The Effect of Demonstrations and Activities on the Students' Attitude towards Chemistry and Their Achievement in Middle School

A project by

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Submitted to the Division of Education of the

Lebanese American University

In partial fulfillment of the requirements for the degree of

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Acknowledgement

To the memory of my dear Mom who supported me

till the last moment of her life.

To my dear family

I would like to thank the professors who supervised my work for their hard efforts

Abstract

The purpose of this study is to investigate whether the use of the combination of lecture, teacher demonstrations, class discussion and student practical/experimental work improves the experimental students' attitudes towards studying chemistry, their understanding of chemistry concepts and as a result their achievement in chemistry more than the control group students who were only exposed to lecture and not to the teacher demonstrations and the practical work. The students' attitudes were surveyed using a questionnaire. The questionnaire was answered by 38 randomly selected grade eight students before and after the research period. Six students of those with largest attitude changes, both positive and negative, were interviewed to highlight the contrast between students. The students' results were collected from tests made at the closure of each concept during the research period. Another questionnaire was given to chemistry teachers in three randomly selected official and private schools to check the teaching methods they are using, their own views about the attitude and the achievement of their students. Students in the experimental group showed a positive attitude change that was associated with evidence of motivated behavior towards chemistry, while students in the control group showed a negative attitude and less motivation towards studying chemistry. In addition, the students' achievements in the experimental group were higher than those of the control group.

Chapter I

Introduction

An Overview

Low achievement and negative attitudes of secondary students are basic problems of chemical education. This is very much the case in most schools in Lebanon where chemistry is taught for the first time as a separate subject in grades seven, eight and nine. Prior to that, there is an integrated science course in grades five and six where chemistry has a limited participation. This low achievement and negative attitude may be due to the abstract chemical concepts at the sub micro (atomic, subatomic and molecular) level that are usually introduced quite early in grade eight.

It is well known that these concepts require formal operational reasoning in the Piagetian sense, and at the same time pose a heavy burden on students' working memory (Herron, 1978; Johnstone, 1991; Tsaparlis, 1997). This fact, combined with the very low (two peiods of fourty five minutes per week) teaching time allocated to chemistry as well as the lack of experiment/practical work during teaching, may be the cause of the low knowledge of basic chemistry and the negative attitude that students used to demonstrate at the beginning of secondary school until university(Odubunmi & Balogun, 1991; Robinson & Niaz, 1991; Tsaparlis, 1997). Tsaparlis commented, "It is as if students came to upper secondary school, and their only knowledge from foreign-language teaching was only the alphabet; no vocabulary, no grammar, no structure of the language".

An investigation of the above knowledge was conducted by many researchers and found that the average achievement of students at the secondary and university levels in chemistry is very low. The number of students going to science majors is declining. This must lead to ring the bells of worry and concerns among educational leaders and governors all over the world. A very fundamental question was always raised, what can educators do to improve the attitude of students towards science and therefore ensure more individuals encounter in science majors. This study sheds light on one of the factors that is affecting the attitude of students towards chemistry and as a result their achievement.

Defining Attitudes towards Science

A problem that has been raised by those studying attitudes towards science (Francis and Greer, 1999; Osborne, Simon & Collins, 2003) is the definition of attitude itself. There seems to be many concepts that relate to attitudes that may or may not be included in their definitions; for example, feelings, motivations, enjoyment, affects, and self-esteem. A common definition has involved describing attitudes as including the three components of cognition, affect, and behavior (Rajecki, 1990). Reid (2006) provides a clear definition of these components:

(1) a knowledge about the object, the beliefs, ideas components (Cognitive);

(2) a feeling about the object, like or dislike component (Affective); and

(3) a tendency-towards-action, the objective component (Behavioral).

In many ways, this seems a sensible view of attitudes because these components are so closely linked together. For example, we know about science and therefore have a feeling or an opinion about it that may cause us to take some actions.

Purpose of the Study

A major target of chemistry education research is to compare various instructional methods, to examine their efficiency, and to suggest improvements or new methods. In this paper, we are going to discuss the influence of teaching chemistry in two different methods:

I- Traditional method that depends on lecture-monologue

II- Inquiry method based on demonstrations and activities and based on meaningful learning.

Therefore, the purpose of this study was to see if there is any relation between the teaching methods of chemistry and students' attitude towards chemistry and their achievements as well.

Hypotheses

For the purpose of this study, the following hypotheses were tested:

H1: Using demonstrations and experiments in teaching chemistry affect the students' attitude towards studying chemistry in a positive way and as a result increase their understanding of abstract chemistry concepts as well as their achievements.

H2: Teaching chemistry in lecture method affects the students' attitude towards studying chemistry in a negative way and as a result decreases their understanding of abstract chemistry concepts as well as their achievements.

Significance of the Study

The results of the study could provide some insights on the effect of chemistry activities and experiments on teaching and learning chemistry. It may also motivate the students to learn more about chemical activities that are everywhere around them in their daily life. This may lead to a change in the students' attitude towards learning chemistry and may encourage many students select chemistry courses in universities.

Limitations

Not all schools are equipped to enable students to experience the discovery experimental approach. On the other hand, some science teachers are either not well prepared and do not know how to teach chemistry by integrating demonstrations and activities in their lesson plans or do not believe in the new approach and prefer to teach in the traditional way they were taught with. Another major obstacle is that many schools are not equipped with chemistry laboratories.

Chapter II

Literature Review

Laboratory activities have had a distinctive and central role in the science curriculum. The great benefits that students will crop by coupling experiments to lecture and being engaged in science laboratory activities are well established and emphasized by educators (Garnett & Hackling,1995; Hofstein & Lunetta, 2004; Lunetta, 1998; Tobin, 1990). During the major Lebanese curriculum reforms in science education in the 1990's, practical work in science education was used to engage students in investigations, discoveries, inquires, and problem solving activities. In other words the laboratory became important at least in the minds of science educators and curriculum developers. Laboratory activities were designed to help students grasp a stronger command on the nature of science and scientific investigation by emphasizing the discovery approach.

Traditional methods of teaching that is teacher-centered, with the teacher lecturing and the student being the passive recipient of knowledge are not effective for science concepts. Research on concept acquisition has revealed that children learn by active interaction initially with concrete objects and later with abstract entities (Tsaparlis, 1997). In addition, Piaget has suggested that cognitive development itself occurs through such an active involvement, an interaction of the child with objects and phenomena that leads to cognitive conflicts and subsequently to equilibration or self-regulation (Piaget, 1964). On the other hand, Ausubel has suggested that meaningful learning can be achieved only when there pre-exist in the mind the necessary relevant concepts and cognitive structures that will subsume the new knowledge; otherwise, rote learning has to be invoked (Ausubel, 1968). These empirical findings and theoretical positions have led to a strong criticism of the prevailing formal methods of instruction, and have instead advocated student-centered (concrete) methods, in which the student has an active part in the construction of new knowledge. For instance, discovery methods and guided discovery were used as a replacement of purely verbal methods, but their effectiveness has been controversial (Hermann, 1969; Rowell, Simon & Wiseman, 1962; Westbrook & Rogers, 1996).

There are two types of effective chemistry teaching techniques: Lecture demonstrations and lecture experiments. In lecture demonstrations, the teacher's knowledge of the behavior and properties of the chemical system is the key to successful instruction, and the way in which the teacher manipulates chemical systems serves as a model not only of technique but also of attitude. The instructional purposes of the lecture dictate whether a phenomenon is demonstrated or whether a concept is developed and built by a series of experiments. Lecture experiments, which some teachers prefer to lecture demonstrations, generally involve more student participation and greater reliance on questions and suggestions, such as "What will happen if…?" Even in a lecture demonstration, however, where the teacher is in full control of directing the flow of events, the teacher can ask the same sort of "What if " questions and can proceed with further manipulation of the chemical system.

In planning a lecture demonstration, the teacher should always begin by analyzing the reasons for presenting it. Whether the demonstration is spectacular or ordinary it should achieve a specific teaching goal rather than doing it for fun only. A demonstration must always have a certain purpose. One important purpose is to enhance the understanding of chemical behavior. Another purpose of demonstrations is to increase the students' ability to make observations that is why it should not be explained ahead of time rather we should leave the students to discover, analyze, and draw conclusions out of it.

Effective Demonstration

There are six characteristics of effective demonstrations which best promote student understanding (Weeks, 1968):

1- *Demonstrations must be timely and appropriate*. They should be done to meet a specific educational objective.

2- *Demonstrations must be well prepared and rehearsed.* To ensure success, all materials and equipments should be collected well in advance so that they are ready at class time. The entire demonstration should be well rehearsed from start to finish.

3- Demonstrations must be visible and large-scale. A demonstration can help only those who experience it. Hence, the teacher needs to set up the effect for the whole class to see.

4- *Demonstrations must be direct and lively.* Action is an important part of a good demonstration. It is the very ingredient that makes demonstrations such efficient attention-gabbers.

5- *Demonstrations must be dramatic and striking.*

6- *Demonstrations must be simple and uncluttered.* A common source of distraction is clutter on the demonstration bench. Make sure that the demonstration area is neat and free of extraneous glassware, scattered papers, and other disorder. All attention must be focused on the demonstration itself.

In principle and in practice, every lecture demonstration is a situation in which teachers can convey their attitudes about the experimental basis of chemistry, and can thus motivate their students to conduct further experimentation, and lead them to understand the interplay between theory and experiment. Lecture demonstrations should not be considered a substitute for laboratory experiments. In the laboratory, students can work with the chemicals and equipment at their own pace and make their own discoveries.

The demonstrations that were used during the study period with the experimental group are taken from different resources (Shakhashiri, 1983; Baker, 2007;

Carvalho, Mendonca, Piedude, & Fatima, 2002; Sanger, 2006; Praksa & Tothova, 2006).

Science education literature emphasizes the importance of rethinking the role and practice of laboratory work in science teaching in general and in the context of chemistry education in particular (Bybee, 2000; Hofstein & Lunetta, 2004; Lunetta, 1998). It is true that research has failed to show a simple relationship between experiences provided to the students in the laboratory and learning science. However, sufficient data do exist to suggest that the laboratory instruction is an effective and efficient teaching medium to attain some of the goals for teaching and learning science. Appropriate laboratory activities can be effective in helping students construct their knowledge, develop logical and inquiry-type skills, as well as problem-solving abilities (Gunstone, 1991; Tobin, 1990).

Appropriate demonstrations that are well prepared, designed to capture student's imagination, safe to dispose of and actually work are effective in classrooms (Baker, 2006). They can also assist in the development of psychomotor skills (manipulative and observational skills). In addition, they have a great potential in promoting positive attitudes and in providing students with opportunities to develop skills regarding cooperation and communication (Bybee, 2000; Gunstone, 1991; Lunetta, 1998; Tobin, 1990). In this respect, the science laboratory is a unique learning environment. Thus, it has the potential to provide science teachers with the opportunities to vary their instructional techniques and to avoid a monotonous classroom-learning environment.

Order of intellectual activities involved in chemistry

In teaching and in learning chemistry, teachers and students engage in a complex series of intellectual activities. These activities can be arranged in a hierarchy that indicates their increasing complexity (Partington, 1960). This hierarchy provides a framework for including lecture demonstrations in teaching chemistry. At the first level, we observe chemical phenomena and learn chemical facts. At the second level, we explain observations and facts in term of models and theories. At the third level, we develop skills, which involve both mathematical tools and logic. Moreover, at the last level, we are concerned with chemical epistemology. We examine the basis of our chemical knowledge by asking questions such as "How do we know that…?" Across all four levels, the attitudes and the motivations of both teacher and student are crucial. The attitude of the teacher is central to the success of interactions with students. Though teachers with high morale, motivation and a mastery of knowledge, learner difficulties, and capacity to facilitate learning are important, correct use of an appropriate teaching method is critical to the successful teaching and learning of chemistry (Grauwe, 1999; Zadra, 2000). Students may learn names and definitions of chemical substances theoretically. However, to master chemical reactions, they need to mix the chemicals and observe subsequent reactions. Knowledge to how teaching methods affect students' learning may help educators to select methods that improve teaching quality, effectiveness, influence and accountability to learners (Wachanga & Mwangi, 2004).

Lecture demonstrations help to focus students' attention on chemical behavior and chemical properties, and to increase students' knowledge and awareness of chemistry. To approach them simply as a chance to show off dramatic chemical changes or to impress students with the magic of chemistry is to fail to appreciate the opportunity they provide to teach scientific concepts and descriptive properties of chemical systems. The lecture demonstration should be a process, not a single event (Shakhashiri, 1983).

Chapter III

Objective of the Study

The objective of this study involves:

1) How chemistry-teaching methods affect students' understanding, achievement and attitude towards chemistry.

2) Whether using demonstrations and laboratory activities affected students' achievement and attitude toward learning chemistry

3) Whether the cognitive achievement and attitude of students taught through demonstrations and experiments were different from that of students taught through lecture teaching method.

The conceptual framework in figure 1 of this study was based on the systems theory developed by Ayot and Patel (1987) that portrayed the teaching-learning process as a dynamic with inputs and outputs.

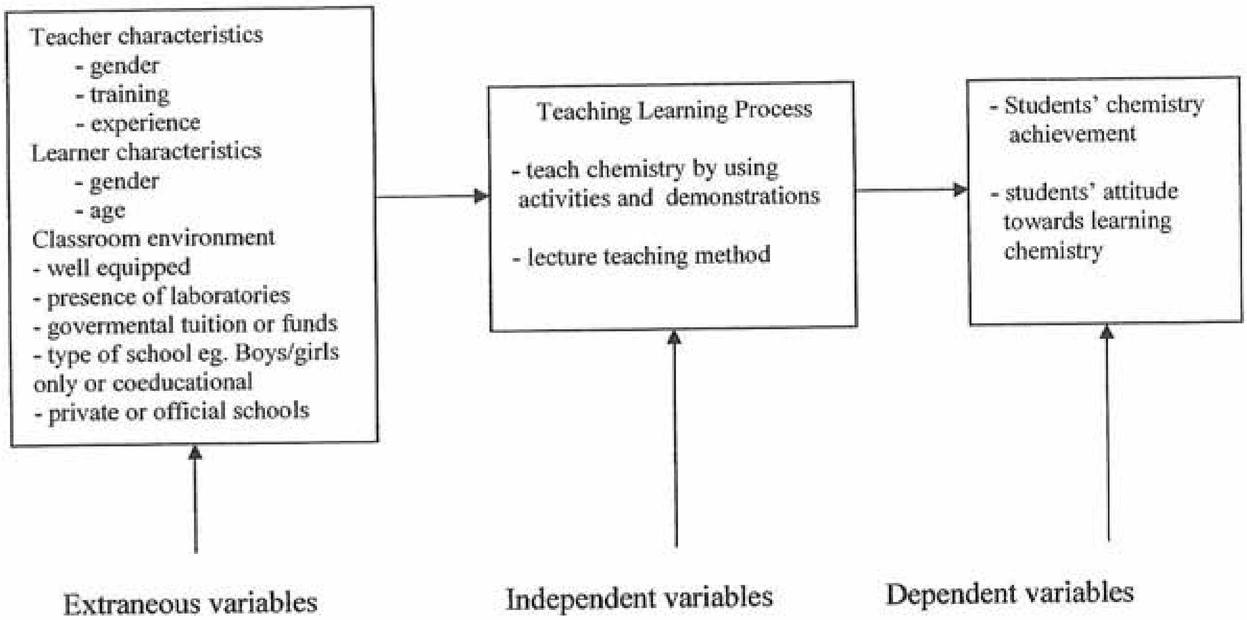

Figure 1. The conceptual framework used to investigate the effect of teaching chemistry using activities and demonstrations on students' attitude towards chemistry and their achievement.

Chapter IV

Research Design and Methodology

The study comprised two main elements:

a) Questionnaire survey of school students and another questionnaire survey of school chemistry teachers.

b) Interviews with school students and school chemistry teachers.

The study was conducted on grade eight students in a private coeducational school in Sidon-Lebanon for three months. Since the classes existed as intact groups and could not, for ethical reasons, be re-constituted for research purposes, the study used the school classes as they are. The eight grade consisted of two sections, one section was considered as the control group and the other section was the experimental group. Two different methods were used in this study. In the method used with the control group instruction was provided through purely verbal means, while in the method with the experimental group use was made of activities and manipulations of experiments along with verbal interaction.

The experimental group was mainly student-centered, but with the teacher playing an active role in the organization of the lessons, trying to lead the students through questions, activities and proper structuring of the lessons to the construction of new knowledge. More specifically, the method was characterized by the inductive teaching of concepts, the use of demonstrations, laboratory activities and group discussions by the students themselves. The control group was teacher-centered, and characterized by the deductive teaching of concepts, where using lecture together with writing on the board, was attempting to incorporate the new concepts hierarchally into the students' cognitive structure. The students in the experimental group were given the chance to perform the experiments and discuss the topics in the class while the students in the control group were all listeners to the lecture and were only allowed to ask questions if they do not understand the concept.

Group 1 (Gr. 8, N=20)	Experimental group
Group 2 (Gr. 8, N=18)	Control group

To control for teachers' gender, training and experience as sources of internal invalidity, the two sections of the same level was taught by the same teacher. The students' gender was already controlled by the school. The students of each level were almost of the same age. The classes were divided evenly considering the gender and the previous performance records of the students.

The opinion of the students on the teaching method, as well as their overall attitude towards chemistry, and their relationship to their teacher was checked by giving each student a questionnaire survey to fill at the beginning of the study period. The same survey was given to the students at the end of the study period to detect any change in their attitude or their motivation to study chemistry. The attitude questionnaire is base on previous questionnaires done by Mackenzie (2003) with few changes to meet the purpose of our study. The questionnaire was designed to assess the attitudes of students towards chemistry learning. The reasons behind using the student's questionnaire are because it: (1) is less expensive and time saving because it is too difficult to interview all students in both groups before and after the study, (2) gives freedom for students to answer in their own time and pace, (3) reduces the embarrassment of the students, and (4) provides more truthful responses. After studying the pre- and post-questionnaires of each student, six students of those with largest attitude changes, both positive and negative, were interviewed to investigate the factors that affected this change in their attitude. The interview provided us with the flexibility to ask and extend with the questions that are important to us (Burns, 2000).

Student achievement was evaluated with respect to the theoretical concepts taught. A chemistry achievement test was given to the students to check their understanding, knowledge, comprehension, and application of the chemistry concept taught. The chemistry tests were designed by the class teacher and revised by the chemistry coordinator in the school. The chemistry concepts that were taught by the teacher were part of the school curriculum. The chemistry units covered during the study period are: 1- chemical reactions ; 2- Acids, bases and salts.

Another questionnaire survey was given to chemistry teachers from three different schools in the same area. The schools were randomly selected without considering the area, the social and economical status of the school and the social status of the students as one official school and two private schools. The survey checked the teaching methods used by the teacher, the availability of chemistry labs in the school, the school financial support for the teacher's requests and the attitude of their students towards learning chemistry from their point of view.

Reliability and validity

The only quantitative part in our study includes the scores of the tests taken by the students during the study period. We followed the Split-half method for estimating the reliability of the tests provided to the students. Two scores were obtained simply by splitting the test into halves. The scores obtained on the first half of the test were correlated with scores on the other half of the test (Burns,2000). The only difficulty we faced is in keeping the level of difficulty of the items in the two halves the same. The Spearman-Brown formula was used to estimate the reliability of the test.

The teacher checked the content validity of the test. An achievement test has content validity if it represents faithfully the objectives of a given instructional sequence and reflects the emphasis accorded these objectives as the instruction was carried out (Burns, 2000). The teacher followed a plan based on specific objectives during her teaching and the test was based on these objectives. The procedures in conducting experimental research (definition of problem, hypothesis to be tested, variables, etc) were well observed.

The validity of the questionnaire was tested by the number of respondents and whether they were done accurately which was correlated with the achievement of the students.

Chapter V

Results and Discussion

The method used with the experimental groups was found superior especially with average and low-achieving students concerning their attitude and achievement. Laboratory activities appear to be helpful for students rated as medium to low in achievement on the pre-study measures. As for high achieving students, the experimental method enhanced their understanding of the concept and the way they analyze it. This enhancement was because of the class discussion that made them understand the concepts deeply.

Students enjoyed laboratory work and the laboratory experiences resulted in positive and improved student attitudes and interest in chemistry. Students were asked to rate their perceptions of the relative effectiveness of instructional methods for promoting their interest in and attitude towards learning chemistry. They reported that personal involvement in the chemistry laboratory and teacher's demonstrations were the most effective instructional method for promoting their interest in chemistry studies when contrasted with teacher's lectures and classroom discussions only.

Influence of teaching methods on the achievement of students

Table 1. Achievement results of high and low achievers in experimental and control group before and after the study period

Group	Sub-group	Pre-evaluation average %	Post-evaluation average %
Experimental (N=20)	High achievers	90	93
	Low achievers	62	74
Control (N=18)	High achievers	91	90
	Low achievers	61	62

The results in the table show that the experimental method influenced the low achievers' achievement a great deal. Science education researchers have examined the role of the laboratory on many variables, including achievement, attitudes, critical thinking, cognitive style, understanding science, the development of the science process skills, manipulative skills, interests and the ability to do independent work. Positive research findings on the role of the laboratory in science teaching do exist (Boghai, 1979; Grozier, 1969, Lott, 1983). Laboratory instruction also increases students' problem-solving ability in physical chemistry. Laboratory could be a valuable instructional technique in chemistry if experiments were genuine problems without explicit directions (Godomsky, 1971). Comber and Keeves (1978) found, when studying science education in 19 countries, that in six countries where 10-year-old students made observations and did experiments in their schools, the level of achievement in science was higher than in schools where students did not perform these activities.

Students taught through demonstrations and activities performed better than those taught through the lecture teaching method. This implies that the demonstration and activity method enhances students' achievement more than the lecture teaching method did. Students need sufficient time to develop the confidence and social skills necessary for effective participation in a cooperative learning class (Johnson & Johnson, 1990). In this study, the experimental groups were given enough time to perform their experiments and discuss their results and deduce conclusions to understand the concepts.

Class discussion and laboratory interaction between students are beneficial for both bright and weak students. Weak students benefit from interaction with brighter students and when bright students explain their ideas to others, they learn the material they are explaining in more depth and remember it longer (Johnson & Johnson, 1992; Johnson, Johnson & Smith, 1998).

Influence of teaching methods on the attitude of students

Table 2. Results of student questionnaire of the experimental group on their attitude towards chemistry before and after the study period.

	Item	% Either totally or partially agreeing	
		Pre	Post
1.	Science is my favorite subject	20	78
2.	Chemistry is my favorite science subject	16	85
3.	Chemistry is more difficult than other science subject	76	50
4.	I feel enthusiastic about chemistry	17	95
5.	I enjoy chemistry periods all the time	10	87
6.	I understand chemistry concepts	37	79
7.	I don't think that chemistry is useful to me	77	45
8.	I don't think that chemistry is related to my real life	80	28
9.	I go to the lab for chemistry experiments	0	100
10.	My teacher does demonstrations in the class	0	100
11.	I get high grades in chemistry	23	69
12.	I would like to take chemistry through my university education	20	43
13.	It is exciting to be a scientist	20	40

Developing favorable attitudes towards science has often been listed as one of the important goals of science teaching. The laboratory, as a unique social setting, has great potential in enhancing social interactions that can contribute positively to developing attitudes and cognitive growth when activities are organized effectively (Hofstein & Lunetta, 1982; 2004). Also, Okebukola (1986) summarized his study, claiming that a greater degree of participation in the science laboratory resulted in an improved attitude towards chemistry learning in general and towards learning in chemistry laboratory in particular.

On the other hand, the attitude towards chemistry wasn't influenced among students in the control group. This is because the students were not exposed to any of the demonstrations and experiments that were used with the students of the experimental group. The role of the teacher in the science and chemistry classroom, and the extent and mode of participation of the students is a recurring issue in the science education literature.

As for the teachers who were interviewed, they did not favor teaching through demonstrations and experiments for the lack of time, big curriculum they have to cover and the lack of laboratories in their schools. Most of the official schools in Lebanon don't have chemistry labs and don't get the financial support from the government to prepare ones. Teachers also are not comfortable with teaching by the experimental method because it needs too much preparation. Most of the teachers are not well trained to work in the lab and are not ready to do so because of the risks and surprises they may face during their work with the students.

Chapter VI

Conclusion

The role of the teacher in the science and chemistry classroom, and the extent and mode of participation of the students is a recurring issue in science education literature. Although it must be admitted that the issue of whether on e instructional strategy is superior to another can not be answered generally. This work, in line with the majority of previous studies, resulted in favor of a student-centered method of teaching intermediate and lower secondary school chemistry, over a receptive, teacher-centered one. The superiority of the student-centered method of teaching could be attributed to the active participation of students in all processes of learning. This develops a positive attitude towards chemistry, and consequently results in higher achievement. Conversely, the passive role that the receptive, teacher-centered method reserves for students leads to many of them experiencing boredom, decreases their interest, and develops a negative attitude towards chemistry, thus resulting in lower achievement. These findings are in accord with many studies that suggest that every teaching method that involves students in an active way in the learning process increases their positive attitude towards science.

The only way to learn about a certain chemistry concept is to see its result, to experiment, and to work in a laboratory. There is nothing more charming than seeing a chemical change or any other chemical demonstration done in the lab before a large class as answered by most students in the experimental group. It seems that students will remember chemistry more fondly because of these good times. The point is that we teachers must realize that chemistry is relatively boring to read and work problems about, unless the student has some vivid mental images of the experimental side of the science. Good demonstrations not only spice up a class session, but they also help teach principles, and they help build up general experimental knowledge of a sort that makes chemistry seem less abstract. Teachers who feel that they have "been down the road" and are tired of demonstrations should remember that it is all new and interesting to their students. The teacher who does not take advantage of demonstrations is doing students a disservice.

Obviously, we teachers are in a high responsible position when it comes to helping form attitudes toward science. Years later, our students will remember only small fragments from our subject, but they definitely will have attitudes toward science. It may be that these attitudes will be unfavorable, if our students hate chemistry for certain reasons discussed by Tom Lippincott (1979) in an editorial entitled "Why Students Hate Chemistry", however, it would be desirable if our students retain a feeling that there is a certain amount of charm associated with the subject of chemistry.

The most important factor that influences the students' attitude is the teacher's attitude. Most teachers are taking this career as a financial support and not a hobby. They are obliged to teach for their living and not because they love to teach chemistry. This reflects clearly on the teacher's attitude in the class that is so obvious to the students. Our motivation to teach is reflected in what we do, as well, in what we do not do, both in and out of the classroom. Our modes of communicating with students affect their motivation to learn. All aspects of our behavior influence students' confidence and their trust in what we say. Our attitudes toward chemicals and toward chemistry itself are reflected in such matters as how we handle chemicals, adhere to safety regulations, approach chemical problems, and explain and illustrate chemical principles. So if we are asking students to have a positive attitude towards chemistry which is the subject we teach we have to start with our own selves first.

Recommendations and Suggestions for Future Research

Based on the findings of this study, the following recommendations are made:

1- It is recommended that schools construct a small lab for science subjects that provides the teachers with the materials they need throughout their teaching.

2- It is recommended that schools send their science teacher to train them on inquiry based teaching strategies that are student-centered and encourage them to include activities and demonstrations in their lesson plans.

3- Further research needs to study the attitude towards science as a function of gender and test the hypothesis that claims: Female students are less positive.

4- Further research needs to study the attitude as a function of class or period of schooling.

References

Ajewole, G. A. (1991). Effects of discovery and expository instructional methods on the attitude of students to biology. *Journal of Research in Science Teaching,* 28, 401-409.

Ayot, H. O., & Patel, M. M. (1987). *Instructional methods.* Nairobi, Kenya: Kenyatta University.

Baker, C. (2006). Exhibition chemistry. *Education in Chemistry*, 43(3), 66.

Baker, C. (2007). Exhibition chemistry. *Education in Chemistry*, 44(2), 42.

Banerjee, A. C. (1997). Effects of lecture and co-operative learning strategies on achievement in chemistry in undergraduate classes. *Inernational Journal of Science Education,* 19(8), 903-910.

Boghai, D. M. (1979). A comparison of the effects of laboratory and discussion sequences on learning college chemistry. *Dissertation Abstracts,* 39(10), 6045A.

Burns, R. B. (2000). *Introduction to research methods*. London, Sage Publication Ltd.

Bybee, R. (2000). Teaching science as inquiry, In J. Minstrel, & E.H. Van Zee (eds.). *Inquiring into inquiry learning and teaching in science*, pp. 20-46. Washington DC: American Association for the Advancement of Science (AAAS).

Carvalho, A. P., Mendonca, A.F., Piedude, M., & Fatima, M. (2002). Chemistry Activities. *Journal of Chemistry Education*, 79, 1464A.

Cohen, H. G. (1992). Two teaching strategies: Their effectiveness with students of varying cognitive abilities. *School Science and Mathematics,* 92, 126-132.

Comber, L. C., & Keeves, J. P. (1978). *Science education in nineteen countries: International studies in evaluation I.* New York: John Wiley & Sons, Inc.

Francis, L. J., & Greer, J. E. (1999). Measuring attitude towards science among secondary school students: The affective domain. *Research in Science and Technological Education,* 17(2), 219-226.

Garnett, P.J., & Hackling, M.W. (1995). Refocusing the chemistry lab: A case for laboratory-based investigations. *Australian Science Teacher Journal*, 41, 26-32.

Godomsky, S. F. (1971). Programmed instruction, computer-assisted performance problems, open ended experiments and student attitude and problem solving ability in physical chemistry laboratory. *Dissertation Absracts,* 31(11), 5873A.

Grauwe, A. D. (1999). The challenges for the school of the future. *International Institute for Educational Planning,* 17(4), 10-11.

Grozier, J. E. (1969). The role of the laboratory in developing positive attitudes toward science in a college general education science course for nonscientists. *Dissertation Abstracts,* 31(11), 2394A.

Gunstone, R. F. (1991). Reconstructing theory from practical experience. In Woolnough, B. E. (ed.), *Practical Science*, pp.67-77. Milton Keynes: Open University Press.

Hand, B., & Treagust, F. D. (1991). Student achievement and science curriculum development using a constructive framework. *School Science and Mathematics,* 91, 172-176.

Hermann, G. (1969). Learning by discovery: A critical review of studies. *Journal of Experimental Education,* 38, 59-72.

Hines, C. V., Cruickshank, D. R., & Kennedy, J. J. (1985). Teacher clarity and its relationship to student achievement and satisfaction. *American Educational Research Journal,* 22, 87-93.

Hofstein, A. & Lunetta, V.N. (1982). The role of the laboratory in science teaching: Neglected aspects of research. *Review of Educational Research,* 52, 201-217.

Hofstein, A. & Lunetta, V.N. (2004). The laboratory in science education: Foundation For the 21st century. *Science Education,* 88, 28-54.

Johnson, D. W., & Johnson, R. T. (1990). Social skills for successful group work. *Educational Leadership,* 47(4), 29-33.

Johnson, D. W., & Johnson, R. T. (1992). *Creative controversy: Intellectual challenge in the classroom.* Edina, MN: Interaction Book Company.

Johnson, D. W., Johnson, R. T., & Smith, K. (1998). *Active learning: Cooperation in the college classroom.* Edina, MN: Interaction Book Company.

Johnstone, A. H. (1991). Thinking about thinking. *International Newsletter on Chemical Education,* 6, 7-11.

Johnstone, A. H., & Al-Naeme, F. F. (1995). Filling a curriculum gap in chemistry. *International Journal of Science Education,* 17, 219-232.

Lippincott, W.T. (1979). Why Students Hate Chemistry. *Journal of Chemical Education*, 56, 675.

Lott, G. W. (1983). The effect of inquiry teaching and advance organizers upon student outcomes in science education. *Journal of College Science Teaching,* 9, 201-205.

Lunetta, V.N. (1998). The school science laboratory: Historical perspectives and context for contemporary teaching. In B. Fraser and K. Tobin (eds.), *International handbook of science education*, pp. 349-264. Dordrecht: Kluwer Academic Publishers.

Odubunmi, O., & Balogun, T. A. (1991). The effect of laboratory and lecture teaching methods on cognitive achievement in integrated science. *Journal of Research in Science Teaching,* 28, 213-224.

Okebukola, P. A. O. (1986). An investigation of some factors affecting students' attitudes toward laboratory chemistry. *Journal of Chemistry Education*, 86, 531-532.

Osborne J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implication. *International Journal of Science Education,* 25(9), 1049-1079.

Partington, J. R. (1960). *A Short History of Chemistry.* New York: Harper Torchbooks.

Piaget, J. (1964). Development and learning. *Journal of Research in Science Teaching*, 2, 176-186.

Praksa, M., & Tothova, A. (2006). Demonstrations. *Journal of Chemical Education,* 83, 1471.

Rajecki, D. W. (1990). *Attitudes*. Sunderland, MA: Sinauer.

Ray, W. E. (1961). Pupil discovery versus direct instruction. *Journal of Experimental Psychology: General*, 118, 219-235.

Reid, N. (2006). Thoughts on attitude measurement. *Research in Science and Technological Education*, 24(1), 3-27.

Robinson, W. R., & Niaz, M. (1991). Performance based on instruction by lecture or by interaction and its relationship to cognitive variables. *International Journal of Science Education,* 13, 203-215.

Rowell, J. A., Simon, J., & Wiseman, R. (1962). Verbal reception, guided discovery and the learning of schemata. *British Journal of Educational Psychology,* 39, 235-244.

Sanger, M. (2006). Demonstrations. *Journal of Chemical Education*, 83, 1632A.

Shakhashiri, B. Z. (1983). *Chemical Demonstrations: a Handbook for Teachers of Chemistry.* Madison, Wisconsin: The University of Wisconsin Press.

Tobin, K.G. (1990). Research on science laboratory activities: In pursuit of better questions and answers to improve learning. *School Science and Mathematics*, 90, 403-418.

Tsaparlis, G. (1997). Atomic and molecular structure in chemical education: A critical analysis from various perspectives of science education. *Journal of Chemical Education,* 74, 922-925.

Wachanga, S. W., & Mwangi, J. G. (2004). Effects of the cooperative class experiment teaching method on secondary school students' chemistry achievement in Kenya's Nakuru District. *International Educational Journal,* 5(1), 26-36.

Weeks,M. E., & Leicester, H. M. (1968). Discovery of the elements. *Journal of Chemical Education*, 47, 167.

Westbrook, S. L., & Rogers, L. N. (1996). Doing is believing: Do laboratory experiences promote conceptual change? *School Science and Mathematics,* 96, 263-271.

Zadra, E. (2000). Learning as a gateway to the 21st century. *International Institute for Educational Planning Newsletter,* 18(2), 14.

Appendix A

Student Attitude Questionnaire

The Effect of Demonstrations and Activities on the Students' Attitude towards Chemistry

A Questionnaire Administered to the students of grade eight

This is a scientific study conducted by Mazena Chamseddine. The study is checking your attitude towards chemistry. Your viewpoint will be assisting the advance of knowledge on the area of this study. When you complete the questionnaire, fold it, and place it on the teacher's desk.

Please, return this form when you finish filling it.

Answer the following questions honestly.

Your response will remain strictly confidential.

Do not sign your name.

You should know your form number of the questionnaire to continue answering it later on in 3 months.

Form number ☐

Instruction 1: Please, rate from 1 to 3, **1** representing strongly agree, **2** representing partially agree, **3** representing don't agree.

You have to fill in the pre-study column and at the end of the study you fill in the post-study column.

Item	Pre-study	Post-study
1. Science is my favorite subject		
2. Chemistry is my favorite science subject		
3. Chemistry is more difficult than other science subject		
4. I feel enthusiastic about chemistry		
5. I enjoy chemistry periods all the time		
6. I understand chemistry concepts		
7. I don't think that chemistry is useful to me		
8. I don't think that chemistry is related to my real life		
9. I go to the lab for chemistry experiments		
10. My teacher does demonstrations in the class		
11. I get high grades in chemistry		
12. I would like to take chemistry through my university education		
13. It is exciting to be a scientist		

<u>**Instruction 2:**</u>

Please, answer each item honestly in the pre-study part and at the end of the study you will fill in the post-study part.

14. Here are some reasons why I like/don't like chemistry periods
pre-study

____

____

____

post-study

____

____

____

15. Here are some suggestions to have in my chemistry sessions

____

____

____

For Experimental Group only
<u>**Instruction 3**</u>**:** Please, rate from 1 to 3, **1** representing strongly agree, **2** representing partially agree, **3** representing don't agree.

You will fill this part at the end of the study

Item	Post-study
1. Demonstrations and experiments help me understand theories in chemistry	
2. Demonstrations and experiments are waste of time	
3. Demonstrations and experiments keep my interest during the lecture	
4. One demonstration per lecture is enough to keep me engaged	
5. All demonstrations and experiments should be colorful or noisy	
6. I love chemistry because of demonstrations and experiments only	

Appendix B

Teacher's Questionnaire

The Effect of Demonstrations and Activities on the Students' Attitude to and achievement ia Chemistry

A Questionnaire Administered to chemistry teachers

This is a scientific study conducted by Mazena Chamseddine. The study is checking the students' attitude towards chemistry as well as their achievement. Your viewpoint will be assisting the advance of knowledge on the area of this study. When you complete the questionnaire, fold it, and place it in the Administration office.

Please, return this form when you finish filling it.

Answer the following questions honestly.

Your response will remain strictly confidential.

Do not sign your name.

Form number ☐

1. **I have been teaching chemistry for ____________ years.**
2. **What teaching approach do you usually use to teach?**

3. **Do you do demonstrations in your classes all the time? If No, Why not?**

4. **Do you have a lab in your school? If yes, give a quality evaluation of the lab you have.**

5. **Do you prepare a lab session for your students even if you don't have a lab (experiment sessions)?**

6. **Do you get support(materials you need, equipments, place, etc..) from the school when you ask for?**

7. **List some reasons that prevent you from teaching chemistry through experimental method all the time.**

8. **How do you rate your students' achievement in chemistry?**

9. **Describe your students' attitude toward chemistry as a subject.**

10. **Do you think that students are able to discover chemical concepts through experimentation?**

11. **What are some things you would like to change in your teaching methods?**

12. **What are the typical issues or topics with which your students have difficulty?**

13. **Propose a method to reduce these difficulties.**

Appendix C

Student's Interview Questions

1- How was your attitude changed about chemistry at the end of this study period?
2- What are some factors that made you change your attitude?
3- Do you think that memorization is an important aspect in learning chemistry?
4- What made you enjoy/ not enjoy chemistry concepts?
5- Did you understand the chemistry concepts in a better way through demonstrations and experiments?
6- Did your achievement change during this study period?
7- Would you choose scientific majors at university?