain is more related with their mathematics performance than girls. Therefore, boys who have developed curiosity and creativity skills are likely to have better mathematics performance than girls.

On the contrary, for open mindedness domain, the emotional regulation subdimension and mathematics achievement is related for girls not for boys. It can be stated that girls who have higher emotional regulations skills may tend to have higher mathematics grades. The result is consistent with some of the research findings in literature. Compared to boys, girls can be able to realize, manage and express their emotions, so they can have developed emotional regulation skills which is positively related with mathematics achievement (Durualp, 2014; İşeri, 2016; Kabakçı & Korkut, 2008; Memiş & Memiş, 2013).

On the other hand, while girls have statistically significant negative relationship with engaging with others domain, boys' mathematics achievement does not have a statistically significant relationship with this domain. Due to the higher awareness about emotions and feelings, girls tend to create more powerful social bonds with their peers (Durualp, 2014). Therefore, girls' priority may be their social connections explained by engaging with others domain which has negative correlation with mathematics achievement (Eroğlu et al., 2021; OECD, 2021).

All in all, there is a differential relationship between mathematics achievement and social and emotional skills for boys and girls. The relationship between improved social and emotional skills and mathematics achievement is stronger for girls than boys. Therefore, improved social and emotional skills of girls' might provide better mathematics achievement compared to boys. Mathematics performances of boys and girls who have higher curiosity and creativity skills are more likely to become more developed. On the contrary, more sociable and energetic girls are likely to have lower mathematics scores while boys' sociability and energy skills are not related with their mathematics performance.

5.3. Mathematics Achievement with Big Five Domains Model of SSES for Different Socioeconomic Status Groups

In this study, one of the aims was to predict the mathematics achievement for different SES groups as low, medium, and high levels to investigate differential relationship using modified big five domains model of SSES.

According to the modified big five domains model results, while the explained variance is indicated as 13% in mathematics achievement for low level SES students, it is stated as 9% for medium level SES students. Moreover, for high level SES group, the model explained 6% of the variance in mathematics achievement. Therefore, it can be stated that model of social and emotional skills strongly predicts the mathematics achievement for low level SES students. The explained variance in mathematics achievement decreases gradually through high level SES students. Overall, this is an indicator for mathematics achievement of students from low socioeconomic status is highly correlated with their social and emotional skills. Therefore, if the students from low socioeconomic status have developed

social and emotional skills, they are likely to have better academic performance on mathematics. On the contrary, if they have low level of social and emotional skills, their mathematics achievement tends to become lower. Therefore, the result demonstrates the significance of supporting socioeconomically disadvantaged students.

Moreover, the study is consistent with the findings in this field including the social and emotional skills. Students from advantaged backgrounds are generally more successful in school, whereas children from disadvantaged backgrounds are at a greater risk of academic failure (Alacacı & Erbaş, 2010; Dolu, 2020; Eroğlu et al., 2021; Sirin, 2005). According to the current study, if the social and emotional skills of students from low SES are not developed sufficiently, their risk of academic failure for mathematics achievement is getting stronger. To prevent long-term disadvantages, the support should be provided to socioeconomically disadvantaged students to integrate and develop social and emotional abilities in addition to academic skills.

Open mindedness domain which was defined as openness to experience with the combination of curiosity and creativity predicts mathematics achievement for both low and high levels of SES. On the other hand, engaging with other domain which was defined as extraversion with the combination of sociability and energy have statistically significant negative relationship for low and high socioeconomic status. Therefore, it can be stated that more extravert individuals who are more sociable, and energetic from low and high socioeconomic status are more likely to have lower levels of mathematics achievement because they attach more importance on social interactions than school expectations (Eroğlu et al., 2021).

Lastly, emotional regulation domain is a significant and positive indicator of mathematics achievement for students from only high SES group. Therefore, it can be stated that if students who are from high socioeconomic status regulate their emotions, they are more likely to have better mathematics performance.

The findings of the study are nearly consistent with the previous research results in the literature because there is a differential relationship between the mathematics achievement and the level of socioeconomic status (Alacacı & Erbaş, 2010; Aslanargun, et al., 2016;

Dolu, 2020; Savaş et al., 2010; Sirin, 2005). Also, socioeconomic status is reported as a significant predictor of mathematics achievement in OECD's SSES report (OECD, 2021). However, findings cannot be compared in detail because there is lack of research about the prediction of the mathematics achievement by the social and emotional skills for different levels of SES groups as low, medium, and high in the literature.

5.4. Mathematics Achievement with Big Five Domains Model of SSES for Different Levels of SEL Evaluation Groups

In the present study, one of the main goals was to predict the mathematics achievement for the levels of SEL evaluation groups defined as non-evaluated, informally evaluated, and formally evaluated using modified big five domains model of SSES.

In accordance with the results, this model explained 6% of the variance in mathematics achievement for non-evaluated SEL groups, while it explained 8% of the variance in mathematics achievement for informally evaluated SEL groups of data. Furthermore, for formally evaluated SEL group, the model explains 9% of the variance in mathematics achievement. Therefore, it can be stated that there is a differential relationship between the modified five domains SSES model and mathematics achievement for non-evaluated groups, and evaluated SEL groups. As it is stated in the literature, the result confirmed that assessment and evaluation of SEL is an important part of developing these skills which are related to academic performance (Agliati et al., 2020; CASEL, 2019; Sutton, 2021).

According to the results, open mindedness domain has statistically significant positive relationship with mathematics achievement for all levels of SEL evaluation groups. It means that whether the social and emotional learning is evaluated or not, students who are open to new experiences with curiosity and creativity are more likely to have higher mathematics performance. However, if the SEL is evaluated formally, the relationship between the open mindedness domain and mathematics achievement become stronger.

From another perspective, emotional regulation domain has statistically significant positive relationship with mathematics achievement in only formally evaluated schools. It can be stated that if the formal evaluation is conducted for SEL programs, students who have

emotional stability tend to become more successful in mathematics. On the contrary of emotional regulation domain, students who are more extraverts are likely to become less successful in mathematics in formally evaluated schools.

Overall, there is a stronger relationship between the mathematics achievement and social and emotional skills in the schools which formal evaluation of SEL programs conducted. Therefore, if the evaluations of the SEL programs are provided to develop students' social and emotional skills, the mathematics achievement of students are more likely to become higher.

5.5. OECD's SSES Technical Report and Findings of the Study

The findings of current study and OECD's SSES study have differentiated in some contexts. First of all, in the current study, first model which is the big five factor model of social and emotional skills did not provide a good fit with the sample data of the study which was 9th, 10th and 11th grade students in Turkey. However, the model has good fit with the OECD's comprehensive data sample including 10 countries' participants. The reason behind the difference is that OECD investigated all of the subdimensions separately in terms of factor loadings and goodness indices while the current study examined them as the five factors and fifteen subdimensions. Therefore, when the subdimensions considered together as a factor, they did not provide good indices. Also, another reason may be extraction of the data of current study from more comprehensive sample data.

From another perspective, OECD's SSES investigated and evaluated all subdimensions separately while the current study investigated as the factors including subdimensions. Therefore, the current study provides implications in terms of factors and their subdimensions while OECD's SSES provides separate findings and results for each subdimensions.

5.6. Implications

The findings demonstrate the significance of educational opportunities in which students may demonstrate their creativity individually and in groups in order to protect and promote their creativity skills as much as possible. Thus, students' creativity and curiosity should be supported by the applications and revisions of policymakers, principals, instructors, and family environment. It may be beneficial for teachers to try to present innovative perspectives to students in the teaching methods and activities they choose, and to encourage creative solutions to support these skills.

From another perspective, sociability and energy skills should be highlighted and organized in a meaningful way to change their perspective on the priority for social connections which are explained by engaging with others domain at the expense of their work in academic field.

Moreover, there is a differential relationship between the mathematics achievement and two domains of the model which are engaging with others and emotional regulation for boys and girls. This means that, improved social and emotional skills of girls provides better mathematics achievement compared to boys. Therefore, girls' needs in terms of social and emotional skills need to be focused and improved during the educational process because their skills have a significant role in their academic processes.

According to the level of socioeconomic status, students from low SES have the strongest relationship between the math achievement and social and emotional skills, while the high SES students have the less strong relationship. Therefore, supporting socioeconomically disadvantaged students in terms of social and emotional skills additional to academic skills is significant to prevent long-term disadvantages. Moreover, supporting creativity and curiosity skills should be attached more importance on the mathematics education of students from low SES while stress resilience and optimism skills should be highlighted and developed for high SES groups of students to foster their mathematics achievement.

When the evaluation of SEL considered, in schools evaluating SEL formally, students should have developed stress resilience, optimism, sociability, and energy skills in a proper way to succeed in mathematics. Therefore, formal evaluation of SEL programs may be conducted to develop the effective learning and teaching programs and strategies which enhance students' social and emotional skills and provide better and more successful academic lives, careers, and life outcomes.

All in all, the study provides qualified and in-depth insights about the differential relationships between the big five domains model of social and emotional skills and mathematics achievement for gender differences, socioeconomic status groups, and level of SEL evaluation groups in Turkey.

5.7. Limitations

There are some limitations of the study. First of all, secondary data collected by OECD was used to conduct the current study. Therefore, big five domains model of OECD's SSES was not confirmed by the data of the study which was 9th, 10th and 11th grade students in Turkey sample. Thus, the model modified with the elimination of the lowest factor loadings from each subdimensions. That's why, the model was investigated with a smaller number of subdimensions.

Additionally, OECD's data and technical framework did not provide detailed information about the types of participants' schools as private or public schools. Therefore, the proportion of participants from public and private schools cannot be considered while analyzing for socioeconomic status of students.

Finally, missing data were eliminated listwise from this analysis, as their presence might have weakened the sampling's representativeness.

5.8. Suggestions

The current study utilized the OECD's SSES data from Istanbul, Turkey. Therefore, findings of the study can provide implications for only Istanbul region. Thus, first suggestion is to apply the instrument of the OECD's SSES in different regions of Turkey in order to generalize the findings to Turkey. With the implementation for different regions, data can be more generalizable for especially socioeconomic status. Also, participants may be chosen from private and public schools to compare the school related factors. Therefore, necessary actions can be taken by policymakers to provide fairness and development in social and emotional skills.

Secondly, in OECD's SSES data, there are many variables provided by principals and teachers which reflect the school climate and learning environment. In future studies, data of principals and teachers can be investigated to predict the relationship between school related factors and social and emotional skills.

On the other hand, investigation of the reasons for the differentiation of the relationship between social emotional skills and mathematics achievement depending on the socioeconomic status and gender can make a great contribution to the field. Therefore, precautions can be provided to support disadvantaged students.

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