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Research Article

Investigating the Relationship Between Individual Innovativeness and Programming Anxiety

Bireysel Yenilikçilik ile Programlamaya Yönelik Kaygı Arasındaki İlişkinin İncelenmesi

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Abstract: This study investigates the levels of anxiety among university students regarding programming and examines the factors influencing this anxiety. The research explores the relationships between students' characteristics such as, risk-taking, leadership qualities, openness to experience, and resistance to change with their programming anxiety. The study's participants were 427 university students who had undergone programming education prior to 2023. Individual innovativeness and programming concerns of the research participants were analyzed primarily with descriptive statistical methods. Afterwards, the relationships between the sub-dimensions of individual innovativeness and levels of programming anxiety were investigated using relational screening models. Results indicate a slight positive correlation between reluctance towards change and receptiveness to new experiences with programming anxiety, whereas a modest negative correlation is observed between willingness to take risks and leadership qualities. The combination of these factors moderately and significantly predicts students' levels of programming anxiety. The research offers valuable perspectives for educators and developers of programs seeking to create methods to ease the anxiety students face in programming education.

Keywords: Programming Anxiety, Resistance to Change, Leadership Qualities, Individual Innovativeness

Özet: Bu çalışma, üniversite öğrencilerinin programlama ile ilgili kaygı seviyelerini araştırmakta ve bu kaygıyı etkileyen faktörleri incelemektedir. Araştırma, öğrencilerin risk alma, liderlik nitelikleri, deneyime açıklık ve değişime direnç gibi özellikleri ile programlama kaygıları arasındaki ilişkileri incelemektedir. Çalışmanın katılımcıları, 2023 öncesinde programlama eğitimi almış olan 427 üniversite öğrencisidir. Araştırma katılımcılarının bireysel yenilikçilik ve programlama kaygıları öncelikle tanımlayıcı istatistiksel yöntemlerle analiz edilmiştir. Sonrasında, bireysel yenilikçiliğin alt boyutları ile programlama kaygı seviyeleri arasındaki ilişkiler ilişkisel tarama modelleri kullanılarak incelenmiştir. Sonuçlar, değişime karşı isteksizlik ve yeni deneyimlere açıklık ile programlama kaygısı arasında hafif bir pozitif korelasyon, risk alma isteği ve liderlik nitelikleri arasında ise mütevazı bir negatif korelasyon olduğunu göstermektedir. Bu faktörlerin kombinasyonu, öğrencilerin programlama kaygı seviyelerini orta derecede ve anlamlı bir şekilde öngörmektedir. Araştırma, eğitimciler ve program geliştiriciler için, programlama eğitimi sırasında öğrencilerin karşılaştıkları kaygıyı hafifletecek yöntemler geliştirme konusunda değerli bakış açıları sunmaktadır.

Anahtar Kelimeler: Programlama Kaygısı, Değişime Direnç, Fikir Önderliği, Bireysel Yenilikçilik

1. Introduction

In the present era, the swift advancement of information and communication technologies has surged the need for proficiency in programming, consequently amplifying the significance of education in this domain. In an era of accelerating digital transformation, programming skills are becoming increasingly important. Programming education may involve new and sometimes complex concepts for students. At this point, students may have concerns about programming. The processes of learning new languages, algorithmic thinking and solving complex problems may cause students to experience insecurity and anxiety towards this field. However, the difficulties encountered by students in this process, their efforts to adapt to new concepts, and uncertainty bring about programming anxiety. Programming anxiety refers to an individual's feelings of worry, stress or insecurity about programming. This anxiety can appear in various forms, often as a feeling that programming skills are inadequate, doubts about the ability to solve complex problems, and concerns about understanding and using programming languages. Anxiety about programming can be experienced by people at all levels, from

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beginner programmers to experienced developers. This anxiety can increase when learning a new programming language, trying to understand complex algorithms, or successfully completing a project.

Connoly et al. (2009) defined programming anxiety as a psychological disorder resulting from students' loss of self-efficacy in programming and negatively affects the learning effect. Bosch and D'Mello (2015) conducted a dynamic analysis of different emotional states of students in writing program code in their research in Python Programming education. They discovered that bewilderment, irritation, and ennui are prevalent occurrences within programming anxiety, impacting students' educational journey and achievements. They discovered that feelings of perplexity, annoyance, and tedium are typical occurrences in programming anxiety, which impact students' educational journey and achievements. Ardıç and Kılıçer's research in 2023 revealed a notable impact of individual innovativeness levels and problem-solving abilities on attitudes toward programming. Moreover, it was discovered that problem solving ability holds greater significance than personal creativity concerning the coding attitude factor.

The findings of research on programming anxiety in the literature emphasize that programming anxiety can affect students' performance, may be related to different factors, and the importance of supportive educational environments. These findings provide an important basis for the development of strategies and support systems in the field of programming education. Anxieties in learning programming can be caused by factors such as lack of self-confidence, previous experiences of failure, lack of knowledge about a particular programming topic, or difficulty in coping with expectations. According to Santos (2020), the need for information systems to make things easier, increase effectiveness and increase productivity has become mandatory, leading to an increase in dependence on software among individuals (Santos, Tedesco, Borba and Brito, 2020). For this reason, every developed and developing country needs to train competent individuals who can maintain the software used and produce applicable and effective solutions to the challenges they will encounter (Demirer and Sak, 2016). One of the prerequisites for achieving this goal is to provide individuals with programming competence, which is deemed necessary to raise well-rounded and knowledgeable citizens (Al-Makhzoomy, 2018). However, many studies reveal that the majority of computer science students perceive programming courses as complex and daunting (Bennedsen and Caspersen, 2007; Connolly, Murphy and Moore, 2009; Jenkins, 2002; Owolabi, Olanipekun and Iwerima, 2014; Robins, Rountree, 2007; Rountree, 2003; Wiedenbeck, Labelle, and Kain, 2004). Moreover, studies show that programming courses have high dropout and failure rates (Bennedsen and Caspersen,2007; Luxton-Reilly et al., 2019). Rogerson and Scott (2010) emphasized that programming anxiety is among the fears of students in programming instruction. These anxieties can prevent an individual from developing programming skills or reduce motivation. Among personal characteristics, problem solving ability and motivation can be thought to be effective in programming anxiety (Amabile, 2018).

The conceptual complexity, logical structure, unfavorable perceptions, and stress associated with programming are perceived as challenges for beginner programmers. To enhance academic success and classroom outcomes while alleviating apprehension about computer programming, educational programming languages can be employed by incorporating theoretical concepts with practical applications in the curriculum (Demir, 2022). Creativity, when combined with problem solving skills in the programming process, can also increase individuals' capacity for innovativeness. Individual innovativeness is closely related to generating new ideas, creativity, and innovativeness. Rogers (2010) defines individual innovativeness as personal growth and change through the adoption, use, or adaptation of new ideas. In other words, individual innovativeness is the process by which individuals influence their own lives and in this process they generate unique solutions through learning, exploring and experimenting, which contributes to their personal development. Individual innovativeness refers to individuals' tendencies to be open to new ideas, embrace change and generate creative solutions. A person learning programming also needs to use traits related to individual innovativeness, such as finding new ways to solve common situations, reasoning and deriving creative solutions. Technological advancements' acceptance can be better facilitated by considering individuals' varying levels of innovativeness (Yi et al., 2006).

The relationship between individual innovativeness tendencies and programming anxiety may affect students' attitudes and achievements in this field. Anxiety is one of the most important obstacles to learning. Küçüksüleymanoğlu and Eğilmez (2013) stated that students may not be able to express their anxiety verbally and may create resistance to learning with suppressed anxiety. Learning for innovativeness is a central element in European policy-making to improve higher education (Hero et al.,2017). For example, it is argued that by having innovative thinking, it is possible to overcome programming challenges in a more creative way. Individuals' lack of innovativeness, reluctance to seek different solutions, or limited ability to think outside the box may also be influential in programming anxiety. Individual innovativeness potential may also affect the anxiety that students face in the process of adapting to new situations. In this context, understanding how programming anxiety levels interact with individual innovativeness tendencies is an important step in developing educational strategies.

Individual innovativeness is linked to a person's intrinsic motivation and willingness to develop and implement ideas. While theoretical viewpoints regarding creativity often emphasize an individual's capacity to produce novel and possibly valuable concepts, definitions of innovativeness also encompass the execution of these novel ideas (Birdi et al., 2016). Anxiety, on the other hand, can

sometimes create an obstacle or reduce motivation in this process. However, both emotions can play a role in the innovativeness process and how one manages this process is important. The relationship between innovativeness and individual success may be linked to how one balances anxiety and motivation. While anxiety managed in a balanced way can help one to be more attentive, focused and creative, excessive anxiety can reduce motivation and hinder innovativeness. In this context, directing motivation and managing anxiety effectively can increase an individual's innovativeness potential. Understanding this dynamic relationship between individual innovativeness and programming anxiety would be an important step towards making programming education more effective and student- oriented. Our study seeks to address the void in this domain by investigating how individual inclinations towards innovativeness influence levels of programming anxiety across different grade levels, genders, and types of graduated high schools attended. The findings to be obtained in this context will contribute to the development of strategies for educators and program developers to support students to approach programming education more positively. The main objective of this study is to evaluate students' levels of individual innovativeness and their programming-related anxiety. Additionally, the study aims to explore how students' individual innovativeness sub-dimensions influence their programming anxiety. Within this context, the research sought answers to the following inquiries:

- Does the programming anxiety vary significantly based on gender among students?
- Does the programming anxiety vary significantly among students graduating from diverse types of high schools?
- Does programming anxiety vary significantly across different grade levels?
- Do the variables of individual innovativeness resistance to change, risk-taking, openness to experience and opinion-leading independently predict students' programming anxiety in a significant way?
- Do the variables of individual innovativeness resistance to change, risk-taking, openness to experience and opinion-leading together predict students' programming anxiety in a significant way?

2. Method

In this study, quantitative research methods such as descriptive statistics and relational survey model were utilized to reach the desired findings. Survey researches are short-term studies involving wide participation and in these studies, the opinions of participants about any subject or event are collected (Fraenkel & Wallen, 2006). In this context, the individual innovativeness and programming anxiety of the participants were examined descriptively, and the relationship between the sub-dimensions of individual innovativeness and programming anxiety levels was explored using the relational screening model. Quantitative research methods such as descriptive statistics and relational survey model were utilized to reach the desired findings. In this context, we conducted a descriptive examination of participants' individual innovativeness and programming anxiety, and investigated the correlation between the sub-dimensions of individual innovativeness and programming anxiety levels using the relational screening model.

2.1. Study Group

The study's participants were university students who had undergone programming education prior to 2023, selected through criterion sampling. University students taking programming courses were included in the study group because the scale (PAS) developed by Yıldırım and Özdener (2022) is recommended for study groups where participants have some experience in creating, coding and debugging programming projects. The primary criteria used to choose participants for the study group included their enrollment as university students and prior experience with coding education. As a result, data was collected from 427 university students for the study. Extensive demographic details of the participants are outlined in Table 1.

Table 1. Participant Demographics

Variable	Sub Variable	f	%
University	Bursa Uludağ	326	76.3
	Hitit	101	23.7
Gender	Female	241	56.4
	Male	186	43.6
Graduated High School	Anatolian High school	134	31.4
	Science High School	92	21.5
	Social Sciences High School	87	20.4
	Imam Hatip High School	81	19
	Vocational High School	33	7.7
Class	Grade 1	59	13.8
	Grade 2	185	43.3
	Grade 3	88	20.6
	Grade 4	95	22.2
Department	Management Information Systems	316	74
	Computer Engineering	111	26

2.2. Data Collection Tools

The Individual Innovativeness Scale (IIS) was employed to assess the levels of individual innovativeness among the participants, while the Programming Anxiety Scale (PAS) was utilized to gauge their levels of anxiety regarding programming. In addition, a questionnaire with demographic questions was prepared to obtain the participants' gender, high school type, the name of the university they studied at, the name of the program they studied at, and their grade level.

In evaluating the individual innovativeness levels among the subjects, the Turkish version of the IIS, whose validity and reliability studies were conducted by Kılıçer and Odabaşı (2010), was used. This scale contains 20 items in total, 12 of which are positive and 8 of which are negative statements. Participants were given 5 point Likert scale options (Strongly Disagree ...Strongly Agree). The scale measures the innovativeness levels of individuals in general and addresses innovativeness at the individual level. Before the analysis, negative statements were reverse scored to facilitate the analysis. After the analysis, the reliability coefficient of the scale was determined as α=0.762. It can be concluded that this value is sufficient for the reliability of the scale (Erkuş, 2005; Güngör, 2016). The Individual Innovativeness Scale has a structure that includes four factors: resistance to change, opinion-leading, openness to experience and risk taking (Kılıçer & Odabaşı, 2010). These four factors in the scale adapted to Turkish account for 52.52% of the variance explained by the quality the scale measures. The internal consistency coefficient for the overall scale was found to be 0.82, and the test-retest reliability was 0.87. In this scale, the "Resistance to change" dimension includes eight items, the "opinion-leading" dimension includes five items, the "Openness to experience" dimension includes five items and the "Risk taking" dimension includes two items. The "Resistance to change" dimension, which consists of negative items in the scale, covers a significant portion of the explained variance. In this study, reliability analysis results for overall the individual innovativeness, the resistance to change, opinion-leading, openness to experience and risk taking sub-dimensions of the individual innovativeness scale are presented in Table 2.

Table 2. Individual İnnovativeness Scale Reliability Analysis

Factor	Number of items	Cronbach's Alpha Value
Resistance to Change	8	.843
Opinion-leading	5	.762
Openness to Experience	5	.810
Risk Taking	2	.662
Individual Innovativeness Scale	20	.762

According to Table 2, the overall individual innovativeness scale and its sub-dimensions were found to be highly reliable (α>0.6). The resistance to change factor was found to be the sub-dimension with the highest reliability value (α =0.843).

The PAS developed by Yıldırım and Özener (2022) was used to measure students' anxiety levels towards programming. Validity and reliability of the PAS were conducted by Yıldırım and Özener (2022). The PAS consists of 11 items in total. PAS consists of two factors (subscales): Peer Anxiety and Programming Skill Anxiety. Each item in the scale was answered with 5-point Likert scale (Never...Always). The approach followed was that a greater total programming anxiety score indicated a higher level of programming anxiety among participants. Put differently, an elevated total score from the scale reflected increased individual programming anxiety. Construct validity of the scale was tested among university students and as a result of the confirmatory factor analysis(CFA), a structure similar to the one obtained with the PAS by Yıldırım and Özener(2022) was acquired (x^2/df=3.42, RMSEA=.080, SRMR=.030, GFI=.91, NFI=.91 and CFI=.92). The factor load values of the items in the assessment tool range from .73 to .89. The reliability coefficient of the scale was determined as α=0.795 after analyzing the data obtained with the PAS used in this study. Cronbach alpha reliability coefficients greater than 0.60 indicate that the scale is highly reliable (Kayış, 2009).

2.3. Collection of Data

To ensure efficient data collection for the study, the researcher developed the data collection instrument, comprising the scales and demographic inquiries, using the online platform 'Google Forms'. Research permissions were obtained from Bursa Uludağ University Ethics Committee for the implementation of the scale (2023-12, K.No:11). The link to the prepared data collection tool was sent to the relevant university groups for a predetermined group of students selected using the criterion sampling method. Data collection started on December 19, 2023 and ended on January 2, 2024.

2.4. Data Analysis

Upon completing the study, data analysis was conducted using the SPSS 28.00, utilizing information gathered from 427 eligible students. Before delving into the analysis, we assessed the normality of both the individual innovativeness and anxiety levels towards programming variables. Specifically, our focus was on the kurtosis and skewness values for the individual innovativeness variable, alongside the mean scores for programming anxiety variables ($IIS_{kurtosis}$=-.419, $IIS_{skewness}$=.223; $PAS_{kurtosis}$=-.404, $PAS_{skewness}$=-.232). The kurtosis and skewness values of all variables were found to be within the acceptable normal distribution assumption limits specified in the literature (Kline, 2005; Çokluk et al., 2010; Huck, 2008).

Independent sample t-test was used to examine the difference of students' programming anxiety according to gender, Kruskal Wallis- H Test was used to examine the difference according to grade level, and one-way analysis of variance (ANOVA) was used to examine the difference according to the type of high school graduated from. At the conclusion of the study, a multiple linear regression analysis was performed to ascertain how the individual innovativeness and problem-solving proficiency levels of high school students impact their perspectives on coding.

3. Results

Table 3 contains descriptive statistics results for the programming anxiety scale and individual innovativeness sub-dimensions. Descriptive statistics express the central tendency and variability in the distribution of measure-

Table 3. Descriptive Statistics Results of Programming Anxiety Scale and Individual Innovativeness subdimensions

		Standard Deviation	N
Prog. Anxiety	2.73	0.93	427
Resistance to Change	2.56	0.56	427
Risk Taking	3.43	0.62	427
Openness to Experience	3.85	0.27	427
Opinion-leading	3.72	0.35	427

ments. The Individual Innovativeness Scale is a 5-point Likert scale. The answers given to the scale are Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree(5). The average value of students' programming anxiety was determined as 2.73. In this case, it was determined that programming anxiety was generally at a moderate level, in other words, at a medium level. The mean value for the resistance to change sub- dimension is 2.56. This value indicates that students exhibit a moderate resistance to change. The students' risk-taking level averaged 3.43. This indicates that students are generally open to taking risks. In the openness to experience sub-dimension, the mean value of the students is 3.85. A high mean indicates that students exhibit a general openness to new experiences. The mean value of the students in the opinion-leading sub-dimension is 3.72. This means that students generally show a tendency towards opinion-leading. These descriptive statistics are used to understand students' tendencies in the dimensions of programming anxiety and individual innovativeness. Programming anxiety is generally high, but there are differences among students in this regard. In addition, students are generally open to risk-taking and opinion-leading.

3.1. Programming Anxiety According to Gender

The outcomes of the normality examination concerning the average ratings of programming anxiety within gender subcategories are provided in Table 4.

Table 4. Mean Scores of PAS According to Gender Normal Distribution

	Gender	Kolmogorov-Smirnova		
		Statistic	df	Sig.(p)
PAS	Female	0.104	241	.093
	Male	0.122	168	.200

The results of the normality test between the mean scores of PAS in gender subgroups are given in Table 4. According to these results, since p>.05, it shows that there is a normal distribution. A t-test was conducted to see whether there was a difference between the mean scores of programming anxiety between males and females.

Students' programming anxiety shows a significant difference according to gender [$t_{(407)}$=11.54, p<.01]. Male students' programming anxiety ($\bar{X}$=36.19) is higher than female students ($\bar{X}$=25.71). This finding can be interpreted as a significant relationship between programming anxiety and gender.

Table 5. T-test Results of PAS Scores for Programming according to Gender

	Gender	N	$\bar{X}$	S	df	t	p
PAS	Female	241	25.71	7.86	407	11.54	.000*
	Male	186	36.19	10.49			
*p<.05							

3.2. Programming Anxiety According to Type of Students' Graduated High Schools

The results of the normality test between the mean scores of programming anxiety in the subgroups of the type of high school graduated from are given in Table 6.

Table 6. Mean P. Normality Test of PAS Scores According to the Type of High School Graduated

Score	Graduated High School	Kolmogorov-Smirnova		
		Statistic	df	Sig.
PAS Avarage Score	Science High School	0.08	87.00	.200
	Anatolian High School	0.08	132.00	.09
	Social Sciences High School	0.11	81.00	.07
	Vocational High School	0.12	31.00	.200
	Imam Hatip High School	0.10	77.00	.08

When reviewing the normality test outcomes presented in Table 6, it becomes apparent that the average anxiety scores concerning programming, categorized by the type of high school attended, exhibit a normal distribution(p>.05).

According to Table 7, when looking at the programming anxiety average scores according to the type of school graduated, it can be seen that he average values of the groups are close to each other.

Since there was a normal distribution, a one-way ANOVA test was conducted to understand whether there was a difference between the programming anxiety scores of the participants based on the type of high school they graduated from. The results of this analysis are given in Table 8. Accordingly, there was no significant difference between the programming anxiety of the participants according to the type of high school they graduated from[$F_{(4-411)}$ =0.94;p>.05].

3.3. Programming Anxiety According to Grade Level

The results of the normality test between the mean scores of programming anxiety in class subgroups are given in Table 9. According to these results, since p<.05, it shows that there is non-normal distribution. Kruskal-Wallis test was performed to see whether there is a difference be-

Table 7. Descriptive Statistics Of Average PAS Scores According to Type of Graduated High School

Type of High School	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Science High School	134	2.71	0.95	0.10	2.51	2.91	1.09	4.91
Anatolian High School	92	2.63	0.88	0.08	2.48	2.79	1.09	4.64
Social Sciences High School	87	2.87	0.97	0.11	2.66	3.08	1.09	4.73
Vocational High School	81	2.84	0.96	0.17	2.50	3.18	1.36	4.64
Imam Hatip High School	33	2.73	0.96	0.11	2.52	2.95	1.27	4.64
Total	**427**	**2.73**	**0.94**	**0.05**	**2.64**	**2.82**	**1.09**	**4.91**

Table 8. ANOVA Results of PAS Scores for Programming according to the Type of High School Graduated from

		Sum of Squares	df	Mean Square	F	Sig.
PAS	Between Groups	400.56	4	100.14	0.94	.439
	Within Groups	43.66	411	106.22		
	Total	44.06	415			

tween the mean scores of programming anxiety according to the level of education of the students.

Table 9. Normal distribution of mean scores of PAS according to grade level.

Score	Grade	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
PAS Avarage Score	1	0.38	59.00	.00
	2	0.11	183.00	.00
	3	0.22	88.00	.00
	4	0.14	86.00	.00

Table 10. Mean PAS Scores by Grade Level Kruskal Wallis-H Test

Score	Groups	N	Mean Rank	Chi-Square	df	p
PAS Avarage Score	1	59	135.57	29.95	3	.000*
	2	185	226.74			
	3	88	231.11			
	4	95	196.58			
	Total	427				

*p<.05

According to Table 10, the Kruskal Wallis-H test was used to determine whether the mean scores of the students' programming anxiety showed a significant difference in terms of the grade level of the students. Accordingly, a significant difference was found between the students' anxiety scores towards programming among the grade level groups (x^2=29.95; df=3; p<.05). This finding shows that programming anxiety differs across grade levels. Mann Whitney-U was applied to understand which grade levels there was a significant difference between.

As a result of the analyses, it is seen that the difference in the mean scores of programming anxiety is between those studying in the 1st grade and those studying in the 2nd and 3rd grades. Between the 1st and 2nd grades, it was seen that the programming anxiety was higher in the 2nd grades (U=3079; z=-4.974; p<.05). When the mean scores in Table 11 are examined, additionally, a notable distinction emerges between the average anxiety scores of third-year students and those of first-year students regarding programming, with the former exhibiting higher anxiety levels compared to the latter (U=1098; z=-5,957; p<.05). There was also a significant difference between the mean scores of 4th grade students' programming anxiety and 1st grade students' scores (U=2051; z=-1,965; p<.05).

Table 12 reveals that the average scores of second-year students ($\bar{X}$=2.88) surpass those of both third-year students ($\bar{X}$=2.85) and first-year students ($\bar{X}$=2.24).

3.4. Findings of Regression Between Programming Anxiety and Individual Innovativeness

The regression analysis results regarding the prediction of programming anxiety according to the variables of individual innovativeness and it's subdimensions resistance to change, risk taking, openness to experience and opinion-leading are given in Table 13. It is seen that at least one of our independent variables has a significant relationship on the dependent variable (p<.001). There were significant relationships between programming anxiety and resistance to change, risk-taking, openness to experience, opinion-leading and individual innovativeness (p<.05). When the pairwise and partial correlations between the predictor variables and the dependent variable are examined, it is seen that there is a weak positive relationship between resistance to change and students' programming anxiety (r=0.224). When other independent variables are controlled, it is seen that there is a weak positive relationship between resistance to change and programming anxiety (r=0.21). There is a weak positive relationship between openness to experience and programming anxiety (r=0.11). When the partial correlation between openness

Table 11. U-Test between PAS Scores Among Dual Grade Levels

	Grade	N	Mean Rank	Sum of Ranks	U	p
PAS Avarage Scores	1	59	82.19	4849.00	3079.00	.000*
	2	185	134.17	24554.00		
	Total	244				
	1	59	48.61	2868.00	1098.00	.000*
	3	88	91.02	8010.00		
	Total	147				
	1	59	64.77	3821.50	2051.50	.049*
	4	95	78.65	6763.50		
	Total	154				
	2	185	135.97	24882.00	8046.00	.992
	3	88	136.07	11974.00		
	Total	273				
	2	185	140.60	25730.00	6844.00	.084
	4	95	123.08	10585.00		
	Total	280				

*p<.05

Table 12. Descriptive Statistics of Average PAS Scores According to Grade Level

Grade	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	59	2.24	0.67	0.09	2.06	2.41	1.82	4.09
2	185	2.88	1.03	0.08	2.73	3.03	1.09	4.64
3	88	2.85	0.69	0.07	2.71	2.99	1.27	4.91
4	95	2.63	0.98	0.11	2.42	2.84	1.18	4.73
Total	**427**	**2.73**	**0.94**	**0.05**	**2.64**	**2.82**	**1.09**	**4.91**

Table 13. Multiple Regression Analysis Results for the Prediction of PAS

Variable	B	Standard Error	β	t	p	Part r	Partial r
Constant	38.93	8.85		4.40	.000*		
Resistance to Change	4.19	0.91	0.23	4.61	.000*	0.22	0.21
Risk Taking	-4.89	0.78	-0.29	-6.27	.000*	-0.30	-0.29
Openness to Experience	4.33	1.99	0.11	2.18	0.03	0.11	0.10
Opinion-leading	-5.22	1.43	-0.18	-3.65	.000*	-0.18	-0.17
Individual Innovativeness	-4.79	0.63	-0.20	-5.37	.000*	-0.21	-0.20
			R=0.39,	R^2=0.15			
			$F_{(4,403)}$=17.70,	p<.001			
			*<.05				

to experience and programming anxiety is examined, it is seen that there is a weak positive relationship (r=0.1). Apart from this, it can be said that there is a negative and weak relationship between students' programming anxiety and individual innovativeness (r=-0.21), opinion-leading (r=-0.18) and risk taking (r=-0.30). When other independent variables are controlled and partial correlation values are examined, it is seen that there is a weak negative relationship between programming anxiety and individual innovativeness (r=-0.21), opinion-leading (r=-0.17) and risk taking (r=-0.29).

The variables of individual innovativeness, resistance to change, risk taking, openness to experience and opinion-leading together show a moderate and significant relationship with students' programming anxiety (R=0.387, R^2 =0.15, p<.001). Individual innovativeness, resistance to change, risk-taking, openness to experience and opinion-leading variables together explain approximately 15% of the total variance in programming anxiety. In other

words, 15 percent of the change in the dependent variable is explained by all of our independent variables.

4. Discussion, Conclusion and Recommendations

The research revealed a notable contrast in programming anxiety scores based on gender, with males exhibiting higher levels of anxiety compared to females. This finding diverges from studies examining programming attitudes, where no significant gender-based differences were observed in attitude scores; however, these studies indicated that men generally reported more favorable attitudes towards programming (Gürsoy & Çekmez, 2019; Erol & Kurt, 2017; Ardıç & Kılıçer, 2023). Chua, Chen and Wong (1999) examined computer anxiety in their study and found that females had more computer anxiety than males, but it was not certain, and there was a negative relationship between computer experience and computer anxiety. In their study, Selinger and Gröstenberger (2024) investigated the effects of gender and age on computer self-efficacy, computer anxiety and perceived fun. Their research results revealed that gender had a significant impact on computer anxiety and that female participants experienced it at higher levels in all age groups. It is possible that the women in this study had lower programming anxiety scores because they had more computer experience than men. Therefore, this result was obtained by limiting this researcher to the participant group. Since the purpose of this study was not to obtain findings regarding the participants' computer experience, the effect of gender on computer use experience and programming anxiety could not be investigated. This issue, which was excluded from the research due to the limitations of this study, can be detailed in future studies. In studies investigating the effect of gender on programming anxiety, performance or success, different results may be obtained, limited to the participants in the research. For example, Byrne and Lyons (2001), in their study comparing the performance of students in an introductory programming course according to their gender, found that women scored slightly higher than men, although there was no significant difference. Considering that there is an inverse relationship between performance and anxiety, as mentioned before, it can be said that women in this study had less anxiety than men. There are even studies showing that women are more successful in programming (Lau and Yuen, 2009; Pioro, 2004; Housten, 1993). In this case, different results emerge in different studies depending on the country where the research was conducted and the characteristics of the student group.

It was seen that there was no difference in programming anxiety scores according to the type of high school graduated by the students in the study. Similarly, Erdoğan (2005) revealed that programming performance, programming success and attitude towards programming do not differ according to the type of high school graduated. According to the other analysis results obtained in the study, there were significant differences in students' programming anxiety scores depending on the grade level. These differences show that programming anxiety scores vary between grade levels. The analyses show that there is a significant difference between 1st and 2nd grade students in their levels of programming anxiety. This difference reveals that 2nd grade students have a higher level of programming anxiety. This may be attributed to the difficulties in getting used to programming and their efforts to adapt to new concepts. Similarly, there was a significant difference between 3rd grade students and 1st grade students in their levels of programming anxiety. In this case, it can be said that 3rd grade students have a higher level of programming anxiety compared to 1st grade students. This difference can be attributed to the students' continuous efforts to improve their programming skills and their encounters with more complex concepts. The analysis shows that there is also a significant difference between 4th grade students and 1st grade students. However, the p-value of this difference shows borderline significance ($p=.049$). In this case, it can be said that 4th grade students' level of programming anxiety is significantly higher than that of 1st grade students. Within the limitations of the research, it has been revealed that the level of programming anxiety of students varies according to grade level, and especially second and third grade students have more difficulties in this regard. It can be thought that understanding students' concerns about programming and reducing these concerns will positively affect their learning process. According to Buche et al. (2007), if an individual's low anxiety progresses to high anxiety while learning programming, his performance increases; If the individual's high anxiety increases, his performance will be negatively affected and cause it to decrease. It is thought that the reason why programming anxiety in the first grade is lower than in other grades is due to the fact that they take very few and intense programming courses. In studies conducted on university students, it has been observed that as students' hours of computer use increase, their computer experience increases and, as a result, their computer anxiety decreases (Necessary & Parish, 1996; Ropp, 1999). As a matter of fact, this study found that anxiety scores decreased from the 2nd grade to the 4th grade.

This study aimed to evaluate the relationships between programming anxiety and individual innovativeness, resistance to change, risk taking, openness to experience and opinion-leading. Accordingly, it was found that individual innovativeness, resistance to change, risk taking, openness to experience and opinion-leading variables significantly predicted programming anxiety ($p<.001$). Significant relationships were found between resistance to change, risk taking, openness to experience and opinion-leading and programming anxiety ($p<.05$).

There is a weak positive relationship between resistance to change and programming anxiety ($r=0.224$), and this relationship continues when other independent variables are controlled ($r=0.212$). In order to overcome the resistance of the university students who participated in the research, they should be open to new ideas, new inven-

tions and new ways of thinking. To reduce students' resistance to the programming process, educational programs should include activities and projects that will encourage them to be open to change and new ideas. Constantly updated curricula can be prepared to facilitate students' adaptation to new technologies and methods. There is a weak positive relationship between openness to experience and programming anxiety (r=0.108), and this relationship continues when other independent variables are controlled (r=0.1). A negative and weak relationship was found between programming anxiety and opinion-leading (r=-0.179) and risk taking (r=-0.298). These negative relationships continued when other independent variables were controlled (r=-0.168, r=-0.288). Resistance to change, risk-taking, openness to experience and opinion-leading variables together exhibit a moderate and significant relationship with students' anxiety scores towards programming (R=0.387, R^2=0.149, p<.001). It is seen that the total variance explained by these variables together is approximately 15%. In other words, 15% of the change in programming anxiety is explained by the variables of resistance to change, risk taking, openness to experience and opinion-leading. These results help us to understand the factors affecting students' level of programming anxiety. Resistance to change, risk-taking, openness to experience and opinion-leading are associated with programming anxiety. The weak positive relationships, especially the relationship between resistance to change and anxiety, highlight the factors that influence students' anxiety towards the programming process. In addition, weak negative correlations suggest that students' opinion-leading and risk-taking tendencies negatively affect their level of programming anxiety. These findings may help educators and program developers to develop strategies to reduce students' programming anxiety. Educational programs should offer a variety of learning experiences that encourage students to be open to new experiences. Project-based learning, collaborative work, and tasks based on real-world problems can enable students to approach the programming process with less anxiety. In order to eliminate the limitations of this study, it is recommended to repeat it with larger participant groups and conduct similar studies on students with different demographic characteristics. Additionally, longitudinal studies can be conducted to examine long-term effects.

Araştırma Etikleri / *Research Ethics*

Ethics Committee Permission: Ethics committee permission for this study was received by the decision of the Bursa Uludağ University Ethics Committee, dated 18/12/2023, at the 2023-12 session and numbered 11.

Yazar Katkıları / *Author Contributions*

Yazar bu makalenin tamamından sorumluluğu kabul etmiş ve gönderilmesini onaylamıştır.

Çıkar Çatışmaları / *Competing Interests*

Yazar çıkar çatışması olmadığını belirtmiştir.

Araştırma Fonlaması / *Research Funding*

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Veri Erişilebilirliği / *Data Availability*

Uygulanamaz.

References

Amabile, M. T. (2018). *Creativity in context: Update to the social psychology of creativity*. Routledge. https://doi.org/10.4324/9780429969782

Ardıç, S., & Kılıçer, K. (2023). The effect of high school students' individual innovativeness and problem solving competencies on their attitudes towards coding. *Batı Anadolu Journal of Educational Sciences*, *14*(Special Issue 2), 1-25. https://doi.org/10.51460/baebd.1197857

Birdi, K., Leach, D., & Magadley, W. (2016). The relationship of individual capabilities and environmental support with different facets of designers' innovative behavior. *Journal of Product Innovation Management*, *33*(1), 19-35. https://doi.org/10.1111/jpim.12250

Bosch, N., & D'Mello, S. (2017). The affective experience of novice computer programmers. *International Journal of Artificial Intelligence in Education*, *27*, 181-206. https://doi.org/10.1007/s40593-015-0069-5

Buche, M. W., Davis, L. R., & Vician, C. (2007). A longitudinal investigation of the effects of computer anxiety on performance in a computing-intensive environment. *Journal of Information Systems Education*, *18*(4), 415.

Byrne, P., & Lyons, G. (2001). The effect of student attributes on success in programming. *SIGCSE Bulletin*, *33*(3), 49–52. https://doi.org/10.1145/507758.377468

Chua, S. L., Chen, D. T., & Wong, A. F. L. (1999). Computer anxiety and its correlates: A meta-analysis. *Computers in Human Behavior*, *15*(5), 609-623. https://doi.org/10.1016/S0747-5632(99)00039-4

Connolly, C., Murphy, E., & Moore, S. (2009). Programming anxiety amongst computing students—a key in the retention debate? *IEEE Transactions on Education*, *52*, 52-56. https://doi.org/10.1109/TE.2008.928922

Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2010). *Multivariate statistics for the social sciences: SPSS and LISREL applications*. Pegem Akademi.

Demir, F. (2022). The effect of different usage of the educational programming language in programming education on the programming anxiety and achievement. *Educational Technology Research and Development*, *70*(3), 4171-4194. https://doi.org/10.1007/s10639-021-10750-6

Erdoğan, B. (2005). The relationship between programming success and academic success, general ability, attitudes towards computers, gender, and type of high school. (Master's thesis). Marmara University, Istanbul, Turkey.

Erkuş, A. (2005). *Scientific research spiral*. Seçkin Publications.

Erol, O., & Kurt, A. A. (2017). Examining the attitudes of the students of the department of ITTE towards programming. *Mehmet Akif Ersoy University Journal of Faculty of Education*, *1*(41), 314-325. https://doi.org/10.21764/efd.64721

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education*. McGraw-Hill.

Güngör, D. (2016). Guidelines for the development and adaptation of measurement tools in psychology. *Turkish Psychological Writings*, *19*(38), 104-112.

Gürsoy, K., & Çekmez, E. (2019). Investigation of middle school students' attitudes and opinions towards programming. *Turkish Journal of Computer and Mathematics Education*, *10*(3), 757-777. https://doi.org/10.16949/turkbilmat.466047

Hero, L. M., Lindfors, E., & Taatila, V. (2017). Individual innovativeness competence: A systematic review and future research agenda. *International Journal of Higher Education*, *6*(5), 103-121. https://doi.org/10.5430/ijhe.v6n5p103

Housten, D. M. (1993). An exploration and analysis of the relationship among learning styles, teaching styles, gender and performance in a college computer science course. (Doctoral dissertation). Kansas State University, Manhattan, Kansas.

Huck, S. W. (2008). *Reading statistics and research* (5th ed.). Pearson.

Kayış, A. (2009). Reliability analysis. In Ş. Kalaycı (Ed.), *SPSS applied multivariate statistical techniques* (pp. 403-419). Asil Publishing.

Kılıçer, K., & Odabaşı, H. F. (2010). Individual Innovativeness Scale (IIS): Turkish adaptation, validity and reliability study. *Hacettepe University Journal of Faculty of Education*, *38*(38), 150-164.

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. The Guilford Press.

Küçüksüleymanoğlu, R., & Eğilmez, H. O. (2013). Burnout levels of music teacher candidates: The case of Uludag University. *International Journal of Social Science*, *6*(3), 905-923. https://doi.org/10.9761/JASSS_610

Lau, W. W., & Yuen, A. H. (2009). Exploring the effects of gender and learning styles on computer programming performance: Implications for programming pedagogy. *British Journal of Educational Technology*, *40*(4), 696-712. https://doi.org/10.1111/j.1467-8535.2008.00847.x

Necessary, J. R., & Parish, T. S. (1996). The relationships between computer usage and computer-related attitudes and behaviors. *Education*, *116*, 384-388.

Pioro, B. T. (2004). Performance in an introductory computer programming course as a predictor of future success for engineering and computer science majors. Paper presented at the *International Conference on Engineering Education*, Gainesville.

Rogers, E. M. (2010). *Diffusion of innovations*. Simon and Schuster.

Rogerson, C., & Scott, E. (2010). The fear factor: How it affects students learning to program in a tertiary environment. *Journal of Information Technology Education: Research*, *9*, 147-171. https://doi.org/10.28945/1181

Selinger, A., & Gröstenberger, E. (2023). The effect of gender and age on computer self-efficacy, computer anxiety and perceived enjoyment among Austrian secondary school teachers. *MAP Education and Humanities*, *4*, 1–9. https://doi.org/10.53880/2744-2373.2023.4.1

Yi, M. Y., Fiedler, K. D., & Park, J. S. (2006). Understanding the role of individual innovativeness in the acceptance of IT-based innovations: Comparative analyses of models and measures. *Decision Sciences*, *37*, 393-426. https://doi.org/10.1111/j.1540-5414.2006.00132.x

Yildirim, O. G., & Ozdener, N. (2022). The development and validation of the Programming Anxiety Scale. *International Journal of Computer Science Education in Schools*, *5*(3), Article n3. https://doi.org/10.21585/ijcses.v5i3.102