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DEVELOPMENT OF "TASK VALUE" INSTRUMENT FOR BIOLOGY AS A SCHOOL SUBJECT

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Abstract. The expectancy-value model of motivation states that individuals' choice, persistence and performances are related to their beliefs about how much they value task. Despite the importance of "task value" in learning biology, lack of the instruments on task value for high school biology courses for practical use indicated requirement to develop an instrument. The purpose of this study is development of "task value" instrument for using in high school biology courses. The study was conducted on 189 ninth grade high school students by applying "task value" instrument, self-efficacy and test anxiety scales. To collect validity evidence, confirmatory, divergent and convergent validity analyses were performed while internal consistency was determined by Cronbach alpha reliability analysis. The results showed that scores on the instrument with 18 items loaded on three factors (importance, interest and utility) and Cronbach alpha values were .64 for importance aspect, .88 for interest aspect and .84 for utility aspect. Based on the findings, it can be suggested that the instrument can be used to determine current motivational status of the students and to predict future performances, efforts and persistence on biology tasks.

Key Words: task value, biology learning, high school, instrument development

1. Introduction

Biology as a scientific discipline has been providing many important innovations for our lives by studies in its basic fields; genetics, biotechnology, molecular biology, microbiology and biochemistry. By famous studies of these fields such as cloning, gene transfer, prevention of microbial diseases and proteomics, they became popular and then entered into daily life with some discussions on important 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, under the title of biology, it begins to occur in high school years. High biology lessons are the most important contexts for learning biology. Biology learning in high school includes many factors which are determinants of learning quality. 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 [1,2,3,4,5]. Under the affective title, some well-defined constructs are included. The most frequently emphasized factors of affective domain in science and biology education literature are attitude, self-efficacy, anxiety and motivation [5,6,7,8,9,10,11,12].

As an affective factor, motivation desires a discrete attention, because motivation to learn is regarded as the single biggest determinant of whether or not a student will learn biology [13] and the overweighed any cognitive variables [14]. Giving more importance to motivation for science education over the other affective factors in science education was also suggested by some researchers [10]. Motivation is defined as the process which instigates and sustains a goal directed activity [15]. Motivational factors are explained, presented and defined in many models [16,17,18,19].

One of the most studied model; expectancy-value model that see the individual as an active and rational decision maker presents a good reflective model for explaining the motivational situation of individuals who have been gaining, using and constructing knowledge for their daily lives by

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themselves [15]. The model states that individuals' choice, persistence and performance can be explained by their beliefs about how well they do task and how much they value task. The model claims that expectancies and values influence directly achievement choices, performance, effort and persistence [19]. In many studies, task value component of the model was showed to be positively correlated with the other important motivational constructs such as self-efficacy, intrinsic motivation, extrinsic motivation, and control of learning beliefs [5, 20, 21, 22, 23]. The correlational evidence gathered by these studies has been supporting the importance of "task value" component of the model over motivational forces which can initiate and provide action on task. Wigfield and Eccles explained that the most studied subcomponents of the "task value" were "importance", "utility" and "interest" (intrinsic value) [19]. They described the "importance" as the importance of doing well on a given task, "utility" as a degree of how a given task fit into an individual's future plans and "interest" as the enjoyment one gets from doing a given task.

In the literature, there are studies showing importance of task value for perspective, achievement and strategy use of students. Li, McCoach, Swaminathan and Tang have studied on perspectives of engineering students upon value of engineering program[24]. They have asserted that low value given by students to personal benefits of engineering might be a reason to decreasing rates of choosing engineering as a carrier. Besides, Greene, Miller, Crowson, Duke and Akey have shown another important role of task value, the authors have stated there are close relationship between perceived utility and strategy use [25]. Strategy use has positively predicted achievement of students, so utility aspect of task value is related to achievement of students via strategy use. Similar results on relationship between strategy use and task value have also been shown by Sungur studying on 391 high school students. She has stated that task value is one of the strongest predictor of metacognitive strategy use [26]. In addition, effective use of metacognitive strategies increases achievement.

The current literature on biology education also supported the importance of task value in learning biology. Koksal and Cimen studied on task value given by the prospective biology teachers to learn different subjects of biology[27]. The study included 65 prospective biology teachers and ordering questionnaire was used for data collection. The findings showed that the participants gave different weights for different biology subjects in terms of value for learning. The participants saw the heart, kidney, brain, spinal cord, cerebellum and liver as the most important and difficult subjects to learn whereas they saw nose, tongue, esophagus, large intestine and gallbladder as the least important and difficult subjects to learn. These findings represent that task value in learning biology varies across subjects; determining perceptions of learners on "task value" at the outset might provide advantages to organize teaching and to determine order of teaching on different biology subjects. Scott et al. studied on effectiveness of fieldwork studies regarding biology in higher education level [28]. They reported that the participants giving high task value learned more about taxonomical relationship among the freshwater invertebrates. McKeachie, Lin and Strayer studied with 60 college level students and they reported the participants having high motivation to get high scores had low task value and interest to learn about biological evolution [29]. They were also anxious and learned the content by memorizing, they did not think about ideas enough. Moreover, Strgar pointed out lower interest of students (N=184, forth, eight grades and university level) in plants and gradual decrease in the interest with age [30]. The author stated that decrease in interest regarding plants might cause insufficient learning on plants. Yumusak, Sungur and Cakıroglu studied on predictors of biology achievement of 519 tenth-grade students[5]. They represented that task value is a significant predictor of biology achievement. VanderStoep, Pintrich and Fagerlin assessed 380 of college students' motivational beliefs [31]. The authors found that motivational beliefs including task value distinguished low-achieving and advanced students in biology and psychology. The literature summarized above support importance of task value in learning biology and requirement of measuring task value in a domain-specific manner.

Wigfield and Eccles studied on task value in different domains including math, reading and English and based on their study, they showed domain effect for task value [19]. Biology as another domain was not studied to determine task value perceptions of students on biology related tasks in spite of importance of biology for daily life. In literature on biology education, attitude, self-efficacy and motivation scales were developed, but no specific "task value instrument" was developed to use in high school level for biology learning [7, 32, 33]. The literature on biology education showed

importance of task value for reaching outcomes of learning biology. Koksal and Cimen studied on task value given by the prospective biology teachers to learn different subjects of biology [27]. The study included 65 prospective biology teachers and ordering questionnaire was used for data collection. The findings showed that the participants gave different weights for different biology subjects in terms of value for learning. The participants saw the heart, kidney, brain, spinal cord, cerebellum and liver as the most important and difficult subjects to learn whereas they saw nose, tongue, esophagus, large intestine and gallbladder as the least important and difficult subjects to learn. These findings represent that task value in learning biology varies across subjects; determining perceptions of learners on "task value" at the outset might provide advantages to organize teaching and to determine order of teaching on different biology subjects. Scott et al. studied on effectiveness of fieldwork studies regarding biology in higher education level [28]. They reported that the participants giving high task value learned more about taxonomical relationship among the freshwater invertebrates. McKeachie, Lin and Strayer studied with 60 college level students and they reported the participants having high motivation to get high scores had low task value and interest to learn about biological evolution [29].. They were also anxious and learned the content by memorizing, they did not think about ideas enough. Moreover, Strgar pointed out lower interest of students (N=184, forth, eight grades and university level) in plants and gradual decrease in the interest with age [30]. The author stated that decrease in interest regarding plants might cause insufficient learning on plants. The literature summarized above support importance of task value in learning biology. Importance of "task value" for biology learning and lack of the instruments on task value regarding high school biology required developing a "task value" instrument.

Development of a task value instrument targeting biology as a task domain will be helpful to determine and assess motivational state of the students before biology tasks are given by biology teachers. The states of the students might be used to predict their future performances, efforts and persistence on a biology task. Biology teachers can easily compare change in motivational states of the students on biology after their instructions and they can also make required changes in their instruction by considering the scores of the students on easily administrable and scorable task value instrument. In addition, curriculum developers can also use task value instrument to determine interests of the students on biology.

Based on the need of task value instrument for high school biology courses and domain sensivity of value given to any task, the purpose of this study is to develop and to validate an instrument for evaluating "task value" aspect of learning on biology as a school subject.

Method

In this study, cross-sectional descriptive study approach was utilized by applying three different instruments; task value instrument, self-efficacy and test anxiety scales.

Participants

The study included 189 participants who were enrolled in ninth grade of three different high schools in Turkey. The focuses of these schools were to provide education on ordinary science, mathematics and social study subjects. The age range of the participants was from 13 to 16. Majority of them were females. The detailed descriptive values about the participants can be summarized as in Table 1.

Instruments

The convergent and divergent validities of the instrument were tested by using two different scales for self-efficacy and test anxiety. In the literature, these two constructs were shown to be correlated positively and negatively with task value [20,23]. So, they were found to be appropriate to use in collecting evidence on convergent and divergent validities of the biology task value instrument. The self-efficacy and test anxiety scales were subscales of the MSLQ (Motivated Strategies for Learning Questionnaire) and they were translated and adapted by Sungur in Turkey [33]. The MSLQ was a self-report instrument and had 81 items. The instrument was a seven point scale with extremes signed by "not at all true of me" and "very true of me". The author conducted adaptation study with 488 high school students from different types of schools. Of the students who responded to the demographic

questions 58.1 % were males (n=254) and 41.9 % were females (n=183). Mean age of the students was 16.59. In table 2, fit index values found by Sungur on the two components of MSLQ can be seen [33].

Table 1. Descriptive Data for the Participants

Variables		***f***	***%***
Gender	*Male*	*82*	*56.6*
	Female	*107*	*43.4*
Age	*13*	*3*	*1.6*
	14	*96*	*50.8*
	15	*78*	*41.3*
	16	*12*	*6.3*
Type of School	*Anatolian High School*	*122*	*64.6*
	Ordinary High School	*67*	*35.4*
Existence of Relatives in the Field of Biology	*Yes*	*16*	*8.9*
	No	*164*	*91.1*

The example items from the scales of test anxiety and self-efficacy in biology learning are “When I take a biology test I think about how poorly I am doing”, “When I study for a biology test, I try to put together the information from class and from the book” and “I am sure I can do an excellent job on the problems and tasks assigned for biology class”, “I’m certain I can understand the ideas taught in biology course”.

Table 2. Fit indexes of the components of the questionnaire reported by Sungur (2004)

Motivation Component	
□2/df	5.3
GFI	.77
RMR	.11
Learning Strategy Component	
□2/df	4.5
GFI	.71
RMR	.08

Self-efficacy and test-anxiety subcomponents were placed under the title of motivation as a component of the MSLQ [23,33]. The reliability coefficients of the self-efficacy and test anxiety subcomponents of the questionnaire were found as .89 and 0.62 by Sungur. The author explained that the data about the questionnaire approved validity and reliability of it. In addition to the previous evidence of Sungur, confirmatory factor analyses for one-factor solution models for each scale were conducted for current study. Item 5 of test anxiety scale was eliminated since its extreme non-normal distribution on scores. Then, multivariate normality was provided for each of them with critical ratios of 6.70 for self-efficacy scale and 2.16 for test anxiety scale. The fit index values and Cronbach alphas calculated on scores of the participants in the current study can be seen in Table 3.

As seen in Table 3, majority of fit indexes for self efficacy scale are in acceptable range. Chi-square ratio index on self-efficacy scores is under 3.00 as a highest cut-off acceptable value [34]. The indexes of CFI and GFI for self-efficacy respectively are higher than .90 cut-off lower limit for CFI and .85 for GFI [35, 36]. As another index considered in this study, RMR is smaller than .10 as an acceptable value [37] whereas RMSEA is slightly higher than cut-off .08 [38]. Except for RMSEA value that might be ignored, self-efficacy scores of the participants have provided evidence for validity of the scale scores. In addition, Cronbach alpha value of .97 is an important indicator for the evidence of internal consistency. The fit indexes and internal consistency coefficient values showed more convincing evidence than the original values determined by Sungur [33].

Table 3. Fit indexes and Cronbach alphas of the self-efficacy and test anxiety scales

Self-efficacy scale	
□2/df	2.60
GFI	.93
RMR	.08
CFI	.97
RMSEA	.09
Alpha	.97
Test Anxiety scale	
□2/df	2.16
GFI	.99
RMR	.15
CFI	.97
RMSEA	.06
Alpha	.48

When looked at the values for test anxiety scale, it is seen that chi-square ratio index, GFI, CFI, RMSEA are in acceptable ranges whereas RMR value is higher than .10. In spite of strong evidence of fit indexes, internal consistency of the scores on test anxiety scale is not good as that for self-efficacy scale.

Findings

Validity and Reliability of the "Task Value" Instrument

Face Validity

For face validity of the instrument, opinions of two experts were consulted. Both of them were experts on the measurement and evaluation. To get ideas of the experts, an evaluation form was used. It had six items in Likert type format and one open place for recommendations at the end of the form. Items of the form can be seen in table 4. The experts did some important critics on the format, items and number of items to be included in the task value instrument. For instance; one of them showed that majority of items was written as positive sentences, except one. Therefore, this item was also converted to positive form. Again, one of the experts recommended some changes in wordings and sentence structures.

Table 4. Items of the evaluation form

Criteria for Evaluation	1	2	3	4	5
Understandability of the items					
Difficulty levels of words in the items					
Appropriateness of number of the items					
Appropriateness of language of the items					
Appropriateness of the items for their aims					
Appropriateness of the items in terms of reading load					

All of required changes in content of the instrument were made by considering the expert opinions before it was applied.

Divergent Validity

For the divergent validity, the correlation between the scores on the task value instrument and test anxiety scores of the participants was used. The expected correlation between them is to be negative and statistically significant. The result for the divergent validity did not confirm the expectation for the scale scores (r= .04, p=.58, N=189).

Convergent Validity

Convergent validity of the scores on the task value instrument was tested by using the correlation value between task value and self-efficacy scores. In contrast to divergent validity, the expectation is to find positive and statistically significant correlation coefficient. The result for the convergent validity approved the expectation for the scale scores (r= .57, p=.00, N=189).

Construct Validity

Item pool of the instrument was prepared by using literature [39,15,19]. At the beginning, the instrument had three theoretical sub-factors as importance, utility and interest which were described by Wigfield and Eccles [19]. In line with these sub-factors, a model for confirmatory factor analysis was hypothesized to test. For testing the model for structure of the instrument, confirmatory factor analysis was performed. To test the hypothesized model, AMOS program was utilized.

First of all, data screening was performed for checking missing values and outliers. Data screening results showed that percentage of missings in data set was below 10 %. Therefore, regression method was seen as appropriate way to handle missings due to continuous nature of the data. The hypothesized model had three latent variables and 24 observed variables. The observed variables are the items of the instrument. The items of the instrument can be seen in Table 5.

Table 5. Items of the hypothesized model

Theoretical factors	Item number	Items
Importance	1	To take higher scores on biology is important for me.
	2	To be good in problem solving in biology course is important for me.
	3	Learning the subjects of biology course is important for me.
	4	Using the resources of biology course to learn is important for me.
	5	Asking good questions in biology course is important for me.
	6	In biology course, making a good presentation is important for me.
	7	Learning the concepts of biology subjects is important for me.
	8	To learn theories and laws in biology subjects is important for me.
Interest	9	I don't think that studying on the assignments of biology course is generally very boring.
	10	I like studying on the subjects of biology course.
	11	I think I am interested in the content of biology course.
	12	I like the subjects of biology course.
	13	I get pleasure when I am dealing with the problems presented in biology course.
	14	I think I am interested in the samples presented in biology course.
	15	I like talking about the subjects presented in biology course.
	16	I am interested in the content of questions asked in the exams of biology course.
Utility	17	I think that what I learn in biology course will be useful for the job I want to do.
	18	I think that what I learn in biology course will be useful for my daily life out of school.
	19	I think that I will use what I learn in biology course, for learning in other courses.
	20	I think that what I learn in biology course will be useful for my life when the events that threaten the nature will occur.
	21	I think that what I learn in biology course will be useful to gain much more Money in future.
	22	I think that what I learn in biology course will be useful to get higher title in my job.
	23	I think that what I learn in biology course will be useful to find a job.
	24	I think that what I learn in biology course will be useful to pass the exams in future.

The hypothesized model for task value with their sub-factors is the model presented in figure 1.

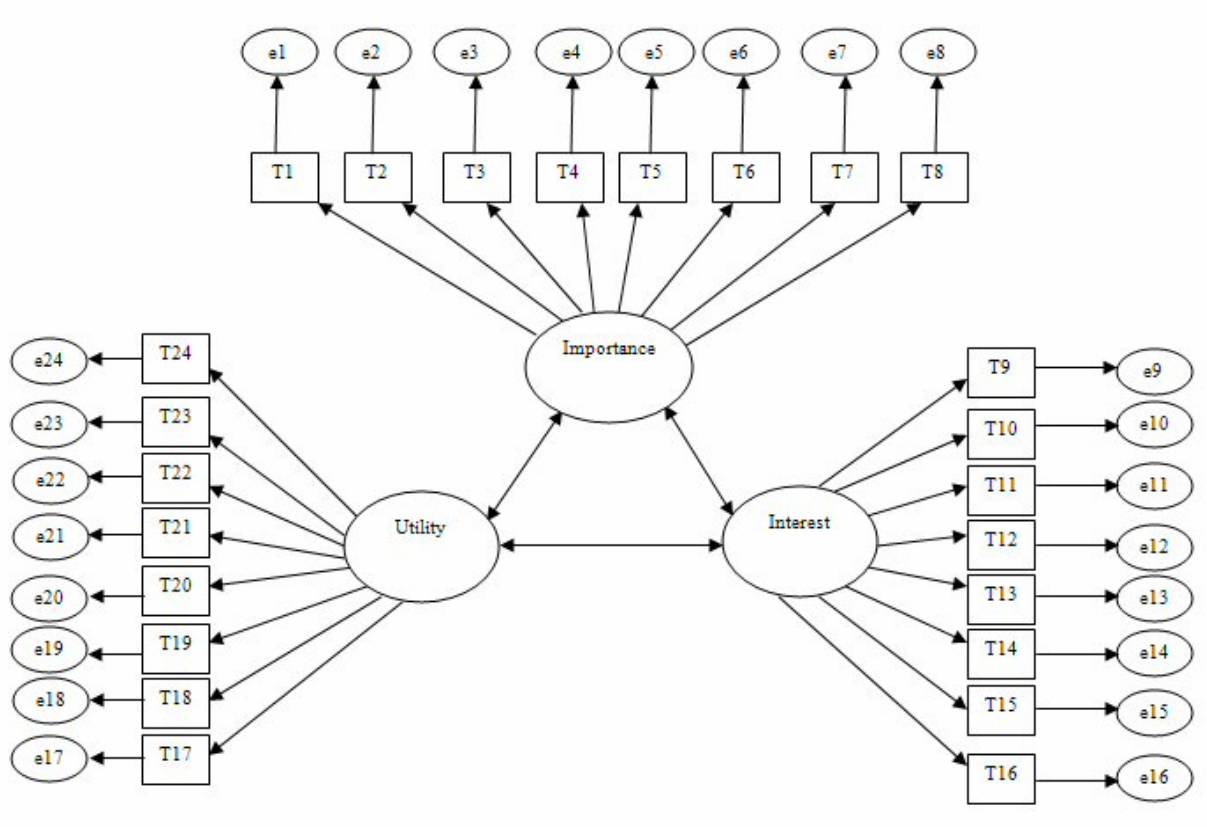

Figure 1. Hypothesized model for the scale factors. (Note: T: items, e: error term)

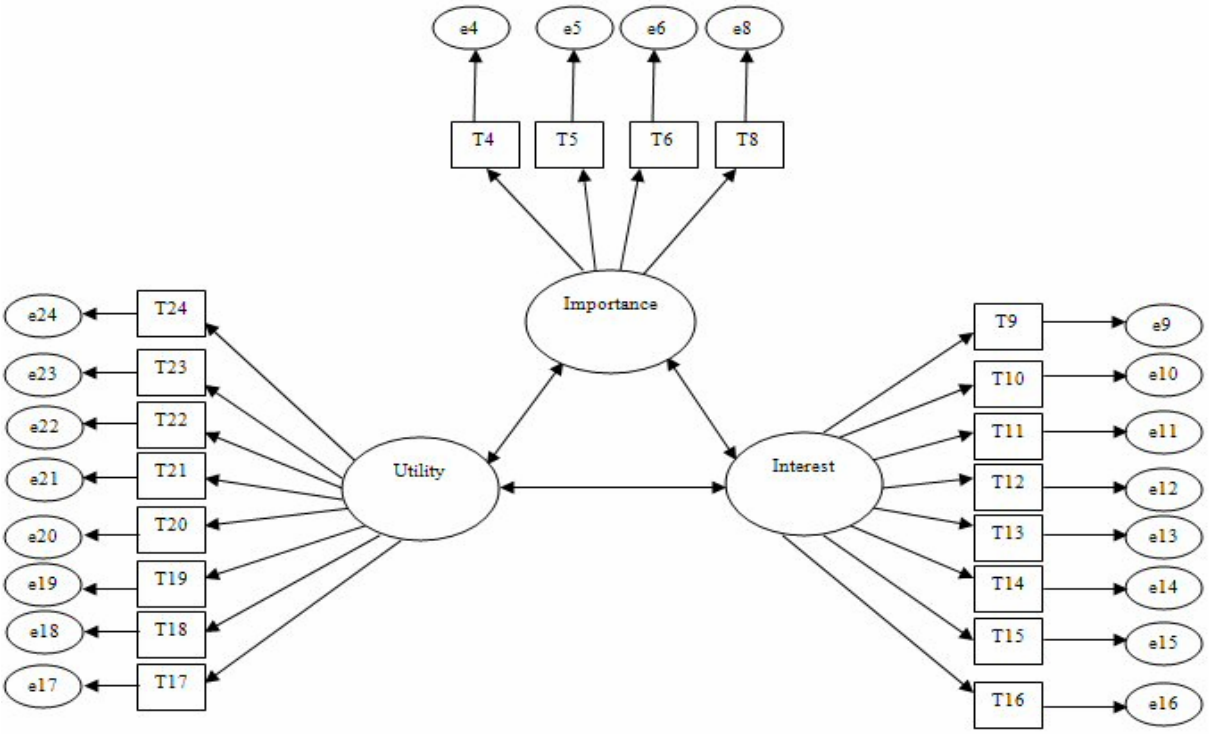

Figure 2. Tested model for the scale factors

After the analysis of the hypothesized model, the items that contributed negatively to multivariate normality were discarded by accepting 2.00 as a cut-off score for skewness and kurtosis based on Araz and Sungur's study [40]. The items numbered as 1, 2, 3 and 7 had higher values than the cut-off for skewness and kurtosis, so they were not included in following stages of the analysis. Then, Mahalonobis d^2 values were investigated for normality in the level of cases to find farthest observations from centroid. For this study, the observations that had smaller probability values than 0.005 were not considered. Thirteen of the cases were found to be contributed to multivariate non-normality. After their elimination, critical ratio value (7.01) regarding multivariate normality and, low skewness and kurtosis values were accepted as evidence for normality of the scores on task value instrument. After providing multivariate normality, the hypothesized model was changed due to the elimination of some items. The revised model can be seen in figure 2.

In the tested model, three-factor solution indicated in the literature was analyzed. Then, the standardized solution results were investigated to get evidence about construct validity of the scores on the task value instrument.

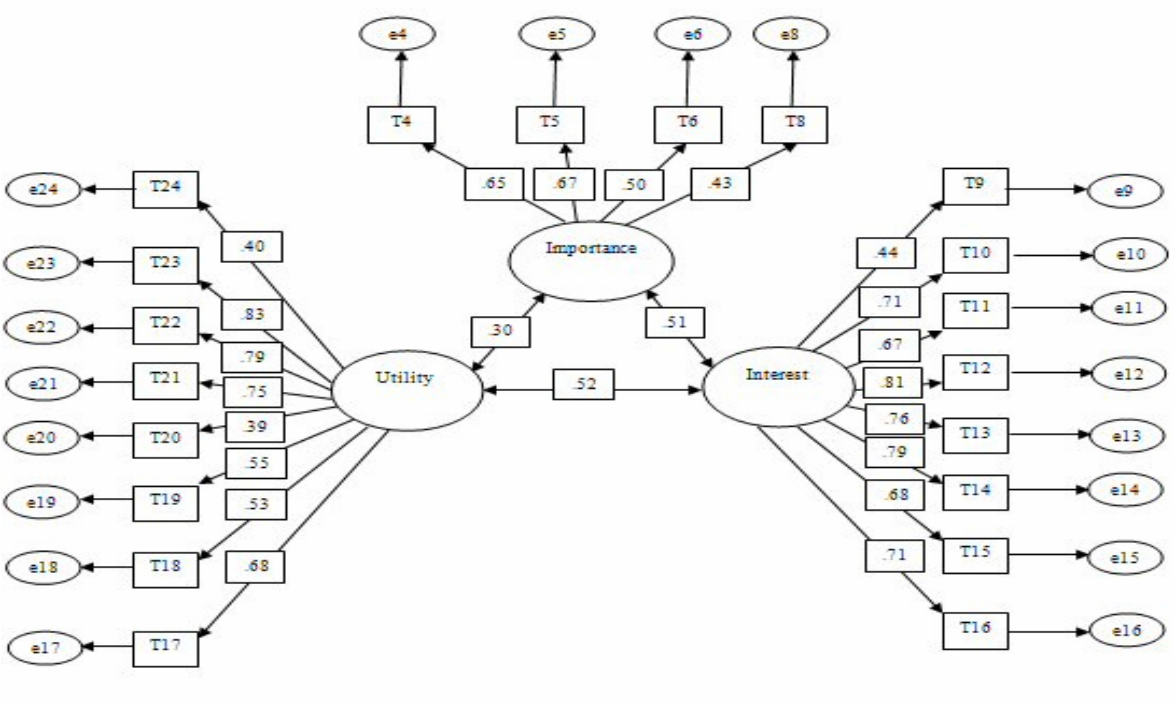

Figure 3. The result of confirmatory factor analysis for three-factor solution

Figure 3 includes the factor loadings of individual items on the factors. Three-factor solution with 20 observed variables provided important points to consider in analysis. Factor loadings and factor score weights can be seen in Table 6.

Table 6 . Factor loadings and Factor Score Weights of the scores on the Items

Items	**Factors**					
	Importance		**Interest**		**Utility**	
	Factor Loading	**FSW**	**Factor Loading**	**FSW**	**Factor Loading**	**FSW**
Item 4	*.65*	*.26*		*.01*		*.01*
Item 5	*.67*	*.24*		*.01*		*.00*
Item 6	*.50*	*.13*		*.01*		*.00*
Item 8	*.43*	*.14*		*.01*		*.00*
Item 9		*.01*	*.44*	*.02*		*.00*
Item 10		*.02*	*.71*	*.07*		*.01*

Item 11		*.01*	*.67*	*.06*		*.01*
Item 12		*.02*	*.81*	*.10*		*.02*
Item 13		*.02*	*.76*	*.08*		*.01*
Item 14		*.01*	*.79*	*.11*		*.02*
Item 15		*.01*	*.68*	*.05*		*.00*
Item 16		*.01*	*.71*	*.06*		*.00*
Item 17		*.00*		*.00*	*.68*	*.10*
Item 18		*.00*		*.00*	*.53*	*.07*
Item 19		*.00*		*.00*	*.55*	*.08*
Item 20		*.00*		*.00*	*.39**	*.05*
Item 21		*.00*		*.01*	*.75*	*.15*
Item 22		*.00*		*.01*	*.79*	*.19*
Item 23		*.00*		*.01*	*.83*	*.23*
Item 24		*.00*		*.00*	*.40**	*.05*

Note: Factor loading refers to standardized regression weight and FSW refers to Factor Score Weights, (*) indicates factor loading below .40.

Table 7. Factor loadings and Factor Score Weights of the scores on the Items after elimination of the item 24

Items	**Factors**					
	Importance		**Interest**		**Utility**	
	Factor Loading	**FSW**	**Factor Loading**	**FSW**	**Factor Loading**	**FSW**
Item 4	*.65*	*.26*		*.01*		*.01*
Item 5	*.67*	*.24*		*.01*		*.00*
Item 6	*.50*	*.13*		*.01*		*.00*
Item 8	*.43*	*.14*		*.01*		*.00*
Item 9		*.01*	*.44*	*.02*		*.00*
Item 10		*.02*	*.71*	*.07*		*.01*
Item 11		*.01*	*.66*	*.06*		*.01*
Item 12		*.02*	*.80*	*.10*		*.01*
Item 13		*.02*	*.76*	*.08*		*.01*
Item 14		*.01*	*.79*	*.11*		*.02*
Item 15		*.01*	*.68*	*.05*		*.00*
Item 16		*.01*	*.71*	*.05*		*.01*
Item 17		*.00*		*.00*	*.70*	*.11*
Item 18		*.00*		*.00*	*.50*	*.07*
Item 19		*.00*		*.00*	*.51*	*.07*
Item 21		*.00*		*.00*	*.76*	*.16*
Item 22		*.00*		*.01*	*.82*	*.23*
Item 23		*.00*		*.01*	*.83*	*.24*

Note: Factor loading refers to standardized regression weight and FSW refers to Factor Score Weights

The investigation of the factor loading weights showed that Item 20 had a factor loading score below .40 [24]. Therefore, the item was eliminated and the analysis was run again. In the second run of the analysis, it was found that item 24 had also a factor loading score at the level of .40. After the elimination of this item, the analysis was run again. The results of the analysis can be seen in table 7.

The third analysis showed that there was no item that had factor loading below .40 and three factors could be separated in the model.

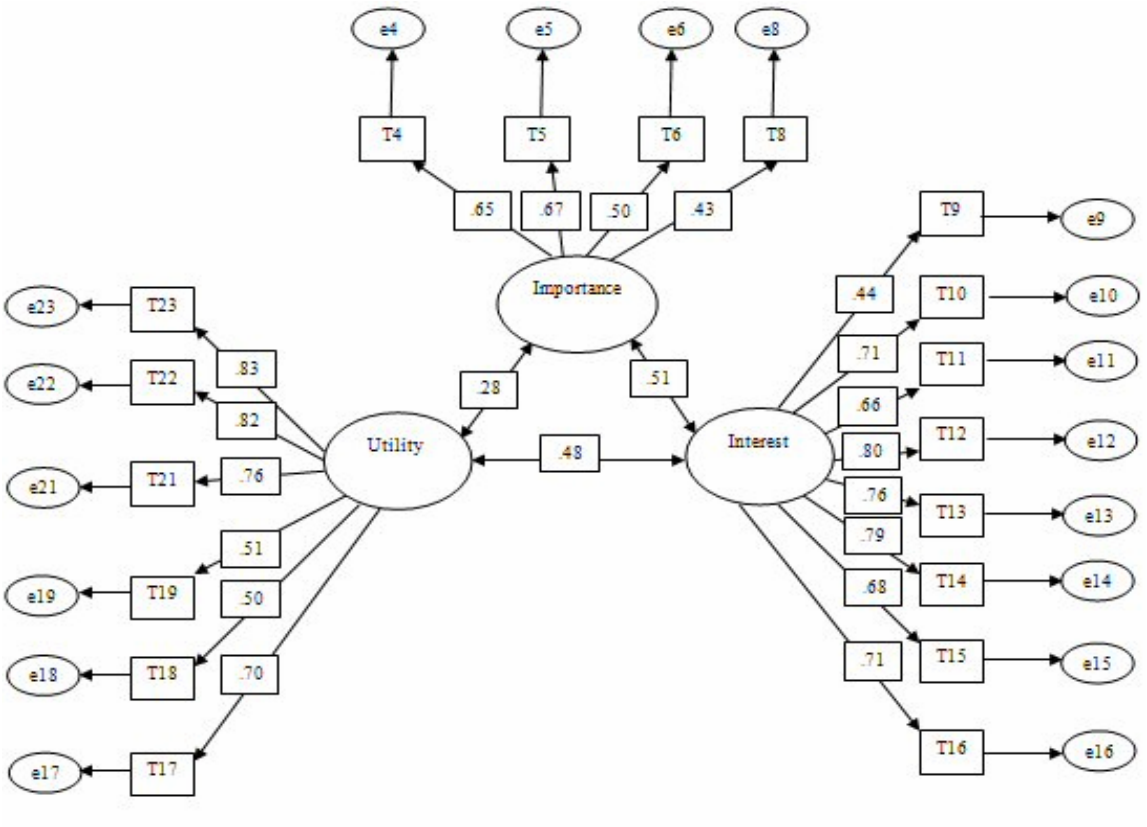

Figure 4. The results of confirmatory factor analysis after item 20 and 24 were eliminated

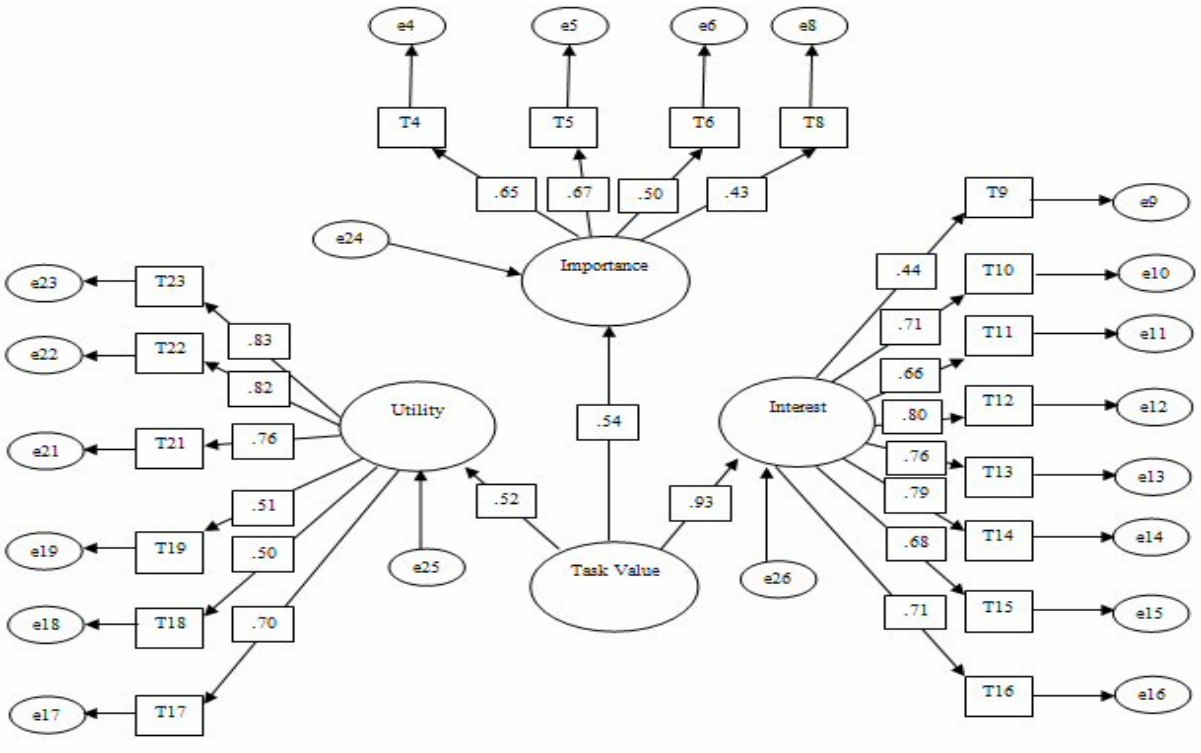

Figure 5. Second order analysis result of the construct

The standardized solution after the elimination of the items of 20 and 24 can be seen in figure 4. The model was tested by using three-factor solution as related individual constructs, but there was also a need to test whether they were sub-components of the same higher-order construct named as "task value" on biology. For testing this assertion, second order analysis as drawn in figure 5 was tested.

Second-order factor analysis results confirmed that there was a higher-order construct (biology task value) which covered three factors as its sub-components. The standardized solution factor loadings can be seen in figure 5.

As seen in Table 8, none of the items had a factor loading below .40 in second order model. At the same time, each factor had its unique factor loading on the "task value" construct above .50. By considering the unchanged fit index values presented in Table 9 for first and second-order confirmatory factor analyses, it might be said that the model is working for the theoretical construct.

Table 8 . Factor loadings and factor score weights of the scores for second-order analysis

Items	Second-order factor	Factors					
		Importance		Interest		Utility	
	Task Value FSW	Factor Loading	FSW	Factor Loading	FSW	Factor Loading	FSW
	.92			.54		.52	
Item 4	.03	*.65*	*.26*		*.01*		*.01*
Item 5	.03	*.67*	*.24*		*.01*		*.00*
Item 6	.01	*.50*	*.13*		*.01*		*.00*
Item 8	.02	*.43*	*.14*		*.01*		*.00*
Item 9	.02		*.01*	*.44*	*.02*		*.00*
Item 10	.06		*.02*	*.71*	*.07*		*.01*
Item 11	.05		*.01*	*.66*	*.06*		*.01*
Item 12	.08		*.02*	*.80*	*.10*		*.01*
Item 13	.07		*.02*	*.76*	*.08*		*.01*
Item 14	.09		*.03*	*.79*	*.11*		*.02*
Item 15	.04		*.01*	*.68*	*.05*		*.00*
Item 16	.04		*.01*	*.71*	*.06*		*.01*
Item 17	.01		*.00*		*.00*	*.70*	*.11*
Item 18	.01		*.00*		*.00*	*.50*	*.07*
Item 19	.01		*.00*		*.00*	*.51*	*.07*
Item 21	.01		*.00*		*.01*	*.76*	*.16*
Item 22	.02		*.00*		*.01*	*.82*	*.23*
Item 23	.02		*.01*		*.01*	*.83*	*.24*

Table 9. Fit indexes for first and second order confirmatory factor analysis

Factor Analysis	CMIN/DF	GFI	CFI	RMSEA	RMR
First Order	1.91	.87	.91	.07	.11
Second Order	1.91	.87	.91	.07	.11

In addition to comparison of first and second order analyses, the fit indexes of the model as stated in first and second order lines of table 9 were in acceptable range except for RMR. As a result of comparison between first and second order analyses, it was seen that second order model was accepted as the model of study.

Chi-square ratio index on the instrument scores was under 3.00 as a highest cut-off acceptable value for each analysis [34]. The indexes of CFI and GFI for the scale scores of the students were also higher than cut-off lower limits of .90 and .85 for CFI and GFI, respectively [35,36]. RMSEA was also smaller than .08 as an acceptable value for each analysis [38]. Only RMR values was slightly higher than cut-off .10 [37].

In addition to investigation of fit indexes, correlation between the factors of task value was also researched to check association of the factors under the same construct.

Table 10. Correlation coefficients for factors

	Importance	Interest	Utility	Total
Importance	-			
Interest	.42*	-		
Utility	.25*	.45*	-	
Total	.56*	.87*	.80*	-

Note: All of the correlation coefficients indicated are significant at the level of .01.

Table 10 summarizes the correlation coefficients for the components of the instrument. As seen from the table, the scores on all components had statistically significant correlation coefficients with each other and whole instrument scores.

Apart from the evidence of fit indexes for construct validity, Cronbach alpha values also provided evidence for internal consistency of each individual component and total instrument scores (Importance =.64, Interest=.88, Utility=.84, Total=.88). Final form of the instrument in English can be seen in table 11.

Table 11. The final form of the Scale in English

4	Using the resources of biology course to learn is important for me.
5	Asking good questions in biology course is important for me.
6	In biology course, making a good presentation is important for me.
8	To learn theories and laws in biology subjects is important for me.
9	I don't think that studying on the assignments of biology course is generally very boring.
10	I like studying on the subjects of biology course.
11	I think I am interested in the content of biology course.
12	I like the subjects of biology course.
13	I get pleasure when I am dealing with the problems presented in biology course.
14	I think I am interested in the samples presented in biology course.
15	I like talking about the subjects presented in biology course.
16	I am interested in the content of questions asked in the exams of biology course.
17	I think that what I learn in biology course will be useful for the job I want to do.
18	I think that what I learn in biology course will be useful for my daily life out of school.
19	I think that I will use what I learn in biology course, for learning in other courses.
21	I think that what I learn in biology course will be useful to gain much more Money in future.
22	I think that what I learn in biology course will be useful to get higher title in my job.
23	I think that what I learn in biology course will be useful to find a job.

Discussion

The results showed that the scores coming from the task value instrument were valid and reliable to use for various purposes in high school biology classes. The final form of the instrument includes 18 items as 4 items for importance factor, 8 items for interest factor and 6 items for utility factor. The number of the items is appropriate to use practically in short time by only asking to sign appropriate category.

Estimates of fit indexes confirmed validly usability of the instrument for measuring task value at the level of high school. The theoretical construct was also supported by Cronbach alpha values as sign for internally consistent scores on the sub-components and whole instrument. Statistically significant correlation coefficients between factors and whole instrument scores also were evidence for related component structure. In addition to internal consistency and construct validity indexes, statistically significant moderate correlation coefficient between task value and self-efficacy was also an evidence for convergent validity of the scores although divergent validity evidence with test anxiety scale scores did not yield expected result. The unexpected result on divergent validity might be caused by low

reliability coefficient value of test-anxiety scale. The other more reliable scales should be used to test divergent validity of the scale in future studies. The findings of this study on reliability supported Sungur 's study [41], Sungur represented correlation between self-efficacy and task value. She investigated students' motivational beliefs and metacognition support perceptions. The sample included 58 college students between the ages 20 to 25. The results of the study showed that task value positively correlated with self-efficacy.

Based on the results of construct validity analysis, it can be said that findings of this study provided an evidence for three-factor structure of task value for biology domain. Eccless et al. defined task value as a three-component structure including utility, interest and importance, the construct validity evidence of this study also confirmed expected structure of task value in learning biology[42]. Similar to the results of present study, Eccless and Wigfield studied on dimensionality of the expectancy-value structure of adolescents [43]. The authors found that the task value component was separated into three factors as importance, utility and interest as found in this study.

The task value was found to be correlated with many educationally important variables in the literature. Bong, in the study on female Korean college students, found that task value was the best predictor of mid-term scores and course enrollment intentions of the students [20]. Eccless and Wigfield also showed task value to be positively correlated with ability perceptions of the adolescents and negatively correlated with task difficulty perceptions of them [43]. The other researchers; Pitrich and DeGroot showed task value (intrinsic value) factors to be statistically significantly correlated with the factors of strategy use, self-regulation and self- efficacy [23]. In addition, literature on biology education represented function of task value in learning biology that appropriate perceptions on task value are related to learning more about taxonomical relationship among the freshwater invertebrates, experiencing lower anxiety in learning biology, using strategies out of rote memorizing when learning biology and having high interest regarding plants [28,29,30]. Yumusak, Sungur and Cakıroglu studied on predictors of biology achievement by applying MSLQ (Motivated Strategies for Learning Questionnaire) and biology achievement test to 519 tenth-grade students. They also represented that task value is a significant predictor of biology achievement [5]. VanderStoep, Pintrich and Fagerlin also used the MSLQ to assess 380 of college students' motivational beliefs. The authors found that these variables including task value distinguished low-achieving and advanced students in biology and psychology[31].

In the literature, there are studies showing importance of task value for perspective, achievement and strategy use of students. Li, McCoach, Swaminathan and Tang have studied on perspectives of engineering students upon value of engineering program [24]. They have asserted that low value given by students to personal benefits of engineering might be a reason to decreasing rates of choosing engineering as a carrier. As for engineering domain, problems regarding to high school students' enrollment rates in biology programs or carriers might be investigated by using task value instrument on biology. Besides, Greene, Miller, Crowson, Duke and Akey have shown another important role of task value, the authors have stated there are close relationship between perceived utility and strategy use [25]. Strategy use has positively predicted achievement of students, so utility aspect of task value is related to achievement of students via strategy use. Similar results on relationship between strategy use and task value have also been shown by Sungur studying on 391 high school students [26]. She has stated that task value is one of the strongest predictor of metacognitive strategy use. In addition, effective use of metacognitive strategies increases achievement. These studies have been showing importance of task value for effective strategy use when learning biology and increasing biology achievement.

Implications

The task value component of the expectancy-value model was showed to be positively correlated with the other important motivational constructs such as intrinsic motivation, extrinsic motivation, and control of learning beliefs [5, 21, 22,]. The predictive and correlational powers of the task value component on the educationally important variables are an indication for considering value given to a task in biology course to design instruction for self-regulation, to evaluate motivation, and to construct groups for collaborative studies in biology teaching. The scale has strong theoretical background

coming from expectancy-value studies. Therefore, the scale developed and validated in this study might provide a way to evaluate and assess the task value for biology in high school settings.

The instrument developed in the current study is an important tool to determine and predict the variables such as perspectives on biology carriers and achievement on biology. At the same time, the instrument might be used for selecting students for special programs regarding biology and then it might be used to test effectiveness of affective implementations in biology learning contexts. The instrument is easy (easily administrable and scorable) to use for instructional purposes by biology teachers, the teachers can use the instrument to determine pre-existing motivational state of the students before taking a biology task. At the same time, the instrument can be used to predict future efforts, performances and persistence of the students on a biology task. Biology teachers and curriculum developers can also use the instrument to determine interests of the students on biology tasks. Researchers can also use the instrument as pre and post applications for testing an implementation regarding to motivation.

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