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Mathematics Teacher Candidates' Classroom Error Climate, Entrepreneurship and Critical Thinking Beliefs

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Abstract

In our age where information is rapidly developing and changing, there is a need for individuals who can propose different solutions to problems. In this context, learning from mistakes aims to raise creative, entrepreneurial and high-level thinking individuals in education. In this sense, the purpose of this study is to determine the relationship between error-based instruction in the classroom and both entrepreneurship and critical thinking. In the study, a relational design, which is one of the quantitative research methods, was used. The sample of the study consisted of 257 pre-service elementary mathematics teachers studying in mathematics education. Statistical Package for Social Sciences (SPSS-Version 22) was used to analyze the data. As a result of the analysis, it was revealed that there was a statistically significant relationship between teacher candidates' classroom error climate and entrepreneurship. As a result of the analysis, it was revealed that there was a statistically significant relationship between teacher candidates' classroom error climate and critical thinking.

Keywords: Error Climate, Critical Thinking, Entrepreneurship

Introduction

In learning environments, it is unavoidable for students to make mistakes. The important thing is to decide whether it is necessary to prevent making mistakes. While classroom environments with a behaviorist approach do not welcome making mistakes, constructivist classroom environments accept mistakes as a natural element of the learning environment and a teaching tool (Borasi, 1989; Steuer et al., 2013). With the emergence of the concept of negative knowledge, which is based on constructivist knowledge theory and metacognition, the importance of utilizing this knowledge in teaching environments has begun to be investigated (Bray, 2011). Negative knowledge is the knowledge about what not to do and how not to do it (Gartmeier et al., 2008). According to this definition, negative knowledge is the knowledge that emphasizes learning from failures and experiences, knowing what is wrong and what should be avoided. According to research, negative knowledge is directly related to learning from mistakes and failures (Borasi, 1996; Heinze, 2005). According to Akpınar and Akdoğan (2010), in addition to affective characteristics, negative knowledge provides the opportunity to reflect on experiences, problem solving and high-level thinking skills. Based on all these, it can be said that the task of negative knowledge is to benefit from mistakes and failures in a way to prevent making mistakes.

Since the 21st century, developments in the world have led to changes in the characteristics of individuals that countries should raise. In this sense, individuals are expected to be critical thinkers, entrepreneurs, creators, collaborators, problem solvers, flexible thinkers, leaders and flexible thinkers (Pektaş & Çelik, 2021). In the context of raising the desired individuals, the goal of countries is to raise thinking and productive people and to plan their education systems accordingly. This means that the country can raise talents with high-level thinking skills (Blesia et al., 2019, Perez, 2023). In our age where information is rapidly developing and changing, there is a need for individuals who can propose different solutions to problems. Education plays an important role in the emergence of these individuals. In the education method based on knowledge transfer, individuals receive information directly, cannot keep up with innovations and changes, cannot find solutions to problems and accept everything. In addition to these characteristics, high-level psychological activities are needed to reveal individuals who

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can develop themselves, produce different solutions, and do not stick to reality (Tüysüz & Kılıç, 2022). In this context, learning from mistakes aims to raise creative, entrepreneurial and high-level thinking individuals in education.

Theoretical Framework

Error Climate

With the constructivist approach, mistakes have ceased to be elements to be avoided in the classroom environment and learning from mistakes has become a teaching activity that supports negative knowledge (Heinze, 2005). There are many studies showing that using errors as a teaching activity increases student achievement (Barbieri & Booth, 2020; Heinze & Reiss, 2007; Rach et al., 2013). Beyond being used as a teaching activity, errors in the classroom can be evaluated from different perspectives. One of these is teachers' interventionist approaches to errors. Peng and Luo (2009) draws attention to the importance of how teachers intervene against errors in the classroom. One of the most important factors in determining how teachers respond to errors is the perceived error climate in the classroom (Steuer et al., 2013).

Each classroom has a unique learning environment and within this environment, students and teachers have different attitudes, behaviors and perceptions towards errors. This situation, which is defined as error climate or error culture, is the evaluation and use of errors in the classroom learning environment as integral elements of the learning process (Steuer et al., 2013). In this way, including errors in the learning process prepares the ground for creating a positive error climate. In such classroom environments, students are open to communication about errors and can cope with them. Teachers, on the other hand, accept students' mistakes, consider them as learning opportunities, and show a tolerant attitude instead of an obstructive attitude (Borasi, 1988).

In order to learn from mistakes, it is first necessary to look at them as learning opportunities. Borasi (1988) emphasized the importance of using errors in the learning environment and likened them to a springboard in teaching. Research has shown that teachers generally view errors positively but do not know how to use them in the classroom (Özkaya & Konyalıoğlu, 2019; Palkki & Hastö, 2018). In studies where teachers used errors as learning opportunities in the classroom, it was found that students had lower cognitive anxiety and students of teachers who used errors effectively in the classroom had positive attitudes towards errors. On the contrary, error-inhibiting attitudes and behaviors also reduce the likelihood of learning from errors. Positive error climates in the classroom both reduce cognitive anxiety and yield positive affective results (Heinze & Reiss, 2007).

Errors play an important role in improving the quality of teaching. Most of the studies have focused on whether teachers or pre-service teachers can identify errors conceptually (Chick & Baker, 2005; Peng & Luo, 2009; Demirci et al., 2017). However, this situation is only related to teachers' content knowledge. In a positive error climate in the classroom, the teacher is expected to use errors in the learning environment, not to correct them directly (Rach et al., 2013). In order to do this, it is important for a teacher to know the perceived error climate in the classroom.

Entrepreneurship and Education

The concept of entrepreneurship, which has always played an important role in the development of civilization, is a multidimensional concept with a very wide scope that increases its value day by day all over the world (Öztürk et al., 2019). It is related to many fields such as economics, sociology, psychology, management and organization and business management. Therefore, the concept of entrepreneur, which is the subject of entrepreneurship, has become a subject of interest to many different disciplines and has become a subject that has been studied (Gözübüyük, 2019). Entrepreneurship can be considered as an individual ability that enables individuals to recognize opportunities to create a new product or service and to transform these opportunities into applications with different values. Among the characteristics of the entrepreneurial individual, it is frequently seen that risk-taking, being a leader, being creative, being courageous, being innovative, having the desire to succeed, and self-confidence are emphasized.

One of the most important factors affecting entrepreneurship is education. Individuals can acquire entrepreneurial characteristics through the education they receive (Changa & Benamraouib, 2014; Şentürk, 2023) as well as the knowledge, skills and equipment needed to become a successful entrepreneur. On the other hand, the contribution of entrepreneurial individuals to increase the welfare level of the society increases the importance of entrepreneurship in education systems day by day (Nkechi et al., 2012). However, it is only possible to provide entrepreneurship skills to students in formal education and to ensure the success of the education to be provided only through the use of appropriate techniques and educational methods in learning environments (European Commission, 2016). It is reported in the literature that entrepreneurship education is highly effective in solving problems in daily life (Amos & Onifade, 2013). For this reason, it is often emphasized that students at all levels of education should be offered different experiences where they can solve the problems they face in real life by using entrepreneurship skills (European Commission, 2016).

In this context, what is expected from education is to help students gain 21st century skills, including entrepreneurship skills, and to help students actively use these skills (Akcanca, 2020; Mutiani & Faisal, 2020). This situation has led to changes in many subjects and areas such as curricula, student and teacher competencies (Dağhan, et al., 2017).

Critical Thinking

The fact that the information in the world has changed drastically and the importance given to thought has increased gradually makes it obligatory for the type of human being planned to be raised in the 21st century to have high-level thinking skills. Critical thinking, which is one of the high-level thinking forms, is of great importance. critical thinking requires the effective use of skills. Beliefs and upbringing are important in critical thinking and decision-making skills. It involves how individuals can think effectively, that is, how to understand and evaluate the subject correctly. And this is realized through critical thinking.

The change in the characteristics expected from individuals in today's society, which is also called the information age, has led to the questioning of the qualifications of the education programs that will provide these characteristics to the individual. The educational institution, which should provide the individual with the best qualities, is obliged to reveal the special and hidden talents in the nature of the individual in the way that the social structure foresees (Rohrer, 2014). The main goal of education is the development of the individual. Education aims to create the environment and conditions that enable development. This aim is to increase the quantity and quality of situations in which the individual can apply reason-based research methods rather than a predetermined end (Russell, 2010).

Skills such as being able to see the differences between proven facts and assertions, having effective communication skills, being able to measure the reliability of sources, having the ability to ask effective questions, having metacognition, distinguishing between inconsistent judgments, recognizing prejudices and cognitive errors are qualities expected from all individuals today. For this reason, meeting the need for individuals with cognitive competence necessitates the necessary teaching to develop critical thinking skills.

Current Study

Entrepreneurship Education Today, the belief that entrepreneurship skills are innate has been rapidly replaced by the view that entrepreneurship can be acquired through education. In the literature, it is stated that everyone can be an entrepreneur, entrepreneurial characteristics can be taught and can be given to individuals in learning environments (Changa & Benamraouib, 2014; Deveci & Çepni, 2015). It is emphasized that education has an important role in the development of entrepreneurial attitudes and behaviors (European Commission, 2016).

The main purpose of entrepreneurship education is to help reveal the skills and high-level thinking that have not been revealed for the entrepreneurship of the individual and at the same time to ensure that these skills and thinking are recognized (Çetinkaya & Özyürek, 2019). The goals of entrepreneurship education include providing students with the skills of independent action, self-motivation, determination, creative thinking and critical thinking.

Bustami, Syafruddin, and Afriani (2018) stated that teachers who adopt a teaching method that is far from making connections with real life are usually teacher-oriented and textbook-based. This causes students' critical thinking skills not to develop. Teachers who use traditional teaching methods and do not involve students in the process do not take sufficient steps in the development of critical thinking skills in students. When these views are examined, Blair (2019) stated that any subject that occupies the mind or imagination can be examined through "critical thinking" and therefore, critical thinking involves a process based on practice rather than a theory or discipline. According to the researches, it is seen that process-oriented education is at the forefront in the development of both entrepreneurship and critical thinking skills. In this sense, the purpose of this study is to determine the relationship between error-based instruction in the classroom and both entrepreneurship and critical thinking. Based on this purpose, the research questions of the study are given as follows:

1) Is there a significant relationship between classroom error climate and entrepreneurship among pre-service elementary mathematics teachers?
2) Is there a significant relationship between error climate in the classroom and critical thinking tendencies of pre-service elementary mathematics teachers?

Method

Design

In the study, a relational design, which is one of the quantitative research methods, was used. Relational design is used to investigate the relationships that may exist between two or more variables (Fraenkel et al., 2012). The purpose of using correlational design in the study is to investigate the relationship between classroom error climate, entrepreneurship and critical thinking performances of pre-service elementary mathematics teachers.

2.2 Sample

The sample of the study consisted of 257 pre-service elementary mathematics teachers studying in mathematics education. The required sample was taken from two state universities located in the Central Anatolia Region of Turkey using convenience sampling. Convenience sampling is the selection of settings, groups, or individuals who are easily accessible and desirable to participate in the study (Onwuegbuzie & Collins, 2007).

Data Collection Instruments

Perceived Error Climate Scale

The main elements of good quality teaching are teacher, student, course and learning outcomes (Wang et al., 2011). The main element that includes these elements is the classroom environment. Effective classroom management and a positive classroom climate in the classroom increase the quality and level of teaching. A positive classroom climate both strengthens classroom interaction and increases student performance (Akınoğlu, 2004; Kohen, 2006). In order to create an effective classroom environment, teachers should be able to make students think in the classroom. The classroom error climate scale consists of 27 items and 7 factors. The items of the scale are organized as 1=Never disagree, 2=Sometimes agree, 3=Sometimes agree, 4=Mostly agree, 5=Always agree. To prove the reliability of the scale, construct reliability (CR) and Cronbach Alpha internal consistency values were utilized. The Cronbach Alpha value was .86 for the overall scale, while it was between 0.73 and 0.89 for the sub-factors. The CR value was calculated between 0.69 and 0.90 for the sub-factors. In this study, the overall Cronbach Alpha coefficient of the scale was found to be 0.88. The Cronbach Alpha coefficients for the subdimensions were as follows: Independence of errors from assessment 0.86, Teacher support following errors 0.78, Absence of negative reactions of the teacher to errors 0.61, Absence of negative reactions of classmates to the error maker 0.68, Taking the risk of making errors 0.69, Analysis of errors 0.62, Functionality of errors for learning 0.61.

Development of Entrepreneurship Scale

Universities have an important role in the development of students' entrepreneurial traits and direct students towards new ventures (Rasmussen and Sorheim, 2006). In many countries, it is emphasized that the entrepreneurial characteristics of students should be developed through the education provided at universities (Armstrong & Tomes, 2000; European Commission, 2016; Hannula, Ruskova et al., 2012). In this way, it is aimed to provide students with the knowledge and skills they need for their future careers (Beca, 2007). The reliability of the 38-item measurement tool consisting of 5 dimensions (risk-taking, innovation, self-confidence, self-confidence, seeing opportunities and emotional intelligence) to determine the entrepreneurial characteristics of pre-service teachers was ensured by Cronbach Alpha and Test Retest reliability, and as a result of the analyzes; the lowest Cronbach Alpha reliability coefficient was found to be .77 and the lowest correlation coefficient for Test Retest reliability was found to be .66. In this study, the Cronbach Alpha coefficient of the 38 items of the scale was found to be 0.92 and according to this result, it was found to be quite reliable. According to the sub-dimensions, the Cronbach Alpha coefficient was found to be Risk-taking 0.66, Seeing opportunities 0.82, Self-confidence 0.78, Emotional intelligence 0.76 and Being innovative 0.76.

Crıtıcal Thınkıng Dısposıtıon Scale

Critical thinking, which is accepted as a factor that facilitates access to and comprehension of information, is one of the desired outcomes of education (Halpern, 1993, 238; Hudgins and Edelman, 1988, 262). Critical thinking is a process. However, Choy and Cheah (2009) explained that critical thinking should not be taught as a natural thinking process that can be performed by every ordinary person. The scale consists of 49 items and 5 dimensions. The dimensions of the scale are metacognition, flexibility, systematicity, perseverance-patience and open-mindedness. The scale is graded as "I completely agree (5), I mostly agree (4), I partially agree (3), I mostly disagree (2), I strongly disagree (1)". The Cronbach Alpha coefficient of the EDE scale is 0.96. In this study, the Cronbach Alpha coefficient of 49 items of the scale was found to be 0.97 and according to this result, it was found to be quite reliable. According to the sub-dimensions, Cronbach Alpha coefficient was 0.92 for metacognition, 0.92 for flexibility, 0.91 for systematicity, 0.88 for perseverance-patience and 0.70 for open-mindedness.

Data Collection and Analysis

The data were collected with the help of a Google form. Only volunteers answered the scale set. Before the data were collected, the participants were informed about the purpose, content and study process of the study and their consent was obtained. Statistical Package for Social Sciences (SPSS-Version 22) was used to analyze the data. During the analysis of the data, descriptive statistics were first calculated. Then, Pearson correlation analysis was performed to determine whether there was a relationship. between the SHI, GE and ED of the participants. When interpreting the correlation, the coefficient; values between 0.70 and 1.00 were considered as high correlation, values between 0.70-0.30 were considered as moderate correlation and values between 0.30 and 0.00 were considered as low correlation (Büyüköztürk, 2017).

Results

Descriptive Statistics

Within the scope of inferential statistics, descriptive statistical analyses were conducted to check the assumptions before using parametric tests. In this context, extreme values were first identified and excluded from the analysis. Then, kurtosis and skewness values were used to check whether the scores were normally distributed. The results are given in Table 1.

As seen in Table 1, the skewness and kurtosis values of the scores obtained from all three scales and sub-dimensions are between +1.5 and -1.5. Therefore, we accepted that all scores were normally distributed (Pallant, 2020) and inferential analyses (Pearson correlation) were performed with parametric tests.

Inferential Statistics

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension Independence of errors from evaluation scores and entrepreneurship total scores and sub-dimensions, there is a positive and significant relationship between the results of Independence of errors from evaluation and entrepreneurship

Tablo 1: Results of the descriptive statistics

	Skewness	*Kurtosis*
Critical Thinking		
Metacognition	-,102	-,451
Flexibility	,028	-,661
Systematicity	,109	-,716
Perseverance and Patience	,032	-,792
Open Mindedness	-,145	-,309
Total	,183	-,708
Entrepreneurship Training		
Risk Taking	-,475	1,489
Seeing Opportunities	-,075	-,485
Self Confidence	-,408	-,198
Emotional Intelligence	-,229	1,004
Being Innovative	,178	,489
Total	-,001	,023
Classroom Error Climate		
a2	-,430	-,466
a3	-,903	,006
a4	,182	,360
a5	-,149	-,452
a6	-,524	-,019
a7	-,508	,341
a8	-,496	-,206
Total	-,224	-,617

Table 2. **Correlation between Classroom Error Climate and Entrepreneurship Education**

		Risk-Taking	*Seeing Opportunities*	*Self-Confidence*	*Emotional Intelligence*	*Being Innovative*	*Total*
Independence Of Errors From Evaluation	Pearson Correlation	,464**	,414**	,401**	,302**	,164**	,419**
	Sig. (2-Tailed)	,000	,000	,000	,000	,009	,000
Teacher Support After Mistakes	Pearson Correlation	,314**	,375**	,391**	,342**	,132*	,371**
	Sig. (2-Tailed)	,000	,000	,000	,000	,037	,000
Lack Of Negative-Reactions Of The Teacher To Mistakes	Pearson Correlation	,052	,109	,059	,120	,030	,103
	Sig. (2-Tailed)	,409	,083	,351	,058	,630	,107
Absence Of Negative Reactions Of Classmates Against The Mistake Maker	Pearson Correlation	,108	,153*	,223**	,200**	-,093	,144*
	Sig. (2-Tailed)	,089	,015	,000	,001	,141	,024
Taking The Risk Of Making Mistakes	Pearson Correlation	,299**	,289**	,349**	,288**	,028	,293**
	Sig. (2-Tailed)	,000	,000	,000	,000	,654	,000
Analysis Of Errors	Pearson Correlation	,073	,121	,188**	,192**	-,058	,116
	Sig. (2-Tailed)	,248	,055	,003	,002	,361	,070
Functionality Of Errors For Learning	Pearson Correlation	,274**	,280**	,366**	,300**	,065	,302**
	Sig. (2-Tailed)	,000	,000	,000	,000	,308	,000
Total	Pearson Correlation	,320**	,352**	,395**	,350**	,057	,353**
	Sig. (2-Tailed)	,000	,000	,000	,000	,365	,000

total score (r=0.41, p<0. 001), risk-taking sub-dimension results at a positive and significant level (r=0.46, p<0.001), seeing opportunities sub-dimension results at a positive and significant level (r=0.41, p<0.001), self-confidence sub-dimension results at a positive and significant level (r=0.40, p<0.005), emotional intelligence sub-dimension results (r=0.30, p<0.001), being innovative sub-dimension results at a positive and significant level (r=0.16, p<0.005).

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension Teacher support following mistakes scores and entrepreneurship total scores and sub-dimensions, there is a positive and significant relationship between Teacher support following mistakes and entrepreneurship total score results (r=0.37, p<0. 001), risk-taking sub-dimension results in a positive and significant level (r=0.31, p<0.001), seeing opportunities sub-dimension results in a positive and significant level (r=0.37, p<0.001), self-confidence sub-dimension results in a positive and significant level (r=0.39, p<0.001), emotional intelligence sub-dimension results (r=0.32, p<0.001), being innovative sub-dimension results in a positive and significant level (r=0.13, p<0.005).

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension, teacher's support for not having negative reactions to errors, and entrepreneurship total scores and sub-dimensions, it was concluded that there was no relationship between them.

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension scores of the absence of negative reactions of classmates against those who make mistakes and entrepreneurship total scores and sub-dimensions, there is a positive and significant relationship between the support of the absence of negative reactions of classmates against those who make mistakes and entrepreneurship total score results (r=0. 14, p<0.005), positive and significant (r=0.15, p<0.005), positive and significant (r=0.22, p<0.001), emotional intelligence sub-dimension results (r=0.20, p<0.001).

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between students' classroom error climate sub-dimension Taking the risk of making mistakes and entrepreneurship total scores and sub-dimensions, taking the risk of making mistakes and entrepreneurship total score results are positively and significantly (r=0.29, p<0. 001), risk-taking sub-dimension results in a positive and significant level (r=0.29, p<0.001), seeing opportunities sub-dimension results in a positive and significant level (r=0.28, p<0.001), self-confidence sub-dimension results in a positive and significant level (r=0.34, p<0.001), emotional intelligence sub-dimension results (r=0.28, p<0.001).

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension Analysis of errors scores and entrepreneurship total scores and sub-dimensions, it is seen that there is a positive and significant relationship between the results of the Analysis of errors self-confidence sub-dimension (r=0.18, p<0.005) and emotional intelligence sub-dimension (r=0.19, p<0.005).

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension Functionality of errors for learning scores and entrepreneurship total scores and sub-dimensions, there is a positive and significant relationship between the results of Functionality of errors for learning and entrepreneurship total scores (r=0. 30, p<0.001), positive and significant relationship between the results of risk taking sub-dimension (r=0.27, p<0.001), positive and significant relationship between the results of seeing opportunities sub-dimension (r=0.28, p<0.001), positive and significant relationship between the results of self-confidence sub-dimension (r=0.36, p<0.001), emotional intelligence sub-dimension (r=0.30, p<0.001).

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between students' classroom failure climate scores and entrepreneurship total scores and sub-dimensions, there is a positive and significant relationship between classroom failure climate results and entrepreneurship results (r=0.35, p<0.001), a positive and significant relationship between classroom failure climate results and entrepreneurship scale sub-dimensions of risk taking results (r=0.32, p<0. 001), there is a positive and significant relationship between the results of classroom failure climate and the results of seeing opportunities from the sub-dimensions of entrepreneurship scale (r=0.35, p<0.001), there is a positive and significant relationship between the results of classroom failure climate and the results of self-confidence from the sub-dimensions of entrepreneurship scale (r=0.39, p<0.001), and there is a positive and significant relationship between the results of classroom failure climate and the results of emotional intelligence from the sub-dimensions of entrepreneurship scale (r=0.35, p<0.005).

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension Independence of errors from evaluation scores and critical

Table 3: Correlation between Classroom Error Climate and Critical Thinking

		Metacognition	*flexibility*	*systematicity*	*perseverance and patience*	*open mind-edness*	*Total*
Independence of errors from evaluation	Pearson Correlation	,493**	,418**	,397**	,331**	,268**	,480**
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000
Teacher support after mistakes	Pearson Correlation	,336**	,370**	,294**	,273**	,181**	,341**
	Sig. (2-tailed)	,000	,000	,000	,000	,004	,000
Lack of negative reactions of the teacher to mistakes	Pearson Correlation	,095	,112	,156*	,106	,094	,166*
	Sig. (2-tailed)	,135	,079	,014	,095	,139	,011
Lack of negative reactions of classmates against the person who made a mistake	Pearson Correlation	,170**	,172**	,095	,076	,063	,139*
	Sig. (2-tailed)	,007	,007	,136	,231	,317	,032
Taking the risk of making mistakes	Pearson Correlation	,369**	,329**	,243**	,233**	,213**	,314**
	Sig. (2-tailed)	,000	,000	,000	,000	,001	,000
Analysis of errors	Pearson Correlation	,180**	,228**	,139*	,101	,061	,152*
	Sig. (2-tailed)	,004	,000	,029	,113	,334	,019
Functionality of errors for learning	Pearson Correlation	,346**	,374**	,282**	,241**	,194**	,330**
	Sig. (2-tailed)	,000	,000	,000	,000	,002	,000
Total	Pearson Correlation	,398**	,400**	,328**	,276**	,219**	,391**
	Sig. (2-tailed)	,000	,000	,000	,000	,000	,000

thinking total scores and sub-dimensions, there is a positive and significant relationship between Independence of errors from evaluation and critical thinking total score results (r=0.48, p<0.001), a positive and significant relationship between metacognition sub-dimension results (r=0. 49, p<0.001), positive and significant (r=0.41, p<0.001), positive and significant (r=0.39, p<0.005), positive and significant (r=0.33, p<0.001), open-mindedness (r=0.26, p<0.001), perseverance and patience sub-dimension results.

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension, teacher support scores following errors, and critical thinking total scores and sub-dimensions, there is a positive and negative correlation between teacher support following errors and critical thinking total score results. significantly (r=0.34, p<0.001), positively and significantly among the metacognition sub-dimension results (r=0.33, p<0.001), positively and significantly among the flexibility sub-dimension results (r=0.37, p<0.001).), among the results of the systematicity sub-dimension at a positive and significant level (r=0.29, p<0.001), among the results of the perseverance and patience sub-dimension at a positive and significant level (r=0.27, p<0.001), among the results of the open-mindedness sub-dimension. There is a positive and significant (r=0.18, p<0.005) relationship.

According to the results of the simple linear correlation process carried out to reveal whether there is a relationship between the students' scores on the classroom error climate sub-dimension, the teacher's lack of negative reactions to mistakes, and the total critical thinking scores and its sub-dimensions, the teacher's lack of negative reactions to mistakes and the total critical thinking scores There is a positive and significant relationship between the score results (r=0.16, p<0.005), and a positive and significant relationship between the systematicity subscale results (r=0.15, p<0.005).

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension, Classmates' lack of negative reactions towards those who make mistakes, and critical thinking total scores and its sub-dimensions, Classmates' absence of negative reactions towards those who make mistakes. and critical thinking total score results positively and significantly (r=0.13,

p<0.05), metacognition subdimension results positively and significantly (r=0.17, p<0.05), flexibility subdimension results positively and significantly (r=0.13, p<0.05). There appears to be a significant (r=0.17, p<0.05) relationship.

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension Taking the risk of making mistakes scores and critical thinking total scores and sub-dimensions, there is a positive and significant relationship between taking the risk of making mistakes and critical thinking total score results. (r=0.31, p<0.001), positively and significantly among the metacognition sub-dimension results (r=0.36, p<0.001), positively and significantly among the flexibility sub-dimension results (r=0.32, p<0.001), Among the systematicity sub-dimension results, it was positive and significant (r=0.24, p<0.001), among the perseverance and patience sub-dimension results, it was positively and significantly (r=0.23, p<0.001), and among the open-mindedness sub-dimension results, it was positively and significantly. There appears to be a significant (r=0.21, p<0.001) relationship.

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension Error analysis scores and critical thinking total scores and sub-dimensions, there is a positive and significant difference between the error analysis and critical thinking total score results (r = 0.15). , p<0.05), positive and significant results among metacognition sub-dimension results (r=0.18, p<0.005), positive and significant results among flexibility sub-dimension results (r=0.22, p<0.001), systematicity sub-dimension results There is a positive and significant (r=0.13, p<0.05) relationship between the two.

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between the students' classroom error climate sub-dimension, the functionality of errors for learning scores, and the total scores and sub-dimensions of critical thinking, there is a positive and significant relationship between the functionality of errors for learning and the total score of critical thinking. (r=0.33, p<0.001), positively and significantly among the metacognition sub-dimension results (r=0.34, p<0.001), positively and significantly among the flexibility sub-dimension results (r=0.37, p<0.001), Among the systematicity sub-dimension results, it was positive and significant (r=0.28, p<0.001), among the perseverance and patience sub-dimension results, it was positively and significantly (r=0.24, p<0.001), and among the open-mindedness sub-dimension results, it was positively and significantly. There appears to be a significant (r=0.19, p<0.005) relationship.

According to the results of the simple linear correlation process performed to reveal whether there is a relationship between students' classroom error climate scores and critical thinking total scores and sub-dimensions, there is a positive and significant difference between classroom error climate results and critical thinking results (r=0.39 p<0.001). , there was a positive and significant difference between the classroom error climate results and the metacognition results from the critical thinking sub-dimensions (r=0.39 p<0.001), and a positive and significant difference between the classroom error climate results and the flexibility results from the critical thinking sub-dimensions (r=0.40 p). <0.001), there was a positive and significant difference between the results of classroom error climate and the systematicity results from the critical thinking sub-dimensions (r=0.32 p<0.001), and a positive and significant difference between the results of the classroom error climate and the results of perseverance and patience from the critical thinking sub-dimensions (r=0.32 p<0.001). (r=0.27 p<0.001), there is a positive and significant relationship (r=0.21 p<0.001) between classroom error climate results and open-mindedness results, one of the critical thinking sub-dimensions.

Discussion and Conclusion

In this research, the relationship between teacher candidates' classroom error climate, entrepreneurship and critical thinking was examined. As a result of the analysis, it was revealed that there was a statistically significant relationship between teacher candidates' classroom error climate and entrepreneurship. The results showed that teacher candidates with a classroom error climate were also more developed about entrepreneurship. Having 21st century skills and therefore entrepreneurial skills is an important dimension of an individual's ability to keep up with the times. It brings to mind the question of how entrepreneurial learning-teaching environments should be organized for the learners of our age (Dağhan, et al., 2017). In designing entrepreneurial learning environments, it is very important to focus on the problems in daily life and the process of solving these problems (Amos and Onifade, 2013). Therefore, these learning environments need to be organized in a social, democratic, collaborative, motivating and inspiring way. It is also very important to use appropriate methods and techniques in learning environments to develop entrepreneurial characteristics in individuals. One of these methods that can be applied in the classroom is to create an error climate environment in the classroom. For this reason, in entrepreneurial learning environments, group work, learning by doing, problem-based learning, drama technique, collaborative learning, peer learning, project-based learning,

learning diaries, activities to establish mini companies, field trips, visits to different workplaces and activities in different fields are included in schools. It is recommended to use methods and techniques such as inviting entrepreneurial individuals who show enthusiasm (SeikkulaLeino, 2011). Considering the results of this study, similar to the previous studies; It has been seen that learning environments where students are active, learning situations are flexible, interactive and knowledge is developed in multi-dimensional terms and error climate is applied in the classroom are necessary for the development of entrepreneurial skills.

Therefore, in the light of the findings of this study and similar studies, it is necessary to create learning environments that will improve the classroom error climate and entrepreneurship of prospective mathematics teachers. Soncini et al. (2021), suggested that effective mathematics instruction focused on knowledge development has a positive impact on students' classroom error climates and entrepreneurship. Therefore, it is necessary to take into account that there is a significant relationship between the classroom error climate and entrepreneurship of prospective mathematics teachers in order to facilitate effective mathematics learning. In fact, since a significant portion of mathematics teachers have traditional learning environments about classroom error climate, we can suggest that constructivist learning environments should be organized to improve pre-service and teacher candidates' classroom error climates and entrepreneurship (Özkaya, Kalaç & Konyalıoğlu, 2022).

As a result of the analysis, it was revealed that there was a statistically significant relationship between teacher candidates' classroom error climate and critical thinking. The results showed that teacher candidates with a classroom error climate also had improved critical thinking skills. An education based on theory and away from practice, where students are not involved in the process; It may negatively affect the development of critical thinking skills in individuals. When the educational objectives are examined, it can be seen that one of the main issues that should be emphasized is critical thinking skills. According to Stobaugh (2013: 58), activities related to critical thinking should be adequately included in curriculum and should be implemented by teachers. But this brings with it some difficulties. This process; It also requires providing auxiliary applications that will motivate students and enable them to use their thinking skills. As a result of this study, one of the practices that can improve critical thinking skills is the error climate in the classroom.

When the curriculum updated in our country in order to raise individuals in line with the requirements of the age is examined; It is seen that entrepreneurship and critical thinking skills are among the skills aimed to be taught to students, and this situation is reflected in the curriculum of many different courses (Özkaya & Konyalıoğlu, 2019). As a developer of students' entrepreneurial and critical thinking skills, the error climate in the classroom encourages a targeted orientation to the teaching of essential topics in mathematics education, in which ways of thinking can be combined and compared, allowing students to see how questions in various areas are related to each other. However, error climate practices in the classroom can also be viewed as more than a skill, especially in situations where the student is exposed to changes and uncertainty and endures failures (Soncini et al., 2023; Steuer et al., 2022). From the perspective of the teaching profession, it is stated that teachers have a great and central role in the development of the entrepreneurial and critical thinking mentality in students, and that the climate of error in the classroom must be provided effectively and practically in teacher training institutions (Tulis et al., 2018).

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