# Turkish chemistry teachers' views about an implementation of the active learning approaches in their lessons

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# Abstract

Active learning is advocated as a better way of teaching for several decades in science education. The purpose of this study was to determine chemistry teachers' thinking and views about student-centered activities applicable in chemistry teaching and learning in the study context. A case study approach was used in this research. At the beginning, semi-structured interviews were carried out with 10 chemistry teachers. Then, a questionnaire was developed based on the data obtained from the interviews. This questionnaire was implemented to 50 chemistry teachers in Amasya. Finally, a semi-structured observation chart was used in chemistry lessons to determine how these activities came true. In this way, the relation between teachers' views about active learning techniques and their actual implementation of them were determined. The findings showed that although teachers are aware of student-centered chemistry instruction, they are still using traditional techniques widely in instruction. It was also found out that laboratories are physically insufficient in many cases and they do not have adequate equipments and chemical substances for performing properly the experiments. One of the reasons why teachers are not using these active learning techniques can be explained by the Student Selection Exam (ÖSS) done yearly to enroll students at Higher Education Institutions. Some suggestions were presented based on the results.

**Key Words:** Active Learning, Student-Centered Learning, Lycée Chemistry Education

# Introduction

Active learning, through which students become active participants in the learning process, is an important means for development of student skills. In the process of active learning, students move from being passive recipients of knowledge to being participants in activities that encompass analysis, synthesis and evaluation besides developing skills, values and attitudes (Sivan, et al., 2000). Active learning not only emphasizes the development of students' skills but also their exploration of their own attitudes and values (Sivan, et al., 2000). When active learning is carried out, simulations, discussions, student presentations, games, role-play, flip charts and handouts are basic elements of chemistry lessons (Sivan, et al., 2000). Meyers and Jones (1993) have maintained that the active learning consists of three factors, which are interrelated. These are: basic elements; learning strategies; and teaching resources. The basic elements of active learning are talking, listening, reading, writing and reflecting. These four elements involve cognitive activities that allow students to clarify the question, consolidate and appropriate the new knowledge. The second factor of active learning is the learning strategies that in corporate the above four elements. These are small groups, co-operative work, case studies, simulation, discussion, problem solving and journal writing. Third factor of active learning is teaching resources that the teacher uses to encourage students to interact and participate actively in the activities.

Recently many researchers in our country and abroad have carried out studies on the effects of active learning (student-centered teaching) approaches on student progress (Sivan, et al., 1991; Sivan et al., 2000; Scholes, 2002; Livingstone & Lynch, 2000; Notar, et al., 2002; Ünal, 1999; Kalem & Fer, 2003).

In a study carried out by Sivan et al. (1991), students took an education through active learning and student-centered learning. Students' perceptions of the effectiveness of these techniques were evaluated by means of a questionnaire and interviews. Results showed an overall contribution of the active learning approach used in tutorials to the development of students' communication and problem-solving skills as well as to their critical-thinking ability. The importance of incorporating aspects of field work into classroom learning was also highlighted.

The efficiency and implementing of active learning techniques on university students were examined in another study by Sivan and et al (2000). In classrooms where active learning techniques are used, it is observed that the lessons become more interesting

and the students take part in the lessons attentively. In addition, it is determined that the success and the interest of the students are improved better in active learning group more than the traditional group. The Livingstone & Lynch's (2002) study found supportive data that the interest and learning of the students are effectively increased.

Kalem & Fer (2003) searched the effects of a model designed for active-learning on the students' view of learning, teaching, communication and learning environment. According to the study realized on the university students, it was seen that the teaching carried out through active learning had positive effects in view of learning, teaching and communication.

As seen from the results of the studies presented above, it is determined that attitude and success of the students are effectively increased by using active learning techniques. Through this point of view, it can be clearly claimed that active learning is an effective way of teaching.

Examining the some studies, it indicates that the concepts and subjects about chemistry are not understood by students and leads some confusion in mind (Karamustafaoglu, 2003; Özmen, 2002; Demircioglu, 2002). It is possible to make them clear by teaching these concepts more concretely and through research, observation and experiments. Students should be facilitated with giving responsibilities and helping them to develop their creativeness. It is accomplished through active learning methods. However, examining the related literature, it is obviously observed that there is not any knowledge how much the active learning approached is used for the chemistry teaching. For these reasons it is necessary to examine the reasons why the active-learning is not used to yield permanent learning.

In our country the number of researches carried out on active learning is not sufficient to determine that whether it will be as successful as it is in other countries. Therefore, we need to find answers to the following questions. How often do the teachers use student-centered active learning techniques in chemistry teaching? Do they have sufficient knowledge about active learning techniques? Do they have enough opportunities to realize them in their classes? The purpose of this study was to answer to these questions and to determine chemistry teachers' thinking and views about student-centered activities carried out in chemistry teaching and learning.

# Methodology

A case study research methodology is used in this study. This methodology provides opportunities to employ a wide variety of techniques for in-depth investigation (Bell 1987, Merriam 1988). In this methodology, the instruments and the sample for each instrument together with the analysis of data are indicated below.

### *Sample*

The sample of the study consisted of 50 experienced chemistry teachers randomly selected from the secondary schools located in Amasya in Turkey.

### *Instruments and Procedures*

Six open-ended questions were developed to find out the teachers' views about active learning techniques, the necessary conditions to use them and how student-centered learning was implemented in the learning environment. The first author of the study asked these questions to the teachers in a semi-structured interview sequence. Based on the interview results, a questionnaire consisting of three parts was developed. In the first part of the questionnaire, the teachers were asked questions related to personal characteristics, such as teaching experience, number of students in their classes, textbooks and other materials they used in teaching chemistry. In the second part; the following issues were written down in charts. These are: learning techniques (learning techniques related to both active and traditional learning), whether or not they are able to use these techniques, and the usefulness of these techniques. Teachers marked their answers in related columns on the charts. The last part also consists of the following questions: What is the meaning of active learning? What does the active learning imply?, How are these techniques implemented in the classes? What is the rate of their usage of this technique in teaching? What are the conditions for implementations of this technique?

The questionnaire validity and reliability were secured by the following steps. Firstly, we wrote items and then invited a group of chemistry educator to check and revise them. Afterwards, the questionnaire was piloted. Finally, based on the pilot results, some revisions were made. These processes should help to increase validity and reliability of the questionnaire. Finally, a semi-structured observation chart was used

in order to determine relations between teachers' views about active learning techniques (based on the data from the interview and questionnaire) and their actual implementation of them. Semi-structured observation charts, developed by Karamustafaoglu, et al (2001) and used with some minor changes, were filled in the classes. In the light of our aim, ten chemistry classes were taught by three teachers in different schools were observed by the first author.

### *Analysis*

The collected data from the interviews were categorized in accordance with similarities and differences of teachers' views. The questionnaire consists of three parts and each part analyzed in different ways. The first and second parts were analyzed by calculating percentages of frequency. The third part was analyzed by evaluating teachers' explanations. The collected data from the semi-structured observations were analyzed by giving tables of frequency of teaching techniques used by the three teachers in their classes in terms of their teaching experiences.

### *Results*

The findings were presented below to determine the views and ideas of the chemistry teachers who use active learning activities in chemistry education.

### *Interview*

The collected data from the interviews were categorized in accordance with similarities and differences of the teachers' explanations. Interview questions and the teachers' responses to these were given below in detail.

**Question 1:** What are the teaching approaches in developing science curriculum materials in Turkey? Do you have necessary information about them?

Most of the teachers gave responses to this question like this: "*Recently, a student-centered curriculum was developed in the field of primary science. However, secondary science curriculum did not renew yet. It was developed in 1992 and according to this curriculum textbooks were published. We teach science with these textbooks. The secondary science curriculum does not have student-centered activities. Although it does not have necessary activities, we developed this type of activities*

*based on our experiences and we have improved these. Nevertheless, we do not have necessary knowledge and skills in using student-centered activities. As a conclusion, primary science curriculum is student-centered, but secondary science curriculum is not. Moreover, most of the teachers do not have adequate knowledge about these activities. Some recent modifications were done in education system. We are unable to keep up with these changes and we usually confront some difficulties. One of them is lesson planning. This year, the format of lesson planning is changed but the related in-service training is not given*". A few teachers also stated that: "*Science curriculum have often changed in recent years. It is difficult for us to follow-up these changes. There is a textbook wanted to be followed up by National Education Ministry and thus, we do this. Because, most of the teachers' and our students' aims are being successful in Student Selection Exam (ÖSS), we do not want to take sufficient information about activities. We have occasionally informed new approaches of teaching in education seminars, but we still do not know how to apply it*".

**Question 2:** Do you know student-centered learning? In your opinion, how to apply this approach in education?

Seven chemistry teachers stated that we knew this approach, while three teachers did not. Four teachers knowing this approach explained like this: "*According to this approach, the most important element is the fact that students are located in the centre and teacher guided to the students. That is, students actively participate in their learning. For example, students could have full responsibility to teach the topic. This approach is especially effective in social science lessons such as history, geography and so forth. However, students could not teach chemistry topics, since they did not know. Students only would be active in laboratory sections because they performed laboratory activities under the guidance of the teachers.* The other teachers also stated that we do not know how to implement this type of approaches.

**Question 3:** Should active learning be applied in implementing student-centered approach? How to use student-centered activities in active learning?

Most of the teachers stated that active learning should be applied in implementing student-centered approach. They also stated that the following issues for either students or teachers should be provided in order to perform student-centered activities. These are; willingness for learning, desire of studying, sufficient materials for performing laboratory activities and teachers' usage of these and other new techniques.

Moreover, they stated that this approach could be more effective if teachers use other new techniques in science lessons.

**Question 4:** What type of methods and techniques do you use in performing active learning? How to use them?

Most of the teachers stated that providing active learning in secondary schools is very difficult. They put forwarded the following reasons about this.

- Classrooms are very crowded
- Students are generally prepared for Student Selection Exam (ÖSS)
- Because of the ÖSS exam, teachers do not performed laboratory activities in the period of laboratory. In this period, they solve some problems related to the exam, rather than going into the details of the topic.

The teachers in their explanations implied that active learning is provided with learning methods such as brainstorming, role playing, demonstration, laboratory works and so on. They stated that it is very hard to use active learning techniques, especially in lycée 2 and 3 levels, as long as there is ÖSS exam and with 35-40 students in each classroom. One of the surprising explanations of the teachers is that school authorities do not encourage to use this type of techniques. Instead, they encourage teachers to solve problems and make other practices related to ÖSS exam.

**Question 5:** Do you have necessary equipments to provide active learning in your school.

Most of the teachers stated that facilities of the schools are insufficient in many cases and it is mostly very hard to provide or buy necessary equipments and chemical substances for performing the experiments. They also stated that because of these deficiencies, laboratory activities were not performed in many cases and therefore active learning for students could not be provided. One of the teachers explained that computer aided instruction is one of the way in providing active learning; however, it is not used. The reasons for this are teacher's lack of necessary information about using computers and having insufficient number of computers in schools. In addition to these, teachers complained the fact that classes are very crowded and this problem was ignored by authorities.

**Question 6:** Do you believe that your experiences are adequate in order to provide active learning? What are your suggestions for further applications of active learning?

Teachers gave similar explanation for this question. Most of them believe that their experiences are adequate in order to provide active learning. Teachers made some suggestions about active learning and they stated like this: "*In order to provide effective teaching one of the requirements is in-service education for teachers. In addition to this, the number of students in classes should be reduced. Laboratories should be prepared for active learning. In Students Selection Exam (ÖSS), items are generally numerical problems; so that these should be reorganized by increasing the items which include conceptual problems. Students should be encouraged to carry out researches. Sometimes, teachers should use computers in their class. Thus, computer needs in schools should be met and students and teachers must be given necessary in-service training about how these computers are used effectively. Apparatus for visual demonstration e.g. concrete models, animations, overhead and so on, should be used to enrich learning environment in laboratories*"

# Questionnaire

### *The First Section of the Questionnaire*

The data obtained from the analysis of the questions asked to the teachers were presented in Table I.

**Table I :** Frequency of demographic characteristics of the teachers

| sex | | teaching experience | | what books | | class population | |
|---|---|---|---|---|---|---|---|
| M | F | 0-14 | 15 and over | ANMEM | TO | 0-34 | 35 and over |
| 30 | 20 | 12 | 38 | 50 | 24 | 32 | 18 |

*M: male, F: female, ANME: approved by National Ministry Education, TO: the others 1 and Ss2*

As illustrated in Table I, 50 teachers, 30 male and 20 female participated in this research. 12 teachers have less than 14 year experience, the rest has over 15 years of

experience. All of them declared that they used the textbook approved by the National Ministry of Education whereas 24 of them declared that they also used other reference textbooks to enrich their lessons. 32 teachers indicated that their classroom populations were 0-34 and the others over 35 students.

### *The Second Section of the Questionnaire*

In this section, the answers given by the teachers about how often they used the teaching methods and activities offered to them in their classrooms what they think on the effects of their students' learning were presented in Table II.

When Table II examined, it was seen that more than half of the teachers claimed that brain storming, experiment in the lab, learning through research, group working, learning through exploration, question-answer method were useful teaching methods for students' understanding. Besides these, more than half of the teachers admitted that the methods such as role playing, demonstration, using computer, individual study, student games, models and analogies, expressing and taking notes were useful at a second degree. They commented nothing about case study, using concept framework and work sheet. Most of the teachers declared that they have never used brain storming, computer, concept mapping, concept framework, student games, work sheet, models and analogies during their teaching. It is determined that organizing a classroom debate, expressing, question-answer method and taking notes were the methods they often use in their classrooms. Besides, nearly half of them declared that they sometimes use the methods such as learning through research, individual study, and group working and learning through exploration during teaching.

**Table II:** The frequency of the methods and activities used in the classrooms and their thoughts on the effects on their students

| Teaching Methods and Activities | Level of importance | | | Degrees of useful | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | always | mostly | sometimes | never |
| | % | % | % | % | % | % | % |
| Brain storming | - | 25 | 75 | - | - | 10 | 90 |
| Role playing | 30 | 50 | 20 | - | - | - | - |
| Case study | - | - | - | - | - | - | - |
| Demonstration | - | 75 | 25 | 10 | 5 | 15 | 70 |
| Experiment in the lab. | - | 20 | 80 | 10 | 5 | 25 | 60 |
| Organizing a classroom debate | 35 | 30 | 35 | 25 | 35 | 25 | 15 |
| Using Computer Programming | - | 90 | 10 | - | - | 5 | 95 |
| Learning through research | - | 45 | 55 | 10 | 5 | 45 | 40 |
| Individual study | - | 60 | 40 | - | - | 45 | 55 |
| Group working | 5 | 45 | 50 | 5 | - | 30 | 65 |
| Watching film, video, etc. | 40 | 15 | 45 | 10 | - | 25 | 65 |
| Using Concept Mapping | 10 | 45 | 45 | - | - | 10 | 90 |
| Using Concept Framework | - | - | - | - | - | - | 100 |
| Learning through exploration | 10 | 25 | 65 | 10 | - | 35 | 55 |
| Using students games | - | 55 | 45 | - | - | - | 100 |
| Work sheet | - | - | - | - | - | - | 100 |
| Using models and analogies | - | 60 | 40 | - | - | 5 | 95 |
| Expressing | - | 80 | 20 | 35 | 65 | - | - |
| Question-answer method | - | 40 | 60 | 20 | 60 | 20 | - |
| Taking notes | - | 70 | 30 | 45 | 35 | 20 | |

### *The Third Section of the Questionnaire*

The data obtained analyzing the three open-ended questions which demand the thoughts of the teachers related with the active learning were presented below by categorizing their common expressions.

***Question 1.*** *Describe how student-centered teaching were carried out?*

Most of the teachers (40) whose teaching experiences are over 15 year's expressed that the students' knowledge level is adequate, the class population is not over-crowded, the teachers and administrators have sufficient information about the application of active learning and the physical capacity of the school is suitable (labs, library…). The other 10 teachers whose teaching experiences above 15 years claimed that the active learning can be performed through solving problems, brain storming, drama, role-playing and individual study. They, moreover, expressed that if the active learning wanted to be successful through the methods mentioned above, they should be supported by using audio-visual materials such as computers, CDs, over-head projectors, chemical materials.

***Question 2.*** *Regarding to the opportunities of the school do you believe active learning methods can be used? Give reasons.*

Nearly all of them declared that they could use the active learning methods if the students level and the physical capacity of the school are adequate and they have the necessary information how they use these methods. They also expressed that the active learning can not be realized because of the lack of school opportunities, students' level, school materials, chemical materials in labs and university entrance exam. Furthermore, half of the teachers said that student-centered teaching could not be exactly carried out. The reason of their claim was that chemistry is a numerical science-subject and it could be more effective if it was taught by a teacher.

***Question 3.*** *What are your suggestions to perform the student-centered teaching?*

The 30 teachers participating the survey expressed that active learning could not be realized but the students could be encouraged to be active. To make the students active could be succeeded through asking questions and debating with them. The other 20 teachers claimed that the students should be motivated to do research, school managers should be illuminated about the benefits of using internet, library and labs, the classrooms should not be over-crowded, the teachers who are not aware of active learning methods and their application should be supported by giving pre-service courses by experts, providing experiments sets per student and the university entrance exam should be revised such as providing questions depending on permanent learning.

# Observation

The observation findings of three chemistry teachers working in different schools and teaching experiences after observed for 10 hours are presented in Table III.

**Table III:** Using methods, techniques and activities

| ACTIVITIES | I | II | III |
|---|---|---|---|
| | f | f | f |
| The repetition of the previous lesson | 10 | 10 | 10 |
| Expression | 10 | 10 | 10 |
| Taking Note | 10 | 10 | 10 |
| Question-answer method | 8 | 10 | 10 |
| Giving samples from their everyday life | 9 | 8 | 8 |
| Using a model | 1 | - | - |
| Experiment in the lab. | 5 | - | - |
| Watching film, video, etc. | - | - | - |
| Demonstration | 2 | 2 | 1 |
| Problem solving | 10 | 10 | 10 |
| Using analogies | 2 | - | - |
| Using techniques where students are active | - | - | - |
| Making experiments using simple tools | 2 | - | - |
| Using concept maps | - | - | - |
| Group working | - | - | - |
| Solving problems the students face in their everyday life | - | - | - |
| Classroom discussion | 5 | 2 | 3 |
| Debate | 2 | 1 | 1 |

*I: teacher with 7 years experience, II: teacher with 15 years experience, III: teacher with 15 years experience, f: frequency of activities used in observed sessions. 1 and Ss2*

As shown in Table III, three teachers have used the activities such as the repetition of the previous lesson; expressing, taking notes, solving and making them solve the

problem in their teaching sessions. They seldom benefit from the techniques such as giving samples from their everyday life, making experiments, classroom discussions and debates. On the other hand they never use the active learning techniques (Problem solving, using concept maps ...).

## Discussion and Conclusion

In this study the thoughts of the chemistry teachers on active learning techniques are found out how often these techniques are used in the schools and what can be done to use the techniques effectively through interviews, questionnaire and observation methods. According to interview data it is clear that teachers do not use the student-centered methods. The most important reason for this is caused by the university entrance examination (OSS) system. Teachers think that the more questions they solve the more successful their students will be in the exam. This idea is also supported by the school administrators. In our country the quality of school is evaluated by the number of students who pass the university entrance exam. Than if it is so, this case is inevitable. The data obtained from the third section of the questionnaire supports the interview findings about university entrance exam. On the other hand, depending on the interview and questionnaire findings, teachers believe that active learning techniques are useful for permanent learning. In the related literature it is found out that there are teachers who believe that the teaching consisting active learning techniques is more effective. It is however determined there are teachers who believe student-centered learning can not be realized as the chemistry is a numerical subject. This belief shows that active learning techniques are necessary in teaching. From the interviews they confessed that they didn't have any idea about active learning techniques. This case is proved during our observations at schools. According to the observation data, teachers prefer traditional teaching techniques such as solving problems, expressing and question-answer. This finding is in agreement with the findings of other national studies (Karamustafaoglu et al., 2001, Karamustafaoglu, 2003, Özmen, 2002, Demircioglu, 2002). It can be claimed that the chemistry teachers do not know active learning techniques and applications.

Based on the collected data, the level of chemistry teachers' use of active teaching methods in their lessons was determined. It is also determined what the necessary procedures to use these methods effectively are. According to interview results,

teachers do not use teaching techniques which requires students' active participation. This possibly stems from the current way of applications of the OSS. Since this exam comprise of the multiple choices test items, teachers commonly think that the more test items they solve, the better learning occurs. Students also make great effort solving lots of multiple-choices questions in order to pass the exam in the school context. Moreover, teachers' views are supported by the school administrators and they urge the teachers to solve many multiple-choices questions in school lessons. Thus, school administrators think that success of their students could rise in this way. Similar results are appeared in the third section of the questionnaire. In general, it can be said that OSS have a great impact on using active learning techniques in classrooms.

It has been determined that the current chemistry teaching program in the secondary schools is not student-centered. So the teachers do not feel themselves need to use active learning approaches in their classes. However, some studies indicate that using student-centered applications is necessary for the permanent learning as chemistry contains abstract concepts. It is believed that the teachers should benefit from the active learning approaches. For the reason to use these approaches effectively, the curriculum should be revised and improved which makes the student active. It has been observed the teachers have idea about active learning theoretically but not have any practice in their classes. This case is supported by a lot of studies in Turkey.

In parallel to the related literature (Sivan, et al., 1991; Sivan, et al., 2000; Scholes, 2002; Livingstone & Lynch, 2000; Notar, et al., 2002; Ünal, 1999; Kalem & Fer, 2003), the teachers have thought that using active learning techniques in science lessons are necessary for students' permanent learning. Nevertheless, they mostly have the idea that these techniques are not used because science (chemistry) course is a numerical subject. This result indicates that the teachers having this idea do not believe active learning techniques. In addition, most of the teachers are also stated that they do not fully understand active learning. The evidence from the classroom observations shows the same results. According to observations, the teachers commonly make use of traditional methods eg: Lecturing, question-answer method, solving sample problems and so forth. These confirm the result of the study (Çepni, 1996) undertaken in our country.

# Suggestions

The suggestions depending on the results of study were presented below.

- University Entrance Exam should provide questions to encourage the students to make interpretation and to use their perception.
- Pre-services courses should be organized for the teachers who have lack of active learning knowledge, techniques and application.
- Schools should be altered proving labs for using these techniques easily and also the number of teaching materials should be increased.
- University lectures should motivate both the students and the teachers to research on the subject through seminars, conferences. They should also persuade the teachers that their teaching is more effective by using active learning techniques.
- School administrator should allow teachers and students to use the labs, libraries widely.
- School administrator and teachers should be illuminated these techniques provide permanent learning for the students for their future life.

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