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Exploring the Sources of Turkish High School Students Chemistry Laboratory Self-Efficacy Beliefs and Motivations

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Abstract: Self-efficacy is a belief of individuals about their abilities to successfully complete an action. Self-efficacy is defined as the judgments of individuals about themselves on how successful they will be in dealing with difficult situations they may encounter. Self-efficacy beliefs are related to individual judgments about how well the necessary actions can be performed to handle possible situations. These beliefs affect the choice of activities an individual wants to do, the level of the efforts and the performance. Learners with strong self-efficacy beliefs aim at new tasks, show stability in these tasks and achieve ultimate success. This kind of learners' trust in their abilities when they confront with problems and motivate themselves. Motivation is necessary for individuals to act as cognitively. Therefore, it is very important for teachers knowing in advance of their students' motivation degree and self-efficacy beliefs. In this research it is aimed that the analysis of the relation between self-efficacy beliefs and motivation variables which are highly effective on learning. For numerical analysis we studied 652 high school students in Turkey. The data is collected with chemistry laboratory self-efficacy beliefs scale and chemistry motivation scale. The correlation between the variables are examined using Structural Equation Modeling (SEM). With this study we conclude that there is a positive and significant correlation between chemistry laboratory self-efficacy beliefs and chemistry motivation. This result can be interpreted that the person with high chemistry laboratory self-efficacy has high chemistry motivation.

Keywords: Structural equation modeling, Multivariate analysis

Introduction

Self-efficacy is described as the beliefs of individuals about their abilities to successfully complete an action. It is a part of social cognitive theory. Self-efficacy implies that individuals generally believe in doing actions, which they can successfully complete and they do not try the things that they think they will not achieve (Bandura, 1994). Self-efficacy beliefs of an individual determine his or her feelings, thoughts, behaviors and motivation strategies. According to Bandura, self-efficacy is highly important for the emergence of individuals' behaviors and the formation of new behaviors. People with strong self-efficacy beliefs can even complete difficult tasks easily. These people see challenges to be mastered, rather than threats to be avoided (Bandura, 1994). It is stated that people with a strong sense of self-efficacy maintain strong efforts to achieve the goals and they are persistent and patient (Aşkar & Umay, 2001). It is possible to remark that self-efficacy is related to the situations such as previous experiences, indirect experiences and positive feedbacks (Yıldırım & İlhan, 2010). Learners with strong self-efficacy beliefs aim at new tasks, show stability in these tasks and achieve ultimate success (Britner, 2008; Zeldin & Pajares, 2000). Self-efficacy beliefs are multidimensional and associated with various areas. For example, self-efficacy beliefs with achievement, attitude, motivation or anxiety.

Motivation has a structure which comprises; internal forces, permanent traits, reactionary behaviour against stimuli, faith and influences. Motivation contains belief, internal forces, and reactive behavior against stimuli. Motivation is necessary for individuals to act as cognitively. Therefore it is very important for teachers knowing in advance of their students' motivation degree. If the teachers know the reason of their students' low motivation or self-efficacy beliefs to lessons, they can improve them of their students.

This study is important in terms of examining cause-effect relationship between chemistry laboratory self-efficacy beliefs and chemistry motivation. The aim of this study is that determine the relationship between chemistry laboratory self-efficacy beliefs and chemistry motivation with structural equation modelling. This research will contribute to the determination of the relationship between self-efficacy beliefs and motivation which are the affective variables in learning and in the view of this result it helps to the restructuring of learning environments that supply student's emotional needs.

Method

In this study relational screening models is used. These models are studies in which relationships between two or more variables are described and analyzed in depth (Karakaya, 2011). For this purpose, structural equation model is used to determine the relationship between chemistry motivation and chemistry lab concerns. SEM includes specific multivariate procedures such as factor analysis, correlation analysis and discriminant analysis and is very useful for statistical analysis. In the correlation analysis, only the interchanges of variables are examined. In this study latent variables are used with SEM. SEM allows for the simultaneous analysis of the direct and indirect effects between observable and non-observable variables and allows linear relationships between variables to be computed correctly (Bayram, 2011; Seçer, 2015).

Sampling

The sample group of the study consists of 652 high school students in Turkey. 55.5% of the students were female, 44.5% were male.

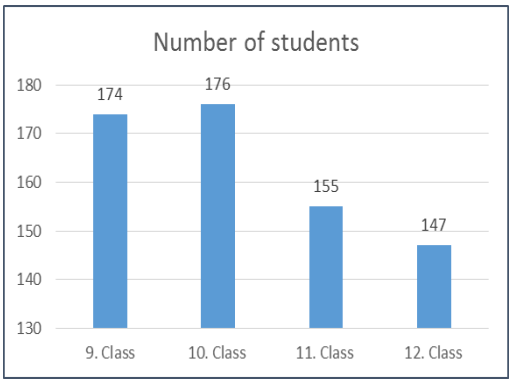

Figure 1. Distribution of sample groups by classes

Data Collection Tools

Chemistry Laboratory Self-Efficacy Beliefs Scale

The self-efficacy beliefs of high school students' towards chemistry laboratory were determined by the "Chemistry Laboratory Self-Efficacy Beliefs Scale" developed by Alkan (2016). The scale consisted of 14 statements in a 5-point Likert Type. The scale had two sub-dimensions named psychomotor self-efficacy and cognitive self-efficacy. The Cronbach Alpha reliability coefficicent of the whole scale 0.885. The Cronbach Alpha reliability coefficient of the psychomotor self-efficacy beliefs sub-dimension was 0.82 and cognitive self-efficacy beliefs sub-dimension was 0.82. The Cronbach's alpha reliability coefficient obtained from sample data's is 0.88.

Chemistry Motivation Scale

Chemistry motivation scale were developed by Glynn, Brickman, Armstrong and Taasoobshirazi (2011) and adapted to the Turkish by Tosun (2013). The motivation scale consisted of 19 statements in a 5-point Likert Type. Scale consists of career motivation, self-efficacy, grade motivation, self-determination, instrinsic motivation as named five sub-dimensions. The Cronbach Alpha reliability coefficicent of the whole scale 0.84. The Cronbach's alpha reliability coefficient obtained from sample data's is 0.89.

Data Analysis

In the analysis SPSS 15 and LISREL 8.7 programmes are used. Descriptive statistics and correlations were calculated for the variables of chemistry laboratory self-efficacy beliefs and chemistry motivation. SEM is used to establish the model of relationships between these variables. Correlation analysis is used to determine the level of relationship between variables, whereas regression analysis is used for functional explanations. However, if the correlation coefficient calculated between two variables is influenced by another variable or variables, or if the causal relation between two variables depends on the effect of a third variable, the correlation coefficient is insufficient to explain this relationship. In this situation SEM should be used. It is also known as a statistical analysis that examines the relations between standardized variables. It contains creation of path diagrams which show relations between variables and detail comments on direct and indirect effects of correlation coefficient. The difference between path analysis and other analysis is that it can analyze direct and indirect effects among variables. The simple model of the path analysis is the model with only direct effects among the variables, and this is similar to the multiple regression analysis. The direct effect means that when the other independent variables are constant, correlation between the one independent variable and dependent variable.

Results and Discussion

Descriptive statistics related to the average of the scales applied within the context of the relationship between chemistry laboratory self-efficacy beliefs and chemistry motivation of high school students are summarized in Table 1.

Table 1. Descriptive statistics of the scales

Scales	M	SD
Chemistry Laboratory Self-Efficacy Beliefs	3.29	.62
Psychomotor self-efficacy beliefs (Y1)	3.24	.75
Cognitive self-efficacy beliefs (Y2)	3.34	.62
Chemistry Motivation	3.36	.62
Career motivation (M1)	3.28	.78
Self-efficacy (M2)	3.42	.75
Grade motivation (M3)	3.53	.75
Self-determination (M4)	3.26	.77
Instrinsic motivation (M5)	3.14	.88

When we examine the Table1, we can say that the level of chemistry laboratory self-efficacy beliefs of students is high and chemistry motivation is medium level. When the sub-scales of the chemistry laboratory self-efficacy beliefs scale are examined, it is noteworthy that the students have the highest average in the dimension of cognitive self-efficacy beliefs. In the sub-scales of the chemistry motivation scale, students have highly motivation about grade motivation and followed by the self-efficacy sub-dimension.

Table 2. Correlations of the Sub-dimensions

		M1	M2	M3	M4	M5	Y1	Y2
M1	Pearson Correlation	1	,624**	,482**	,589**	,568**	,083*	,104**
	Sig. (2-tailed)		,000	,000	,000	,000	,033	,008
	N	652	652	652	652	652	652	652
M2	Pearson Correlation	,624**	1	,574**	,544**	,525**	,137**	,099*
	Sig. (2-tailed)	,000		,000	,000	,000	,000	,012
	N	652	652	652	652	652	652	652
M3	Pearson Correlation	,482**	,574**	1	,493**	,509**	,145**	,149**
	Sig. (2-tailed)	,000	,000		,000	,000	,000	,000
	N	652	652	652	652	652	652	652
M4	Pearson Correlation	,589**	,544**	,493**	1	,489**	,109**	,129**
	Sig. (2-tailed)	,000	,000	,000		,000	,005	,001
	N	652	652	652	652	652	652	652
M5	Pearson Correlation	,568**	,525**	,509**	,489**	1	,046	,039
	Sig. (2-tailed)	,000	,000	,000	,000		,237	,315
	N	652	652	652	652	652	652	652
Y1	Pearson Correlation	,083*	,137**	,145**	,109**	,046	1	,687**
	Sig. (2-tailed)	,033	,000	,000	,005	,237		,000
	N	652	652	652	652	652	652	652
Y2	Pearson Correlation	,104**	,099*	,149**	,129**	,039	,687**	1
	Sig. (2-tailed)	,008	,012	,000	,001	,315	,000	
	N	652	652	652	652	652	652	652

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

In Table2, we give the correlations between all sub-scales using correlation analysis. From this table we can say that all correlations are significant and there is a positive correction between chemistry laboratory self-efficacy beliefs and chemistry motivation.

Findings regarding the Structural Equation Modeling;

To examine the relationship between the latent variables chemistry laboratory self-efficacy beliefs with chemistry motivation we have used Structural Equation Modeling. In this analysis our null hypothesis is;

H_0 : There is no significant correlation between the chemistry laboratory self-efficacy beliefs with chemistry motivation.

H_s : There is significant correlation between the chemistry laboratory self-efficacy beliefs with chemistry motivation.

The model which obtained from SEM is given in Figure1.

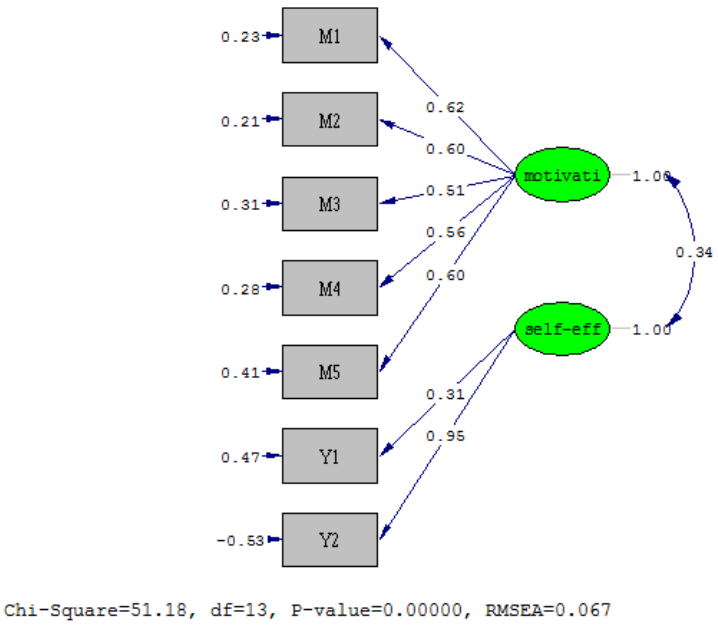

Figure 2. The SEM model for chemistry laboratory self-efficacy beliefs with chemistry motivation

In Figure 2, we can see that there is a positive and significant correlation between the chemistry laboratory self-efficacy beliefs and chemistry motivation. The standardized path coefficient from chemistry laboratory self-efficacy beliefs and chemistry motivation is found as 0.34.

Table 3. Results of SEM for chemistry laboratory self-efficacy beliefs with chemistry motivation

Variables	Path Coefficient	T Values	R^2
M1	0.62	22.93	0.63
M2	0.60	22.90	0.63
M3	0.51	18.50	0.46
M4	0.56	20.19	0.52
M5	0.60	18.79	0.47
Y1	0.31	6.79	0.17
Y2	0.62	22.93	0.63

The path coefficients which are obtained with path diagram are given in Table3 and we can say that all are significant. The goodness of fit of the model shown in Figure1 is examied with the criterias given in Table 4. We can say that our model is significant based on all criterias. (For details see: Dursun and Kocagöz, 2010).

Table 4. Criteria of SEM

	Well Fitness	Acceptable Fitness	Result
RMSEA	0<RMSEA<0.05	0.05<RMSEA<0.10	0.067 Acceptable
NFI	$0.95 \le NFI \le 1$	$0.90 \le NFI \le 0.95$	0.98 Well
NNFI	$0.97 \le NNFI \le 1$	$0.95 \le NNFI \le 0.97$	0.98 Well
CFI	$0.97 \le CFI \le 1$	$0.95 \le CFI \le 0.97$	0.99 Well
GFI	$0.95 \le GFI \le 1$	$0.90 \le GFI \le 0.95$	0.98 Well
AGFI	$0.90 \le AGFI \le 1$	$0.85 \le AGFI \le 0.90$	0.95 Well
χ^2	51.18 (sd=13 p=0.00)		

According to above Table there is significant correlation between the chemistry laboratory self-efficacy beliefs with chemistry motivation.

Conclusion

In this study we have examined the relationship between chemistry laboratory self-efficacy beliefs and chemistry motivation using different statistical tools. We try to take into account the direct and indirect correlations between sub-scales of chemistry laboratory self-efficacy beliefs and chemistry motivation. We try to model the sub-scales with SEM. We obtain a statistically significant model. We can conclude that there is a significant positive relationship between chemistry laboratory self-efficacy beliefs and chemistry motivation.

The present study has several inferences for high school students. It is important to improve students' motivation towards chemistry and to increase self-efficacy beliefs towards laboratory in learning environments. These expectations can be realized when students' have a chance to observe their teachers who use the science and chemistry effectively (i.e., experimenting in class) or when students use chemistry experiments in their own instruction during the projects. Teachers should help students to see the benefits of chemistry through experiments which are basic and not dangerous. Through can be augmentable the self-efficacy beliefs of high school students towards laboratory and so augmentable the motivation towards chemistry. For example, chemistry teachers should use daily life applications and daily chemistry experiments in their lessons to make them more conceptual, which will allow students' to see how chemistry is helpful and useful in understanding science concepts. Furthermore, teachers should gain more experience in using chemistry laboratory; this could be succeed by presenting more laboratory applications include incorporating experiments use in teaching chemistry. Teachers' laboratory practices not only enhances students' motivations, but also reduces their laboratory self-efficacy beliefs. Grounded on our feedback of students' statements and wishes, laboratory applications can be impressive in enhancing chemistry motivations and chemistry laboratory self-efficacy beliefs.

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