CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS

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Abstract. *Context-based questions can be effective in reducing test anxiety and increasing science achievement. The purpose of this research was to determine the effects of context-based questions on the test anxiety and science achievement of secondary school students enrolled in a science course, in relation to gender. Seventy students who were found to have high levels of test anxiety were selected from the 185 seventh-grade students at a public school in Turkey. The Revised Test Anxiety Scale (RTAS) was used to measure the students' test anxiety. The scores the students obtained in three different examinations were considered as indicators of their academic achievement. The analysis results showed that there was a statistically significant difference between the test anxiety and science achievement scores of the students who were given context-based questions and the corresponding scores of the students who were given conventional questions. However, there was no statistically significant difference between the main effect of gender and treatment and there was no gender interaction effect. These findings suggest that context-based questions can be considered as a better alternative to conventional questions for reducing students' test anxiety and improving their science achievement.*
Key words: *context-based questions, conventional questions, science achievement, secondary school students, test anxiety.*

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Introduction

Academic achievement refers to the degree or level of success attained in school performance. Students' academic achievement is an extremely important indicator of whether they will continue higher education and plays an equally important role in the decision regarding their selection and placement in an organization or institution (Mokashi, Yadav, & Khadi, 2012). In many countries, for example, Turkey, students' secondary school, college, or university academic performance is evaluated with the help of standardized tests and examinations that are part of the countries' educational systems. Many factors influence students' achievement in these tests and examinations. One of these factors, namely, test anxiety, is a major concern for both educators and policy planners. Test anxiety is considered to be a special case of anxiety that occurs in an assessment context or evaluative situation. Mallow and Greenburg (1982, p. 358) noted that "general test anxiety differs from science anxiety." It is important to note the difference between these two types of anxiety as since educators usually evaluate students on tests, they may misinterpret science anxiety to be generalized test anxiety. Similarly, Wynstra and Cummings (1990) found that while test anxiety, especially the construct of emotionality, may overlap with the construct of science anxiety, they are not the same construct (Raymond & Wells, 2003). The concept of test anxiety has been given different definitions in literature due to the multimodal nature of the construct. Wine (1971) defined it as a person's response to the nervousness induced by the testing situation, characterized by negative self-centered thoughts and statements. Likewise, Spielberger (1972) defined test anxiety as an unpleasant state characterized by feelings of tension and apprehension, worrisome thoughts, and the activation of the autonomic nervous system when an individual faces evaluative achievement-demanding situations (Ergene, 2003). Furthermore, Zeidner (1998, p. 17-18) described test anxiety as the responses that accompany concern about possible negative consequences or failure in an examination or similar evalu-

Journal of Baltic Science Education, Vol. 15, No. 3, 2016

ISSN 1648–3898   CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND
SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS
(P. 382-390)

ative situation. Test anxiety has also been described as an emotional component of human beings that manifests itself in life endeavors in a form of worry and restlessness (Olatoye, 2007). On the other hand, Hong (1998) regards test anxiety as a complex multidimensional construct involving cognitive, physiological, and behavioral reactions to evaluative situations (Ali & Mohsin, 2013). According to Spielberger and Wagg (1995, p. 3-14), test anxiety is composed of cognitive attention processes that interfere with performance in academic situations or examinations. Similarly, Olatoye and Afuwape (2003) argue that test anxiety is a psychological condition in which a person experiences distress before, during, or after an exam or other assessment, to such an extent that the anxiety causes poor performance or interferes with normal learning (Olatoye, 2009).

Test anxiety is an important predictor of academic achievement. According to Oludipe (2009), test anxiety is one of the major causes of students' underachievement and low performance at different educational stages in their lives. Thomas and Gadbois (2007) reported that test anxiety was a significant predictor of mid-term examination grades and Sgoutas-Emch et al. (2007) stated that test anxiety significantly predicted students' achievement in a science course (Olatoye, 2009). There is a large volume of research focusing on test anxiety and achievement in relation to students' gender (Adigwe, 1997; Chapell et al., 2005; Crocker et al., 1988; Hembree, 1988; Khalid & Hasan, 2009; Nadeem et al., 2012; Payne et al., 1983; Payne, 1984; Rana & Mahmood, 2010; Tryon, 1980). The findings of this research indicate that there is a significant and negative relationship between test anxiety and academic achievement and that gender affects test anxiety and students' level of achievement. While Payne et al. (1983) observed differential relationships between test anxiety and test performance in males and females, Crocker et al. (1988) did not observe any gender difference in test performance after students' differing levels of text anxiety, which could have caused differences in test performance, had been statistically controlled (Adigwe, 1997). In yet another study, Olatoye (2007) found a negative relationship between test anxiety and students' achievement; however, the researcher found no significant difference between the anxiety of male and female examinees.

Moreover, several researchers (Bandalos et al., 1995; Cassady & Johnson, 2002; Chapell et al., 2005; Hong, 1999; Mwamwenda, 1994; Rasor & Rasor, 1998; Schonwetter, 1995; Seipp & Schwarzer, 1996; Spielberger, 1980; Zeidner, 1990) have explored gender differences with respect to test anxiety and found that females have higher levels of overall test anxiety than do males. Zeidner (1990) indicated that the difference in test anxiety scores (TAS) of males and females is due to a gender difference in scholastic ability. Seipp and Schwarzer (1996) and Spielberger (1980) reported that in a majority of cultural groups, women tend to have higher levels of test anxiety than do men. Cassady and Johnson (2002) stated that one explanation for gender-based differences in test anxiety is that although males and females feel the same levels of test worry, females have higher levels of emotionality (Rana & Mahmood, 2010). In the same vein, Schonwetter (1995) found that males with low test anxiety showed higher achievement outcomes, perceived more success with regard to their performance, and felt more confident than high test-anxious males or females. Hong (1999) and Rasor and Rasor (1998) found that female students reported higher trait test anxiety and statistics course anxiety than did males. They reported that female students need more help than males in overcoming test anxiety. Some research has been conducted on the relationship between test anxiety and science achievement. Adigwe (1997) reported a negative correlation between test anxiety and students' science achievement. In a related study, Tomljenove and Nikcevic-Milkovic (2005) showed that students have different levels of test anxiety and they found a negative correlation between test anxiety and academic achievement (Idaka, Egbona, & Bassey, 2011). Additionally, Oludipe (2009) revealed that low test-anxious students performed better than high test-anxious students on both numerical and non-numerical tasks in physics (Rana & Mahmood, 2010).

From the foregoing, it is apparent that the research findings on test anxiety are varied and are not easy to summarize. In this study, emphasis is laid on science achievement, because science is fundamental to other subjects and is vital in understanding the complexities of modern technology and the many other scientific developments useful to mankind. Prior to this research, there have been no reports on the effect of context-based questions on test anxiety and science achievement. Several research studies have only assessed the relationship between test anxiety and variables such as fear of success, science attitude, and science achievement in relation to students' gender, and the effects of different interventions. Past studies have also assessed purpose orientations of learning methods and test anxiety. Hence, there is a need to obtain more empirical support with regard to the concept of text anxiety and find ways to reduce the test anxiety levels of male and female secondary school students. Context-based questions can be effective in reducing test anxiety and increasing science achievement. Also, context-based questions can reduce text anxiety in both males and females. This research aimed at identifying the effects of context-based questions on the test anxiety and science achievement of Turkish lower secondary school students, in relation to

Journal of Baltic Science Education, Vol. 15, No. 3, 2016

CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND
SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS
(P. 382-390)

ISSN 1648–3898

gender. Specifically, it attempts to determine whether context-based testing results in lower test anxiety and better science achievement. Therefore, the following question was investigated: What are the effects of context-based questions and gender on seventh-grade students' test anxiety and science achievement?

Methodology of Research

Research Design

In this research, to identify the effectiveness of context-based facing conventional questions on the test anxiety and attitudes towards science of lower secondary school students,   have used quasi experimental "equivalent control group with pre-post-test" design (Berg & Latin, 1994). The equivalent control group refers to the elements of which no characteristics between two groups had a different expected value. Prior to the experimental treatment, the two groups should be similar in terms of many aspects, which is a standard assumption (Leedy & Ormrod, 2001). The first control before treatment should confirm whether the two groups are at least similar in terms of the dependent variables under investigation. If one group receives the experimental treatment and group differences are found with respect to the dependent variable, and the research comes to the conclusion that the post treatment differences are the result of that treatment (Hossain at al., 2013). In this research, 70 full-time students from a co-educational lower secondary school in west part of Turkey constituted the sample; they were divided into two groups (control and experimental) of equal number (n=35). There were two independent variables: treatment (context-based and conventional questions) and gender. Initially, a test anxiety scale was applied as a pre-test to the control and experimental groups. The experimental design of the research has been represented in Table 1. The results revealed that before the treatment was administered, both the groups of students were equivalent in terms of their levels of test anxiety; in other words, before the treatment strategy was implemented, both the groups had similar levels of test anxiety (Table 2).

Table 1.   Pre-test and post-test control group design.

Group	Pre-test	Treatment	Post-test
EG (n = 35)	O_1	X_1	O_2
CG (n = 35)	O_3	X_2	O_4

EG: Experimental group; **CG**: Control group; O_1 and O_3: Pretest of test anxiety; O_2 and O_4: Posttest of test anxiety; X_1: Context-based questions; X_2: Conventional questions.

Sample

The sample of the research comprised first semester seventh-grade students (academic year 2013-2014) enrolled in a science course at a state lower secondary school in western Turkey. Permission for student participation was obtained from the related chief departments and students voluntarily participated in the research. First, as a pre-test, the Revised Test Anxiety Scale (RTAS) was administered to all the 185 seventh-grade students, from which a sample of 70 students with high levels of anxiety based on the test anxiety scale, expedient was selected. The students were then randomly assigned to an experimental or control group, each of which had 35 students (18 males and 17 females). The RTAS was then administered again to both groups as a pre-test and an independent sample t-test was carried out. No statistically significant difference was found between the pretest TAS of the two groups (for the RTAS, t = -.611; p > .05). The pre-test mean scores are presented in Table 2.

Journal of Baltic Science Education, Vol. 15, No. 3, 2016

ISSN 1648–3898   CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND
SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS
(P. 382-390)

Table 2.   **Pre-test means, standard deviations, and standard error means with regard to the test anxiety scores.**

	Groups	Gender	N	Mean (TAS)	Std. Dev. (TAS)	Std. Error Mean (TAS)	p
Pre-test	EG	Male	18	40.77	9.37	2.20	.604
		Female	17	43.35	12.30	2.98	
		Total	35	42.02	10.88	1.84	
	CG	Male	18	42.88	12.57	2.96	
		Female	17	38.11	12.37	3.00	
		Total	35	40.57	12.52	2.11	

Note. p > .05; EG: Experimental group; CG: Control group; TAS: Test anxiety scores.

As shown in Table 2, the mean pre-test score of the experimental group was 42.02 (SD = 10.88), while that of the control group was 40.57 (SD = 12.52). These results reveal that the difference between the mean pre-test scores (for test anxiety) of the experimental and control groups [t(68) = -0.611, p > .05] was not significant at the .05 alpha level. This suggests that at the beginning of the research, the test anxiety levels of both the groups were equal.

Instrument

Test Anxiety: Test anxiety was measured by using the RTAS (Benson et al., 1992; Benson & El-Zahhar, 1994). The Turkish adaptation of this scale was done by Akın et al. (2013). This scale consists of 20 items, which have been divided into four subscales by means of factor analysis. The subscales are Worry, Tension, Bodily Symptoms, and Test-Irrelevant Thinking. Respondents indicate their responses using a four-point Likert-type scale (1 = almost never to 4 = almost always), based on the frequency with which what is described in each item is experienced. A Cronbach alpha reliability coefficient of 0.89 was obtained for the RTAS. In the present research, the Cronbach Alpha internal consistency reliability coefficient of the scale was calculated as 0.92.

Science Achievement (SA): A couple of tests consisting of context-based and conventional questions were developed in order to measure the science achievement of the students (Kurbanoğlu & Koç Nefes, 2015). The test questions were selected from the seventh-grade textbook that is part of the general science curriculum. The validity of the test questions were achieved by consulting 15 science teachers. Pilot testing was conducted on 45 (25 male and 20 female) students from a school. Item analysis was performed to determine the difficulty level and discrimination power of each item. Also, the Kuder-Richardson formula was used to determine the reliability of the context-based and conventional tests; the resulting reliability co-efficient was (α = 0.68), which indicates that the tests were satisfactorily reliable (McMillan & Schumacher, 2001). The scores obtained on the three examinations were calculated as an indicator of the science achievement of the students.

Procedure

Instead of conventional science questions, using context-based questions that reflect the real world can reduce students' test anxiety. To measure the science achievement of the students, various context-based tests covering science concepts were prepared. Before the measures were administered, the participants were informed of the purpose of the research. At the beginning of the research, the RTAS was administered as a pre-test, to the experimental (n = 35) and control (n = 35) groups. After the pre-test was administered, context-based questions were given to the experimental group and conventional questions were given to the control group by the researcher, as part of three examinations over 16 weeks. The context-based and conventional questions were given at the same time to both the experimental and control groups. Then, the scores obtained on the three examinations were calculated as an indicator of the students' science achievement. After the students had finished answering the examinations, the RTAS was simultaneously administered to both the experimental and control groups, as a post-test.

Journal of Baltic Science Education, Vol. 15, No. 3, 2016

CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND
SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS
(P. 382-390)

ISSN 1648–3898

Data Analysis

After the 70 students had finished answering the examinations, the data obtained from them were statistically analyzed using the Statistical Package for Social Sciences (SPSS 20). The significance level was set at .05. In order to determine the effects of the treatment (context-based versus conventional questions) and gender on students' test anxiety and science achievement, a two-way multivariate analysis of covariance (MANCOVA) was used, since it uses the pre-test as a true covariant rather than treat it as mere interesting information (Dugard & Todman, 1995).

Results of Research

In this research, a 2×2 factorial experimental design was used. The first independent variable, namely, treatment group, had two levels (context-based questions and conventional questions), and the second independent variable, namely, gender, also had two levels (male and female). In order to examine how much of the variance in test anxiety and science achievement (the dependent variables) can be explained by the treatment and by gender, a two-way MANCOVA was used and the results are reported based on the objectives of the study stated earlier. Before the analyses, it was verified as to whether the assumptions for appropriately conducting a MANCOVA, namely, homogeneity of variance and normality, were fulfilled. For the assumption of homogeneity of variance, Box's Test of Equality of Covariance Matrices was performed. It was found that both the assumptions of normality and homogeneity were fulfilled ($p > .05$). The students' results before the MANCOVA was conducted are provided in Table 3. Table 3 provides the descriptive values for the science achievement scores of the male and female students in the experimental and control groups, before and after the treatment was administered.

Table 3.   **Descriptive statistics for the pre-test, post-test and science achievement mean scores according to treatment group and gender.**

Group	Treatment	Gender	N	Pre-test Means (TAS)	Post-test Means (TAS)	I[st] Exam	IInd Exam	IIIrd Exam	Means of the Exam Scores
EG	Context-based questions	Male	18	40.77	35.88	59.72	65.83	65.50	63.68
		Female	17	43.35	39.58	61.53	58.18	64.53	61.41
		Total	35	42.02	37.68	60.60	62.11	65.03	62.58
CG	Conventional questions	Male	18	42.88	46.55	54.83	55.11	53.28	54.41
		Female	17	38.11	43.64	61.00	59.35	57.35	59.23
		Total	35	40.57	45.14	57.83	57.17	55.26	56.75

As shown in Table 3, the experimental group students' mean pre-test test anxiety score was 42.02 (males: 40.77; females: 43.35), while the control group students' mean pre-test TAS score was 40.57 (males: 42.88; females: 38.11). Before the treatment was administered, the experimental group students' mean test anxiety score (42.02) was higher than that of the control group (40.57). However, an independent sample t-test indicated that this difference between the scores was not statistically significant (see Table 2). After the treatment was administered, the experimental group students' mean post-test test anxiety score (37.68) was lower than that of the control group (45.14). On the other hand, the experimental group students' mean science achievement score was 62.58, while that of the control group was 56.75. Based on the data provided above, it can be inferred that the experimental and control groups obtained different science achievement scores. Moreover, the results revealed that the experimental group students obtained higher science achievement scores than did the control group students. To ascertain whether the difference between the TAS of the control group and experimental group and the difference between the science achievement scores of the two groups were statistically significant, a two-way MANCOVA analysis was used.

In order to answer the research question, a two-way MANCOVA with the pre-test TAS as the covariate was used to elucidate the effects of the treatment and gender on the students' text anxiety and science achievement. The two-way MANCOVA provided an analysis of the main effects of treatment group and gender and also revealed the two-way interaction between treatment group and gender. For significant main effects ($p < .05$), post-hoc analyses

Journal of Baltic Science Education, Vol. 15, No. 3, 2016

ISSN 1648–3898

CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND
SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS
(P. 382-390)

of variance tests (using Tukey's follow-up) were performed to determine where the differences existed. The results of the data analyses are provided in Table 4, which presents the results of the analysis of covariance for the test anxiety and science achievement scores.

Table 4. **Analysis of covariance for test anxiety and science achievement scores with the pre-test as a covariate.**

Source of Variation	df	Sum of Squares	Mean Square	F	p	Partial Eta Squared
Pre-test	1	774.560	774.560	5.938	.018**	.246
Main effects						
Treatment	1	1854.862	1854.862	9.292	.003*	.125
Gender	1	39.458	39.458	.584	.584	.005
Two-way interactions						
Treatment* Gender	1	26.581	26.581	.653	.653	.007
Error	65	8478.622	130.440			

Note. *$p < .01$, **$p < .05$.

The two-way MANCOVA results for the test anxiety and science achievement tests indicated that regardless of gender, a significant difference existed between the experimental and control groups with regard to text anxiety and science achievement, with a small effect size ($p < .05$, partial eta squared $=.125$). According to Cohen (1988), an effect size of 0.2 is small, one of 0.5 is medium, and one of 0.8 is large. Post-hoc analysis (using Tukey's follow up) of the treatment's main effect on test anxiety and science achievement indicated that the experimental group's performance was significantly different from that of the control group. The means of the control group scores (M_{SA} = 56.75, M_{TAS} = 45.14) were significantly higher than the means of the experimental group scores (M_{SA} = 62.58, M_{TAS} = 37.68). It was found that the main effects of gender and treatment and the gender interaction effect were not statistically significant at the .05 level. The results obtained seem to suggest that context-based questions were more effective in improving the students' test anxiety and science achievement than were the conventional questions. Therefore, while context-based questions decrease students' test anxiety, they increase their science achievement.

Discussion

According to the literature, many factors can influence students' achievement at different levels. Pintrich et al. (1993) pointed out that students' affective features (such as anxieties and attitudes) may shape their interest, motivation, and curiosity in learning. The test anxiety of students has a combined and relatively significant influence on science achievement. This dependent variable is an important predictor of science achievement. The assessment strategy used is also a variable to take into account when considering efforts to ease students' test anxiety and improve their science achievement. Therefore, what type of assessment strategy to use is a major concern for both educators and policy planners. The present research explored the effects of context-based questions on test anxiety and science achievement in relation to the gender of secondary school students.

In the research, significant differences were found between the experimental group's pre-test and post-test mean test anxiety scores. In the pre-test (before the treatment was administered), the experimental group's mean test anxiety score was high. However, after the treatment was administered, the experimental group's post-test mean test anxiety score was low and science achievement mean score was high. The findings of this research confirmed that the experimental group students' TAS decreased as their science achievement scores increased. Similarly, there was a difference between the control group's pre-test and post-test mean test anxiety scores. In the pre-test, the control group students' mean test anxiety score was low. However, in the post-test, the students' mean test anxiety score increased. These findings indicate that the control group students' science achievement scores decreased as their test anxiety increased. In this context, rather than the conventional questions, the context-based questions were more effective in decreasing test anxiety and increasing science achievement. Furthermore, the analysis

Journal of Baltic Science Education, Vol. 15, No. 3, 2016

CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND
SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS
(P. 382-390)

ISSN 1648–3898

of the data revealed that the experimental group students, who were given context-based questions, obtained significantly higher science achievement scores than the control group students, who were given conventional questions. Thus, it can be inferred that high achieving students have low levels of test anxiety, while low achieving science students have high levels of test anxiety.

These findings support the findings of Adigwe (1997) and Zoller and Ben-Chain (2007), who found that students who have high anxiety levels tend to obtain lower science scores. Conversely, students who have low levels of anxiety tend to obtain higher science scores. In yet another study, Olatoye (2009) and Idaka et al. (2011) found that students had different levels of test anxiety and that there was a negative correlation between test anxiety and academic achievement. Furthermore, the results of the present study showed that treatment (i.e., context-based versus conventional questions) had no significant effect on the mean science achievement scores of the students with regard to gender. Findings of Olatoye (2007) also support these results. He found that there was a negative relationship between test anxiety and students' achievement and found no significant difference between male and female examinees' anxiety. Nevertheless, the present study revealed that the students (males and females) in the experimental group obtained higher science achievement scores than did the students in the control group. In addition, it was found that in the experimental group, the male students were more successful than their female counterparts; in contrast, in the control group, the female students were more successful than their male counterparts.

Various researches (Bandalos et al., 1995; Cassady & Johnson, 2002; Chapell et al., 2005; Hong, 1999; Mwam-wenda, 1994; Rasor & Rasor, 1998; Schonwetter, 1995; Seipp & Schwarzer, 1996; Spielberger, 1980; Zeidner, 1990) have found that, on average, male students perform better than female students. Consequently, context-based questions appear to have a positive effect in terms of reducing students' test anxiety and improving their science achievement. On the other hand, conventional questions appear to have a negative effect in terms of reducing test anxiety. Putsoa et al. (2003) showed that there was a statistically significant improvement in students' performance when they were given contextualized items. Similarly, Ahmed and Pollitt (2000) observed that context-based questions were favorable for high-performing students and also recognized the contribution of context-based questions in reducing students' test anxiety. The results of previous studies (Berk & Nanda, 2006; Erbe, 2007; Foster, Paulk, & Dastoor, 1999; Kondo, 1996; Noh et al., 2000; Serok, 1991; Stöber, 2004) indicate that various measures and strategies reduce test anxiety among students. However, these studies have not substantiated that context-based questions can reduce students' test anxiety and improve their science achievement. This research, however, has shown that context-based questions can reduce test anxiety and improve science achievement.

Conclusions

The results of this research showed that context-based questions are more effective (partial eta squared = .125) than conventional questions on the test anxiety and science achievements of secondary school students. But, context-based questions are not effective in relation to gender. The students' test reduced anxiety impairment, while conventional questions tended to increase it. Additional studies with treatments involving context-based questions to reduce students' test anxiety impairment need to be conducted to gain a deeper understanding of the value of context-based questions in reducing students' text anxiety. Based on the conclusion, this research lends a few recommendations as follows: This research was conducted on a sample of 70 lower secondary school students. Further research on this problem could be done on a larger sample to determine the validity of the findings of the present research. Additionally, research should be conducted with high school and university students, as well as the use of a larger sample. The present research was limited to the comparison of male and female students in government school. Furthermore, the present research was limited to the science achievement of secondary school students.

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Journal of Baltic Science Education, Vol. 15, No. 3, 2016

ISSN 1648–3898
CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND
SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS
(P. 382-390)

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389

Journal of Baltic Science Education, Vol. 15, No. 3, 2016

ISSN 1648–3898

CONTEXT-BASED QUESTIONS IN SCIENCE EDUCATION: THEIR EFFECTS ON TEST ANXIETY AND
SCIENCE ACHIEVEMENT IN RELATION TO THE GENDER OF SECONDARY SCHOOL STUDENTS
(P. 382-390)

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