

*Full Length Research Paper*

# Evaluating high school students' anxiety and self-efficacy towards biology

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**Anxiety and self-efficacy are among the factors that impact students' performance in biology. The current study aims to investigate high school students' perception of biology anxiety and self-efficacy, in relation to gender, grade level, interest in biology, negative experience associated with biology classes, and teachers' approaches in the class. The research was designed as a survey model. The study group consisted of 160 students in 9<sup>th</sup>, 10<sup>th</sup>, and 11<sup>th</sup> grades at 4 different high schools in Ankara during 2014 Spring Semester. Biology Anxiety Scale and Biology Self-Efficacy Perception Scale, both developed by the researchers, were used as data collection tools. Data were analyzed through t test, ANOVA, and Pearson Correlation in SPSS software package. The research results show that interest in biology and negative past experience were significant predictors of students' biology anxiety and that students' biology self-efficacy percepts significantly differed on gender, grade level, interest in biology, past experiences, and teachers' approaches in the classes. Considering the relationship between anxiety and self-efficacy, activities must be organized at schools in order to reduce students' biology anxieties.**

**Key words:** High school students, biology subject, perception, anxiety, self-efficacy.

## INTRODUCTION

Biology, an important branch within science, is among the basic courses in secondary education curricula. Biology, whose general content is about recognition of living things by all their characteristics, is a subject with a wide coverage. It is important to discover factors affecting the learning of biology, for increasing efficiency in this course (Yüksel, 2004). Increased interest in the biology science today provided increased importance for biology classes at schools (Kelerman, 1995). Developments in science impact people's lives through many fields, such as medi-

cine, defense industry, and agriculture (Kutlu, 2010). The relationship between biology and the daily life will reveal the necessity of biology education (Kılıç, 2004).

Anxiety is described as subjective feelings associated with worries, nervousness, and tension (Spielberger, 1976, p. 5). Anxiety is a complex psychology term including many variables. Simply put, anxiety is the feeling of worries along with increased vigilance, increased sympathetic nervous system, and difficulty in concentrating (Kelly, 2002). Anxiety is the state of

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alertness brought up with feelings of tension, fear, and worries that people show when they consider themselves threatened (Spielberg and Gorsuch, 1970).

Increased anxiety levels invite the individual to retreat to flatter and simpler behaviors; to have anxiety; and to be over-focused on pleasing others. However, mid-level anxiety stimulates and protects the organism and provides motivation. When managed well, anxiety helps the individual to work more to be successful and to take measures against the unfavorable (Akgun et al., 2007).

A literature review showed many studies investigating anxiety on demographic variables such as gender and age. Mousavi et al. (2008) investigated the effect of gender on test anxiety. Zanakis and Valenzi (2010) studied the effect of grade level on anxiety. Torkzadeh and Dyke (2002) examined the relationship between computer self-efficacy and computer anxiety. Nomura et al. (2008) evaluated the relationship between attitude and anxiety. Muris (2002) investigated the relationship between students' learning experiences and their anxieties.

Self-efficacy, on the other hand, is one of the basic concepts of social learning theory. Self-efficacy belief is described as "individual's judgment on whether s/he has the skills to complete a task" (Bandura, 1986). In other words, it is individual's own opinion about whether s/he can achieve. Efficacy beliefs consist of two different structures such as self-efficacy and expectation to get results. Self-efficacy belief is about individual skills impacting tasks and the expectation to get results is about the belief that certain actions will result in certain way (Gibson and Dembo, 1984).

It is known that self-efficacy beliefs have four basic sources. These are successful experiences, indirect experiences, oral persuasion, and individual's physical and affective status (Bandura, 1986). Self-efficacy beliefs impact people's targets set for themselves, how strong their efforts are in reaching those targets, how long they can face the challenges in reaching their targets, and their reaction to failure (Bikmaz, 2004). High-level self-efficacy belief positively impacts the individual's later behaviors. An important factor for individuals to affect motivation and behaviors is the increase in individuals' confidence about their own capacity (Tschannen-Moran et al., 1998).

According to Schunk (1990), self-efficacy belief is the most important predictor of human behaviors. When individuals believe that they have the skills and the power of control to complete a task, they will be more eager to prefer this task, voice their decision, and exhibit the required behaviors (Gibson and Dembo, 1984; Sharp, 2002). Zimmerman (2000) states that self-efficacy belief is responsive to subtle changes in the context of students' performance; to interaction with personally-regulated learning methods; and to paving way to students' academic achievement. In other words, changes in performance affect learning methods,

academic achievement, and self-efficacy belief.

Individuals with high levels of self-efficacy may be more comfortable and efficient when facing tasks with high-level difficulties. On the other hand, individuals with low levels of self-efficacy believe that the tasks to be completed were harder than they actually are. Such belief increases anxiety and stress and limits the view that an individual requires in order to solve a problem. Therefore, self-efficacy belief strongly impacts individuals' achievement levels (Pajares, 2002).

A review of literature reveals some case studies that investigated the relationship between the self-efficacy perception and the demographic variables such as gender, grade level, and age (Wilson et al., 2007; Marlino and Wilson, 2003; Torkzadeh and Dyke, 2002).

It is observed in the literature that research on the effect of self-efficacy and anxiety on students' performance includes studies on general self-efficacy and anxiety (Muris, 2002; Wang and Liu, 2000; Haycock et al., 1998), the issues in the mathematics education (Bursal and Paznokas, 2006; Ertekin et al., 2009; Swars et al., 2006) and in the computer education (Sam et al., 2005; Mueller et al. 2008; Durndell and Haag, 2002), and the test anxiety and self-efficacy (Pajares and Schunk, 2001).

## Purpose

When the related literature is reviewed, it is observed that there are not enough studies on anxiety towards biology and biology self-efficacy. Thus, the current research aims to investigate high school students' levels of anxiety and self-efficacy beliefs towards biology. The following questions were put forward for the purposes of the current study:

1. Do high school students' levels of anxiety towards biology significantly differ on gender, grade level, biology achievement grade, interest in biology, teachers' interest in students, students' past negative experiences with biology, and teachers' approaches in the classes?
2. Do high school students' self-efficacy percepts significantly differ on gender, grade level, biology achievement grade, interest in biology, teachers' interest in students, students' past negative experiences with biology, and teachers' approaches in the classes?
3. Is there a significant relationship between students' biology anxiety and their percepts of self-efficacy?

## METHODS

### Research model

The current study was designed as the survey model. Survey models are appropriate for studies aiming to describe a past or present case as it was or is (Karasar, 1999).

**Table 1.** Descriptive information of the sample.

| Variable                              | Frequency (f) | Percentage (%) |
|---------------------------------------|---------------|----------------|
| Gender                                |               |                |
| Female                                | 86            | 54             |
| Male                                  | 74            | 46             |
| Grade level                           |               |                |
| 9                                     | 52            | 33             |
| 10                                    | 48            | 30             |
| 11                                    | 60            | 37             |
| Past negative experience with biology |               |                |
| Yes                                   | 95            | 59             |
| No                                    | 64            | 41             |
| Teacher's approach                    |               |                |
| Appreciating                          | 74            | 46             |
| Disorderly                            | 20            | 13             |
| Authoritarian                         | 47            | 29             |
| Indifferent                           | 19            | 12             |

### Sample

Purposeful sampling was used in the current research. This sampling method consists of a typical phenomenon from among many, associated with the research problem, in the population (Büyüköztürk, 2012). Therefore, four schools to represent the population were selected in Ankara. In the current research, the study group consisted of 160 students that attended four high schools in Ankara during 2013-2014 academic years. Demographic information on students is presented in Table 1.

A review of Table 1 reveals that 54% of the students participating were females; 46% were males; 33% of the students participating were in 9<sup>th</sup> grade; 30% in 10<sup>th</sup>; and 37% were in 11<sup>th</sup> grade; 59% had a past negative experience with biology; 41% did not have such experience; 46% had an appreciating biology teacher; 13% had a disorderly teacher; 29% had an authoritarian teacher; and 12% had an indifferent teacher.

### Data collection tools

Personal information form, Biology Anxiety Scale, and Biology Self-Efficacy Percept Scale were used as data collection tools in the current research.

Personal data form was prepared in order to reveal demographic information on the participant students. The form included sections such as gender, grade level, biology achievement grade, interest in biology, teachers' interest in students, students' negative experiences of biology such as failures or students unable to respond to teacher's questions in the class, and teachers' approaches in the classes.

In the process of creating the Biology Anxiety Scale, first of all, the related literature was reviewed (Aydın, 2013; Petridou and Williams, 2007; Duman, 2008; Selkirt, Bouchey and Eccles, 2011) and an item pool was formed by selecting items thought to be relevant. Later, a group of 30 students were asked open-ended questions. Student responses were content-analyzed and the items picked were included in the item pool. Draft Biology Anxiety Scale was created by selecting items from the pool, with an expert. Draft scale included 25 items. The draft scale was analyzed in terms of validity and reliability upon administration with study group. The scale was finalized after validity and reliability analyses.

Biology Anxiety Scale with single factor consisted of 14 items. It is a 5-point Likert scale with options such as *Strongly Disagree*, *Disagree*, *Neutral*, *Agree*, and *Strongly Agree*. The scale had a KMO value of .80;  $p < 0.00$  and Cronbach's alpha was found to be .86.

In the process of creating the Biology Self-Efficacy Scale, first of all, the related literature was reviewed (Köksal and Taşdelen, 2008; Ekici, 2008; Akkoyunlu and Kurbanoglu, 2003; Bıkmaz, 2004; Yılmaz et al., 2006) and an item pool was formed by selecting items thought to be relevant. Later, a group of 30 students were asked open-ended questions. Draft Biology Self-Efficacy Scale was created by selecting items from the pool, with an expert. The created draft scale included 26 items. The draft scale was analyzed in terms of validity and reliability upon administration with study group. The scale was finalized after validity and reliability analyses.

Biology Self-Efficacy Percept Scale with single factor consisted of 13 items. It is a 5-point Likert scale with options such as *Strongly Disagree*, *Disagree*, *Neutral*, *Agree*, and *Strongly Agree*. The scale had a KMO value of .91;  $p < 0.00$  and Cronbach's alpha was found to be .93.

When data obtained through Biology Anxiety Scale was examined, each item was assigned points from 1 to 5. The lowest possible score on the scale was 14 and the highest possible score was 70. Scores examined show that anxiety level increases from 14 to 70.

When data obtained through Biology Self-Efficacy Percept Scale was examined, each item was assigned points from 1 to 5. The lowest possible score on the scale was 13 and the highest possible score was 65. Scores examined show that anxiety level increases from 13 to 65.

### Data analysis

Data obtained in the research were analyzed through SPSS 20 software. For anxiety and self-efficacy scores, t test was used in order to find differences on negative experience associated with biology; ANOVA test was used in order to find differences on grade level, level of interest in biology, and level of biology knowledge; and Pearson correlation was used in order to define the relationship between anxiety and self-efficacy scores.

**Table 2.** Information on high school students' biology anxiety and self-efficacy scores.

|               | N   | Minimum | Maximum | $\bar{X}$ | SS    |
|---------------|-----|---------|---------|-----------|-------|
| Anxiety       | 160 | 14,00   | 55,00   | 25,31     | 9,08  |
| Self-Efficacy | 160 | 13,00   | 65,00   | 44,46     | 11,16 |

**Table 3.** Anxiety and self-efficacy scores t test results.

|               |                  |        | N  | $\bar{X}$ | SS    | df  | t     | p     |
|---------------|------------------|--------|----|-----------|-------|-----|-------|-------|
| Self-efficacy | Gender           | Female | 86 | 47,81     | 9,85  | 158 | 2,753 | 0,02* |
|               |                  | Male   | 74 | 41,82     | 10,20 |     |       |       |
| Anxiety       | Past experiences | Yes    | 95 | 27,50     | 8,99  | 157 | 3,674 | 0,00* |
|               |                  | No     | 64 | 20,85     | 7,63  |     |       |       |
| Self efficacy | Past experiences | Yes    | 95 | 42,36     | 11,78 | 157 | 2,939 | 0,00* |
|               |                  | No     | 64 | 49,00     | 8,03  |     |       |       |

## FINDINGS

This section presents the findings obtained from students' responses. Table 2 indicates that high school students' average anxiety score was  $\bar{X}=25.31$ . This finding shows that students' anxiety towards biology was low-level. Students' self-efficacy average score was  $\bar{X}=44.46$ . This finding indicates that high school students' self-efficacy percept was between mid and high levels.

A review of Table 3 shows female students' average self-efficacy scores as  $\bar{X}=47.81$  and male students' average scores as  $\bar{X}=41.82$ . T test scores indicate that female students' self-efficacy beliefs toward biology significantly differ from those of male students ( $t(160)=2.753$ ;  $p<0.05$ ). Anxiety towards biology score of those with negative past experiences with biology was  $\bar{X}=27.50$  and that of those with no negative past experiences with biology was  $\bar{X}=20.85$ . A review of t test results indicate that anxiety towards biology of students with negative past experiences with biology significantly differs from that of students with no negative past experiences ( $t(157)=3.674$ ;  $p<0.05$ ). Average self-efficacy scores of students with negative past experiences with biology was  $\bar{X}=42.86$  and that of students with no negative past experiences with biology  $\bar{X}=49.00$ . T test results show that self-efficacy scores of students with no negative past experiences with biology was significantly higher than that of students with negative past experiences with biology ( $t(157)=2.934$ ;  $p<0.05$ ).

In Table 4, high school students' biology self-efficacy percepts significantly differed on grade level ( $F_{(2-157)}=4,166$ ;  $p<0,05$ ). Scheffe results indicate that the difference between self-efficacy scores was in favor of 9<sup>th</sup> and 11<sup>th</sup> grades. And their scores of self-efficacy percepts

significantly differed ( $F_{(3-156)}=6,381$ ;  $p<0,05$ ). Scheffe results showed that the difference in self-efficacy scores was between students with low biology achievement and students with high and very high biology achievement. Table 4 shows that high school students' biology anxiety and biology self-efficacy scores significantly differed on the interest in biology ( $F_{\text{anxiety}(4-155)}=4,846$ ;  $p<0,05$ ;  $F_{\text{self-efficacy}(4-155)}=4,945$ ;  $p<0,05$ ). According to Scheffe results, the difference in anxiety scores is found between students with low interest in biology and students with mid, high, and very-high level interest in biology. Their biology self-efficacy percepts significantly differed on teachers' approaches in class ( $F_{(3-156)}=4,580$ ;  $p<0,05$ ). According to Scheffe results, the difference in self-efficacy scores was in favor of students with teachers having appreciating approaches between students with teachers having appreciating approaches and students with teachers having disorderly approaches.

A review of Table 5 shows that there was a mid-level negative relationship between students' anxiety scores and self-efficacy scores ( $r=-0,335$ ;  $p<0.05$ ). In other words, it may be said that as students' anxiety levels increase their biology self-efficacy percepts will decrease.

## DISCUSSION

The results of the current research showed that high school students' biology anxiety levels were low and their biology self-efficacy percept levels were between mid and high levels.

It was found that, grade level significantly predicted the biology self-efficacy. Pajares (2002) pointed out that self-efficacy percept differed on grade level. However, Kahyaoglu and Yangin (2007) defined that high school

**Table 4.** Anxiety and self-efficacy scores ANOVA results.

| Score         | Group              |                | Sum of squares | df  | Mean square | F     | p     | Scheffe  |
|---------------|--------------------|----------------|----------------|-----|-------------|-------|-------|--|
| Self-efficacy | Grade              | Between Groups | 965,801        | 2   | 482,901     | 4,116 | ,019* | 9-11   |
|               |                    | Within Groups  | 11379,039      | 157 | 117,310     |       |       |  |
|               |                    | Total          | 12344,840      | 159 |             |       |       |  |
| Self efficacy | Achievement        | Between Groups | 1953,527       | 3   | 651,176     | 6,381 | ,01   | Low-high,<br>Low -very high                          |
|               |                    | Within Groups  | 8572,791       | 156 | 102,057     |       |       |  |
|               |                    | Total          | 10526,318      | 159 |             |       |       |  |
| Anxiety       | Interest           | Between Groups | 1351,773       | 4   | 337,943     | 4,846 | ,001* | Very low-mid<br>Very low- high<br>Very low-very high |
|               |                    | Within Groups  | 6346,185       | 155 | 69,738      |       |       |  |
|               |                    | Total          | 7697,958       | 159 |             |       |       |  |
| Self efficacy | Interest           | Between Groups | 4673,568       | 4   | 1168,392    | 4,945 | ,000* | Very low-Very<br>high                                |
|               |                    | Within Groups  | 7256,390       | 155 | 79,741      |       |       |  |
|               |                    | Total          | 11929,958      | 159 |             |       |       |  |
| Self efficacy | Teachers' approach | Between Groups | 1525,352       | 3   | 508,451     | 4,580 | ,005* | Disorderly-<br>appreciating                          |
|               |                    | Within Groups  | 10324,833      | 156 | 111,020     |       |       |  |
|               |                    | Total          | 11850,186      | 159 |             |       |       |  |

**Table 5.** Pearson correlation results of high school students' biology anxiety and self-efficacy.

|               |   | Anxiety | Self-efficacy |
|---------------|---|---------|---------------|
| Anxiety       | r | 1       | -,355**       |
|               | p |         | ,000*         |
|               | N | 160     | 100           |
| Self-efficacy | r | -,355** | 1             |
|               | p | ,000*   |               |
|               | N | 160     | 100           |

\*p&lt;0.05.

students' self-efficacy did not differ on grade level. Biology self-efficacy results indicate that biology self-efficacy percept significantly differed on gender and female students had higher biology self-efficacy percepts than male students had. This result is in parallel with Wilson et al. (2007) and Marlino and Wilson's (2003) research results. However, Yaman et al. (2003) showed in their research that grade level was not significant in determining self-efficacy.

It was found that students' biology anxiety levels significantly differed on their interest in biology. Biology anxiety levels of students with low interest in biology were significantly higher than those of students with higher levels of interest in biology. It was observed that students who liked biology as a subject had less biology anxiety. This result shows that interest in biology is an important predictor of biology anxiety. Zanakis and Valenzi (2010)

stated in their study that participants with interest in statistics had low statistics anxiety. When the self-efficacy percepts are examined, it is observed that students' self-efficacy percepts significantly differed on interest in biology and students with higher interest in biology had higher levels of self-efficacy percepts than students with lower interest in biology. Torkzade and Van Dyke (2002) in their research defined a positive relationship between computer attitude and self-efficacy. These results show that students' interest in biology is among important factors that impact their biology anxiety and self-efficacy percepts.

Experience with a subject is among the elements affecting students' performance in that subject. Significant differences in biology anxiety and self-efficacy percepts of students, who had negative experience with biology in the past, were pointed out. It was found that biology anxiety in students with past negative experience with biology was higher than that in students without a past negative experience. Bekdemir (2010) found in his/her research that the unfavorable experiences in the class increased students' mathematics anxiety. In addition, students with negative experiences with biology had lower levels of self-efficacy than students without those. Bandura (1986) stated that one basic source of self-efficacy beliefs was experience. It may be said, in other words, that past negative experiences increased students' anxiety and decreased their self-efficacy in a subject. Brinkerhoff (2006) in a study found that experience was a significant predictor of self-efficacy.

Biology self-efficacy of students with higher biology knowledge levels was found to be higher than that of students with lower biology knowledge levels. Based on this, it may be said that knowledge level is a significant

variable in determining students' self-efficacies. Tenaw (2013) in a study defined a mid-level relationship between self-efficacy and achievement scores. However, Valentine et al. (2004) emphasized that the relationship between self-efficacy and achievement cannot be generalized to every country.

The results associated with self-efficacy showed that students' self-efficacy significantly differed on teachers' approaches in class. It was found that self-efficacy percepts by students with appreciating-approach teachers were higher than those in students with disorderly-approach teachers. This result indicates that teachers' approaches towards students in class had an important role in students' formation of self-efficacy percepts. Studies conducted emphasize that self-efficacy is associated with teachers' approaches and skills used in class management (Ekici 2008; Henson, 2001; Savran and Çakıroğlu, 2001).

A mid-level, negative relationship was found between high school students' biology anxiety and self-efficacy percepts. This result may indicate that increasing levels of biology anxiety in students will decrease their self-efficacy percepts. Fagan et al. (2003) found a negative relationship between students' computer self-efficacy and their anxiety. Yıldırım (2011) in a study found that increase in students' anxieties reduced their self-efficacy beliefs.

## CONCLUSION and RECOMMENDATIONS

In conclusion, biology anxiety and self-efficacy percepts are among significant factors impacting students' biology performance. The current study found that interest in biology and past negative experiences with biology were significant predictors of students' biology anxiety and gender, grade level, interest in biology, past negative experiences, and teachers' approaches in class were significant predictors of students' biology self-efficacy percepts.

The following suggestions are put forward in consistence with the study results:

Considering that students with higher interest levels in biology have lower biology anxiety levels, teachers must conduct activities to raise students' interest in biology.

One of the results obtained in the current research is that anxiety levels of students with past negative experiences with biology were higher and their self-efficacy percepts were low. Therefore, learning environments must be organized to motivate students for achievement.

The negative relationship between biology anxiety and self-efficacy requires activities to eliminate the anxiety in students.

Considering the teachers' approaches in class significantly impacting students' self-efficacy percepts, teachers must have encouraging approaches in class.

## Conflict of Interests

The author(s) have not declared any conflict of interests.

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