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A HANDS-ON ACTIVITY TO PROMOTE CONCEPTUAL CHANGE ABOUT MIXTURES AND CHEMICAL COMPOUNDS

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Abstract. *The study revealed students' conceptions about mixtures and chemical compounds and also investigated the effects of a hands-on activity designed to improve their understanding of differences between two concepts. The sample consists of 52 seventh grade students in a primary school. Students' ideas were elicited by a test consisting of six open-ended questions. An intervention designed based on students' preconceptions. The intervention, in which two different colored balls of clay were used, comprises a hands-on activity whose aim was to help students distinguish essential differences between mixtures and chemical compounds. After the intervention, the test was re-administered to the sample as a post-test. Both qualitative and quantitative assessment indicated positive effects of the intervention on students' understanding. The results suggest that teachers and curriculum developers should take into account this kind of activities in order to help students understand confusing concepts.*

Key words: *students' understanding, mixture, chemical compound, hands-on activity.*

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Introduction

There have been many studies concerning students' alternative conceptions about various science phenomena (Pfundt and Duit, 2000). These studies generally agreed that students come to science class with some beliefs and ideas about physical phenomena derived from their prior learning either from school or from their interaction with the physical and social world (Wandersee, Mintzes, and Novak, 1994; Duit, 2004). These beliefs and ideas are sometimes different from the conceptions accepted by the scientific community. In the literature, a number of terms such as preconceptions, misconceptions, alternative conceptions were used to describe these alternative conceptions. However, when these terms are used, they often convey a similar meaning (Taber, 2000). In this article, the term 'misconception' is used to describe any conceptions different from or inconsistent with those accepted by the scientific community. For better learning, it has been advised by several researchers that the students' earlier conceptions should be taken into account at all stages of instruction (Smith, Disessa, and Roschelle, 1993).

Over the past twenty years, research in chemistry education has shown that a large proportion of the students or even teachers have problems understanding of element, compound and mixture (Briggs and Holding, 1986; Ben-Zvi, Eylon, and Silberstain, 1988; Laverty and McGarvey, 1991; Ayas and Demirbaș, 1997; Sanger, 2000; Taber, 2002; Papageorgiou, 2002; Papageorgiou and Sakka, 2000; Stains and Talanquer 2007a, b). Stains & Talanquer (2007a) found out that misclassifications of a substance commonly occurred when students failed to clearly identify or differentiate the distinct features that characterize

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an element, a compound, or a mixture. Misclassifications have been observed in tasks involving pictures at both the macro and the micro levels (Briggs and Holding, 1986; Sanger, 2000; Taber, 2002; Stains and Talanquer, 2007a). In harmony with this result, some studies have also proven that students frequently cannot distinguish between mixtures and chemical compounds (Briggs and Holding, 1986; Ben-Zvi, Eylon, and Silberstain, 1988; Laverty and McGarvey, 1991; Ayas and Demirbaŗ, 1997; Papageorgżou, 2002).

Mixture and chemical compound is one of the fundamental concepts of science taught from primary school onwards. An understanding of these concepts is a prerequisite for many science concepts taught in the later stages of schooling. Both primary and secondary curricula aim to represent this topic for students. These concepts are essential for students to grasp many aspects of chemistry. For these reasons, revealing students' misconceptions and facilitating conceptual change become very important point. Although there are many studies eliciting students' ideas about mixtures and chemical compounds, there are few providing conceptual understanding about distinct features between mixtures and chemical compounds. Amongst the mentioned studies before, only one research made by Papageorgżou (2002) suggested a teaching strategy-in which a clay activity included-for distinguishing mixture and compound, but he did not implement it. In this research, we have tried to design a hands-on activity regarding the activities suggested by Papageorgżou (2002) and we find it worth be investigating its success on remediation of students' misconceptions.

Since new knowledge is constructed on the base of existing cognitive structure, misconceptions have been addressed before new ones are developed. However, students' misconceptions could be so deeply rooted that traditional instruction may be somewhat inadequate for conceptual change toward focused scientific concepts (Wandersee, Mintzes, and Novak, 1994). Studies in science education show that teaching strategies based on the conceptual change approach have been effective in remediation of students' misconceptions (Smith, Blakeslee, and Anderson, 1993; Treagust, Harrison, and Venville, 1996; Case and Fraser, 1999). The conceptual change approach suggests that the four conditions must exist before a conceptual change is likely to occur (Posner, Strike, and Hewson, 1982). These are:

(1) Students must become dissatisfied with their existing conceptions (dissatisfaction).

(2) The new concept must be clear and understandable for students (intelligibility).

(3) The current problem should be solved using the new concept (plausibility).

(4) Similar future problems can be solved by using the new concept (fruitfulness).

There are many specific instructional strategies based on the conceptual change model of Posner, Strike, & Hewson (1982) such as concrete activities, refutational text, hands-on activities, concept mapping, and computer-aided instruction and so forth. Hands-on activities were preferred in this study due to their positive effects on conceptual change, students' achievement and understanding (Kahle and Damnjanovic, 1994; Case and Fraser, 1999). Hands-on activities are an exciting way to help students to develop conceptual understanding. These activities can be done individually, in small groups, or as a whole class. Hands-on activities as an active learning technique enable students to construct scientific understanding of a subject through fun (Kahle and Damnjanovic, 1994; Case and Fraser, 1999; Bilgin, 2006). Learners can engage in the process of building their own knowledge structures from the acquired information in the activities. Moreover, hands-on activities may improve students' attitudes towards investigation, and students may find a chance to observe links between natural phenomena and scientific facts. With hands-on activities, students can acquire the basic skills required to carry out observations and experiments as well as the methodology of investigating a subject in a scientific manner. They may also learn to express accurately the processes involved as well as the results (Kahle and Damnjanovic, 1994; Freedman, 1997; Wenglinsky, 2000). Hence, we carried out the present study in an effort to address the students' misconceptions of mixtures and chemical compounds concepts and distinguishing both of them.

The purpose of this study was to investigate effectiveness of a hands-on activity designed to improve students' understanding of mixtures and chemical compounds and their differentiations. The following research questions were addressed:

- What are the seventh grade students' conceptions of mixtures and compounds?
- To what extent can a hands-on activity using different colored balls of plastic modeling clay facilitate better understanding and provide conceptual change about these concepts?

Methodology of Research

The research was conducted with 52 seventh grade students (28 girls and 24 boys, whose ages were ranged from 13 to 15 years) in a class of a public school which was randomly chosen in an urban area in Trabzon, Turkey. The sample had studied the subject "*Mixture and Compound*" in the first semester. Before the intervention, in order to assess the misconceptions held by these students, "*Mixture and Compound Test" (MCT)* was devised by the researchers. The MCT consists of six open-ended questions as shown in Figure 1.

1. What is the mixture? Explain this term in your words and give examples from your daily life?
2. What are the properties of the mixtures?
3. What is the chemical compound? Explain this term in your words and give examples from your daily life?
4. What are the properties of the chemical compounds?
5. What are the fundamental distinctions between mixture and chemical compound?
6. The following drawings contain representations of atoms and molecules. Classify each of these drawings (labeled 1-4) as **mixture** and **compound** and explain your reasons.

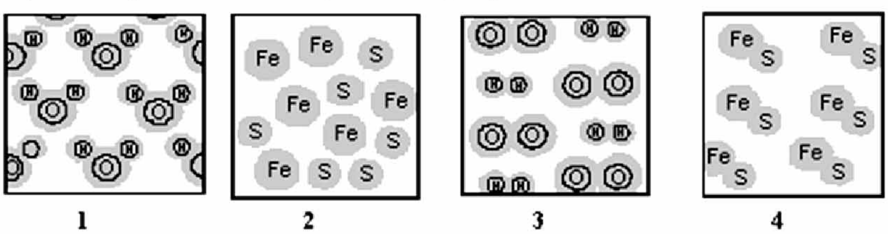

Figure 1 represent a ____________. Because __________________
Figure 2 represent a ____________. Because __________________
Figure 3 represent a ____________. Because __________________
Figure 4 represent a ____________. Because __________________

Figure1. Mixture and compound test (MCT) used in this study.

The questions were phrased in a way that could be understood easily by the respondents. In addition, all questions were piloted with a group of 26 seventh grade students and required modifications were made prior to the administration of the test. The content validity of the test items was ensured by science educators consisting of one professor of chemistry education and two research assistants. In the first five questions, students were asked to define the terms of mixture and chemical compound, their properties and distinctions between two in their words. In the last question, students were asked to classify particulate drawings as a mixture or a chemical compound. This question also requires students to explain their reasons. Students' ideas about the microscopic structural features of elements, compounds, and mixtures have mainly explored by using particulate drawings (Briggs and Holding, 1986; Nurrenbern and Pickering, 1987; Sanger, 2000; Stains and Talanquer, 2007a, b) as in the present study.

The MCT firstly was administered to the sample as a pre-test. After the intervention, the MCT test was re-administered to the sample as a post-test by which the effects of the intervention was measured. The results of the pre- and post-tests were analyzed in order to assess quantitatively what the effect of the intervention was. Also, students' misconceptions and the effects of intervention on them were calculated qualitatively based on pre- and post-test findings. Students' responses to the test items were evaluated and scored regarding the following categories listed in Table 1.

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Table 1. The criteria for the classification of students' responses to test items.

Level of understanding	Criteria for the classification of student responses	Score
Sound Understanding (SU)	Responses that include all components of the scientifically accepted ideas	10 p
Understanding (U)	Responses that include most of the components of the acceptable ideas	8 p
Partial Understanding (PU)	Responses that include at least one of the components of the acceptable ideas but not all.	6 p
Partial Understanding With Misconceptions (PUM)	Responses that show partial understanding of concepts by students but that may also contain a kind of misconception	3 p
Specific Misconception (SM)	Responses that include descriptive, incorrect or illogical information.	0 p
No Understanding (NU)	Repeats a part or full of question, irrelevant or uncodable responses, and no answer. Such as "I don't understand", "I don't know" or "I have no idea"	0 p

Results of Research

Students' Misconceptions of Mixture and Chemical Compound

The percentages of students' answers in each category for the open-ended test items on pre-test are shown in Table 2.

Table 2. Percentage of students' responses for categories of understanding on the pre- test.

Test Items	SU	U	PU	PUM	SM	NU
1	4	15	64	4	13	-
2	2	2	84	6	2	4
3	36	6	46	10	-	2
4	6	2	69	15	2	6
5	2	6	57	27	2	6
6-a	50	27	11	4	8	-
6-b	52	11	17	10	8	2
6-c	27	6	21	-	44	2
6-d	25	6	27	-	38	4

Since one of the research questions of this study was to determine students' misconceptions about mixtures and compounds, their explanations for the test items on pre-test were examined in detail, especially two categories, "*Partial Understanding with Misconceptions*" and "*Specific Misconceptions*" wherein they include misconceptions. In this way, students' misconceptions and difficulties were defined and presented in Table 3 in which their percentages of these also presented.

Although the students had studied the subjects in the first semester, the findings of the pre-test showed that the sample hold several misconceptions about mixture and compound as seen in the Table 3. We identified that the students held some major problematic conceptions about properties of the mixtures and compounds.

Table 3. Students' misconceptions and difficulties elicited by analyzing the pre-test.

Students' misconceptions and difficulties	%
All mixtures are substances that do not have the same properties throughout the sample. Or, all mixtures are heterogeneous**	23
Mixtures are pure substances**	21
Mixtures are homogeneous**	23
Mixtures are combination of the two or more substances that are not pure **	15
Mixtures are always combination of two different elements**	27
The properties of the components in a mixture are not retained (C_1)*	41
Mixtures always comprise of two substances**	21
The components of a mixture cannot be physically separated (A_1)*	36
The components of mixtures can be separated but compounds cannot (A_2)*	0
The components of a mixture combine in exact proportion (B_1)*	25
Compound is a combination of two same elements**	27
Compounds are a combination of the two same substances**	23
Compounds are heterogeneous**	25
The properties of the components in a compound are retained (C_2)*	38
Pure compounds are homogeneous mixtures**	15
The component of a compound can be separated only by the process of electrolysis (A_3) *	17
The components of a compound combine in different proportion (B_2)*	21

(*) **:** Misconceptions about differentiation between mixture and compound. (The intervention was designed based on these misconceptions)

(**) **:** Misconceptions taking into account by a few studies in the mentioned literature some of which activity were developed to refine these.

There were four basic ideas that some students found difficult to grasp and that gave rise to many alternative conceptions.

Firstly, they failed to grasp the idea that mixtures are not pure substances. Instead, they think that mixtures are pure substances. Some materials such as air, water, honey, yoghurt that students encounter are frequently labeled "*pure*" in everyday language, although they are really mixtures of substances. Consequently, conflict of meaning can arise for students. Also, they care about the properties of air, water and so on; then they think that all mixtures are homogenous substances by an over-generalization. In contrary to this view, some students think that all mixtures are substances that do not have the same properties throughout the sample. But, it is known that solutions are homogenous mixtures having the same properties throughout the sample. Students may have the idea that mixtures are heterogeneous because of the under-generalization regarding the properties of some mixtures.

Secondly, some students think that compounds cannot be separated in anyway or others think that they only can be separated by the process of electrolysis. Although the components of a mixture can be physically separated, those of a chemical compound cannot be separated unless chemical methods are used. A possible reason for this may be the view that compounds are new substances that exist by a combination of two or more elements by losing their properties. Moreover, this view may stem from that science teachers and textbook authors use electrolysis method in most cases to separate a chemical compound.

Although a chemical compound is a substance formed by joining of two or more elements together through chemical bonding, a mixture is the combination of elements or compounds without any chemical bonding. The third problematic ideas held by students were that a mixture

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or a chemical compound is the combination of two elements, not more. As mentioned above, this may stem from the common usage of examples of compounds or mixtures consisting of two components in science classes. Although the components of a mixture are in random proportion, those of a compound are in specific proportion. In contrary to this, some students have the idea that a mixture is in specific proportion and a compound is in random proportion. These students probably mixed up the concepts of mixture and compound and use these concepts instead of each other. We suggest that, this stems from students' previous experiences. When students observe that their mothers mix up the ingredients of a meal in a specific proportion, they may erroneously conclude that mixtures should be in specific proportion. Since students' previous experiences are very important in formation of misconceptions, especially at younger ages, they resisted changing their preconceptions.

Finally, some students have an idea that although the properties of the components in a compound are retained, the properties of a mixture differ from its components. This idea may also be the result of the students' confusion with the concepts of mixture and compound.

As a general consideration of the four basic ideas, it is concluded that students have difficulties about the properties of mixtures and compound and the differentiations between them. To overcome these difficulties, an intervention was designed based on the study by the Papageorgżou (2002) who suggested a teaching strategy in which a clay activity included to distinguish mixture and compound.

Effects of Intervention in Facilitating Conceptual Change

Design of Intervention

As a general evaluation of pre-test data (see Table 3), the findings generally indicate that students do not fully differentiate between mixture and chemical compound; hence, they held some major misconceptions about properties of mixture and compound. While some of them have been given in the literature (Sanger, 2000; Stains and Talanquer, 2007a), the others that were essential differences between mixtures and chemical compounds have not. In order to achieve conceptual change, the intervention was designed (See Appendix).

The intervention was suggested in a study by Papageorgiou (2002), however, it was not administered and its effects in facilitating conceptual change were not investigated. The intervention, in which two different colored balls of clay were used, comprises a hands-on activity whose aim was to help students to distinguish essential differences between mixtures and chemical compounds. It was adapted to Turkish context and phrased in a way that could be understood easily by the respondent. In addition, it was piloted with a group of 26 seventh grade students and required modifications were made prior to the administration. The final form of it was administered the sample as a group activity. Each group consisted of four students. Hands-on activity lasted for two 40 minutes period.

At the beginning of the hands-on activity, the worksheet (see Appendix) on which students would write down their responses was handed out to each group. Then, they were asked to follow the steps given in the activity paper. During the instruction, students' were encouraged to discuss their ideas with their peers about what would happen in the given circumstances in the activity to check their prior knowledge, ideas and beliefs and to construct the concepts properly in their mind. Finally, they made real laboratory experiments about mixture and chemical compound at the end of the activity to compare results derived by the clay activity with those deduced by the real experiments. In harmonious with constructivist view and conceptual change model, initially it was provided for students to make them aware that their prior ideas were insufficient in explaining the given phenomena. Challenging students' misconceptions with the experiences contradict to their existing cognitive structures; students were forced to be dissatisfied with their existing concepts. Then, they were provided experiences in which the new scientific concepts would seem plausible, intelligible and fruitful to them.

Evaluation of Intervention

To find out the changes on students' understanding of the differences between mixture and chemical compound, the MCT was re-administered to the sample as a post-test following the intervention. The misconceptions and their percentages before and after the instruction are given in Table 4.

Table 4. Students' misconceptions and their changes after the intervention

Misconceptions	Pre-Test %	Post-Test %	Conceptual Changes %
All mixtures are substances that do not have the same properties throughout the sample. Or, all mixtures are heterogeneous.	23	15	(+ 8)
Mixtures are pure substances	21	10	(+ 11)
Mixtures are homogeneous	23	8	(+ 15)
Mixtures are combination of the two or more substances that are not pure.	15	8	(+ 7)
Mixtures are always combination of two different elements.	27	13	(+ 14)
The properties of the components in a mixture are not retained (C_1)*	41	6	(+ 35)
Mixtures always comprise of two substances.	21	10	(+ 11)
The components of a mixture cannot be physically separated (A_1)*	36	4	(+ 32)
The components of mixtures can be separated but compounds cannot. (A_2)**	0	8	(- 8)
The components of a mixture combine in exact proportion (B_1)*	25	0	(+ 25)
Compound is a combination of two same elements.	27	12	(+ 15)
Compounds are a combination of the two same substances	23	15	(+ 8)
Compounds are heterogeneous	25	10	(+ 15)
The properties of the components in a compound are retained (C_2)*	38	2	(+ 36)
Pure compounds are homogeneous mixtures	15	2	(+ 13)
The component of a compound can be separated only by the process of electrolysis (A_3) *	17	3	(+ 14)
The components of a compound combine in different proportion (B_2)*	21	0	(+ 21)

(*) : Misconceptions about differentiation between mixture and compound. (The intervention was designed based on these misconceptions)

(**) : Misconceptions taking into account by a few studies in the mentioned literature some of which activity were developed to refine these.

+ : shows positive conceptual change, - : shows negative conceptual change

As can be seen from Table 4, as a general evaluation of the data, percentages of the students' misconceptions except for A_2 dropped from pre-test to post-test. This shows that conceptual change occurred in students' minds. However, conceptual change did not occurred merely in misconception A_2.

Since the intervention was designed based on the essential differences between chemical compound and mixture, misconceptions about them was examined in detail. If an average is taken over the items testing particular misconceptions, on average misconception A_1 dropped from 36% to 4%, misconception A_2 increased from 0% to 8%, misconception B_1 dropped from 25% to 0%, misconception B_2 dropped from 21% to 0%, misconception C_1 dropped from 41% to 6%, and misconception C_2 dropped from 38% to 2%. It will be noted that while the greatest conceptual change seemed to occur in connection with misconceptions A_1, B_1, B_2, C_1, and C_2, conceptual change with respect to misconception A_2 did not.

Moreover, students' overall achievement scores on pre- and post-test were calculated and data was analyzed by means of SPSS 10.0 ™ to make statistical comparisons between two cases and to determine the overall effectiveness of the activity.

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Table 5. The summary of the paired sample t-test.

	Subject (N)	Mean	Std. Deviation	df	t	p
Pre-test	52	52.87	14.66	51	-8.134	.000
Post-test	52	70.23	14.98			

After the statistical analysis, it was found out that there is a significant difference between pre- and post- test in favor of post-test ($t_{(26)}$ = -8.134, $p<0.05$). As can be seen from Table 5, students performed higher scores in post-test than in pre-test.

Conclusions

This paper suggests some answers to the two research questions posed in the introduction. In response to the first question, we found several misconceptions some of which were previously reported in the literature. The use of the test appeared to highlight the major difficulties students have. Amongst them, we identified that there was a major problematic issue for many students about differentiations between mixtures and chemical compounds. Intervention in order to overcome this difficulty was developed based on the literature.

The second research question is whether an intervention using a hands-on activity facilitates better understanding and provides conceptual change about these concepts? A response to this question is that the intervention generally did have positive effects upon students' understanding. It is clear from the Table 4 as a qualitative data and Table 5 as a quantitative data. Both quantitative and qualitative analysis indicated a clear increase on understanding of mixtures and chemical compounds on the average for groups of students. But, complete conceptual change was not seen in their understandings. As explained by Chinn & Brewer (1993), there are several reasons why complete conceptual change is so difficult. On being given information that contradicts a strongly held belief, a learner may ignore it, trivialize it, compartmentalize it, hold it in abeyance, change an insignificant part of the current belief but otherwise keep it intact, or provide a more complete conceptual change. On this basis the changes with respect to misconceptions A_1, $B_{1,2}$ and $C_{1,2}$ can be regarded as significant. This result indicate that present study that use of hands-on activity can be one of the effective means for inducing conceptual change.

However, conceptual change with respect to misconception A_2 was not effective. While this misconception is not seen in the pre-test results, it is seen in the post-test. It is inferred from this finding, intervention led to form a new misconception. In hands-on activity; a small yellow colored ball of clay mixed up with a blue one and therefore a larger green ball formed. Since the new existing green colored ball of clay different from the older ones in terms of their colors, students erroneously may think that small blue and yellow colored balls of clay did not compose from the larger green colored ball of clay. Probably, the analogical connections of similarities between colored balls of clay and elements were not obvious for the students. As mentioned by Taber (2001) and Nottis & McFarland (2001), analogy may raise an unexpected misconception as seen in this study. Sometimes analogical connections of similarities are not obvious and may require attention in instruction through different techniques such as bridging. Therefore, teachers need to focus on the goal of helping students to develop qualitative models of physical phenomena that can help students to make sense of abstract concepts. Moreover, although it is not seen in this study, students may think it is necessary to heat two elements to form a chemical compound. This view is valid only when the experiment about formation of FeS was done in teaching of subject. Therefore, teachers in their classes should emphasize that heat is not necessary to form compounds and show an illustration of how a compound can form without heat (for example, the elements sodium and oxygen can form sodium oxide at room temperature).

As a final remark, there are a number of teaching ways or strategies that are applicable in a classroom situation and that may be used for conceptual change in students' ideas. On the basis of the present study, it can be deduced that hands-on activities may be powerful way to foster science learning viewed from a conceptual change perspective. If teachers demand to get their students to learn meaningfully, they need to employ various strategies or tools in their classes to enhance student understanding of problematic science concepts. A variety of learning activities which optimize student involvement in the learning process help students to improve their performance. No one asserts that the students who are exposed to the teaching for conceptual change will immediately relinquish their preconceptions in favor of the scientists' explanations of the concepts unless they are persuaded that their preconceptions are wrong and deficient for the given phenomena. Therein, preconceptions are tenacious and may require repeated challenges in different settings and contexts to replace students' newly structured knowledge. Therefore, it is necessary to develop effective teaching ways, tools or strategies and present to teachers for their use in science classes to teach abstract and difficult science concepts.

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Appendix. A clay activity as intervention used in the study.

MIXTURES AND COMPOUNDS (A MODELLING CLAY ACTIVITY)

First Part:

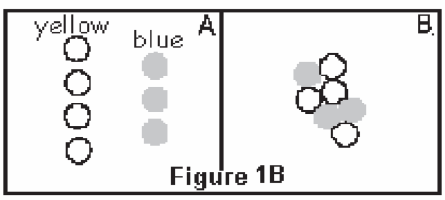

Figure 1B

- ✓ Make four yellow and three blue small balls by using clay.
- ✓ Randomly arrange these different-colored balls as in Figure 1B.

- ➤ In this arrangement, yellow and blue balls can be separated from each other easily?
- ➤ In this formulation, does each component retain its properties (i.e. color)?

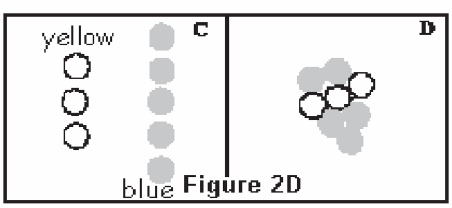

Figure 2D

- ✓ Make three yellow and five blue small balls by using clay and then arrange them as in Figure 2D.

- ➤ In these arrangements (Figure 1B, Figure 2D), is the number of yellow balls and blue balls used equal? Or, are their components (different-colored balls) in random proportion?

Second Part:

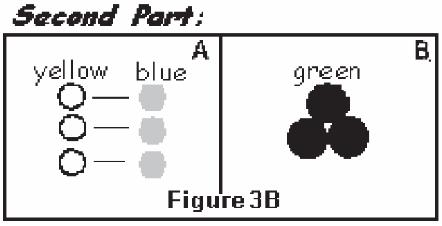

Figure 3B

- ✓ Make three yellow and three blue small balls by using clay.
- ✓ Mix together a yellow-colored ball and a blue-colored ball (1:1 proportion), so that they form a single ball of a new color in Figure 3B. At the end, you will get three larger green balls.

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As continued Appendix

- In such a formulation, can you separate the initial balls from one another by physically?
- In such an organization, do the properties of initial balls change?

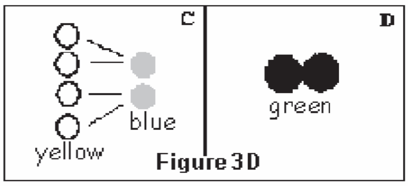


Figure 3D

- ✓ Make four yellow and two blue small balls by using clay.
- ✓ Mix together two yellow-colored balls and a blue-colored ball (2:1 proportion), so that they form a larger ball of green color in Figure 3D. Repeat the procedure using the other balls and get two larger green balls.

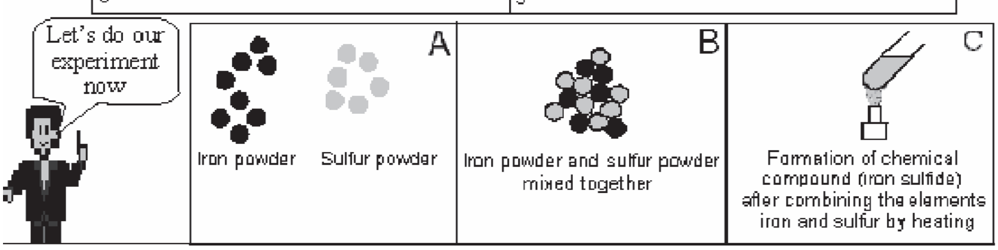
- Can you compose again the initial balls (blue and yellow color) from the new existing two green balls?
- In these arrangements (Figure 3B, Figure3D) is the number of yellow balls and blue balls used to make green balls equal? Or, do the different-colored balls combine each other to make green balls in exact proportions?

Regarding the activities that you did by using clay in the first and second part, fill in the blanks each one shows the properties of mixtures or chemical compounds in the chart below.
***Note: If the statement is true; put* (+), or not; put (-) sign.**

	You can get the initial balls from the new formations physically	Initial balls don't retain their properties	There is an exact proportion between the numbers of the balls that come together
I. Cases			
II. Cases			

By regarding the properties in the chart above, write down the properties of mixtures and compounds

Properties of Mixtures	Properties of Chemical Compounds
1	1
2	2
3	3



Резюме

СОБСТВЕННАЯ ПРАКТИЧЕСКАЯ ДЕЯТЕЛЬНОСТЬ УЧАЩИХСЯ В РАЗВИТИИ ПОНИМАНИЯ СМЕСЕЙ И ХИМИЧЕСКИХ СОЕДИНЕНИЙ

Байрам Косту, Суат Унал, Алипаса Аяс

Исследованы представления учеников о смесях и химических веществах, а также влияние их собственной практической деятельности, разработанной для улучшения понимания разницы между двумя понятиями. Выборка состояла из 52 учеников седьмого класса базовой школы. Для выяснения

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представлений школьников использовали тест из шести свободных вопросов. На основе этих исходных представлений была разработана методика организации практической деятельности школьников с двумя пластилиновыми шариками разного цвета. Цель данной методики - помочь ученикам усвоить существенную разницу между смесями и химическими соединениями. После занятий по этой методике в выборке был проведен заключительный тест.

Качественные и количественные оценки свидетельствуют о положительном эффекте методики в развитии понимания учеников. Учителям и разработчикам учебных программ следует использовать этот вид деятельности, чтобы помочь ученикам различать часто смешиваемые понятия.

Ключевые слова: понимание учеников, смесь, химическое соединение, собственная практическая деятельность

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