Üniversite Araştırmaları Dergisi, 2023, Cilt 6, Sayı 4, Sayfa: 443-449
Journal of University Research, 2023, Volume 6, Issue 4, Page: 443-449

Araştırma Makalesi
Research Article

An Example of an Activity Developed in Accordance with the 5E Learning Model for Teaching Solutions

Çözeltiler Konusunun Öğretimi İçin 5E Öğrenme Modeline Uygun Olarak Geliştirilmiş Bir Etkinlik Örneği

İclal Avinç Akpınar[1*], Samih Bayrakçeken[2]

[1]Erzurum Technical University, Rectorate, Occupational Health and Safety Coordination, Erzurum, Turkey
[2]Ataturk University, Kazim Karabekir Faculty of Education, Chemistry, Erzurum, Turkey

Orcid: İ.A. Akpınar (0000-0001-9994-6733), S. Bayrakçeken (0000-0001-8777-6714)

Abstract: In today's life, individuals are forced to be a constant learner to ensure their development. It is necessary to save the act of learning from rote learning, to gain the ability to think independently, and to raise individuals who learn by understanding. In this study, it is aimed to develop and present an active learning activity example prepared to be used at various levels of science teaching. In order for learners to achieve this goal, effective student-centered methods and techniques are needed. 5E model is one of them. In this study, activities related to the subject of solutions were developed, implemented, evaluated and necessary corrections were made in accordance with the 5E learning model. In this study, concept achievement test and semi-structured interview were used as data collection tools and both qualitative and quantitative data collection tools were used together to provide data diversity. In the analysis of quantitative results, t-test and MANOVA model were used, and in the analysis of qualitative data, the interviews with the students were transcribed. The results showed that the experimental groups were more successful than the control groups in terms of concept achievement in the subject of solutions after the application.

Keywords: Active learning, 5E model, Solutions, Activity.

Özet: Günümüz yaşantısında bireyler gelişimlerini sağlamak için sürekli öğrenen olmaya zorlanmaktadırlar. Öğrenme eylemini ezbercilikten kurtarıp bağımsız düşünebilme yeteneği kazanmak, anlayarak öğrenen bireyler yetiştirmek gerekmektedir. Çalışmada, fen öğretiminin çeşitli düzeylerinde kullanılmak üzere hazırlanmış aktif öğrenme etkinlik örneği geliştirmek ve kullanıma sunmak amaçlanmıştır. Öğrenenlerin bu hedefe ulaşabilmeleri için öğrenci merkezli etkili yöntem ve tekniklere ihtiyaç vardır. 5E modeli bunlardan bir tanesidir. Bu çalışmada 5E öğrenme modeline uygun olarak çözeltiler konusu ile ilgili etkinlikler geliştirilmiş, uygulanmış, değerlendirilmiş ve gerekli düzeltmeler yapılmıştır. Bu çalışmada veri toplama aracı olarak kavram başarı testi ve yarı yapılandırılmış mülakat kullanılmış olup nitel ve nicel veri toplama araçları bir arada kullanılarak veri çeşitliliği sağlamaya çalışılmıştır. Nicel sonuçların analizinde t- testi ve MANOVA modeli kullanılmış, nitel verilerin analizinde ise öğrencilerle yapılan mülakatlar çözümlenerek kayda geçmiştir. Sonuçlar uygulama sonrasında çözeltiler konusu kavram başarısı açısından deney gruplarının kontrol gruplarından daha başarılı olduğunu göstermiştir.

Anahtar Kelimeler: Aktif öğrenme, 5E modeli, Çözeltiler, Etkinlik.

1. Introduction

In the traditional learning approach, it is believed that information can be directly transmitted from the teacher to the student. However, according to new approaches, there is an argument for placing limits on the habit of information transmission in learning and asserting that acquired knowledge should be obtained by associating it with content. The common view among educators who embrace this is that learners should actively participate in the learning process to mentally structure the information. This transforms the instructional process from being a presentation of theoretical information to becoming an active process. In order for students to achieve this goal, there is a need for student-centered effective methods and techniques (Ünal, 2003).

In the field of learning theory and the philosophy of constructivist approach, many researchers such as Jean Piaget,

[*] İletişim Yazarı / *Corresponding author*. Eposta/*Email* : iclal.akpinar@erzurum.edu.tr
Geliş Tarihi / *Received Date*: 23.03.2023 — Kabul Tarihi / *Accepted Date*: 31.08.2023
doi: 10.32329/uad.1269230

[§]This study was conducted within the scope of doctoral thesis no. 266572

Eleanor Duckworth, George Hein, Howard Gardner have conducted in-depth studies. Through these studies, various models have emerged, and one of them is the 5E model.

The 5E learning model was initially developed by Karplus and Thier in the early 1960s under the name "learning cycle model," based on Piaget's theory of cognitive development (Lawson & Abraham & Renner, 1989). The learning cycle was initially composed of three stages: (1) Exploration, (2) Introduction of terms, and (3) Concept application. Later, the learning cycle, consisting of three stages, was expanded by the Biological Science Curriculum Study (BSCS) to include five stages. The BSCS team, led by team leader Rodger Bybee, developed an instructional model they named the 5E model, which reflected constructivism. Bybee collaborated with other educational researchers to create the 5E model (Bybee et al., 2006).

5E model engages students in activities at each stage, assisting them in learning concepts on their own. The 5E model serves as a framework that brings together specific characteristics of learning methods, aiming to activate and integrate an individual's prior knowledge related to the newly learned subject or concept.

The advantages of the 5E model, as outlined by Fish (1999), are provided as follows (Öztürk, 2008):

- Achieves greater success in learning.
- Enhances the retention of concepts.
- Develops a positive attitude towards science education.
- Cultivates a positive attitude towards science in general.
- Improves comparative analysis skills.

Attains a superior position in scientific process skills.

1.1. Steps of the 5E model

In the 5E model, each "E" represents a different digit. The model takes its name from the initials of the English names of its steps. The 5E model, which is thought to be very useful in the teaching process, consists of the steps of Engagement, Exploration, Explanation, Elaboration and Evaluation (Ayas, Çepni, Johnson & Turgut, 1997); (Campbell, 2006); (Çepni, Akdeniz, Keser, 2000); (Smerdan, Burkam & Lee,1999).

The steps of the 5E model can be summarized as follows:

Engage: This step is named in the literature as encouraging, attracting attention, arousing curiosity, logging in, entering, participation, checking preliminary information. The main function of the entry stage is to identify students' current knowledge and motivate them to learn by attracting their attention with appropriate questions, problem situations or demonstration experiments. He states that one of the most important factors affecting student success is motivation, and if students are interested in the subject and thus motivated, they will want to satisfy their own curiosity (Ekici, 2007). Therefore, this step is extremely important. It is reported that such educational situations increase students' success (Hiçcan, 2008).

Exploration: The first step is taken in this step to solve any situation left unanswered in the previous step. This step is the step with the most student activity. At this stage, students are enabled to access some information on their own by researching from various sources, conducting experiments or discussing. Students question events by observing, exploring and thinking about them. The discovery phase offers the perfect time to foster collaborative learning. When students work in groups, common experiences that enable sharing and communication occur (Koç, 2002). In this way, students begin to build basic knowledge together.

Explain: Students often have difficulty forming new relationships and correct concepts without the teacher's guidance. This step, where the teacher provides summative and explanatory information to conceptualize the information acquired, is the most teacher-centered step of the course. This step is the most important part of the course in providing the objectives intended for the course. In this step, students share with the class the knowledge they have gained based on their experiences in the previous steps and the relationships they have established. This step gives students the opportunity to demonstrate their understanding, scientific skills and behaviors (Boddy, 2003); (Bybee, 2006). Additionally, at this step, complementary explanations are made by the teacher. For this purpose, the teacher can use the direct explanation method or make explanations through discussion, simulation, film or video. This step includes relating previous steps, sequencing experiences, and formal expressions.

Eleboration: In this step, the subject that was started to be examined is returned to again after obtaining new information. Students develop their conceptual understanding with different examples and deepen their knowledge by applying the information they have learned to different situations. The aim is to reinforce the newly acquired knowledge and skills by giving students the opportunity to apply and use the new ideas they have acquired in the previous steps in similar situations.

Evaluation: Evaluation is the last step of the course. In this step, students evaluate what they have learned. The teacher also tries to evaluate the change in the students. In fact, according to the model, the evaluation process should be done from the very beginning of the process, that is, from the entrance step, and the end of the course should not be waited. While doing this, the teacher gets an idea about the progress of the lesson (Süzen, 2009). This step allows the teacher to more formally evaluate what students have learned. It is important for students

who are accustomed to seeing evaluation only as grades, to know that they will be evaluated at the end of the course, so that they will be more interested in the previous steps of the course.

1.2. Activity Prepared Topic

In the study, an active learning activity that can be used in teaching the subject of solutions in chemistry courses in secondary education and higher education programs that train teachers was developed.

- The topic prepared for the activity was determined as solutions and the sub-title as "Dissolution case and solubility".

1.3. Preparation of Activity

The work carried out during the preparation of the events is summarized below:

- By determining the subheadings of the subject of solutions, the subject area acquisitions based on the preparation of the activities were created.
- Literature was reviewed and examples of active learning activities prepared in accordance with the 5E model were investigated. For this purpose, chemistry curricula, newly developed Science and Technology curricula in our country, domestic and foreign theses and books were examined.
- Studies were conducted on how the activities should be organized according to the 5E model and a draft was created.
- Techniques that could be used in the activity were determined (demonstration experiment, educational game, worksheet, structured grid).
- Various examples from daily life, problem situations and research assignments were determined, experiments that can be easily carried out in the classroom environment with practical materials were planned, determination of what kind of material would be more appropriate for the subject, creation of original worksheets that can attract students' interest in terms of both content and shape, determination of appropriate questions to be asked about misconceptions, discussion topics or explanations to be made and placing them in the steps in accordance with the model.

1.4. Implementation of the Activities

A quasi-experimental research design with pretest-posttest control group was used in the implementation of the activities. In the control group, the lessons were taught with the traditional approach, while in the experimental group, the lessons were taught with active learning activities developed in accordance with the 5E model.

2. Method

2.1. Data Collection Tools

The data collection tools used in this study are concept achievement test and semi-structured interviews. In the study, both qualitative and quantitative data collection tools were used together and in this way, the limitations of one data collection technique were tried to be overcome with another technique (Yıldırım and Şimşek, 2005). The consistency between the data was tested through data triangulation (Mcmillan & Schumacher, 2006).

Concept Achievement Test (CAT)

A multiple-choice concept achievement test consisting of 20 items was prepared to cover the general acquisitions on "dissolution case and solubility". This test was applied to a total of 51 students studying in the 3rd and 4th grades of the Science Teacher Education Program and the reliability coefficient (Cronbach alpha) of the test was found to be 0.55. While some of the items in the test were created by the researchers, some of them were taken from the literature (Uzuntiryaki, 1998; Powers, 2000; Açıkkar, 2002; Pınarbaşı, 2002). With the approach of taking expert opinions, the validity of the tests was tried to be increased.

The interview protocol was prepared and semi-structured interviews were conducted with a total of 10 students, 5 from the experimental group and 5 from the control group. Some of the interview questions were aimed at determining the conceptual understanding of the students and the difference between the experimental and control groups in terms of concept achievement was tried to be determined.

2.2. Data Analysis

Quantitative analysis of the test data was made by taking into account the total scores of the students from the pre-test and post-test. After the pre-tests were administered, a t-test was conducted to determine whether there was a statistically significant difference between the experimental and control groups in terms of concept achievement. Since there was no statistically significant difference according to the pre-test results, MANOVA model was used to analyze the post-test results.

Qualitative analysis of the data was made by evaluating the interviews with the students. The students' answers

Tablo 1. Experimental Design of the Study

Groups	Pretests	Experimental Procedure (Implementation)	Post-Tests
Experimental Group	(CAT)	Active Learning Activities Developed in Accordance with the 5E Model	(CAT) (SSI)
Control Group	(CAT)	Traditional Teaching Approach	(CAT) (SSI)

Here (CAT) stands for Concept Achievement Test and (SSI) stands for Semi-Structured Interview.

to questions aimed at questioning their conceptual understanding of the content of the subjects were analyzed.

3. Findings

3.1. Pre-Test Findings

In order to determine whether there was a statistically significant difference between the experimental and control groups in terms of concept achievement, a concept achievement test (CAT) was applied to the groups respectively. The data obtained from these tests were analyzed by independent samples t-test.

The results of the t-test analysis for the subject of solutions are given in Table 2.

Table 2. Pre-test t-test Results

TEST	GROUP	X	t	p
CAT	Experiment	10,86	-0,239	0,812
	Control	11,05		

As can be seen in Table 2, according to the results of the t-test analysis of the pretest data, it can be said that there is no significant difference between the experimental and control groups in terms of concept achievement.

3.2. Post-Test Findings

After the application, a post-test was applied to the groups to determine whether there was a statistically significant difference in terms of concept achievement between the experimental groups using active learning activities prepared in accordance with the 5E model and the control groups using the traditional method. Since there was no statistically significant difference between the students in the experimental and control groups in terms of all pre-tests according to the pre-test results, the post-test data were analyzed using MANOVA model. MANOVA analysis results are given in Tables 2 and 3.

Table 3. Posttest MANOVA Results

Dependent variables		Square of averages	X	F	p
CAT Post Test	Experiment	33,631	14,76	6,804	0,013
	Control		12,95		

According to Tables 2 and 3, there was a statistically significant difference between the experimental and control groups in terms of concept achievement after the application (F= 6,804; p= 0,013). In science teaching, the mean concept achievement of the experimental groups was higher than the control groups (XE = 14,76; XC = 12,95). According to these results, it can be said that the experimental groups were more successful than the control groups in terms of concept achievement in the subject of solutions after the application. In other words, it can be said that the activities prepared based on the 5E model are more effective than the traditional approach in understanding the concepts related to the subject of solutions.

In addition, the analysis of semi-structured interviews conducted with the students in the experimental and control groups after the application supports the view that the students in the experimental group were more successful than the students in the control group. In the analysis of the interviews, it was determined that the students in the experimental group answered the questions in more detail and by associating the concepts with each other and that these students exhibited fewer misconceptions.

3.3. Findings from Interviews

While analyzing the findings obtained from the interviews, firstly, the answers given by the students around the main questions were quoted. Here, the interviews were transcribed by coding the students with numbers.

When the answers given by the students to the questions "What happens if salt is thrown into water?" and "How does dissolution occur?" regarding the concept of dissolution were examined, it was seen that all of the experimental group students developed a correct conceptual understanding of the concepts of dissolution and melting and stated that salt thrown into water would dissolve. In addition, it was also stated by the experimental group students that it would be wrong to use the expressions melting and dissolution interchangeably in the questions asked as drilling, that this was due to the use of these two words interchangeably in everyday language, and that science literate individuals should know the difference between these two concepts.

Among the control group students (S17, S9, S10), among the answers given to the same question, there were those who stated that the salt thrown into the water would disappear. In their explanations, these students stated that salt disappears but does not turn into water, it exists in water, but it cannot be seen by the eye because salt enters between water molecules. Again, S18, one of the control group students, stated that salt thrown into water would melt. In the definitions made by the student with the following drilling questions, it was seen that he explained that salt dissolves but called it melting, that is, he used the same description for dissolution and melting and used them interchangeably.

Different answers were received about how dissolution occurs. The answer that the solute particles settle in the spaces in the solvent while the dissolution takes place is among the answers received from the control group students (S9, S8, S6). In addition, for the question of how dissolution occurs at the molecular dimension, the answers that salt surrounds water (S13, S14, S15, S1, S3, S19, S26, S27) and that there is no interaction between salt and water (S18, S19, S5, S28, S23) were received.

Excerpts to exemplify the answers given by the students in different groups to the questions about dissolution in

the interview are given below: (Here, R represents the researcher and S represents the student.)

"R: What happens when salt is added to water?

S10: It disappears from the eye.

R: Does it disappear in the solution or does it turn into anything?

S10: No, it does not turn into anything. But we cannot see it because it gets in between.

R: It gets in between what?

S10: Salt gets in between the water and we cannot see it.

R: How does dissolution take place?

S10: When salt is put into the water, pluses and minuses, that is, opposite charges, come together. Oxygen comes around sodium and hydrogen comes around chlorine. So water comes around the salt. This shape shows the same distribution all over the container."

.....

"R: What happens when salt is added to water?

S8: As long as we do not stir, the salt settles to the bottom. It dissolves.

R: Doesn't it dissolve if we don't stir it?

S8: It dissolves even if we do not stir it, but it dissolves less.

R: How does dissolution happen?

S8: The salt is dispersed in the water. Salt enters between the water. There is homogeneous salt between them. "

.....

"R: What happens when salt is added to water?

S14: A solution is formed. Salt dissociates into ions and dissolves. Water is the solvent.

R: How does dissolution happen?

S14: In a solution, pluses and minuses attract each other. Hydrogen and chlorine find each other. They are homogeneously distributed. Salt dissociates into ions.

R: Do the oxygen and hydrogen of water remain separately?

S14: I think there is no change in water. Sodium goes next to oxygen and chlorine goes next to hydrogen, this is the same everywhere in the container. "

4. Conclusion, Discussion and Recommendations

In this section, the general results obtained from the post-test results and qualitative findings given to the groups within the scope of the study after the implementation, the interpretation and discussion of these results are given.

The post-test results of the concept achievement tests in all treatment schools on the subject of solutions show that there is a statistically significant difference between the experimental and control groups in terms of concept achievement and the mean achievement of the experimental groups is higher than the control groups. According to this result, it can be said that active learning activities developed in accordance with the 5E model are more effective than the traditional approach in terms of students' understanding of the concepts of solutions.

In the semi-structured interviews conducted with the students in the experimental groups, the answers to the questions "1-Are there any concepts that you knew wrong before but you learned the correct ones with these activities?", "2-What did this activity bring you?"; the students stated that they had the opportunity to correct many concepts that they knew wrong before during the implementation of active learning activities. Below are student statements reflecting this situation and excerpts from the interview with the experimental group students;

"I thought that the solute enters the gaps in the dissolution event, I did not know that it surrounds it".

"I learned that salt does not enter the air spaces in water, but dissolution occurs through interactions."

"I learned that it is not correct to say that sugar dissolved in tea."

"R: What happens when salt is added to water?

S26: It becomes a solution

R: How would you describe what dissolution is?

S26: Salt dissociates into Na+ and Cl- ions. First NaCl and water will interact. We write its reaction. If we consider their interaction,

the positive ion sticks to oxygen and the negative ion comes next to the plus charged hydrogen. The same distribution is seen everywhere in the container."

"R: What happens when salt is added to water?

S22: Dissolution happens

R: How would you describe the dissolution process?

S22: When salt dissolves, it dissociates into ions. Water surrounds the salt and there is a polarization. The hydrogen side of the water approaches the chlorine, the oxygen side of the water approaches the sodium side and breaks the salt. In this way it is homogeneously distributed. It is necessary to draw all around it because of the surrounding case."

In addition, the inclusion of applications (experiments, analogies, animations, worksheets, presentations, etc.) that can appeal to more sensory organs of the students in the experimental groups, associating the subjects with daily life, providing opportunities for students to express their own ideas through in-class discussions and trying to create learning environments by learning by doing can be considered as other reasons for the success of the students in the experimental groups. In each step of the model, it is also stated that students' taking responsibility by actively participating in the lesson helps them to develop a sense of self-confidence (Saka et al., 2006). It has been reported in various studies that students' active participation in the research process by conducting experiments helps them to understand abstract subjects more easily and helps them to learn information more deeply by structuring their knowledge by themselves and applying their knowledge and experiences to new situations (Demircioğlu et al. 2004; Saygın et al., 2006).

Within the scope of this study, the following recommendations can be put forward:

- It is seen as a great need to develop and reproduce new activities similar to the activities developed in the study for all subjects of chemistry. Developing new activities in line with this need will make a great contribution to science teaching.
- In order to develop a correct conceptual understanding in students, the activities should be developed by taking into account the misconceptions related to the subject and appropriate conditions should be provided for students to reveal their current understanding and correct their misconceptions during the teaching process.
- For the successful implementation of active learning activities in schools with limited facilities, experiments and other activities should be designed to be carried out with simple and easily available materials.
- Evaluation should be done not only at the evaluation stage of active learning activities, but also at other stages to a certain extent in order to determine whether the target has been achieved or not.
- As in the development of educational programs, activity development is a work that requires continuity, and it is seen as a need to continuously improve the activities with the information collected from the applications. Otherwise, activities may become outdated over time.
- The study can be made more comprehensive and it can be evaluated whether there are similarities in learning processes in different subjects.
- The study can be applied for different courses at different grade levels.

5. References

Açıkkar, E. (2002). Second Year High School Students' Understanding Levels and Misconceptions about Solubility. (Master's Thesis), *Karadeniz Technical University, Institute of Science and Technology, (Thesis no.127446).*

Ayas, A., Çepni, S., Johnson, D., Turgut, M.F. (1997). Teaching Chemistry, Teacher Education Series. Ankara: *YÖK/World Bank National Education Development Project Publications.*

Boddy, N., Watson, K., Aubusson, P. (2003). A Trial of the Es: A referent model for constructivist teaching and learning. *Research in Scinece Education*, 33, 27-42.

Bybee, R. W., Taylor, J. A., Gardner, A., Scotter, P.V., Powell, J. C., Westbrook, A. and Landes, N. (2006). The BSCS 5E Instructional Model: Origins and Effectiveness. *BSCS 5415 Mark Dabling Boulevard Colorado Springs, CO 80918.*

Campbell, M.A. (2006). The Effects of The 5e Learnıng Cycle Model on Students' Understandıng of Force and Motıon Concepts. (*Electronic Theses and Dissertations*), *Education the University of Central Florida Orlando. 2004-2019. 809. https://stars.library.ucf.edu/etd/809*

Demircioğlu, G., Özmen, H., Demircioğlu, H. (2004). Investigating the Effectiveness of Implementing Activities Developed Based on Integrative Learning Theory. *Turkish Science Education Journal*,1, 21-34.

Çepni, S., Akdeniz, A.R., Keser, Ö.F. (2000). Development of Sample Guide Materials Suitable for Integrative Learning Theory in Science Teaching, *19th Physics Congress, 26-29 September, Fırat University, Elazığ.*

Ekici, F. (2007). The Effect of Course Materials Prepared According to the 5E Learning Cycle Suitable for Constructivist Approach

on the 3rd Year High School Students' Understanding of Oxidation-Reduction Reactions and Electrochemistry. (Master's Thesis), *Gazi University Institute of Educational Sciences, (Thesis no. 207020).*

Hiçcan, B. (2008). The Effect of Teaching Activities Based on the 5E Learning Cycle Model on the Academic Achievement of 7th Grade Primary School Students in the Subject of First Order Equations with One Unknown in Mathematics Course. (Master's Thesis), *Gazi University Institute of Educational Sciences, (Thesis no. 218082).*

Koç, G. (2002). The Effect of Constructivist Learning Approach on Affective and Cognitive Learning Products. (Doctoral Thesis), *Hacettepe University, Institute of Social Sciences, (Thesis no. 113407).*

Lawson, A. E., Abraham, M. R., Renner, J. W. (1989). A Theory of İnstruction: Using The Learning Cycle to Teach Science Concepts and Thinking Skills [Monograph, Number One]. Kansas State University, Manhattan, Ks: National Association for Research in Science Teaching.

Mcmillan, J. H., Schumacher, S. (2006). .Research in Education, (New York: Longman).

Öztürk, Ç. (2008). The Effect of the 5E Model in Geography Teaching on Science Process Skills, Academic Achievement and Attitude. (Doctoral Thesis), *Gazi University, Institute of Educational Sciences, (Thesis no. 214836).*

Uzuntiryaki, E. (1998). The Effect of Concept Map Supported Concept Change Approach on Students' Understanding of the Solution Topic. (Master's Thesis), *Middle East Technical University, Institute of Science and Technology, (Thesis no. 75855).*

Ünal, H. (2003). The Effect of the Learning Circle Method on Success in Teaching the Science Course "Classification and Transformations of Matter". (Master's Thesis) *Marmara University, Institute of Educational Sciences, (Thesis no. 133566).*

Pınarbaşı, T. (2002). Examining the Effectiveness of the Conceptual Change Approach in Understanding Resolution-Related Concepts. (Doctoral Thesis), *Atatürk University, Institute of Science and Technology, (Thesis no.121471).*

Powers, A.R. (2000). Relationship of Students' Conceptual Representations and Problem- Solving abilities in Acid- Base Chemistry. (Doctor of Philosophy), College of Arts and Sciences Department of Chemistry and Biochemistry, Colorado The Graduate School.

Saygın, Ö., Atılboz, G., Salman., S. (2006). The Effect of Constructivist Teaching Approach on the Success of Learning Biology Course Topics: The Basic Unit of Life - Cell. *Journal of Gazi Faculty of Education, 26(1), 51-64.*

Saka, A., Akdeniz, A.R. (2006). Development of Computer Aided Materials on Genetics and Its Application According to the 5E Model. *The Turkish Online Journal of Educational Technology*-TOJET, 5(1), 14.

Smerdon, B. A., Burkam, D. T., Lee.V. E. (1999). Access to Costructivist and Didactic Teaching: Who Gets It? Where Is IT Practised? *Teachers College Record,* 101 (1),5–34.

Süzen, S. (2009). Evaluation of Science and Technology Lessons Taught with 5E and Traditional Methods with Structured Grid. *National Education*,38, (181),169-183.

Yıldırım, A. ve Şimşek, H. (2005). Qualitative Research Methods in Social Sciences, (5th Edition), Ankara, Seçkin Publishing.

Annex 1. Activity:

Dissolution ≠ Melting

Teaching Techniques Used: Demonstration experiment, Educational game, Worksheet (Structured grid)
Estimated Duration: 25 Minutes

Aimed gains with the activity:

1.1.3. Recognize that dissolution is a case and explanations of how dissolution occurs are theories.
1.1.5. Knows that dissolution is a physical event like expansion and melting.
1.1.8. Realizes that solvent and solute interaction takes place in dissolution and that the properties of both solvent and solute are important.
1.1.14. Understands the role and importance of observation and experiment in chemistry.

1- Entering

The teacher takes two beakers and puts water and some granulated sugar in one of the beakers and a few ice cubes in the other. After waiting for a while, he asks the students to compare and interpret what they observed in these two beakers. "What happened when sugar was added to the water? What did the ice turn into after a while? Questions such as these are asked and students are made to think.

2- Exploration

Then the students are asked "What do you estimate the melting temperature of sugar to be? How many degrees do you think the temperature should be increased for salt to melt?" and the students are asked to make a guess. After receiving various guesses from the students, they are informed that the melting point for sugar is approximately 185 °C and for salt this value is 801 °C and asked whether it would be possible for sugar to melt in water at room temperature. Thus, it is ensured that the students discover that sugar placed in water does not melt but dissolves. Explanations about the subject are made.

3- Explain

In line with the answers given by the students, the concepts of dissolution and melting are clarified under the guidance of the teacher. A question such as "What are the similar and different aspects of melting and dissolving?" is discussed with the participation of the students. Reminding that the terms used in daily life cause misconceptions, it is reminded that it is more accurate to use the expression "dissolved" instead of "dissolved" for sugar thrown into tea and that the word "dissolution" should be used in everyday language. The importance of science literacy can be emphasized here.

4- Elaboration

The teacher prepares cards on which the concepts of solution, solvent, solute, dissolution, dissolution, melting are written and folds them into a bag. The teacher divides the class into 5 groups and each group chooses one of their groupmates as a representative and this person chooses a card from the bag and tries to explain the concept written on the card to their friends without using that word. If the group members do not know the concept their friends are trying to explain, it is the turn of the other group. In this way, the confusion is tried to be eliminated.

5- Evaluation

At the end of the lesson, students are given a worksheet (Appendix 1.1) and asked to fill it in. Each question on the worksheet is read by the teacher and if there is anything that is not understood, it is explained. The completed worksheets are then collected and evaluated.

Appendix 1.1

Worksheet

Name-Surname:

1- Melting	*2- Ice*	*3-Dissolving*
4- Sugar	*5-Solvent*	*6-Dissolution*
7- Solution	*8-Sugar water*	*9-Water*

Answer the questions given below by writing the box numbers above in the dotted spaces left blank.

Question 1: Which one(s) can be characterized as homogeneous?
……..

Question 2: Which one(s) has two or more components?
……

Question 3: Which ones can be matched with each other in terms of their functions?
……

Question 4: Which two boxes together form a third one?
……

Question 5: Which one(s) are case?
……