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The relation between intellectual risk-taking regarding science classes and test anxiety inventory of secondary school

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In learning of students, cognitive and affective skills and interaction of these skills are very significant. Intellectual risk taking (IRT) and test anxiety inventory (TAI) fall between these cognitive and affective skills. In this research, in addition to the relation between the skills of secondary school students, whether their class level and science success (SS) have any affect receives scrutiny. The research data has been obtained from 591 students, studying in 12 different government schools in 5 different provinces of Central Blacksea Region of Turkey. Three different data collection tools were used in this research conducted with the cross-sectional method. The correlation analysis results show that there is a negative relation between success in science and TAI, whereas there is a low relation between TAI and IRT. MANOVA results have revealed that as class level gets higher, IRT decreases and TAI does not have a significant tendency. It has been found that as the academic success of students gets higher, their TAI decreases and their IRT points do not have a specific tendency.

Keywords: intellectual risk taking; science class; science success; test anxiety

Introduction

Science has a place in every area of life and as a subject it contributes students to prepare for the daily life, follow science and technology closely, and obtain embraced permanent information. In the curriculum (2018), it is aimed that cognitive skills, such as solving problems, scientific process, and science literacy, over and above the daily life skills that are acquired by the students. Another skill included in the programme is risk-taking. Risk-taking has an important place in academic activities. Noting that there are different types of risk-taking Neihart (1999) classifies this skill into five groups, viz.: cognitive, social, affective, physical, and spiritual risk-taking.

Risk-taking in education is a cognitive process, and has different stages, such as thinking profoundly about a problem, subject, or case (Beghetto, 2009), and making an inference about the problem (Clifford & Chou, 1991), presenting a hypothesis, and rearranging the results of those hypotheses by discussing them with peer groups and creating new alternatives for solutions (Weiner, 1994). IRT involves cognitive actions that the students make during the process of contributing educational activities and contemplating, using existing knowledge, and acquiring new knowledge. Examination types are also among those risks that students face affecting their future, in addition to the selection of school and department (Yaman, 2017). The exams constitute the most important factor that student will take in moving to the next stage in their lives, causing students to take risks as well as causing them anxiety.

Test Anxiety

Exams are one of the most important ways of shaping the lives of students, but may enhance the anxiety of the students (Dündar, Yapıcı & Topçu, 2008). Those effects may cause psychosomatic and cognitive complaints before, during, or after an exam (Totan & Yavuz, 2009). According to Spielberger (1966), TAI is an unpleasant occasion of emotions during a formal exam, or in an evaluation environment that hinders an individual from revealing his/her real performance; has cognitive, affective and behavioral features and creates anxiety in an individual. Another definition states that the TAI is the unpleasant emotions and excitement experienced by the students during any kind of evaluation (Öner, 1990). There are emotional, physiological and psychological dimensions of test anxiety (Pekrun, 2004; Zeidner, 2004). Öner (1990) studied TAI according to two subscales: dimension of worry involving one's own internal negative assessment about her/himself; and dimension of emotionality that includes physiological signs occurring in an individual during an exam. Spielberger and Vagg (1995) determined TAI to have two dimensions, called Worry (TAI-W), and Emotionality (TAI-E), respectively. Worry is the cognitive dimension of the TAI. The individual's negative evaluations about him include negative internal conversations and thoughts about failure and inadequacy. Dimension of worry is the process within which the individual believes he/she cannot do what she/he has to do during the exam, where he/she will not be able solve the problem he/she is facing, and where the individual is distracted by negative thoughts, such as "what if I cannot succeed, what if I cannot do." Affectively, this dimension stimulates the autonomous nervous system, which constitutes the sensory physiological side of the TAI. The affective dimension is a process including physical reactions, such as fast heart rate, sweating, getting hot and cold chills, skin rashes, nausea, irritability, and tension.

Exams are one of the most important elements of the education process. It is known that in every stage of education the exams have a great influence on the students especially in our country (Yaman, 2011). Coşaner and Serin (2012) have indicated that test anxiety is a special type of anxiety, which can cause fear and uneasiness during assessment. Generally, anxiety can also be seen as a life experience, as it will appear in a certain part of an individual's life. Hill and Sarason (1966) specify that the anxiety was seen mostly in school environment, and since anxiety is such an intensive emotional situation, it also affects the performance of the students during the exam (Çapulcuoğlu & Gündüz, 2013).

It is known that there is a strong relation between anxiety and learning. The qualification of this relation cannot be fully defined, yet it is accepted that some certain level of anxiety is essential for learning (Kılınçkaya, 2013). Bilicioğlu and Yılmaz (2017) have compared the success of Turkish and Singaporean students and stated that exam success, as well as the test anxiety of Singaporean students, who ranked first in international exam (Programme for International Student Assessment [PISA]), was higher than the level of Turkish students. By way of contrast, in a preliminary study examining the relation between these variables conducted by Atkinson (1957), it has been stated that test anxiety has an adverse influence on the success of students. By describing the influence of test anxiety on performance with the attention model, Wine (1980) has indicated that highly anxious people gave unrelated responses in their exams. In other words, they spent their time worrying instead of studying. Cassady (2004), on the other hand, stated that very anxious students cannot use their cognitive skills, and that therefore, they have solid concerns in exams. The results of those studies show that students with high anxiety levels obtain low success in the exams. Success or failure in the exams is related to many of the cognitive and affective skills of the students.

Intellectual Risk Taking

Strum (1971) pointed out that the students with high-risk taking skills are more willing to take part in activities in classes, even though they know they are going to fail, and that likewise, they are braver about taking the exams. Clifford (1988) has noted that those students enjoy the learning process and are also more successful at putting up resistance against problems during this process. This situation can mean that students with high risk taking skills are going to be more successful at dealing with the test anxiety. Aksan (2006), as well as Pitan and Atiku (2017), have stated that there are numerous factors that students encounter during decision-making or the problem-solving process. Aksan has classified those factors as affective, physical, and

cognitive, respectively. Affective factors comprise of tension, stress, anxiety and motivation; physical factors comprise of light, sound, heat; and that cognitive factors comprise of exercises, way of perception and decision-making processes. These factors affect the academic accomplishment of the students directly or indirectly. The reason for this is that as the affective skills progress, the upper cognitive skills improve as well (Boyer, 2006). Liebert and Morris (1967) defined test anxiety as a cognitive component concern. This concern includes negative expectations from the exam, as well as internal conversations about the possible failures in the exam. From this point of view, this concerning situation influences especially students, because their exams affect the future opportunities of the individuals. One of the affective and cognitive features of students is IRT (Çakır & Yaman, 2015). IRT, academic success, and test anxiety, can be considered to be the main processes that affect the behaviours of students while approaching a topic (Chin, Williams, Taylor & Harvey, 2017; Hill & Sarason, 1966). Knowing the skill levels of secondary school students regarding these variables shapes the education that will be offered. Moreover, studies comparing test anxiety and IRT skills with the SS of secondary school students are found, yet no studies including these two variables can be found in the literature review. In this study, we aim to determine whether there is a relationship among the SS, IRT and TAI skills of secondary school students, and to point out the extent to which these variables explain one another. Depending on this problem, it has been discussed by researchers as to whether the IRT and TAI scores of the students differ according to grade and SS.

Method

In the research conducted in cross-sectional review, findings regarding the variables have been reached by obtaining data from the sample at once (Fraenkel & Wallen, 2000).

Participants

The data was obtained from 591 secondary school students studying in 12 different public schools in five different provinces in the respective 2016–2017 and 2017–2018 academic years in the Central Black Sea Region of Turkey. The data was collected from the 5th-8th grades using convenient sampling method. This type of sample involves the choice of sample that can be easily reached in the study. Two hundred and eighty of the participant students are female, while 311 of them are male.

Measures

In the research, three different data collecting tools were used. The first scale is the perception scale

related to Intellectual Risk Taking and Predictors in Science Learning, which was adapted to Turkish by Yaman and Köksal (2014). The adapted scale was developed by Beghetto (2009) as a Likert-type scale, where the propositions proceed from completely incorrect, to completely correct. The scale has four sub-factors: IRT, interest in science (IS), creative self-efficacy (CSE) and perceptions of teacher support (PTS). It is stated that the structure validated measurement tool by the Exploratory and Confirmatory Factor Analysis can be used for secondary school students by taking the fit indices and expert opinions. Cronbach's Alpha internal consistency coefficient was calculated separately for both of the sample groups and found for the first group as .87 and for the second group as .86. Reliability levels related to the sub-factors obtained with alpha factor analysis (AFA) were .75, .80, .83 and .72, respectively. According to the analysis performed on the data of the research, the reliability coefficient of the entire scale was determined to be 0.89. The reliability levels of the collected data in this study were .75, .80, .83, and .72, respectively.

The second data-collecting tool was TAI, developed by Spielberger (1980) and adapted into Turkish by Öner and Albayrak-Kaymak (1990). TAI consists of 20 items, graded according to quartile rating. A reliability study about TAI has been conducted and reliability coefficient has been found to be $r = .95$. The internal consistency coefficient of TAI for this research was found to be .90. In addition, the researchers have stated that the validity level of TAI is high. TAI consists of two subtests, viz.: Worry (TAI-W) and Emotionality (TAI-E). For this reason, it is suggested that the scores related to these subtests have to be analysed and interpreted separately. The higher score of the exams means a higher level of TAI of the students (Öner, 1990).

- a. TAI-W subtest is related to the cognitive aspect of the TAI. It constitutes the individual's negative opinions, failures, and personal incompetencies; in short it means internal conversation of the individual. Eight out of the 20 items in the inventory are intended to the measure the worry anxiety of the students. The sum of the obtained scores from these items constitutes the raw score related to the worry subtest of the students. The reliability level of TAI-W is .76.
- b. The TAI-E subtest is related to excitement and emotional aspect of the TAI. Physiological signs and practices based on psychological basis, such as rapid heartbeat, sweating, nausea, and tension, which are also included in the physical infrastructure of the excitement (Öner, 1990). The reliability level of TAI-E is .86.

The third dependent variable of the research is the report score of the science course in the period of data collecting. Three written examinations, three in-class activities scores, and one project score are considered while calculating the report card score

of the students. The average score of the students is 72.96, the standard deviation is 18.05, coefficient of skewness is -.78, and coefficient of kurtosis is .82. In the versatile analysis of variance, the scores of the students were categorised by considering the grades of the Ministry of National Education (MEB, 2015). Accordingly, between 85.00-100 is Very Good; between 70.00-84.99 is Good; between 60.00-69.99 is Average; between 50.00-59.99 is Pass and between 0.00-49.99 is a Fail. These categories are also used as independent variable and the relation between them and the dependent variable is examined.

Analysis

The data collected with two different measurement tools were analysed using descriptive analysis. Collected data is first examined to find out whether there is any kind of deficient and erroneous information. It was determined that in all the data, 59 of the 22,838 set cells were left blank by the students. It has been examined whether those boxes were left open at random, and it has been determined that there is not any kind of order. The ratio of the number of blank set cells to the number of filled cells was to be .002. As this ratio is lower than 1/20, serial average score was appointed for every blank set cell (Hair, Anderson, Tatham & Black, 1998). By calculating the Mahalanobis distance values, the research data has been examined so as to determine whether it matches with the normal distribution assumption values (Büyüköztürk, 2010). With this analysis, the outlier values, which could create a threat for the normality and linearity assumption of the data, were checked. In the analysis, 11 values for these assumptions have been found, which were not included in the analysis. It has been accepted that the loss to data ratio does not have a significant effect on the results, due to the fact that it was smaller than 5% (Tabachnick & Fidell, 2013). After the removal of those students from the data set, the number of samples dropped to 591 students.

Parametric statistical techniques were used because of the fact that the data analysed after these operations have a normal distribution. For the normality test, the skewness and kurtosis values were examined, and the values for each dependent variable were determined to be between -1.00 and +1.00. In addition, for the versatile Analysis of Variance (ANOVA), the Box's test results were used. The parametric analyses used in the analysis are the Pearson Product-Moment Correlation Coefficient, and the versatile variance analysis. The values obtained for the correlation analysis were categorised as follows: between .00-.29 is low; between .30-.69 is average; between .70-1.00 shows a high degree of relation (Büyüköztürk, 2010). In the variance analysis, Eta-square (effect size) values were also calculated. This analysis is

conducted to determine at what level the examined variable exists in the research results independently from the samples and the performed tests (Field, 2005). The obtained eta-square value is interpreted according to the classification determined by Cohen (1988). Hereunder, the effect size for $\eta^2 \leq .01$ is small, for $.01 < \eta^2 \leq .06$ is average and for $.06 < \eta^2 \leq 0.14$ is larger. In order to test the way of the difference between the groups in versatile variance

analysis, a single factor ANOVA analysis is made, and for the differences between the groups, Scheffé from the post hoc tests are used. For all analysis, the confidence interval is accepted as 95 percent.

Findings

In this section, the analyses of the data obtained from the students regarding dependent and independent values takes place.

Table 1 The perception levels of secondary school students in science learning in terms of IRT and predictors, relation between TAI level and SS scores

Variable	1.1	1.2	2	2.1	2.2	2.3	2.4	3
1. TAI Total Score	.90	.96	-.02	-.00	-.12	.03	.01	-.11
1.1 Sub-factor 1. TAI-W		.75	-.05	-.04	-.12	.00	-.03	-.13
1.2 Sub-factor 2. TAI-E			.00	.02	-.11	.05	.03	-.09
2. IRT Total Score				.78	.74	.84	.73	.22
2.1 Sub-factor 1. IRT					.46	.50	.37	.12
2.2 Sub-factor 2. IS						.47	.44	.25
2.3 Sub-factor 3. CSE							.59	.18
2.4 Sub-factor 4. PTS								.16
3. SS Score								

According to the Table 1, it was determined that there is a strong positive correlation between the average scores of the two scales and their own subfactors. It has been found that while the relation between the success of students and TAI was negative, the relation between the success of students and IRT was positive. On the contrary, while this relation was found to be significant, it was positive with all subscales of IRT and predictor scales, but the relation was negative regarding the scores of the TAI scale. It is also seen that there is a significantly lower correlation between TAI and its sub-factors and sub-factor of interest directed to science. In addition, it is found that there is a negative and low relation between the worry sub-factor of TAI and CSE of IRT. Moreover, it is determined that the scores of TAI and IRT are generally low.

Table 2 Covariance equation results for the two-way ANOVA test regarding IRT and TAI of students

Box's M	F	SD1	SD2	p
5.22	.58	9	1627942	.818

According to the Table 2, the data shows that a multiple variant analysis is possible for the data set regarding dependable variables as to the Box's M test results.

Table 3 Descriptive statistical results for the two-way ANOVA test regarding IRT and TAI of students

Variable	Group	N	M	S
IRT	Class grade			
	5	169	4.36	.75
	6	167	4.25	.74
	7	162	4.00	.80
	8	93	3.87	.82
	Total	591	4.15	.80
TAI	5	169	44.85	12.76
	6	167	46.29	12.83
	7	162	45.05	11.60
	8	93	41.66	12.27
	Total	591	44.81	12.45
IRT	Score grade			
	Fail	43	3.99	.75
	Passing	63	3.87	.82
	Middle	90	3.94	.86
	Good	208	4.16	.74
	Very good	187	4.38	.77
	Total	591	4.15	.80
TAI	Fail	43	48.97	10.13
	Passing	63	47.38	11.80
	Middle	90	46.40	12.97
	Good	208	43.06	11.79
	Very good	187	44.17	13.25
	Total	591	44.81	12.45

According to the Table 3, IRT scores of the students in different classes show a tendency to

decrease as the class level increases. It has also been found that the homogeneity of the scores of the student gets lower as the class level decreases. On the other hand, it is determined that the TAI scores of the students doesn't show any kind of tendency to fall or rise in a certain way; rising from Fifth Grade to the Sixth Grade, and falling in the seventh and eighth grades.

According to Table 3, it was determined that the students, having Pass marks, have the lowest

IRT scores, and the students having Very Good marks, have the highest IRT scores according to the levels of SS scores of the students. As the scores of the students increase, risk-taking skills show a tendency to increase from Pass to Very Good. On the other hand, TAI scores show a tendency to fall from Fail to Good and tendency to rise in Very Good. The highest TAI is seen in the students with a Fail grade, and the lowest TAI is seen in the students with Good grade.

Table 4 Versatile variance analysis results regarding to the SS and IRT scores of the students

	Wilks' Lambda (λ)	F	Hypothesis df	Error df	p	Eta Squared (η^2)
Grade	.95	4.77	6	1142	.000	.025
Science success	.92	6.19	8	1140	.000	.042
SxAB	.95	1.14	24	1140	.290	.023

In Table 4, it is specified that the dependent variables show significant differences according to the situation of being in different classes (Wilks' $\lambda = .95$; $F = 4.77$; $p < .000$; $\eta^2 = .025$). Hereunder, it is determined that there is an important influence of the class levels of the students on changing the SS and IRT scores. The result of η^2 shows that the influence has an average effect.

According to the same table, IRT and TAI become significantly different (Wilks' $\lambda = .92$; $F = 6.19$; $p < .000$; $\eta^2 = 0.042$). This result means

that the change in SS has an average effect on both of the dependent variables. On the other hand, it is determined that the interaction between classes and SS score does not cause a significant difference on the dependent variables ($p > .05$).

When the mutual influence of the class and SS levels of the students on the dependent variables is examined, it is determined that there is no significant difference ($p > .05$). In addition, these two variables have an average effect on the IRT and TAI scores.

Table 5 Two-factor ANOVA results for repetitive measurements related to the class and SS scores of the students

Source	Variable	Type III SS	df	MS	F	p	η^2
Grade (G)	IRT	15.68	3	5.23	9.20	.000	.046
	TAI	246.94	3	82.31	.54	.655	.003
SS	IRT	20.84	4	5.21	9.17	.000	.060
	TAI	2099.31	4	524.83	3.44	.009	.024
GxSS	IRT	11.42	12	.95	1.68	.068	.034
	TAI	1140.41	12	95.03	.62	.823	.013
Error	IRT	324.33	571	.57			
	TAI	87033.78	571	152.42			

When Table 5 is examined according to the class levels it is seen that the IRT levels of the secondary school students become significantly different ($F(3, 571) = 9.20$, $p < 0.01$) and TAI scores do not become different at a significant level ($p > 0.05$). According to the SS of the students, it is determined that a significant difference occurs, according to their risk taking skills ($F(4, 571) = 20.84$, $p < 0.01$) and TAI scores ($F(4, 571) = 3.44$, $p < 0.05$). On the other hand, class level and SS scores of the students do not create an important

effect on the two dependent variables ($p > .05$). It is specified that the class level has an average effect ($\eta^2 = .046$) on the IRT skills, and has a minor effect ($\eta^2 = .003$) on TAI. However, score of SS has a major effect ($\eta^2 = .060$) on IRT and an average effect ($\eta^2 = .024$) on TAI scores. The mutual effect of class level and SS score has an average effect ($\eta^2 = .034$) on IRT and a minor effect ($\eta^2 = .013$) on TAI scores. The results of multiple comparative tests are given in Table 6.

Table 6 Multiple comparison test results according to the class levels of the students

Variable	Test	I (Grade)	J (Grade)	Mean Difference (I-J)	p
IRT	Scheffé	5	7	.36	.001
		5	8	.49	.000
		6	7	.26	.029
		6	8	.39	.002

According to the Table 6, it has been found that the differences in IRT skills among classes

generally tend to favour lower grades. It is determined that the greatest difference is between

the Fifth and Eighth grades; the lowest difference is between the Sixth and Seventh grades.

As seen in Table 7, the difference between the IRT skills according to the SS scores of the students are in favour of students with Very Good

grades. The greatest difference is between Very Good and Passing grades; the lowest difference is between Very Good and Fail. There is no significant difference between IRT scores of the students having Very Good and Good grades.

Table 7 Multiple comparison test results according to SS scores of the students

Variable	Test	I	J	I - J	p
IRT	Scheffé	Very good	Fail	.38	.036
		Very good	Passing	.51	.000
		Very good	Middle	.44	.000

Discussion and Conclusion

In this study, when the IRT, TAI and SS scores of the secondary school students were compared according to science learning, it was determined that there has been a low-level relation between TAI and IRT. Another result obtained from the research showed that there was a relation between SS of the students and IRT skills towards science learning and TAI. This relation is negative with TAI, and positive with IRT. IRT and TAI includes both cognitive and affective skills. When the literature is reviewed, it is accepted by many researchers that the cognitive and affective features have an effect on the learning of the students. (Bandura, 1997; Beghetto, 2009). In a study by Çapulcuoğlu and Gündüz (2013) conducted on high school students, it was found that anxiety affects success negatively, making it difficult to handle. Chin et al. (2017) have noted that fear of failure increases the anxiety level of the students even more. In the research conducted on effects of anxiety on Fourth, Fifth and Sixth grade students, Koçkar, Kılıç and Şener (2002) have found that there was a relation between academic success and anxiety and as the anxiety rises, the academic success falls. They also envisaged that more than 50% of the students had high anxiety. Spielberger and Vagg (1995) stated that when the anxiety level of students is high, then they perceive exams to be a threatening process. As a result of this study, the reverse relation between anxiety and SS shows parallels with the results of the above-mentioned research.

Another research finding is that as the class level increases, the IRT levels show a tendency to fall. Beghetto (2009) also found a significant negative relation ($\beta = -0.21$) between grade levels and IRT scores of the secondary school students in the study. In the study of Daşcı and Yaman (2014), it was determined that the risk-taking levels of students are higher at younger ages. Stating this situation may have a relation with the decrease of teacher support, where Milner and Khoza (2008) and Oliveira (2010) noted that creating supportive learning environments would be beneficial. The fact that risk-taking is an ability that can be affected by cognitive and affective factors can be considered as an explanation of this situation identified in the study. When the class levels of the

students are examined, it is highly remarkable that as adolescence approaches, risk-taking levels decrease. Kiran-Esen (2003) points out that there is a relation between adolescence and level of risk taking. These students demonstrate higher risk taking behaviours than those in later periods of adolescence. The results of the study show certain similarity with the results above.

The findings of the research show that the TAI increases from the Fifth Grade to the Sixth Grade, and decreases from the Sixth Grade to the Eighth Grade. The results of the study conducted by Kayapınar (2006) show that TAI scores do not have a certain tendency, according to the age of the students. In the relevant study, the highest rate of anxiety was seen at the age of 16; while the lowest rate of anxiety was seen at the age of 15; the anxiety level between the ages of 13 and 14 is in-between these mentioned ages. Hembree (1988) found in his study on K12 classes that the anxiety levels of students increase from the First Grade to the Eighth Grade, and decrease from the Eighth Grade to the Twelfth Grade. In related research, it was stated that test anxiety had a complex structure, which was affected by many cognitive and affective factors. Apart from the class level, many factors, such as gender, type of test, attitude, ability level, school environment, are under risk, or have not have an effect on test anxiety. There is a negative relation between SS and test anxiety, as revealed by the results of this research. Similarly to some studies in the literature, test anxiety has a tendency at first to increase, and then to decrease. As stated by Hembree (1988), there are many reasons for this situation, and the class level can be described as the variable with the greatest uncertainty among the variables that has an effect on this feature. The difficulty of fully revealing the effect of class level is almost impossible to fully control all variables such as teaching programme, teacher attitudes and behaviours, physical situation of the school and the classroom, friendships, and test types. Nevertheless, it is believed that it would be useful to consider the reasons for different test anxieties in different grades in other research relying on numerous variables. It has been found that students with an acceptable grade have the lowest IRT scores and students with a Very Good grade have the higher scores in regards to their SS

scores. Studies show that there is a relation between academic success in science and IRT (Yaman & Köksal, 2014). As the scores of the students increase, IRT skills decrease, with a certain slope from Pass to Very Good. It is known that students experience TAI (Öner, 1990). When the TAI scores of the students are examined, it has been determined that there is a tendency to decrease from Fail to Good whereas there is tendency to increase at Very Good grades. The highest TAI was seen in the students with the grade of Fail and the lowest level of anxiety was seen in the students with Good grades. Albayrak-Kaymak (1987) obtained findings showing that TAI affects the success level of the students significantly. In addition, Von der Embse and Hasson (2012) have revealed that while the TAI level of students increases, SS scores of the students decrease.

The results of the study show that the interaction between class level and SS has no significant effect on IRT and TAI scores of the students. The main reason for this situation could be that as the class level increases, the scientific success does not show a tendency to decrease or increase. Nevertheless, while increase of the class level causes decrease of the IRT, when it shows an interaction with the increase in scientific successes, it does not cause a significant difference.

Suggestions

According to the research results and considering the reverse relation between the interest in science, which is one of the sub-dimensions of IRT and TAI, it may be suggested that studies could be performed in order to increase the interest of the students in science so that their TAI decreases. One of the outstanding findings of this research is the positive relation between success in science and risk-taking skills and the negative relation between success in science and TAI. Moreover, there is a poor relation between TAI and risk-taking. According to the research results, it could be possible to state that the students need to develop their risk-taking skills, in order to increase their success in science and decrease their TAI.

As the research results show that there are changes in different directions in cognitive and affective skills of the students as their age increases, it would be important to reveal the causes of these changes. In such research, qualitative research methods such as observation or interviews where detailed information could be collected, may be preferred. This detailed information can provide effective evidence for comparison of results of experimental and control groups in experimental studies, which include students at different success levels.

Authors' Contributions

Belgin Bal-İncebacak wrote the introduction and findings, Süleyman Yaman conducted the statistical analyses and wrote method and findings, and Aslı Sarışan-Tungaç wrote method and discussion sections. All authors wrote conclusion and suggestions sections together and reviewed the final manuscript. All suggestions from reviewers were discussed together, and worked on until reaching consensus.

Notes

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