

Vocational High School Students' Sense of Self-Efficacy and Test Anxiety Regarding Biology Learning

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Abstract

Self-regulation perspective on motivation provides an important model to study on motivation in biology education. Motivational part of the Pintrich's model as one of the most studied models has self-efficacy and test-anxiety factors as two dominant factors reflecting positive and negative sides of the model in terms of number of relationship with other factors in the model. In the study, two hundred thirteen vocational high school students were included and survey technique was used for examining the factors across grade level in the study. Two subscales of MSLQ were applied to collect data. The data was analyzed by using MANOVA and Pearson-product moment correlation via SPSS 13. The results showed self-efficacy and test anxiety scores differed significantly between ninth and tenth graders. Again, they were correlated negatively at the same levels.

Keywords: *Self-efficacy, test anxiety, biology learning, vocational high school*

INTRODUCTION

Biology as a science has been providing many important innovations for our lives by studies in its basic disciplines; genetics, biotechnology, physiology, ecology, molecular biology, microbiology and biochemistry. Although the disciplines of biology provided many benefits for our daily lives (cloning, gene transfer, prevention of microbial diseases, proteomics etc.), they also caused some discussions on the issues such as ethical problems and side effects of genetic engineering products. With pros and cons, learning biology for daily life became a need in today's world. Although learning biology begins at elementary grades, it begins to occur in high school years under the title of biology for the first time. High school biology lessons are the most important contexts for learning biology. Biology learning in high school includes many factors which are determinants of quality for learning. These can be classified as affective and cognitive factors. For the cognitive domain; reasoning ability, information processing and academic achievement are among the most studied constructs (Lawson, 2006; Lawson, Banks & Logvin, 2007; Schunk, 2000; Yumuşak, Sungur & Çakıroğlu, 2007, Köksal & Yel, 2007) whereas attitude, self-efficacy, anxiety and motivation are among the most frequently emphasized factors of the affective domain in the science and biology education literature (Osborne, Simon & Collins, 2003; Ekici, 2005; Savran & Çakıroğlu, 2001; Baldwin, Ebert-May & Burns, 1999; Mallow, 2006; Yumuşak, Sungur & Çakıroğlu, 2007; Glynn & Koballa, 2006).

As an affective factor, giving more importance on motivation over the other affective factors in science education was suggested by some researchers (Osborne, Simon & Collins, 2003). In general, motivational factors have been studied as separate constructs. But, more integrationist and holistic models are required to explain them together in one explanatory model. Self-regulation models for motivation are strong models including motivational factors and cognitive variables together in an integrationist and holistic frame. These models try to explain motivation in the process of self-regulation which is very important for gaining, using and constructing knowledge for daily life situations (Zimmerman, 2005; Pintrich, 2005, Winne, 2001). By considering the importance of motivational factors in learning biology for daily life on the other affective and cognitive factors, it might be said that motivational model studies from self-regulated learning perspective might fill in the gap between affective and cognitive factors in learning biology.

Motivation in self-regulation frame might be defined as the process which instigates and sustains a goal directed activity by coordinating its subcomponents including self-efficacy, task value, intrinsic motivation, anxiety etc. (Pintrich & Schunk, 2002). There are many models for explaining motivation from self-regulation perspective (Zimmerman, 2005; Pintrich, 2005, Winne, 2001, Zeidner, 1998). But the self-regulated learning model of Pintrich as one of the most studied model has importance since the model is an eclectic model combining findings of previous studies on self-regulation. The model that accepts one individual as an active and rational decision maker might be a good reflective model for explaining motivational situations of individuals who have been gaining, using and constructing knowledge for their daily lives (Pintrich, 2005). The Pintrich's model of self-regulated learning includes more comprehensive components of learning and combines previous self-regulation models' effective and powerful parts in more meaningful way. In the model, there are two components as motivational and cognitive factors for explaining self-regulated learning. Among the motivational components, self-efficacy and test-anxiety are the most important ones due to the fact that they represent dominant positive and negative sides of motivational situation in the model. Dominance of them on the other motivational and cognitive components in terms of number of correlations with other factors was shown by many studies (Pintrich & De Groot, 1990; Yumuşak, Sungur & Çakıroğlu, 2007). Correlational dominance means number of significant correlation coefficients of one factor with other factors in the model. In the correlation studies, self-efficacy component of the model was showed to be positively correlated with the other important motivational constructs such as intrinsic motivation, extrinsic motivation, task value, control of learning beliefs and cognitive constructs such as academic achievement and cognitive strategy use (Pintrich, 1999; Pintrich & De Groot, 1990, Douglas, 2006, Yumuşak, Sungur & Çakıroğlu, 2007; Bong, 2001, Kan & Akbaş, 2006). The evidence related to correlations found in these studies has been supporting the importance of "self-efficacy" component of the model for motivational forces which can initiate and provide action on task. Some of these studies approved that test-anxiety was shown to be the other important component which was negatively correlated with majority of the other motivational factors and cognitive components (Pintrich & De Groot, 1990; Yumuşak, Sungur & Çakıroğlu, 2007). The effects of test anxiety and self-

efficacy on academic performance were emphasized in many studies (Pajares & Schunk, 2001; Hill & Wigfield, 1984; Hembree, 1988). Although their importance for vocational high school students was emphasized, the majority of studies were made on the traditional students. In the national and international literature, there was no enough specific study on self-efficacy and test-anxiety in the context of biology learning for vocational education by considering them as the dominant positive and negative motivation factors. Again, vocational high schools have importance over the other type of high schools due to their gender homogeneity in Turkey. Insufficient studies on the problem drive the attention to study on self-efficacy and test anxiety across some basic variables such as grade level as a beginning point for further studies.

Considering lack of studies on and importance of the variables studied in this study, the aim of this study was determined as to investigate differences in “self-efficacy” and “test-anxiety” related to biology learning in vocational high school context across grade level. In the study, quantitative methodology, causal-comparative method and the survey technique for collecting data were used to conduct study.

METHOD

Participants

The study included 213 participants in three different grades of all departments in one vocational high school. The focus of the schools is to provide education on industrial competencies and jobs with the departments on leveling, wood technologies, informatics technology and installment. Participants' age range is from 14 to 18. Many of them come from low-income families with the rate of 72% that means majority of the participants gain 1000 TL and lower rates in a month. All of the participants are males and number of their brother and sisters ranges from 1 to 6. Another important thing about the participants is that the only ninth graders were enrolled in the biology courses whereas the others were enrolled in the specific field courses. The other descriptive values about participants can be seen in the following table.

Table 1
Demographics for the Participants

Values		f	%	Missing
Grade	Ninth	131	61,5	0
	Tenth	63	29,6	
	Eleventh	19	8,9	
Family Interest in Education	Every time	128	60,1	7
	Sometimes	57	26,8	
	Occasionally	13	6,1	
	None of time	8	3,8	
Having Relatives in the Field of Biology	Yes	21	9,9	12
	No	180	84,5	
Previous Participation to any extracurricular Biology Activities	Yes	24	11,3	7
	No	182	85,5	

Instruments

To collect data, two different scales for self-efficacy and test anxiety were used. The scales were subscales of the MSLQ (Motivated Strategies for Learning Questionnaire). Self-efficacy and test-anxiety subcomponents are found under the title of motivation as a component of the MSLQ. The MSLQ was translated and developed by Sungur (2004) in Turkey. The contemporary version of the MSLQ is a self-report instrument and has 81 items. The instrument is a seven point scale ranged from “not at all true of me” to “very true of me”. The author conducted the pilot study on 488 high school students from different types of schools. Of the students who responded to the demographic questions 58.1 % were males (n=254) whereas 41.9 % were females (n=183). Mean age for the students was 16.59. The author reported some fit indexes to each component of the questionnaire. The results found by Sungur (2004) can be seen in the Table 2.

Table 2
Fit indexes of the sub-scales of the questionnaire

Scale	χ^2/df	GFI	RMR
Motivation Scale	5.3	.77	.11
Learning Strategy Scale	4.5	.71	.08

The reliability coefficients of self-efficacy and test anxiety subscale of the questionnaire are .89 and .62. The author explained that the data on the questionnaire approved validity, reliability and usability of it for future use. In addition to the results of Sungur (2004)’s study, reliability and validity evidences were also gathered for the participant group of this study. For conducting the confirmatory factor analysis and calculating Cronbach alpha reliability coefficients, AMOS 7 and SPSS 13 programs were used. The results of the analyses are illustrated in the table 3.

Table 3
Fit Indexes of the Self-Efficacy and Test Anxiety Sub-scales of the Questionnaire for the Participants of This Study

Sub-scale	χ^2/df	GFI	RMR	CFI	RMSEA	Cronbach α
Self-efficacy	2.85	.94	.14	.95	.09	.90
Test anxiety	6.72	.94	.28	.89	.16	.76

The results on reliability and validity with the support of majority of the fit indices, when compared with the original values of Sungur (2004), approved that the scale is appropriate to use for the purpose of this study. As cited by Sungur (2004) from Pintrich, et al., (1991), although the goodness of fit indices are not excellent for whole scale, the model shows sound structures and one can reasonably claim factor validity for the sub-scales. Then, she continued that deployment of the various fit indices may differ depending upon teacher demands, course characteristics, and student characteristics.

With this idea in mind, usability, validity and reliability of the scales on self-efficacy and test anxiety were found appropriate to use in this study. The example items from the scales of self-efficacy and test anxiety in biology learning are “I feel strong beats of my heart in biology exams”, and “I am sure I can easily learn basic concepts of biology subjects”.

Procedure

The instruments were applied to the students by their teachers. Before the application, the teachers informed the students about the aim of the study and importance of willingness to participate in it. Convenience sampling was used for the study. The teachers stated that the data gathered will be secured and will not be used without their permission. So, the participation to the study was based on willingness. The application of the instruments was conducted in a week period in April, 2007-2008. The time for application lasted for 10 minutes in one session. The data gathered was recorded on SPSS 13 sheet and analyzed by using one-way MANOVA technique with one independent and two dependent variables and Pearson product-moment correlation. The predetermined values for errors and sample size of the study are .05 for alpha level, .80 for power and large effect for effect size. By using these values, it was found that the sample size for these values should be 66 per group and total number should be 198. Although size per group was not partially appropriate, the sample size of the study was found appropriate to go further with convenient sample due to the fact that total number of individuals in the sample was 213 (>198). The target population of the study was all students of vocational high schools in the city; Zonguldak, where the study was conducted while the accessible population was all students of the school.

FINDINGS & RESULTS

Descriptive Statistics

The number of participants and their mean scores on self-efficacy and test anxiety scales have been varying to some degree. The number of the participants for each grade level ranged from 19 to 131 and their mean scores for self efficacy ranged from 3.45 to 4.20 whereas mean scores of them for test anxiety ranged from 3.48 to 4.29. Descriptive values can be seen in table 4.

Table 4
The Mean, Standard Deviation and Frequency Values of the Participants

Dependent Variables	Groups	n	Mean	SD
Self-efficacy	9 th Grade	131	4,20	1,28
	10 th Grade	63	3,45	1,55
	11 th Grade	19	4,14	1,31
Test-anxiety	9 th Grade	131	3,48	1,43
	10 th Grade	63	4,29	1,54
	11 th Grade	19	3,86	1,22

Profile plots for the dependent variables across the groups can be seen in figure 1 and figure 2.

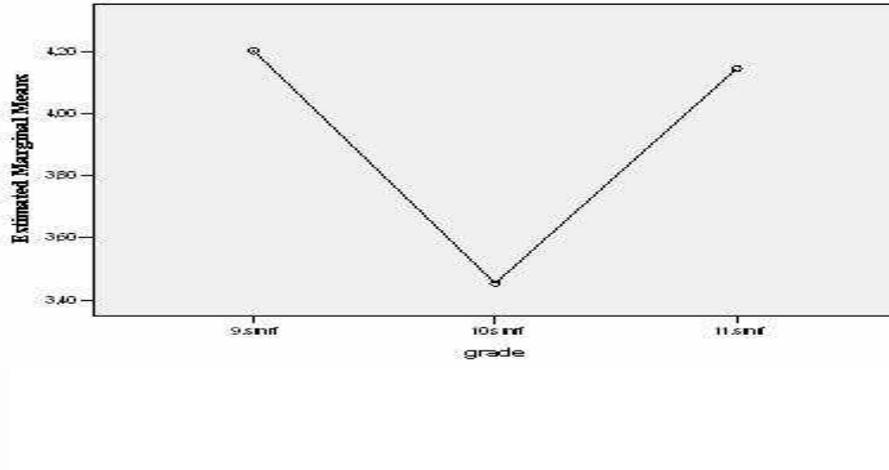


Figure 1. Profile plot for estimated marginal means of self-efficacy scores of the students

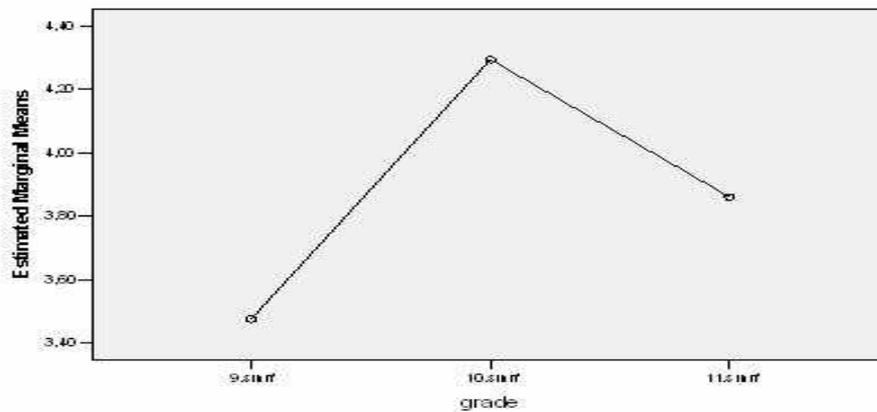


Figure 2. Profile plot for estimated marginal means of test anxiety scores of the students

After providing the assumptions for MANOVA, analysis of the data was conducted. MANOVA result is presented under this title. The study has been including

two dependent variables; self-efficacy and test anxiety levels and one independent variable as grade with its three levels.

When looked at the MANOVA results, it is seen that there are statistically significant differences between scores of the students on self-efficacy and test anxiety scales across grade levels (Wilks's $\Lambda = .91$, $F(2, 210) = 4.88$, $p < .05$). The partial η^2 value was moderately strong, .05. After that point, post-hoc test; Bonferroni, was used to conclude about grade levels that differed in terms of the variables. By considering Levene's test results, Bonferroni test was found to be appropriate for post-hoc comparison. Table 5 contains results of post-hoc test on the dependent variables for each group. The effect size values of the individual comparisons were computed by using the formula of " $d = t \sqrt{N_1 + N_2} / N_1 N_2$ " and interpreted by Cohen's criteria (Green & Salkind, 2002).

Table 5
Post hoc comparison of the students' scores on two dependent variables across grade levels

Dependent Variable	Paired Grades	Mean Difference	S.E.	<i>d</i>	<i>p</i>
Self-efficacy	9-10	.75	.21	.50	.00*
	9-11	.06	.34	.04	.99
	10-11	-.69	.36	.46	.17
Test-anxiety	9-10	-.81	.22	.51	.00*
	9-11	-.39	.35	.27	.83
	10-11	-.43	.38	.29	.76

Note: Level of significance for the study is .05

The results of the post hoc comparisons showed that there was a statistically significant difference between self-efficacy scores of the students in only two groups. It was found that the difference between the scores of ninth and tenth graders was statistically significant in favor of ninth graders and so ninth graders had more self-efficacious about biology learning than tenth graders with the moderate effect size ($MD = .75$, $p < .05$, $d = .50$). In terms of self-efficacy, there were no statistically significant differences between the other comparisons across groups.

By looking at the post-hoc test results for the test anxiety scores, it might be seen that similar results with the analysis of self-efficacy scores were found. There was statistically significant difference between scores of ninth and tenth graders in favor of ninth grade students ($MD = -.81$, $p < .05$, $d = .51$). According to the results, tenth graders were more test anxious in biology than ninth graders with the moderate effect size. When the other comparisons were considered, it was found that there were no statistically significant differences among the other group comparisons.

Results of Correlation Analysis

Changes in correlation coefficients between self-efficacy and test anxiety scores of the students across their grade level are presented under this title. The correlation coefficients and significance of them for all students and for different grades can be seen in table 6.

Table 6
Correlation analysis results for self-efficacy and test anxiety

Variable Pair	Grade level	r	p	N
Self-efficacy and Test anxiety	All of Grades	-.40	.00*	213
	Ninth	-.28	.00*	131
	Tenth	-.50	.00*	63
	Eleventh	-.39	.10	19

Note: Level of significance is .05 for the correlations

According to the result of correlation analysis, the relationship between scores on self-efficacy and test-anxiety was statistically significant with negative characteristic and the strongest for tenth graders ($r=-.50, p<.05$). Then, the relationship between scores on the dependent variables in ninth grade was the moderately strong ($r=-.28, p<.05$). The correlation coefficient found for eleventh grade students was not statistically significant.

CONCLUSIONS & DISCUSSIONS

The results of this study showed important differences in self-efficacy and test anxiety scores of the students about learning biology subjects. When taken into account all mean scores of the students in each grade level, it can easily be said that all the students feel themselves as self-efficacious on learning biology whereas they consider themselves as test anxious in evaluation situations of learning biology. When looked at the mean scores of the students in different grade levels, certain differences for the dependent variables across grade level can be seen. Self-efficacy scores of the ninth grade students were higher than tenth and eleventh grade students, but statistically significant difference existed only between the scores of ninth and tenth grade students on self-efficacy in favor of the ninth grade students. This result might be related to differences in experiences of the students in biology lessons. At the time of the study, ninth grade students have been experiencing biology subjects under the title of biology for the first time. Therefore, they did not see all processes such as all evaluation situations, all subjects of the biology and taking feedback about their situations in learning biology whereas tenth and eleventh grade students experienced all processes in biology lessons. The evidence on test anxiety scores of the students supported the idea of “experience differences” in evaluation of learning biology. According to the results on test anxiety, tenth and eleventh grade students experienced similar evaluation situations whereas ninth grade students did not experience same processes due to the lack of time to complete all processes of biology lesson at the time of the study. Again,

non-significant result for the difference of scores on self-efficacy between tenth and eleventh grade is another evidence for similarity in experiences. It is more correct to say that tenth and eleventh grade students had similar experiences for learning biology subjects and in evaluation for learning biology. They did not take any course on biology after ninth grade while ninth grade students were in the process of biology lessons.

As the other variable of the study, test anxiety scores of the students in different grades also differed significantly between ninth and tenth grade students in favor of ninth grade students. The lowest level for test anxiety was found for ninth grade students in contrary to the result for self-efficacy. In the literature, there is a study which does not have consistent result with this study. In the study cited by Hembree (1988) from Sarason, Davidson, Lighthall, Waite and Ruebush (1960), it was found that test anxiety increased during early school year, then it reached the top point at the grade 5 and remained the same during high school level, after the high school, small decline was seen at the level of college. For the vocational high school students, test anxiety levels for evaluation of biology learning did not remain the same during high school years and presented differences across grade level. The inconsistency might be related to consideration of traditional high school students in the study rather than vocational high school students. The difference between ninth and tenth grade students might be related to self-efficacy levels of them for learning biology. As shown in this study, literature also stated that test anxiety and self-efficacy are negatively correlated factors of the motivation (Pintrich & De Groot, 1990; Yumuşak, Sungur & Çakıroğlu, 2007). The students who feel about themselves as inefficient to learn biology may develop anxiety about evaluation processes in biology lessons by considering its negative results coming from the inefficiency. As another explanation, lack of experience on evaluation in biology lessons in ninth grade during the study might be a reason for lower test anxiety level of ninth grade students since they did not experience all testing and evaluation process in biology learning. However, tenth and eleventh grade students experienced all testing and evaluation process in biology lessons as differently from ninth grade students. Again, non-significant difference between tenth and eleventh grade students might be a sign for similar experiences, because both of the groups did not take any course on biology after ninth grade.

This study is a causal-comparative study, so it does not have any explanatory power for cause-effect relationship between self-efficacy and test anxiety. With this characteristic of the study in mind, there is a need for conducting path analysis studies on the same type of the population to show causal link and direction of the link between the variables. Focusing on self-efficacy and test anxiety, other motivational factors such as values, expectancies and attributions should also be examined by using path analysis to construct explanatory model for vocational students. What is more, the results of the study are limited to the 213 participants and to the instruments used. Lack of random selection is another limitation of the study. With these limitations in mind, the study might provide important data to study interaction of the dependent variables of the study and lower achievement scores of vocational high school students. In addition, the results might give a frame for motivational differences among the students for biology learning

in such contexts. The variables considered in this study might provide a deeper understanding on the related cognitive outcomes.

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