

# Exploratory and Confirmatory Factor Analysis Study for the Scale of Attitudes towards Chemistry Homework

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## **Abstract**

In this study, new items were added to the "Scale of Attitudes Towards Homework", which was developed by Yucel (2004) with the aim of determining secondary school students' attitudes towards chemistry homework tasks they are given. The final version of the scale was also analyzed in terms of its validity and reliability via the exploratory and confirmatory factory analysis. For the reformation of the assessment tool, the sampling (n=250) was enhanced up to 630 secondary school students. Following steps were taken in the development of the Scale of Attitudes Towards Chemistry Homework Tasks: (1) Literature review and construction of the item pool, (2) Taking expert opinions, (3) Total correlations of items, (4) Item distinctiveness, (5) Exploratory factor analysis, (6) Guttman Spithalf coefficient internal consistency reliability obtained through Cronbach Alpha and Split-half method. (7) Examination of the correlations between subscales (8) Confirmatory factor analysis. The Cronbach Alpha reliability coefficient of the scale was calculated to be .85 and the conclusions of the confirmatory factor analysis supported the structure with three subdimensions. Confirmatory factor analysis concluded that the model had an acceptable fit value and the scale was reliable and valid in terms of determining positive and negative attitudes of students towards chemistry homework tasks. In other words, the final version of the scale was found to be reliable and valid in terms of determining the attitudes of secondary school students towards homework.

## **Keywords**

The scale of attitudes towards chemistry homework tasks, reliability, validity, exploratory factor analysis, confirmatory factor analysis.

## Introduction

Academic achievement levels of students have been accepted as an important indicator of the education system in Turkey as well as many countries. With the aim of determining the failures and elements in need of improvement within the education system, homework has been a common topic of evaluation activities. Homework is a task given to students to perform outside the school for enhancing and enabling the permanence of the learnt knowledge or experiences. Students take the advantage of homework studies by reinforcing their knowledge when revising or solving problems through focusing on the points they miss during the lessons (Sarigöz, 2011). Homework, as one of the most efficient learning activity outside the school, is a functional tool when students lack the adequate time for individual work or practice in the classroom due to high number of students in a classroom or lack of time allocated (Yucel, 2004). Students, who complete their homework tasks timely, not only revise what they learn during the lesson but also develop their own ways of studying for reviewing the topics (Paulu & Perkinson, 1995). Homework tasks are not necessarily written activities. Students should be able to use new tools and perform new experiments. Hence, further observation and experiments facilitate students in becoming aware of their knowledge and skills while affecting their development on the positive (Bryan & Burstein, 2004; Cooper, 2001; Macbet, 2003; Swanson, 2001).

Constructivist approach, as one of the latest trends in education, has affected the visions of many countries by its focus on the knowledge, construction of the knowledge and its usage (Acat, Anılan & Anagun, 2007). It has been embraced in Turkey starting from the 2004-2005 academic year. Major changes in educational approaches and practices require the reflection of these changes in the homework tasks given to students. Students' roles in the constructivist approach are to research, examine, evaluate and learn on their own while teachers take the role of guides as experts. This causes the constructivist approach to be considered as an approach involving irregularity and lacking order. However, constructivist approach requires more order in the classroom than traditional approaches, which may sometimes be complex for the inexperienced teachers (Foote, Brophy & Battaglia, 2001; Karacaoğlu, 2010). Similarly, homework tasks assigned by inexperienced teachers remain meaningless and dysfunctional for students. Constructivist approach requires the assignment of homework tasks, which enable students to transfer knowledge into new situations, make comparisons, share knowledge and aim further than simply accomplishing activities and presenting them in the classroom (Cooper, Lindsay, Nye & Greathouse, 1998; Cooper, 2001; Corno, 2000; Gill & Shlossman, 1996).

Homework assignments do not only provide the revision of the topics. They serve various aims such as decreasing the possibility of forgetting, reinforcing learnt topics, keeping students' minds active, developing research and expression skills, enabling students to organize their ideas, teaching students to reach the sources of knowledge, ensuring the attainment of problem solving skills, making cause and effect connections and improving self confidence levels (Cooper, 2001; Doyle & Barbar, 1990; Fehrman, Keith, & Reimers, 1987; Foyle & Bailey, 1985; Gur, 2002; Hong, 1998; Kathleen, 2001; Krapp, 1988; Kucukahmet, 2004; Neilson, 2005; Okutan, 1990; Onal, 1995; Smith, 1989; Tan, 2005; Temel 1989; Yesilyurt,

2006). It is very important to assess to what extent these goals are achieved as well as the effectiveness of the practice at all levels (Aladag & Dogu, 2009; Batan, 2007; Buyuktokatli, 2009; Cahit & Dogan, 2009; Cetinkaya, 1992; Gur, 2002; Kapikiran & Kiran, 1999; Kiciroglu, 2004; Ocal, 2009; Sarigoz, 2011; Yesilyurt, 2006; Yucel, 2004; Yucel, 2008). In the light of this view, the "Scale of Attitudes Towards Homework", which was developed by Yucel (2004) with the aim of determining attitudes of secondary school students towards chemistry homework tasks was improved. In order to increase the reliability of the data obtained from the scale, the number of items were increased by addition of items, which are thought to exemplify the qualities to be assessed and distinguish between sub-categories. The sampling group (n=250) was extended (n=630). The reliability and validity studies were repeated through exploratory and confirmatory factor analysis. It is assumed that the assessed data shall depend on a single treat as much as possible. However, considering the content of each item, it is difficult to say that it assesses a single dimension (Ozguven, 2004). Therefore, the scale, which had a single dimension in the previous version, was analyzed for potential explanation on various variables in meaningful, interrelated and independent factors that are less in number (Cronbach, 1990; Hair, Black, Babin, Anderson & Tatham, 2006; Nunnally, 1967). According to Cokluk, Sekercioğlu and Buyukozturk (2010) knowledge about the structure of assessment could increase with the exploratory factor analysis. However, in order to obtain detailed knowledge, this analysis could remain inadequate. Therefore, many studies involve both exploratory and confirmatory factor analysis as they have known and unknown variables. In order to display the factor pattern of the assessment tool, it is required that confirmatory analysis shall be administered along with the exploratory analysis. Hence, the new version of the scale was applied confirmatory factor analysis in order to assess whether it supported the expected structure or not.

## **Methods**

This study aimed to develop a Likert-type scale by restructuring the "Scale of Attitudes Towards Homework" developed by Yucel (2004) with the aim of determining secondary school students' attitudes towards chemistry homework tasks. To achieve this aim, a total of 630 (487 female and 143 male) students studying at 9th, 10th, 11th and 12th grades of general secondary schools were selected as sampling. As Tabachnick and Fidell defines 300 participants as "good", 500 as "very good", and "1000" as "perfect" number of sampling in factor analysis, the pilot study concluded that adequate data were obtained for the statistical analysis.

## **Results of Research**

### **Preparation of the Data Collection Tool**

Since it is impossible to observe behaviors of individuals directly, attitudes could be derived from their observable behaviors (Tavşancil, 2010). The "Scale of Attitudes Towards Chemistry Homework Tasks" was developed in the light of this assumption. Following steps were taken in the development of the Scale of Attitudes Towards Chemistry

Homework Tasks: (1) Literature review and construction of the item pool, (2) Taking expert opinions, (3) Total correlations of items, (4) Item distinctiveness, (5) Exploratory factor analysis, (6) Guttman Spithalf coefficient internal consistency reliability obtained through Cronbach Alpha and Split-half method. (7) Examination of the correlations between subscales (8) Confirmatory factor analysis.

### **Review and Item Pool Construction**

The most important challenge in developing an original scale is writing items appropriate to the theoretical structures of characteristics to be assessed. Therefore, the theoretical structures of characteristics shall be well-examined and researched in terms of dimensions. Otherwise, obtained data may fail to support the theoretical structures of the characteristic (Seker & Gencdogan, 2006). Therefore, during the preparation of the Scale of Attitudes Towards Chemistry Homework Tasks the theoretical structure was carefully examined with the aim of constructing the scale format (Cooper, 2001; Corno, 2000; Cowan, & Hallam, 1999; Kralovec & Buell, 2001; Mengel, Holchroft & Okan, 1989; Zahn, 1966); similar scales with different sampling were searched (Berberoglu, 1990; Gramling, 2011; Sarigoz, 2011; Xu, 2007) and statistical resources for developing a data collection tool were analyzed (Bindak, 2005; Cokluk, Sekercioğlu & Buyukozturk, 2010; Cronbach, 1990; Hair, et al., 2006; Kalayci, 2006; Nunnally, 1967; Ozguven, 2004; Tabachnick & Fidell, 1996, 2001). Then, the obtained statements were added to the scale previously developed by Yucel (2004). More than a single item was considered for each attitude to be questioned. Moreover, attitude items were reorganized in terms of sentence length and Turkish grammatical structure. An item pool of 30 items, which were thought to be adequate for distinguishing and to exemplify the attitudes to be assessed, was created. The direction of an attitude means its emotional characteristic such as displaying likes or dislikes as well as positive and negative feelings. The degree of an attitude reflects the acceptance or refusal according to the level of its direction (Ozguven, 2004). Therefore, it was decided that the Scale of Attitudes Towards Chemistry Homework Tasks shall be in 5-point Likert-type, which is common in the field of social sciences.

### **Taking Expert Opinions**

For providing the content validity of the Scale of Attitudes Towards Chemistry Homework Tasks, expert opinions were taken. Experts examined the scale in terms of its capacity to assess students' attitudes towards chemistry homework tasks successfully as well as its appropriateness to the age levels of secondary school students. The number of items was reduced according to the expert opinions and a total of 26 items were obtained with 14 positive and 12 negative attitude contents.

### **Application Stage**

Legal permissions were taken from the Ankara City Directorate of Education for applying the study in the certain secondary schools. Randomly chosen 630 students formed the sampling of the pilot study. The data obtained were analyzed in terms of students' responses to all items or a single one as a means of pre selection. As a result of this stage, 607 data were uploaded to computers for evaluation purposes regarding the analysis. Since the analyses would be done via SPSS 15.0 and Lisrel 8.7, the positive items of the scale were coded from 5 to 1 indicating "Strongly agree" to "Strongly disagree". Negative items were coded from 1 to 5

5 on the opposite way. Therefore, the highest score that could be obtained from the trial format was 130 and the lowest was 26. The statistical results regarding the reliability and validity analysis of the scale are explained in the following related sections of this paper.

### Item Analysis

Item analysis is one of the statistical analyses made in scale development studies. Item analysis is made with the aim of removing or revising the ineffective items in a data collection tool (Ozguven, 2004) and it presents strong data on the structural validity of the scale. Therefore, item-total correlation-based item analysis was made for the validity and reliability studies of the Scale of Attitudes Towards Chemistry Homework Tasks along with the independent group-t test made for the comparison of 27% sub group, main group and item scores. Students' scores were listed from highest to lowest and top 163 students, which formed the 27% of the sampling, were coded as main group (1), while the last 163 students were coded as sub-group (2). The values obtained from the evaluation of the scale are displayed on Table 1.

Table 1. Item analysis values of scale of attitudes towards chemistry homework tasks.

|   | 1: Main<br>2: Sub | $\bar{X}$ | t*  | Item total<br>Correlation |    | 1:Main<br>2: Sub | $\bar{X}$ | t*  | Item total<br>Correlation |
|---|-------------------|-----------|-----|---------------------------|----|------------------|-----------|-----|---------------------------|
| 1 | 1                 | 3.75      | 10  | .41                       | 14 | 1                | 3.92      | 9.1 | .33                       |
|   | 2                 | 2.32      |     |                           |    | 2                | 2.69      |     |                           |
| 2 | 1                 | 3.88      | 12  | .45                       | 15 | 1                | 3.62      | 8.4 | .37                       |
|   | 2                 | 2.34      |     |                           |    | 2                | 2.47      |     |                           |
| 3 | 1                 | 3.00      | 3   | .10                       | 16 | 1                | 3.43      | 6.9 | .31                       |
|   | 2                 | 2.51      |     |                           |    | 2                | 2.50      |     |                           |
| 4 | 1                 | 4.18      | 12  | .47                       | 17 | 1                | 3.84      | 12  | .44                       |
|   | 2                 | 2.67      |     |                           |    | 2                | 2.34      |     |                           |
| 5 | 1                 | 4.12      | 13  | .49                       | 18 | 1                | 3.96      | 12  | .47                       |
|   | 2                 | 2.53      |     |                           |    | 2                | 2.51      |     |                           |
| 6 | 1                 | 3.56      | 8   | .31                       | 19 | 1                | 3.99      | 12  | .46                       |
|   | 2                 | 2.45      |     |                           |    | 2                | 2.47      |     |                           |
| 7 | 1                 | 4.01      | 11. | .46                       | 20 | 1                | 3.61      | 8.3 | .35                       |
|   | 2                 | 2.60      |     |                           |    | 2                | 2.55      |     |                           |
| 8 | 1                 | 3.55      | 5   | .24                       | 21 | 1                | 3.89      | 11  | .44                       |
|   | 2                 | 2.75      |     |                           |    | 2                | 2.49      |     |                           |
| 9 | 1                 | 4.11      | 14. | .48                       | 22 | 1                | 3.49      | 7.5 | .26                       |
|   | 2                 | 2.42      |     |                           |    | 2                | 2.44      |     |                           |

|    |   |      |     |     |    |   |      |     |     |
|----|---|------|-----|-----|----|---|------|-----|-----|
| 10 | 1 | 4.07 | 13. | .49 | 23 | 1 | 3.77 | 10  | .43 |
|    | 2 | 2.40 |     |     |    | 2 | 2.46 |     |     |
| 11 | 1 | 4.19 | 10. | .41 | 24 | 1 | 3.61 | 8.1 | .36 |
|    | 2 | 2.87 |     |     |    | 2 | 2.50 |     |     |
| 12 | 1 | 4.25 | 14. | .49 | 25 | 1 | 3.61 | 9.4 | .35 |
|    | 2 | 2.54 |     |     |    | 2 | 2.33 |     |     |
| 13 | 1 | 4.02 | 10  | .44 | 26 | 1 | 3.01 | 3.1 | .11 |
|    | 2 | 2.68 |     |     |    | 2 | 2.53 |     |     |

\*p<.01

As Table 1 displays, the t-value of the difference between the attitude score averages of main and sub groups for each item was calculated and significant differences between the groups were examined. Moreover, the item-total correlation coefficient values were examined and found to change between .10 and .49. In item analysis, in order to protect the summability aspect of the scale, it has to be higher than .25 (Ozdamar, 1997). According to the analysis results, the item total correlations of items 3, 8 and 26 had values lower than .25. Therefore, these items were removed from the scale as they destroyed the internal consistency of the scale. The validity and reliability degree of the scale depends mainly on the quality and qualifications of its items. Therefore, good items were chosen through item analysis and the reliability and validity of the data collection tool were ensured (Ozguven, 2004).

### Exploratory Factor Analysis

In order to obtain proof for the structural validity of the Scale of Attitudes Towards Chemistry Homework Tasks, exploratory factor analysis was applied. This factor analysis is used when turning various interrelated variables into meaningful and independent factors, which are less in number (Hair, et al., 2006). However, in order to decrease the possible problems, the size of the sampling and normality require to be questioned before the exploratory factor analysis studies (Cokluk, Sekercioglu & Buyukozturk, 2010). Therefore, the appropriateness of the data structure for the factor analysis in terms of sampling size was assessed through Kaiser-Meyer-Olkin measure of sampling adequacy test. The normal distribution of the data was tested with the Barlett globalization test values.

Table 2. Scale of attitudes towards chemistry homework tasks and barlett test analysis results.

|   |          |        |
|---|----------|--------|
| Kaiser Meyer Olkin Measure of Sampling Adequacy |          | .849   |
| Barlett Globalization Test                      | $\chi^2$ | 3913.0 |
|   | df       | 210    |
|   | p        | .000   |

Table 2 displays that the Kaiser-Meyer-Olkin sampling value was calculated to be 0.84 and the Barlett Globalization Test result was found to be significant [ $\chi^2 = 3913$ ;  $p < .01$ ]. Kaiser-This is described as "good" in the literature (Hair et al, 2006; Tavsancil, 2010) and the

appropriateness of the data structure were proven. Principal components analysis was applied as the most frequently used factorization techniques of exploratory factor analysis (Tabachnick & Fidel, 2001). The Varimax Vertical rotation technique was used for rotation and 3 factors were found to have eigenvalues ( $\lambda$ ) higher than 1.00. Later, the overlapping of the items and their factor loading values were evaluated according to the literature (Cokluk, Sekercioglu & Buyukozturk, 2010; Hair et al., 2006; Tabachnick & Fidel, 2001) and the items with factor loading values equal to 0.40 or higher, and the items with more than .01 differences in their both loading values were determined. Therefore 21 items with factor loading values between .46 and .83 were included in the final version of the scale while items 7 and 17 were removed from the scale as they could not match the literature scope.

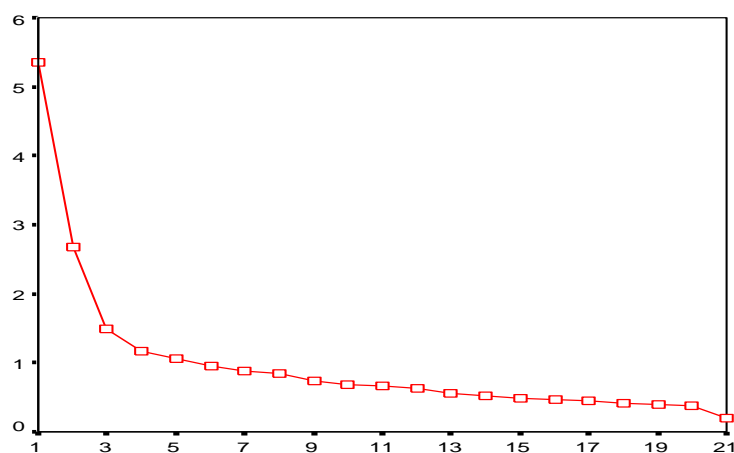


Figure 1. Scree plot for scale of attitudes towards chemistry homework tasks

According to the Scree Plot, which serves to the major aim of the factor analysis and helps in determining the number of factors according to its contributions to the variance (Cokluk, Sekercioglu & Buyukozturk, 2010), the point where the graphic curve has an instant fall is where the third factor is located. Therefore, the items of the Scale of Attitudes Towards Chemistry Homework Tasks were decided to be listed under three factors. One of these factors was called "Usefulness" with its content of benefits of chemistry homework tasks. The second factor with negative attitudes was named as "Negativity" and the third factor with items containing positive attitudes was called "Positivity". Some values obtained from the exploratory factor analysis are displayed on Table 3.

Table 3. Exploratory factor analysis on the scale of attitudes towards chemistry homework tasks.

| Factors               | Factor Loading | $\lambda$ | Described percentage of differences | Average | F    | $\alpha$ | P     |
|-----------------------|----------------|-----------|-------------------------------------|---------|------|----------|-------|
| Factor 1 (Usefulness) |                | 5.3       | 20.2                                | 3.36    | 9.04 | .84      | .0001 |
| 11                    | .759           |           |                                     |         |      |          |       |
| 12                    | .690           |           |                                     |         |      |          |       |

|                       |      |     |      |     |      |           |
|-----------------------|------|-----|------|-----|------|-----------|
| 9                     | .689 |     |      |     |      |           |
| 10                    | .685 |     |      |     |      |           |
| 19                    | .620 |     |      |     |      |           |
| 13                    | .601 |     |      |     |      |           |
| 21                    | .601 |     |      |     |      |           |
| 4                     | .596 |     |      |     |      |           |
| 5                     | .526 |     |      |     |      |           |
| 18                    | .516 |     |      |     |      |           |
| Factor 2 (Negativity) |      | 2.6 | 13.9 | 3.0 | 7.07 | .74 .0001 |
| 15                    | .725 |     |      |     |      |           |
| 16                    | .684 |     |      |     |      |           |
| 20                    | .613 |     |      |     |      |           |
| 6                     | .594 |     |      |     |      |           |
| 24                    | .579 |     |      |     |      |           |
| 25                    | .530 |     |      |     |      |           |
| 14                    | .525 |     |      |     |      |           |
| 22                    | .464 |     |      |     |      |           |
| Factor 3 (Positivity) |      | 1.4 | 11.0 | 3.1 | 7.0  | .72 .0001 |
| 1                     | .831 |     |      |     |      |           |
| 2                     | .819 |     |      |     |      |           |
| 23                    | .515 |     |      |     |      |           |

Kaiser-Meyer-Olkin Measure of Sampling= 0.84; The (variance) explanation rate of the total difference: 45.315

Table 3 displays that the factor loading of items grouped under the structure with three factors had higher values than acceptable and the variance explanation score of the three factors was found to be 45.31%. This value is described as adequate in social sciences (Scer et.al., 1988; adapted by Tavsancil, 2005). Similarly, the contribution of the factors to the total variance was 20.2% for the first factor, 13.9% for the second factor and 11% for the third factor, which is adequate. These findings show that the Scale of Attitudes Towards Chemistry Homework Tasks has a strong factor structure. In order to assess whether the three sub-dimensions of the Scale of Attitudes Towards Chemistry Homework Tasks



addressed the same characteristics, Pearson Multiplication of Moments was calculated among the three factors. The findings are displayed on Table 4.

Table 4. The correlation coefficients of scale of attitudes towards chemistry homework tasks factors.

| Factor     | Usefulness | Negativity | Positivity |
|------------|------------|------------|------------|
| Usefulness | 1          | .21        | .52        |
| Negativity | .21        | 1          | .22        |
| Positivity | .52        | .22        | 1          |

$p < .01$

Table 4 shows that there are positive significant relationships between the factors of the scale. In other words, factor variables were found to be supportive of each other ( $r = .52$ ,  $r = .21$ ,  $r = .22$ ,  $p = 0,0001$ ).

#### **The Reliability Study of the Scale of Attitudes Towards Chemistry Homework Tasks**

For the reliability analysis of the Scale of Attitudes Towards Chemistry Homework Tasks, Cronbach Alpha Coefficient and Split Half reliability analysis was administered to the whole scale and all sub dimensions. The statistical analysis concluded that the Cronbach Alpha ( $\alpha$ ) was .85 and the Guttman Splithalf coefficient determined via the Split-half method was 0.84. This is another finding that the scale is reliable (Nunnally, 1967). Additionally, The Cronbach Alpha Reliability Coefficient was calculated for the first sub-dimension as .84, for the second sub-dimension as .74 and for the third sub-dimension as .72. This shows that all items of the Scale of Attitudes Towards Chemistry Homework Tasks are consistent. Shortly, the reliability analysis resulted that the Scale of Attitudes Towards Chemistry Homework Tasks was reliable enough to be accepted in research on the social sciences.

#### **Confirmatory Factor Analysis**

Following the exploratory factor analysis, confirmatory factor analysis was made for questioning the validity of the obtained structure. For displaying the factor pattern of the assessment tool, it is required to analyze the assessment tool through confirmatory techniques (Cokluk, Sekercioglu & Buyukozturk, 2010). The 3-dimensional structure of the scale was tested for confirmation through the structural equality modeling technique. The Path Diagram obtained from the Lisrel 8.7 software is displayed on Figure 2.

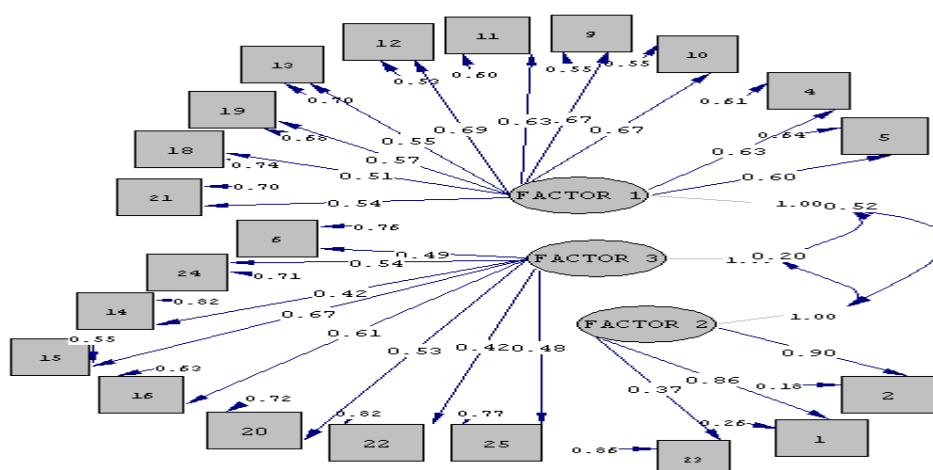


Figure 2. Path diagram for scale of attitudes towards chemistry homework tasks.

The model was questioned based on the literature in terms of its production of acceptable values (Brown, 2006; Byne, 1994; Cokluk, Sekercioglu & Buyukozturk, 2010; Hair, et al., 2006; Hooper, Caughlan & Muller, 2008; Joreskog & Sorbom, 1993; Schumacker & Lomax, 1996; Sumer, 2000; Tabachnick & Fidell, 2001; Kline, 2005; Raykov & Marcoulides, 2008; Yilmaz & Celik, 2009), and the results were shown on Table 5.

Table 5. Fit measures of the model

| Fit Measure | Value | Fitting    |
|-------------|-------|------------|
| $\chi^2/df$ | 3.0   | Good       |
| RMSEA       | .060  | Good       |
| GFI         | .090  | Good       |
| AGFI        | .087  | Acceptable |
| RMR         | 0.05  | Good       |
| NFI         | 0.91  | Good       |
| NNFI        | 0.93  | Good       |
| CFI         | 0.94  | Good       |

The model was found to have acceptable fit values as a result of the confirmatory factor analysis as displayed on Table 5. In other words, the confirmatory factor analysis results supported the finding that the scale has three dimensions. These findings show that the scale is a reliable and valid data collection tool in determining students' attitudes towards chemistry homework tasks.

## Results of Research

Many variables could be assessed in education. However, this requires assessment tools, which facilitate the observation of the size to be assessed and its mathematical expression. Each tool enables the observation to be made more sensitively. Assessment tools used in education vary according to the structure of the size to be assessed and the group that the

tool shall be administered to. For assessment, the assessment tools appropriate to the goal of the evaluation shall be selected or developed (Turgut, 1995). In the light of this view, the "Scale of Attitudes Towards Homework", which was developed by Yucel (2004) with the aim of determining attitudes of secondary school students towards chemistry homework tasks was improved with the addition of new items<sup>2</sup>.

The reliability and validity were analyzed for the final version of the study. In construction and changing of attitudes, educational institutions and teachers have important effects (Tavşancıl, 2010). However, while questioning these effects, students' attitudes shall also be determined. Therefore, various assessment tools have been developed and applied with the aim of assessing students' attitudes towards chemistry homework tasks (Berberoglu, 1990; Gramling, 2011; Gurlevik, 2006; Oguz, 2010; Sarigoz, 2011; Tilgel, 2010; Xu, 2007; Yucel, 2004). In this study, the scale that was developed by Yucel (2004) was restructured to serve better to analyzing students' attitudes towards chemistry homework tasks from different perspectives. For displaying the factor pattern of the tool, both exploratory and confirmatory factor analyses were applied. The process of improving the Scale of Attitudes Towards Chemistry Homework Tasks was initiated with the literature review and item pool construction. The previously prepared pool of 45 items was reevaluated and an item pool of 30 items was obtained. After taking the expert opinions, the number of items decreased to 26. A pilot study was made with the participation of 630 secondary school students. The data were evaluated and 607 data were found to be appropriate to analysis. Statistical analysis started with item analysis. Item-total correlation-based item analysis was made for the validity and reliability studies of the Scale of Attitudes Towards Chemistry Homework Tasks along with the independent group-t test made for the comparison of 27% sub group, main group and item scores. Factor analysis stage followed the item analysis. Prior to the exploratory factor analysis, in order to test the sampling size for appropriateness in factorization, Kaiser- Meyer- Olkin test was applied and the result was found to be 0.84. This showed that the sampling size was adequate for factor analysis (Hair et.al., 2006). Moreover, the Barlett Globalization Test results concluded with a qhi-square value of significance at the 0.0001 level [ $\chi^2 = 3913.005$ ]. Principal components analysis and Varimax Vertical Rotation technique were used for the exploratory factor analysis. The analyses concluded with three factors with eigenvalues ( $\lambda$ ) higher than 1.00. In the end, 21 items with factor loading values between .46 and .83 were included in the scale, while the items 7 and 17 were removed as they failed to comply with the acceptability standards. The three dimensional structure of the Scale of Attitudes Towards Chemistry Homework Tasks was made certain with the Scree Plot Graph. The first of these factors was called "Usefulness" with its content of benefits of chemistry homework tasks. The second factor with negative attitudes was named as "Negativity" and the third factor with items containing positive attitudes was called "Positivity".

The Scale of Attitudes Towards Chemistry Homework Tasks was found to have a strong factor structure as their factor loadings were found to be higher than acceptable values and the explanation rate of the three factors was adequate being 45.31%. In order to assess

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<sup>2</sup> Developed scale can be found at the corresponding author's e-mail (Contact:aysemseda@gmail.com).

whether the three sub-dimensions of the Scale of Attitudes Towards Chemistry Homework Tasks addressed the same characteristics, Pearson Multiplication of Moments was calculated among the three factors. The analysis concluded with the determination of positive relationship among the factors ( $r = .52$ ,  $r = .21$ ,  $r = .22$ ,  $p = 0,0001$ ). This finding was accepted as supportive of the consistent factor structure of the scale. The reliability of the scale was analyzed through Cronbach Alpha Coefficient and Split Half, which concluded with the Cronbach Alpha ( $\alpha$ ) as .85 and the Guttman Splithalf coefficient determined via the Split-half method as 0.84. This is another finding that the scale is reliable (Nunnally, 1967). Additionally, The Cronbach Alpha Reliability Coefficient was calculated for the first sub-dimension as .84, for the second sub-dimension as .74 and for the third sub-dimension as .72. This shows that all items of the Scale of Attitudes Towards Chemistry Homework Tasks are consistent. Finally, the three-dimensional structure obtained was confirmed via the structural equality modeling. Confirmatory factor analysis concluded that the model had an acceptable fit value ( $\chi^2/df=3$ , RMSEA=0.06, GFI=0.90, AGFI=0.87, RMR= .050, NFI= 0.91, NNFI= 0.93, CFI= 0.94) and the scale was reliable and valid in terms of determining positive and negative attitudes of students towards chemistry homework tasks. However, the administration of the Scale of Attitudes Towards Chemistry Homework Tasks could be applied to a greater number of students from different cities of Turkey for further contribution to both the scale and the subject field.

### Acknowledgements

Along with the effects of homework tasks on secondary school students' achievements, their attitudes should also be determined. Therefore, this restructured scale is thought to serve the literature as a reliable and valid assessment tool in determining students' attitudes. Determination of the dimensions of the attitudes is thought to have various benefits for the researchers of the subject field. With the help of the developed assessment tool, secondary schools students' attitudes towards their homework tasks would be able to be analyzed in terms of their different dimensions. Determination of students' attitudes through the scale would set a great resource for teachers in assigning homework tasks for their students. Therefore, determination of students' attitudes through the scale and the analysis of the obtained data are thought to contribute not only the literature but also the whole world of education.

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