http://www.eab.org.tr

Educational Research Association
The International Journal of
Educational Researchers 2015, 6 (2) : 15-31
ISSN: 1308-9501

http://ijer.eab.org.tr

The Comparison of 7th Grade Students' Scores Achieved Through Different Assessment Tools in "The Granular Structure of Matter" Unit

(7. Sınıf Maddenin Tanecikli Yapısı Ünitesinde Farklı Ölçme Araçları ile Yapılan Ölçümlerin Karşılaştırılması)

Cigdem AKKANAT[1]
Sevilay KARAMUSTAFAOGLU [2]
Murat GÖKDERE[3]

Abstract

Comparative relational screening method was used in this study, in which complementary assessment tools were used to measure the 7th grade students' success in the unit entitled "The Granular Structure of Matter". The study was carried out with 23 participants, 7th grade students studying in Hamamözü in Amasya. The tools prepared for this study included achievement tests, diagnostic branched trees, structured grids and knowledge maps. At the end of the unit, the participants were asked to create concept maps about the concepts they had learned throughout the unit, and then these concept maps were evaluated. The differences in students' scores achieved for various assessment tools were analyzed and it was found that there was a significant difference among all the assessment tools except for knowledge maps and concept maps. It was seen that the students were less successful in diagnostic branched trees compared to the others. Finally, some suggestions for educators were made.

Keywords: Science and technology course, 7th grade, complementary assessment tools, concept maps.

Özet

Tamamlayıcı ölçme araçlarının 7. Sınıf öğrencilerinin 'Maddenin Tanecikli Yapısı' ünitesindeki başarılarını ölçmede kullanıldığı bu çalışmada ilişkisel tarama modeli kullanılmıştır. Araştırma Amasya ili Hamamözü ilçesinde öğrenim görmekte olan 23 7. Sınıf öğrencisi ile yürütülmüştür. Araştırmada başarı testi, tanılayıcı dallanmış ağaç, yapılandırılmış grid ve bilgi haritaları geliştirilmiştir. Ünite sonunda öğrencilerden ünite boyunca öğrendikleri kavramlar ile ilgili sınıfta kavram haritaları oluşturmaları istenmiş ve bunlar yapısal olarak değerlendirilmiştir. Öğrencilerin farklı ölçme araçlarından aldıkları puanlar arasındaki farklılık incelenmiş; bilgi haritaları ve kavram haritası haricindeki tüm ölçme araçları için anlamlı farklılık bulunmuştur. Öğrencilerin oluşturdukları kavram haritalarının genellikle basit yapıda olduğu ve öğrencilerin çapraz bağlantı ve hiyerarşi kullanmada yetersiz kaldıkları görülmüştür. Araştırma sonuçlarına ilişkin, eğitimcilere çeşitli öneriler sunulmuştür.

Anahtar Kelimeler: Fen ve teknoloji dersi, 7. sınıf, tamamlayıcı ölçme araçları, kavram haritaları.

[1] Ministry of Education, Amasya, Turkey. cakkanat@gmail.com
[2] Amasya University, Turkey. sevilayt2000@yahoo.com
[3] Amasya University, Turkey. mgokdere@yahoo.com

Introduction

The alterations made in the curriculum of primary and elementary school level science and science and technology classes in the last ten years have prescribed the harmonious use of different approaches that give importance to individual differences in assessment and evaluation, reveal learning deficiencies and place skills such as creativity and creative thinking at the forefront. The assessment of achievements in high-level cognitive skills necessitated by the renewed curriculums requires the use of other assessment and evaluation tools along with the traditional ones. This is because learning deficiencies can be revealed more effectively when complementary assessment tools supporting educational activities are used, and these can be eliminated through various methods. Current assessment and evaluation approaches value not only summative evaluation but also formative evaluation, which deems the learning process important. Constructivist assessment and evaluation approaches are termed 'alternative' or 'complementary' in the literature (Bahar, Nartgün, Durmuş and Tekbıçak, 2012). Korkmaz (2004) regards complementary assessment and evaluation as a system that can define a learner's skills (in cognitive, affective and psychomotor aspects) in a more comprehensive way as it is based on realistic, performance-based, applicable and constructivist tests (as cited in Fidan & Sak, 2012). Since complementary assessment tools can assess high-level skills related to the solution of real-life problems, they enable a learner to be more participative, take initiative and develop self-discipline (Janisch, Liu & Akrofi , 2007). Portfolio, performance task, project, presentation, self-evaluation, peer-evaluation, group-evaluation, observation, interview, poster, rubric, structured grid, diagnostic branched tree, word association, checklist, concept map and knowledge map are some examples of complementary assessment tools. Some of the limitations of these tools can be listed as that the complementary and alternative assessment tools' validity and reliability are low, their content is limited, it requires more time to apply and evaluate them, teachers' proficiency in these tools is low and they are rarely used at schools (Baxter & Shavelson, 1994; Çakan, 2004; Lawrenz, 2001; Okur & Azar, 2011; Yeşilyurt, 2012).

Although traditional assessment and evaluation tools have higher validity and reliability, they are not enough to exactly reveal the learning level of students. Therefore, it is essential to use complementary assessment tools along with traditional ones adopting an integrated approach to overcome this problem.

Unfortunately, teachers in our country seem not to be knowledgeable enough about complementary assessment tools despite the emphasis on their use in the renewed curricula (Çoruhlu, Nas & Çepni, 2009; Güneş, Dilek, Hoplan, Çelikoğlu & Demir 2010). Some of these tools such as diagnostic branch trees, structured grids, concept maps and knowledge maps are rarely adopted by teachers at schools (Karamustafaoğlu, Çağlak & Meşeci, 2012; Kaya, Balay & Çeken, 2012; Sağlam-Arslan, Avcı & İyibil, 2008).

Structured grids are an alternative to multiple choice tests. They are composed of rows and columns in a way that creates boxes. Either drawing or writing could be included depending on students' level and content of a task, and the students are expected to determine the box(es) with the correct answers (Johnstone, Bahar & Hansell, 2000). The number of boxes may vary according to students' development level.

A diagnostic branched tree includes some true and false statements, getting gradually more complex, and students are expected to choose the correct ones. Thus, a branched tree, ending with 8 or 16 statements to be chosen among, is created. This tool can be seen as an alternative to 'True/False tests'. With this technique, incorrect concepts can be better revealed.

Concept maps are defined as schematic diagrams suggesting meaningful relations between concepts (Novak & Gowin, 1984). The idea of concept map emerged in 1970s, and it was rooted in the studies on developing children's science concepts by J. Novak, who had been inspired from Ausubel's work (Novak & Cañas, 2006). As a technique, it was defined and developed for educational purposes by Novak (Novak & Gowin, 1984). Concept maps are about determining the borders of relationships between ideas. They start with a word, concept or statement representing the question to be answered (Novak & Cañas, 2006). Novak points out that concept maps can be used as (a) a learning strategy, (b) a teaching strategy, (c) a curriculum planning strategy, (d) and a tool for testing students' science-related concept learning in order to increase educational success.

According to McClure, Sonak and Suen (1999), teachers' making use of concept mapping strategy for assessment will enhance the assessment and evaluation approach in the following ways: Firstly, they are more effective in revealing students' misconceptions since they owe their susceptibility to mistakes resulting from (a) the natural structure of students' knowledge, (b) the factors hindering or deteriorating students' concept comprehension and (c) students' oblivion. Secondly, compared to traditional subjective assessment techniques (like performance tasks), concept mapping requires quite simple productive skills, and thus, poses less threat to proper assessment of students' knowledge. In their study evaluating the use of concept mapping as an alternative assessment tool in science education, Ruiz-Primo and Shavelson (1996) stated that the measurements based on concept maps consist of (1) a task providing an assessor with evidence on students' knowledge structure, (2) a particular format necessary for student answers (creating a concept map, filling in the gaps on a concept map, etc.), and (3) a point-scoring system needed for proper and consistent evaluation of students' concept maps. They further mentioned that concept mapping tasks can include various approaches like filling in the gaps in a concept map outline, creating concept maps, organizing concept cards, grading the relationship levels of concept pairs, writing an essay, or undertaking a survey.

Different approaches play a big role in obtaining more data on students' concept learning styles by enabling students to display gained knowledge in diverse ways. On the other hand, different from concept maps, knowledge mapping is a technique in which knowledge is exhibited through drawings, diagrams, graphs and articulation, and interactions between pieces of knowledge are shown in a relational way (Bacanak, Karamustaoğlu, Değirmenci & Karamustafaoğlu, 2011).

Some studies carried out using both traditional and alternative assessment and evaluation approaches are available in the literature. Lawrenz et.al. (2001) used different assessment formats (multiple-choice tests, a test consisting of open-ended questions, an applied laboratory test, and applied research) in order to assess the success of 9th grade students coming from various subgroups in the U.S.A. on a national basis in science, and they found out that different skills were tested when different assessment formats were used, and the success rates of subgroups in science varied accordingly. Kartal and Buldur (2007) compared the scores obtained through tests based on alternative assessment techniques with the ones received through traditional assessment and evaluation tools. They found that diagnostic branched tree was the tool the students were most successful at and structured grid was the one they were least successful at. Furthermore, when the test scores were compared, it was seen that they did better in the exams prepared through alternative assessment and evaluation techniques. Oğuz (2008) researched the relationship between the scores for assessment and evaluation portfolio in education of the students studying primary education and their achievement test and attitude scores, besides the gender-based variations in the scores, and identified a significant relationship between portfolio scores and achievement scores, and a significant difference between two genders, in favor of the females. Çetin and Çakan (2010) determined significant differences in 5th grade students' Science and Technology class success rates when different assessment tools were used. The study showed that the students did better at multiple-choice exams than they did at written exams and performance tasks. Buluş, Kırıkkaya and Vurkaya (2011) studied the effects of using structured grid, diagnostic branched tree and prediction-observation-explanation tools among alternative assessment and evaluation tools on the academic success and the attitude of 6th grade students, and they found a significant difference in their attitudes towards science and success in it.

No relevant research comparing the scores obtained through structured grid, diagnostic branched tree, knowledge map, concept map and achievement test together was encountered in the literature. Therefore, the purpose of this study is to compare the scores of the 7th grade students obtained through different assessment tools developed for 'The Granular Structure of Matter' unit.

Research Problem

Is there any significant difference between 7th grade students' scores for various assessment tools?

Sub-problems

1. Is there any significant difference between the achievement test scores and the ones for the structured grids, the diagnostic branched trees, the knowledge maps and the concept map?

2. Is there any significant difference between scores achieved for the structured grids and the ones achieved for the diagnostic branched trees, the knowledge maps and the concept map?

3. Is there any significant difference between scores obtained for the diagnostic branched trees and the ones achieved for the knowledge maps and the concept map?

4. Is there any significant difference between the scores for the knowledge maps and the concept map?

Method

Comparative relational screening method was used in this study. It aims at defining the participants, either individuals or objects, as they are in their own context. There is no possibility of grading in comparisons as there is in correlation. The validity possibility of the findings is high since the researcher carried out the study in the natural environment (Karasar, 2014).

Subjects

The research group consists of 23 7th grade students, 15 girls and 8 boys, studying in Hamamözü, Amasya during 2012-2013 academic year. Considering transportation, time and ease of implementation, convenience sampling method was used.

Data Collection Tools

An achievement test, knowledge maps, structured grids, diagnostic branched trees and a concept map prepared by the researchers, considering the objectives of the unit 'The Granular Structure of Matter' for the 7th grade Science and Technology Course in 2012-2013 academic year, were used as data collection tools. In addition, the students were provided with 2-hour training on the purpose, nature and drawing principles of concept mapping, and a 3-hour application study on various topics aiming to draw concept maps properly was carried out with the students. At the end of the unit, the students were asked to create a concept map about the matter unit. The features of the tools used in the study are as follows.

The Achievement Test

In order to prepare the questions in the test, the unit objectives were categorized according to Bloom's taxonomy. Later, 32 questions about the objectives were written, after preparing and analyzing the table of specifications for the unit. To provide content validity, these questions were investigated by 2 teachers who have masters in science education and 3 professors, and they were approved. The test was later given to 64 7th grade students studying at two different elementary schools. As a result of item analysis, 7 questions were omitted, and the final version of the test was prepared. The relationship between the unit objectives and the questions in the achievement test is shown in the Table 1.

Table 1

The distribution of the questions in the achievement test in accordance with the objectives

Objectives	Question number(s)
1.1. Noticing that all the atoms of an element are the same on a model	6
1.2. Intuiting that the atoms of different elements are different using a model or shapes	6
1.3. Listing the first 20 elements of the Periodic Table and the names of the common elements encountered in daily life.	4
1.4. Realizing that showing the elements using symbols eases scientific communication.	4
1.5. Stating the symbols when the names of the first 20 elements of the Periodic Table and the names of the common elements encountered in daily life are given, or vice versa.	4
2.1. Defining the atoms in touch with each other as "bonded atoms"	15
2.2. Deducing that an atom is made up of relatively simpler elements basing it on frictional electrification	1
2.3. Showing nucleus, basic atomic particles and electrons in representative pictures.	1
2.4. Comparing electron, proton and neutron in terms of mass and charge	1
2.5. Relating proton and electron numbers in neutral atoms	2
2.6. Stating that the proton number (atomic number) of the same element's atoms is always the same, while the neutron number can change at the very least	2
2.7. Stating that the electrons' distances from the nucleus in the same atom can vary	2
2.8. Showing electron shells on drawn atom models and counting electron numbers outwards in each shell	2, 10

Table 1. Contd.

Objectives	**Question number(s)**
2.1. Defining the atoms in touch with each other as "bonded atoms"	15
2.2. Deducing that an atom is made up of relatively simpler elements basing it on frictional electrification	1
2.3. Showing nucleus, basic atomic particles and electrons in representative pictures.	1
2.4. Comparing electron, proton and neutron in terms of mass and charge	1
2.5. Relating proton and electron numbers in neutral atoms	2
2.6. Stating that the proton number (atomic number) of the same element's atoms is always the same, while the neutron number can change at the very least	2
2.7. Stating that the electrons' distances from the nucleus in the same atom can vary	2
2.8. Showing electron shells on drawn atom models and counting electron numbers outwards in each shell	2, 10
2.9. Drawing the electronic configuration model of light atoms with a known number of protons ($Z\leq20$)	2,3,8
2.10. Comprehending the historical development of atomic models, and realizing that electron cloud model is the most realistic perception	9
2.11. Noticing that scientific models are valid as long as they explain observed Phenomena and to the degree they do so, and these models don't necessarily claim to exactly match with the reality	9
3.1. The atoms with eight electrons on the outer shell are not inclined to exchange electrons (stable)	2,8
3.2. Identifying the atoms inclined to exchange electrons	5
3.3. Guessing how many electrons an atom can give up or get looking at the electronic shell configuration	5,10
3.4. Deducing that atoms are positively charged when they give up electrons, and negatively charged when they get them	5
3.5. Naming the charged atoms as ions.	3
3.6. Naming positively-charged ions as cation and negatively-charged ones as anion	3, 7
3.7. Knowing the names and formulas of common polyatomic ions	7, 16
4.1. Relating closeness among atoms to chemical bond concept	11, 12
4.2. Guessing attraction and repulsive forces between ions, and naming forces of attraction as "ionic bond"	11,12, 13
4.3. Naming a bond formed through electron-sharing as "covalent bond"	12, 15
4.4. Explaining why nobel gases don't form chemical bonds	8
4.5. Drawing molecular models of H_2, o_2 and N_2 formed through electron-sharing	15
4.6. Showing the molecule and atom on a molecular solid crystal model or its picture	6, 17
4.7. Relating covalent bonds and molecules to each other	15
5.1. Noticing that different atoms can combine and form new substances	14
5.2. Recognizing that there are at least two elements in each compound	6
5.3. Showing atoms or molecules on a molecular compound model or its picture	6
5.4. Specifying the ratio of atomic number of each element in molecules, and the ratio of atomic numbers of elements in lattice structures	16
5.5. Writing the formulas of simple ionic and some covalent compounds encountered frequently in daily life	15
5.6. Giving examples of elements and compounds consisting of molecules	14
6.1. Noticing that there are more than one element or compound in mixtures	18, 19
6.2. Explaining the difference between heterogeneous mixture (suspension) and homogenous mixture (solution)	19

Table 1. Contd.

Objectives	Question number(s)
5.4. Specifying the ratio of atomic number of each element in molecules, and the ratio of atomic numbers of elements in lattice structures	16
5.5. Writing the formulas of simple ionic and some covalent compounds encountered frequently in daily life	15
5.6. Giving examples of elements and compounds consisting of molecules	14
6.1. Noticing that there are more than one element or compound in mixtures	18, 19
6.2. Explaining the difference between heterogeneous mixture (suspension) and homogenous mixture (solution)	19
6.3 Giving examples of solid, liquid and gas substances' solutions in liquids	23
6.4. Explaining the interaction between solvent molecules and solute ions or molecules	22, 23
6.5. Realizing the dissolution process accelerates as the temperature gets higher	22
6.6. Discovering that the smaller solute grain (particle) size becomes, the faster dissolution gets	21
6.7. Classifying solutions as concentrated and dilute solutions	20
6.8. Showing how to dilute and/or concentrate solutions by experiment	20
6.9. Demonstrating by experiment that some solutions conduct electricity, and explaining the difference between electrolytic and non-electrolytic substances	23,24, 25
6.10. Explaining the reason why rainwater and surface water are partial conductors, and the dangers this can pose	25

The KR-20 reliability coefficient of the test was found to be 0.81, so it can be said that the test is highly reliable. Its difficulty level was 0.53 and its discrimination level was measured to be 0.52. This shows that the test difficulty is moderate and it is quite discriminative.

Knowledge Map

Six knowledge maps including questions aiming at all the objectives in the unit were prepared by the researchers. In order for the validity, the knowledge maps were examined by two lecturers and two science teachers. The students were asked to fill in the gaps given in the knowledge maps. The assessment of the maps was done by allocating one point for each blank. The knowledge map scores were obtained for each student by adding up the points received from all the maps. A sample knowledge map is available in Appendix 1.

Diagnostic Branched Tree (DBT)

Seven different diagnostic branched trees were prepared by the researchers in a way aiming at all the unit objectives, and they were graded based on each exit. For each correct answer, 1 point was given, and the total points each student collected from all the diagnostic branched trees constituted his/her score in this assessment part. In order for the validity, the diagnostic branched trees were examined by two lecturers and two science teachers. A sample diagnostic branched tree is provided in Appendix 2.

Structured Grid

Seven structured grids were prepared about the unit. In order for the validity, the structured grids were examined by two lecturers and two science teachers. The number of boxes and the number of correct answers were considered while grading. The formula [[(C1/C2-C3/C4)+1]5] (C1: The number of correctly chosen boxes by the student, C2: The total number of correct boxes, C3: The number of incorrectly chosen boxes by the student, C4: The total number of incorrect boxes) was used for calculating the total grade for every student in each grid. A total score was obtained by adding up the results from all grids. A sample structured grid is given in Appendix 3.

Concept Map

The students were given 2-hour training on concept mapping and its drawing principles, and a 3-hour application study based on creating concept maps on different topics was carried out because this was the first time they were creating their own concept maps following the rules, although they were familiar with concept mapping. Students' concept maps prepared at the end of the unit were evaluated by two graders in accordance with Novak and Gowin (1984) scoring criteria. Even though there are more current grading systems, this one was preferred due to its being relatively more practical. Based on Novak and Gowin (1984)'s criteria, the grading is done considering the following:

1. *Concepts*: 1 point is given for each valid concept that is connected to at least one other concept by a proposition.

2. *Propositions*: 1 point is given if the relationship between two concepts indicated by a connecting line and linking word(s) is valid and meaningful.

3. *Hierarchy*: 1 point is given for each hierarchy level if the concepts on the map have been presented in a hierarchical order (moving from general to specific in a way including the concepts within the same scope at the same level).

4. *Cross Links*: 10 points are given if the links between the concepts in different parts of the map are bilaterally valid, and 2 points are given if they are unilaterally valid.

5. *Examples*: 1 point is given for each valid example written under the concepts.

A sample student concept map can be found in Appendix 4.

Data Analysis

At the end of the unit, the students were given the achievement test, concept maps, diagnostic branched trees, structured grids and knowledge maps respectively. They were asked to draw a concept map about the unit. The concept maps were later evaluated according to Novak and Gowin (1984)'s structured scoring system considering hierarchical levels, cross links, concepts and examples. They were then graded by two science teachers. The consistency between two graders was calculated as 0.996 using Spearman's rho test, one of nonparametric methods. Based on the result, it can be said the graders are quite consistent. The scores obtained from the application were analyzed with an appropriate program. Since it was found that different measurement distributions belonging to the same group were different from each other, nonparametric Wilcoxon Signed Ranks Test was used for the analyses. This test is an equivalent of T-test, which is a parametric test. Its difference from the T-test is that it compares the order of the participants. Besides differences between the two sets of scores, calculations are made considering the difference significance in this test (Baştürk, 2011).

Findings

In this study, the achievements of the students in "The Granular Structure of Matter" unit were assessed using various assessment techniques. The descriptive statistics on the assessment tools are given in Table 2.

Table 2

The descriptive statistics on the assessment tools

Assessment tools	N=23	Range	Min	Max	$\bar{X}$	Sd
Achievement test		50,00	37,50	87,50	60,87	13,97
Structured Grid		183,63	271,00	454,64	364,7	58,42
Diagnostic Branched Tree		18,00	3,00	21,00	17,66	4,31
Knowledge map		44,00	4,00	48,00	30,09	12,59
Concept map		81,00	7,50	88,50	33,24	20,75

The differences among the scores the students got from these tools were investigated. As the scores achieved from all of the tools were not regularly distributed and the sample size was smaller than 30, one of nonparametric methods, Wilcoxon Signed Ranks Test was applied. The findings of the Wilcoxon Signed Ranks Test are given in Table 3.

Table 3

The Wilcoxon Signed Ranks Test results of the scores obtained from the assessment and evaluation tools

Assessment tools	**Ranks**	**n**	**Mean Rank**	**Sum of Ranks**	**Z**	**p**
Structured grid-Achievement test	Negative ranks	0	0	0	-4,197[a]	0,000
	Positive ranks	23	12	276		
	Ties	0	-	-		
Concept map-Achievement test	Negative ranks	21	12,71	267	-3,924[b]	0,000
	Positive ranks	2	4,5	9		
	Ties	0	-	-		
DBT-Achievement test	Negative ranks	23	12,00	276	-4,199[b]	0,000
	Positive ranks	0	0	0		
	Ties	0	-	-		
Knowledge map-Achievement test	Negative ranks	23	12	276	-4,197[b]	0,000
	Positive ranks	0	0	0		
	Ties	0	-	-		
DBT-Concept map	Negative ranks	16	13,94	223	-3,133[b]	0,002
	Positive ranks	6	5	30		
	Ties	1	-	-		
Structured grid-Achievement test	Negative ranks	0	0	0	-4,197[a]	0,000
	Positive ranks	23	12	276		
	Ties	0	-	-		
Concept map-Achievement test	Negative ranks	21	12,71	267	-3,924[b]	0,000
	Positive ranks	2	4,5	9		
	Ties	0	-	-		
DBT-Achievement test	Negative ranks	23	12,00	276	-4,199[b]	0,000
	Positive ranks	0	0	0		
	Ties	0	-	-		
Knowledge map-Achievement test	Negative ranks	23	12	276	-4,197[b]	0,000
	Positive ranks	0	0	0		
	Ties	0	-	-		
DBT-Concept map	Negative ranks	16	13,94	223	-3,133[b]	0,002
	Positive ranks	6	5	30		
	Ties	1	-	-		

a. Based on negative ranks
b. Based on positive ranks
*Str. Grid>Achievement test – Con. Map.<Achievement test-DBT<Achievement test-
Know. Map<Achievement test-DBT<Con. Map – Str. Grid>Con. Map- Str. Grid>DBT- Know. Map >DBT- Know. Map<Str. Grid

In the comparisons of the achievement test results based on the Wilcoxon Signed Ranks Test findings, it was found that there was a significant difference between the scores achieved from the structured grids, concept maps, diagnostic branched trees and knowledge maps and the ones obtained from the achievement test (respectively z=-4,197,p<0,05; z=-3,924, p<0,05; z=-4,199, p<0,05; z=-4,197, p<0,05). In all comparisons except for the ones with the structured grids, it was seen that this difference was in favor of the achievement test when the mean ranks of difference scores and the sum of ranks of difference scores were considered. Apart for the structured grids, the students were less successful at the other assessment and evaluation tools compared to the achievement test. They got higher scores than the achievement test only in the comparisons made with the structured grids.

A significant difference (z=-3,133, p<0,05) was identified between the diagnostic branched tree scores and concept map scores, and the difference is in favor of the concept maps. In addition, it was found that there was a significant difference between the structured grid scores and concept map scores, and the structured grid scores and the branched tree scores (respectively z=-4,197, p<0.05; z=-4,198, p<0,05). In both comparisons, it was observed that the difference was in favor of the structured grids when the mean ranks of difference scores and the sum of ranks of difference scores were considered.

A significant difference was found when the knowledge map scores were compared with the diagnostic branched tree and structured grid scores (respectively z=-3,774, p<0,05; z=-4,198, p<0,05). When the comparison was with the diagnostic branched tree scores, this difference was in favor of knowledge maps, but it was in favor of the structured grids upon the comparisons between the knowledge map and the structured grid scores. No significant difference was noticed between the knowledge map and concept map scores (z=-0,796, p>0,05).

Discussion and Conclusion

In this study, which compares the scores achieved from different assessment and evaluation tools developed in order to measure the objectives of 7th grade 'The Granular Structure of Matter' unit, a significant difference was found between the scores obtained from the achievement test, the structured grids, the diagnostic branched trees, the knowledge maps and the concept maps. Research supporting this finding is available in the literature (Kartal and Buldur, 2007; Karacak-Deren, 2008; Turan, 2010; Buluş-Kırıkkaya and Vurkaya, 2011). Based on the finding, it can be said that students' grades attained through different assessment tools vary, and their success level differentiates based on the assessment tools. Therefore, it would be appropriate to utilize various tools for assessment and evaluation while measuring student success.

In the comparisons with the achievement test, the students had a lower amount of success in the other assessment and evaluation tools except for the structured grids. This may have resulted from the fact that they are not familiar enough with these tools. In a number of studies investigating the teachers' proficiency in assessment tools, it was revealed that complementary assessment tools are rarely used at schools (Fidan and Sak, 2012; Karamustafaoğlu et.al., 2012). This causes students not to be well-accustomed to these tools. Another reason for this situation is that, while the use of complementary assessment tools is encouraged in the Science Education Curriculum, there is no clear reference to a specific exam grade for applying these tools in the assessment-related part of the regulation on primary and secondary education institutions although it states 'it is essential to vary question types in exams' (MEB, 2014), an thus, it becomes teachers' own preference whether to utilize these assessment tools or not. Since using any tool which has not been included in the regulation for assessing student success will fail to comply with it, this may bring about some unfavorable circumstances for the teachers, which eventually discourages them from applying these assessment tools.

The students received higher grades only in the structured grids compared with the achievement test. This could have resulted from their being an alternative to achievement tests (Durmuş and Karakırık, 2005). Research supporting and objecting this finding has been encountered in the literature. Kartal and Buldur (2007) compared student scores achieved from exams prepared according to alternative assessment and evaluation techniques with the ones obtained from exams prepared according to traditional assessment and evaluation techniques in their study, and they found out that the technique the students were least successful in was the structured grid. Furthermore, in a study by Danili and Reid (2005), learners received better grades from multiple-choice questions compared to structured grid questions, which collides with our findings. They also found a significant relation between the scores obtained from multiple-choice tests and the structured grids.

According to the comparisons made with the diagnostic branched trees, the students got lower grades in this tool than the others. This may have been brought about by the fact that teachers do not include this tool much in assessment at schools. Indeed, Orhan (2007) mentioned that the diagnostic branched tree was the least popular alternative assessment tool among teachers.

There was no significant difference between the scores achieved from the knowledge maps and the concept maps. Getting close results may be due to the fact that these two tools include very similar elements, and they are based on concepts and knowledge reconstruction processes. In a school context, it could be more useful to choose one between knowledge maps and concept maps and to utilize it only. As a result of the significant differences measured between the other assessment tools, it could be said that using them altogether will be more effective to reveal student achievement. Thus, a student who cannot do well in tests including multiple-choice questions may have a chance to perform better in other assessment techniques. When teachers increase the number and variety of the tools they use to assess student success, not only the quality but also the validity and reliability of the assessment and evaluation processes at schools will improve.

In this study, the 7th grade students' success in the unit 'The Granular Structure of Matter' was evaluated through various assessment tools, and the scores they obtained from these tools were compared. As a result;

1. There was a significant difference among the scores gained from different assessment tools.
2. It was observed that their scores in all alternative assessment tools were lower than those in the achievement test except for the structured grids. It was found that they did better than they did in the achievement test only in the structured grids.
3. The assessment tool in which they were least successful was the diagnostic branched tree.
4. There was no significant difference between the students' knowledge and concept map scores.

In the light of these findings, the following suggestions can be put forward for educators and researchers:

- Considering the variations in students' performance in different assessment tools, teachers could be encouraged to employ complementary assessment techniques more often in order to increase student proficiency in the assessment tools apart from achievement tests, and thus, evaluate their success level more efficiently.
- Students could be provided with the opportunity of having practice in diagnostic branched tree after giving them information about it through action research in order to improve their performance in the diagnostic branched trees.
- Along with the differences among the scores obtained from various assessment tools, some research could be done using these tools to reveal misconceptions and conceptual associations.
- Students' answers given for each assessment tool could be closely examined through qualitative studies.
- The results obtained in this study are limited to the comparisons of the scores obtained from assessment tools that include questions testing the objectives of only one unit. Therefore, repetitive research through assessment tools including questions that test the objectives of all the units could provide more valid and reliable data.
- In this study, a limited number of samples were included and a nonparametric approach, Wilcoxon Signed Ranks test, was utilized. Researchers could work with a bigger sample and use more efficient statistical methods.

References

Bacanak, A., Karamustafaoğlu, S., Değirmenci, S ve Karamustafaoğlu, O. (2011). Fen öğretiminde bilgi haritası kullanımı: ekosistem örneği. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 17, 133-145*

Bahar, M., Nartgün, Z., Durmuş, S. ve Bıçak, B. (2012). *Geleneksel-tamamlayıcı Ölçme ve Değerlendirme Teknikleri Öğretmen El Kitabı*. Pegem Akademi Yayınları, Ankara.

Baştürk, R. (2011). *Bütün yönleriyle SPSS örnekli Nonparametrik İstatistiksel Yöntemler (2. Baskı).* Anı Yayıncılık, Ankara.

Baxter, G. P., & Shavelson, R. J. (1994). Science performance assessments: Benchmarks and surrogates. *International Journal of Educational Research*, 21, 279–297.

Buluş Kırıkkya, E. Ve Vurkaya, G. (2011). Alternatif Değerlendirme Etkinliklerinin Fen ve Teknoloji Dersinde Kullanılmasının Öğrencilerin Akademik Başarıları ve Tutumlarına Etkisi. *Kuram ve Uygulamada Eğitim Bilimleri*, 11(2), 985-1004.

Çakan, M. (2004). Öğretmenlerin ölçme değerlendirme uygulamaları yeterlilik düzeyleri: İlk ve Ortaöğretim. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi*, 37(2), 99- 114.

Çetin, M. O. Ve Çakan, M. (2010). Fen ve Teknoloji Dersi Başarılarının Farklı Yaklaşımlarla Ölçülmesi ve Bu Yaklaşımlara İlişkin Öğrenci Görüşleri. *Eğitimde ve Psikolojide Ölçme ve Değerlendirme Dergisi*, 1(2), 93-99.

Çoruhlu,T. Ş., Nas, S.E. ve Çepni, S., (2009). Fen ve Teknoloji Öğretmenlerinin Alternatif Ölçme Değerlendirme Tekniklerini Kullanmada Karşılaştıkları Problemler: Trabzon Örneği. *Yüzüncü Yıl Üniversitesi, Eğitim Fakültesi Dergisi.* 6(1) 122- 141.

Danili, E. & Reid, N. (2005). Assessment Formats: Do They Make a Difference?. *Chemistry Education Research and Practice*, 6(4), 204- 212.

Durmuş, S., & Karakırık, E. (2005). A computer assessment tool for structural communication grid. *The Turkish Online Journal of Educational Technology*, 4 (4), 3-7.

Fidan, M. Ve Sak, İ. M. (2012). İlköğretim Öğretmenlerinin Tamamlayıcı Ölçme Değerlendirme Teknikleri Hakkında Görüşleri. *Bartın Üniversitesi Eğitim Fakültesi Dergisi*, 1(1),174-189.

Güneş, T., Dilek, N.Ş., Hoplan, M., Çelikoğlu, M. ve Demir, E.S. (2010). Öğretmenlerin Alternatif Değerlendirme Konusundaki Görüşleri ve Yaptıkları Uygulamalar. *International Conference on New Trends in Education and Their Implications,* 11-13 November, Antalya, Turkey.

Janisch, C., Liu, X., Akrofi, A. (2007). Implementing alternative assessment: opportunities and obstacles. *The Educational Forum, 71*(3), 221–230.

Johnstone, A. H., Bahar,M., Hansell, M. H. (2000). Structural communication grids: A valuable assessment and diagnostic tool for science teachers. *Journal of Biological Education*, 34 (2) (2000), pp. 87–89

Karamustafaoğlu, S., Çağlak, A., & Meşeci B. (2012). Alternatif ölçme değerlendirme araçlarına ilişkin sınıf öğretmenlerinin öz yeterlilikleri. *Amasya Üniversitesi Eğitim Fakültesi Dergisi*, *1*(2), 167-179.

Karasar, N.(2014) Bilimsel Araştırma Yöntemi, Nobel yayın Dağıtım, Ankara.

Karacak-Deren, Ş. (2008). *İlköğretim 8. Sınıf genetik ünitesinin 5E modeline göre tasarlanan multi-medya destekli öğretiminin öğrencilerin erişi ve tutumuna etkisi.Unpublished Master thesis*, Muğla Üniversitesi, Fen Bilimleri Enstitüsü, Muğla.

Kartal, S. ve Buldur, S. (2007, Eylül). *Fen öğretiminde alternatif değerlendirme tekniklerinin kullanılması durumunda öğrencilerin başarı düzeylerinin incelenmesi*. 16. Ulusal Eğitim Bilimleri Kongresi'nde sunulan bildiri, Gaziosmanpaşa Üniversitesi Eğitim Fakültesi, Tokat.

Kaya, A., Balay, R. Ve Göçen, A. (2012). Öğretmenlerin alternatif ölçme ve değerlendirme tekniklerine ilişkin bilme, uygulama ve eğitim ihtiyacı düzeyleri. *International Journal of Human Sciences* [Online]. (9)2, 1229-1259.

Lawrenz, F., Huffman, D. and Welch, W. (2001). The Science Achievement of Various Subgroups on Alternative Assessment Formats, *Sci Ed* 85, 279–290.

McClure, J. R., Sonak, B., Suen, H. K. (1999). Concept Map Assessment of Classroom Learining: Reliability , Validity and Logistical Practicality. *Journal of research in science teaching* . 36(4), 475-492.

MEB (2014) Milli Eğitim Bakanlığı Okul Öncesi Eğitim ve İlköğretim Kurumları Yönetmeliği, Ankara

Novak, J.D. and Govin, D.B.(1984) *Learning How To Learn*, Cambridge: Cambridge University Press.

Novak J. D. (1990). Concept mapping: A usefull tool for science education. *Journal of Research in Science Teaching*, 27(10), 937-949.

Novak, J. D.& Cañas, A. J. (2006), The Theory Underlying Concept Maps and How to Construct Them, Technical Report IHMC CmapTools 2006-01, Florida Institute for Human and Machine Cognition.

Okur, M. ve Azar, A. (2011). Fen Ve Teknoloji Dersinde Kullanılan Tamamlayıcı Ölçme Ve Değerlendirme Tekniklerine İlişkin Öğretmen Görüşleri. *Kastamonu Eğitim Dergisi*. 19(2), 387-400.

Oğuz, A. (2008). Sınıf Öğretmenliği Öğrencilerinin Gelişim Dosyası, Başarı Testi Ve Tutum Puanları Arasındaki İlişki. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*. 21, 45-59.

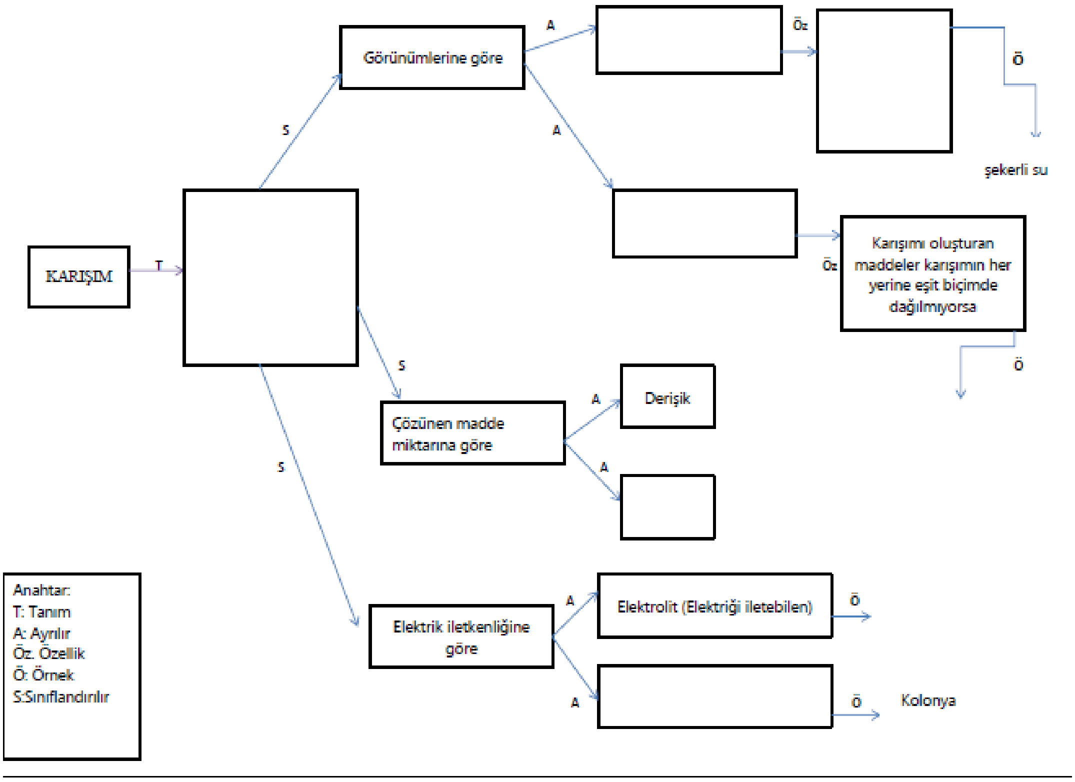
Ruiz-Primo, M. A., & Shavelson, R. J. (1996). Problems and issues in the use of concept maps in scienceassessment. *Journal of Research in Science Teaching*, 33(6), 569-600.

Sağlam-Arslan, A., Avcı, N., & İyibil, Ü. (2008). Fizik öğretmen adaylarının alternatif ölçme değerlendirme yöntemlerini algılama düzeyleri. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 11*, 115-128

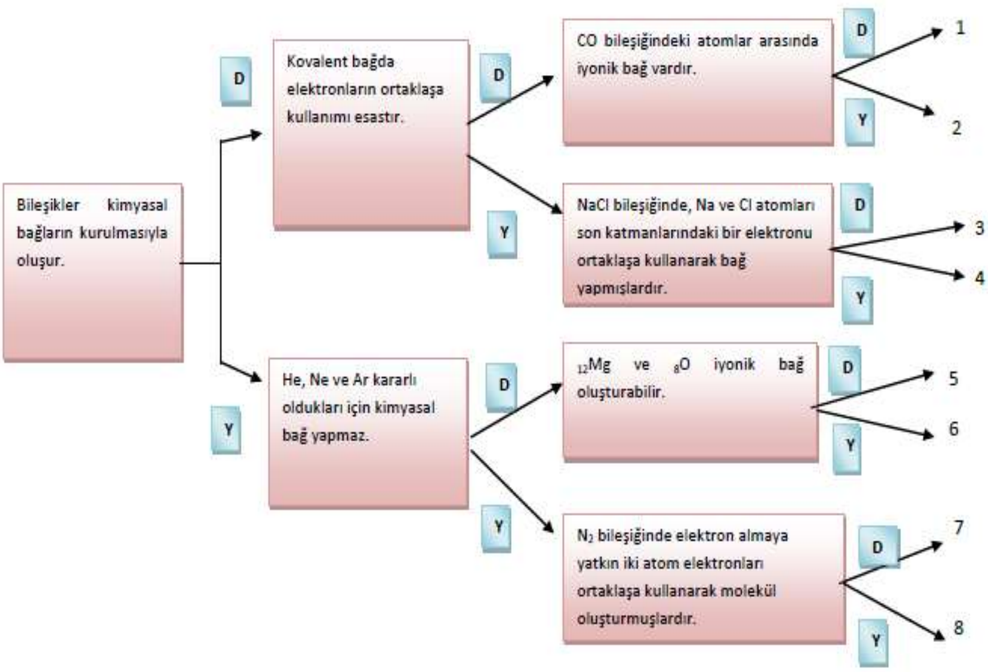
Turan, N. (2010). *Alternatif Değerlendirme Tekniklerinden Kavram Haritası ve Dallanmış Ağaç ile Klasik Değerlendirme Tekniklerinin Öğrenci Başarısı Açısından Karşılaştırılması (Unpublised Master Thesis)*. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara

Yeşilyurt, E. (2012). Fen ve teknoloji dersinde kullanılan ölçme değerlendirme yöntemleri ve karşılaşılan güçlükler. *Turkish Studies - International Periodical For The Languages, Literature and History of Turkish or Turkic*, 7(2),1183-1205.

Appendix 1-Knowledge Map

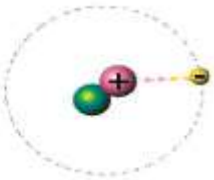
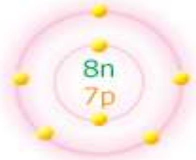
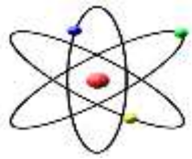
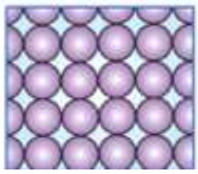
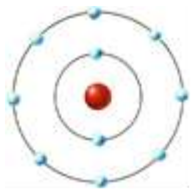
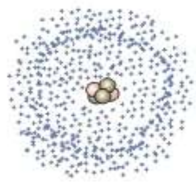


Appendix 2-Diognostic Branched Tree



Appendix 3-Structured Grid

Kutucuk numarasını kullanarak aşağıdaki soruları cevaplayınız.

1 	2 	3 
4 	5 	6 
7 	8 	9 
10 	11 	12 

Yukarıdaki elementlerden hangisi/hangileri aynı elemente ait atomları göstermektedir? ……………………………………………………………….

Yukarıdaki kutulardan hangisinde/hangilerinde atomu oluşturan parçacıklar konumları ve yükleriyle birlikte doğru şekilde verilmiştir? ……………………………………………………………………………..

Yukarıdaki kutulardan hangisinde elektron bulutu atom modeli gösterilmiştir?………………………………

Yukarıdaki atom modellerden hangisi Rutherford'un atom modeline ait olabilir? ……………………………

Yukarıdaki atom modellerinden hangileri günümüzde geçerliliğini kaybetmiştir? …………………………

Bir elementin bütün atomlarının aynı olduğunu kanıt göstermek için hangi kutuları kullanabiliriz? ………………………………………………………

Appendix 4- Concept Map of a student