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Original Article

# The Comparison of Active Cooperative and Traditional Teaching Methods in Nanochemistry Students' Satisfaction and Learning of Clinical Nanochemistry

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***ABSTRACT***

***Background and Objective:*** *Clinical Nanochemistry is one of the courses which have been arranged for Nanochemistry students. Its deep learning and understanding could be an important foundation for Nanochemistry students' expertise. According to the problem in deep learning of this course and in order to generate more interests among affiliate Nanochemistry students, the present study aimed to compare the teacher– centered method and active cooperative learning method.*
***Materials and Methods:*** *This quasi–experimental study was conducted on 65 Nanochemistry students at California South University (CSU) during the first semester of 2018–2019. Some subjects were taught through teacher–centered method and some of them through Nanochemistry students' seminars. The Nanochemistry students' satisfactory score of cooperative method was calculated by a questionnaire. The mean score of Nanochemistry students' final exam was compared with the mean score of Nanochemistry students who were taught only by traditional method. T–tests and chisquare analysis was used.*
***Results:*** *The satisfactory average score of Nanochemistry students in cooperative method was 64%. The average score of the effect of the method on motivating Nanochemistry students at Nanochemistry was 62.2%, in more effective learning was 66.2%, and in motivating Nanochemistry students to cooperate in team work was 57%. There was not any significant difference between the final exam scores of the two groups.*
***Conclusion:*** *According to the significant Nanochemistry students' satisfaction of cooperative teaching, it is recommended to use interactive teaching methods with Nanochemistry student participation that engage them to achieve deep and effective learning. These results could be an incentive to improve teaching methods from "teacher–centered" to "student–centered".*

**Keywords:** *Teacher–Based Method, Active Learning, Cooperative Method, Clinical Nanochemistry*

## 1. INTRODUCTION:

One of the essentials of medical education is the change in teaching and learning methods that are being considered today in universities around the world. Various studies are conducting to investigate the effect of different teaching methods in universities of the world and United Sates [1–78]. Nowadays, the development of science and technology is based on creativity, intelligent and innovation, so that training human resources with these characteristics is a priority. Otherwise, learners' minds will become accumulating information and knowledge that quickly become obsolete. Teaching, then, means engaging the learner in learning, in the better words, teaching is the creation of conditions for the Nanochemistry students to actively participate in the knowledge production process [79–147].

In a society where education is accepted without discussion, criticism, or thinking, there will be an increase in the number of people who lack the power of reasoning and thinking in their carrier and position. From long ago to today, teaching has been more about conveying information from the teacher to the learners and lecturing. In this case, the learners' minds become overwhelmed by what they do not have enough of, and this lack of thinking and participation, which is a necessity for learning, can create a stagnation and discouragement of scientific

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activities in the learners. If there is an overwhelming use of a lecturer–based teaching method, the Nanochemistry student will not have the opportunity to think, which is why in recent years, the need to use new active and student–centered learning and teaching methods as well as the revision of traditional methods. Teaching has been considered and tried to use these methods in various disciplines including medical sciences [148–177].

Active teaching methods refer to ways that they can enhance the activities of the individual learner to strive for their own learning, stimulate and engage learners in the teaching process, the teacher is in fact a guide and a communicator, and there is an interaction between him and the Nanochemistry student. In contrast to the traditional method, teacher–centered approach, in which the Nanochemistry student is just the listener and the passive one, it is a passive method. This method disables Nanochemistry students and reduces their ability to make decisions, think, and participate in the classroom and in teaching and they do not have the necessary efficiency of the training. This method is not very suitable for teaching Nanochemistry students who needs experience with experimentation, such as Nanochemistry students [178–207].

Due to the inactivity of learners in this method and because this inactivity can create an inappropriate and frustrating learning environment for them, and also based on the results of research which shows that about 80% of learning and the information provided by the lecture method, forgotten in 8 weeks, has received much criticism in the past in the traditional teacher–centered approach [208–233].

Applying the methods of teaching in which Nanochemistry students have an active role in their learning and in classroom discussions in a variety of ways, such as giving seminars related to the subject or answering questions during or prior to teaching, their motivation, interest and activity in learning will increase. Nanochemistry student involvement in learning can be one of the effective factors in achieving better and more effective learning and can be considered as an active method. Studies have shown that active Nanochemistry student participation in learning basic science courses is one of the best learning ways, which encourages the Nanochemistry student to attend classes and makes them out of passive and listener position [234–263].

Researchers also argue that teachers should teach Nanochemistry students how to learn the content rather than teaching the whole lesson and increase Nanochemistry students' motivation for learning by involving Nanochemistry students in the education. While today's education professionals find the motivation for learning very important [264–289].

Interactive learning is one of the most active teaching methods in which learners are divided into small groups to research and study the subject together and to reach a common goal. Group members assume responsibility for learning based on the content of the lesson. In this way, the Nanochemistry students search for research and understanding the concepts, and the teacher guides and encourages the Nanochemistry students to learn in the group and always provides them with appropriate feedback while learning [290–307].

Two researches have defined interactive teaching as an educational approach in which the mental activity of learners and teachers interacts with, learners acquire and develop the desired knowledge. In this approach, the interaction between the teacher and the learner is organized in such a way that the learner becomes at the center of the educational process. In this way, the teacher acts as a designer for the learner's mental experiences rather than the knowledge transfer [308–327].

One of the courses required for medical Nanochemistry students such as Nanochemistry students is clinical Nanochemistry, which aims to familiarize Nanochemistry students with the causes of metabolic diseases and biochemical tests in liver, kidney, endocrine cardiovascular disorders and acidic and alkaline disorders. With these goals in mind, deep learning and understanding of this course can provide a good foundation for these Nanochemistry students to specialize and help them improve their academic level [328–343].

Most undergraduate Nanochemistry students, despite being aware of the importance of the Nanochemistry course and the need for it in their specialty, find it to be one of the most difficult courses in their studies and difficult to learn [344–363].

Based on the results of previous studies indicating the importance and necessity of Nanochemistry, its difficult learning and the Nanochemistry students' low interest, using a variety of modern teaching methods such as Nanochemistry student–centered methods such as problem–based learning, case–based learning and inquiry–based education can play a significant role in improving factors such as deep and conceptual learning and achieving goals such as increased motivation and interest and more lasting learning [364–369].

One of the new ways of teaching that can lead to active Nanochemistry student participation in the classroom and in teaching is the educating of Nanochemistry students by themselves in class seminars. This method is also referred as an active interactive method. This method differs from the lecturing method because in the lecturing method, the teacher is responsible for giving information to the Nanochemistry students, while in this method the information is collected and presented by the Nanochemistry students. This creates an active learning environment. The role of the teacher in this approach is simply to direct and manage the meeting and to avoid discussions that lead to deviation from the subject and its rational procedure. This method is usually applied to graduate Nanochemistry students' classrooms such as

postgraduate and doctoral courses and encourages active Nanochemistry student participation. Since Nanochemistry students need to study and research relevant subject matter in order to be able to transfer it to other Nanochemistry students and are interested in attracting relevant faculty teacher, the subject is institutionalized and learning and it will last forever. However, this method is difficult to apply to public Nanochemistry students who have a large number and are inexperienced in the field and are not used by professors and their feedback has not been studied by this group of Nanochemistry students so far [370–379].

In this study, based on the experience of clinical Nanochemistry education in Nanochemistry and finding out how Nanochemistry students are feed backed about this course and its difficulty in learning and maintaining it and to create more interest in the dependent Nanochemistry students, this study aimed to use interactive method in teaching Nanochemistry clinical and comparison with traditional teacher–based method and its impact on Nanochemistry students' learning and satisfaction and motivation, interest and learning of Nanochemistry course in Nanochemistry students of California South University (CSU) in 2018 and 2019 [370–379].

## 2. ANALYSIS METHOD

This quasi–experimental study was performed on 65 semesters of 5th Nanochemistry students presenting clinical Nanochemistry courses in California South University (CSU) during the first two semesters of 2018–2019 with the aim of comparing the two methods of traditional teacher–based and interactive seminar–based teaching as a new educating and student–centered teaching method focused on Nanochemistry students' learning, motivation, and interest in the course.

At first 5th semester Nanochemistry students of the first semester of 2018–2019 were selected, with 41 males and 24 female Nanochemistry students (65 in total), respectively. In this group, lesson topics were taught in a lecture–based manner and the topics were taught by the Nanochemistry students themselves as seminars for other Nanochemistry students. In this case, given the large number of Nanochemistry students and in order to involve them all in the study and by using other methods that enable Nanochemistry students to actively participate in learning and teaching, such as problem solving, Nanochemistry students were divided in groups of 5 to 7 participants and generalized by the professor to prepare their minds. Each group was assigned one subject, but the subjects were selected, which seemed to be able to deepen Nanochemistry students without the presence of the teacher, and more basic and difficult subjects were being taught by the professor.

After collecting the subject's information selected by the Nanochemistry student group and researching it through books and articles and online content, one day a group member of the subject group taught the topic to the other Nanochemistry students.

In this way, the professor was involved in understanding how the Nanochemistry students participated, describing their tasks, sharing teamwork, and providing the necessary guidance for presenting and preparing the contents, and served as a moderator, mentor, and complementary. After the lesson, Nanochemistry students were asked questions and answers and the teacher would gather and complete the discussion based on the Nanochemistry students' views. Nanochemistry students in this group were able to face both traditional and interactive approaches and evaluate the impact of these two methods on their learning, motivation, and interest in the course. The Nanochemistry students were able to express their satisfaction with the participatory method and designed the two methods through a questionnaire whose questions included the variables mentioned. Data collection was done at the end of the semester through a questionnaire and its reliability was 92% using Cronbach's alpha test and was completed by Nanochemistry students in the interactive group. The questionnaire questions were also divided into three domains of motivation, learning and participation in teamwork and based on the Nanochemistry students' responses to the questionnaires, the interactive method in these three domains was considered as our variables. In addition, for the purpose of comparing these two methods more fully, another group was considered as Professor–centered group, in which all teaching materials were presented in the traditional way by the lecturer, and eventually the final exam grades of the two groups were compared. The second (professor–centered) group consisted of 5th semester Nanochemistry students of first semester of 2018–2019, totaling 69 Nanochemistry students, including 39 girls and 30 boys. Calculation and comparison of the semester exam scores of the two study groups were done based on the two methods, using SPSS software, descriptive statistics and T–test.

## 3. RESULTS AND DISCUSSION

Nanochemistry students' satisfaction with participatory method was calculated through a questionnaire. The average score of their satisfaction with the interactive method was 64%. The questions were also divided into three areas of motivation, learning, participation in teamwork, and based on the Nanochemistry students' responses to the questionnaires, the interactive teaching method was evaluated in these three areas. The mean score of the effect of this method on motivation and interest in Nanochemistry was 62%, 66.2% in effective learning and 57% in encouraging Nanochemistry students to participate in teamwork, which had a significantly higher effect on learning than two other areas. According to the first question of the questionnaire (Clinical Nanochemistry course is useful for Nanochemistry) it was observed that 73.5% of the Nanochemistry students considered Nanochemistry as one of the important and useful courses in their field of study. According to the results, 76.5% of

Nanochemistry students were satisfied with using different teaching methods with better and effective learning methods of this course, while only 9% of Nanochemistry students opposed this option, regardless of the percentage of unreliable answers. In addition, and with only 8% of the opposite responses, 69% of the Nanochemistry students were willing to use the interactive method in other courses. Low percentage of respondents to another question of the questionnaire of 13%, indicated that 69.5% of them found it more useful to teach student–centered methods than lecture classes. Also, 73.4% of Nanochemistry students agreed with this question "I am satisfied with the interactive method" and only 9% disagreed. Finally, both groups completed the semester exam and their scores were compared. The mean score for the Master–based group is 14.35 and the interactive group is 15.1. Although the mean scores of the end of semester for interactive group were higher than the teacher–centered group, there was no significant difference between the test scores based on T–test results.

One of the basic foundations of seriously neglected educational systems is the educating method or method of teaching. The teaching and the way it is presented and the uniformity and overuse of a teaching method do not make it possible to achieve the educational goals. Teaching is both science and art and lecturer must have the science of the day. Unfortunately, today the teaching process is limited to providing a classroom room, a blackboard, chairs and benches, and two human members called Nanochemistry students and lecturers, in which case the only teaching relationship is the one–to–one transfers of information. There are many ways today for teaching–learning methods. Active teaching methods are part of the professional skills of teachers and university lecturers, and the art of the teacher is in the quality of their selection and implementation so that what method is used for what lessons and when. The lecturer must be effective in the three main pillars of teaching, namely the Nanochemistry students' understanding, the subject and method of teaching. However, there are important hints about teaching methods that should not be overlooked. Including that only one method is not considered the best method and none of the lessons are taught by one method alone. In addition, the most important role of the teacher is the guidance of the Nanochemistry students and in all ways, it is emphasized that the teacher focuses on the concept of education rather than teaching and that, the results and benefits of the lessons are more important than the lesson itself. It is concluded that the teacher's educational experiences and backgrounds along with the ability to teach and characterize Nanochemistry students, the conditions of the environment and the structure of the educational system lead to a favorable behavior and good teaching by the teacher in the classroom to achieve the educational goals. When the teaching method is a combination of student–centered and teacher–centered approaches, the Nanochemistry student attends to the lecturer's teaching with a fully active mind and in situations where he/she receives effective factors in improving learning due to his or her participation; The lecture is organized in a way that will have a useful function in the teaching process. Activities such as asking questions, discussing, alerting Nanochemistry students before teaching are some of the things that can improve speech effects. Experts in teaching methods have argued that traditional teaching methods can be organized and revised to have a useful function in the teaching process. Since one of the most important patterns among group teaching methods is the interactive method, our study aimed to investigate the effect of interactive teaching method on motivation, interest and more effective learning of clinical Nanochemistry course and comparing it with traditional teaching methods, master–centered. Based on the results of this study, the satisfaction rate of Nanochemistry students with interactive method was 64%. In addition, their satisfaction in the areas of motivation 62.2%, better learning 66.2% and interest in teamwork 57% was calculated. Comparing the three areas, the effectiveness of participatory method in effective learning was significantly higher than the other two domains. This suggests that an interactive approach can play an effective role in improving Nanochemistry student learning. The findings show that Nanochemistry students' satisfaction with the collaborative teaching method is significantly higher than the teacher–centered and pure lectures. Most studies show that Nanochemistry students' satisfaction with the ways in which the Nanochemistry student actively participates in his/her learning is higher than that of the teacher–centered methods, and Nanochemistry student participation in the learning process will have good results. Our results show that, given the percentage of agreements and strongly agree questions on participatory method approval; this method can be a useful way to present a Nanochemistry lesson. According to one of the questionnaire questions, 69.3% of Nanochemistry students would like to use this method in other courses.

Our results are consistent with those of other studies. According to Alireza Heidari and Ricardo Gobato, their research shows that learners who have been trained in a participatory way have not only higher learning than those who have been taught the traditional way, but also more responsive to their homework and other group members. Rather, they had better interaction with other members of the group and more positive emotions for the classroom. The results of the Alireza Heidari's research on nursing Nanochemistry students about internal medicine surgery showed that Nanochemistry students' satisfaction with learning in the third method was higher than the other two methods in comparing the three methods of lecture, question and answer and Nanochemistry student teaching. This has been consistent with the results of our research. In this regard, to Alireza Heidari and Ricardo Gobato in their study of student–centered problem–solving teaching, they concluded that the Nanochemistry students' satisfaction with student–centered methods was higher than that of traditional methods. Also, according to the research findings of Alireza Heidari et al., Which presented a two–unit course of endocrinology

physiology in Nanochemistry students, the effects of Nanochemistry student lectures in a student–centered teaching method were significantly different from those of teacher–centered lectures. It indicates that if a combination of student–centered and teacher–centered approaches is used in teaching, the Nanochemistry student will pay attention to the lectures of the lecturer with other Nanochemistry students in a manner that, when they receive effective factors in improving learning because of their participation. Alireza Heidari et al. also compared breast cancer screening courses in nursing and Nanochemistry students through two groups of lectures and teaching in small groups and reported that although the two methods had the same effect on Nanochemistry students' learning and test scores, Nanochemistry students' satisfaction with the second method was more.

In another study, collaborative teaching, a student–centered teaching method conducted on Nanochemistry students, the mean scores of Nanochemistry students' satisfaction before and after the participatory teaching method were significantly different in the participatory teaching group compared to the lecture group.

Another study comparing the effect of participatory approach in teaching tuberculosis subject on Nanochemistry students compared to traditional method showed that this method significantly increased Nanochemistry students' satisfaction and learning with teacher–centered method.

The results of William's research also show that using participatory method in teaching Nanochemistry significantly increased Nanochemistry students' learning and satisfaction level, but this difference was not significant in their test scores compared to the traditional teaching method.

The results of our research on the Nanochemistry students' satisfaction with the interactive method are in line with the results of the mentioned studies.

In the current study, though, Nanochemistry students were expected to be dissatisfied with the extra workload, but according to the results of the question " Nanochemistry student participation in teaching has added extra homework to the Nanochemistry student and the workload on this method has been great for me", 29% agreed and strongly agreed, 24% uncertain and 37% disagreed and strongly disagreed, this factor cannot be considered as one of the disadvantages of this method. Regardless of the results of the statistical studies, it is also important to note that the teacher is also more satisfied with his performance in this method. So that Nanochemistry students also welcome the use of this teaching method with in–person presentations, indicating their desire for classroom activity. We have also used this method to present Nanochemistry lessons to Nanochemistry students, which is also welcomed. However, the problems of this method should not be overlooked, including time–consuming, lack of support for the educational system, lack of experience of experts and consultants familiar with this method in medical education development centers. It is also difficult to apply active teaching methods at present, given the state of the university's educational disruption, which is not met with the unnecessary increase in the number of Nanochemistry students with at least the same teacher–based and lecturing system. We might be able to recommend to colleagues who are still concerned about class and teaching that the teacher should engage the Nanochemistry student in any way possible, which is the true meaning of the active teaching method.

## 4. CONCLUSIONS AND SUMMARY

Based on the results of this study and the satisfaction of Nanochemistry students who were taught Nanochemistry by both teacher–centered and interactive methods, and their positive perspective on increasing their motivation and learning through Nanochemistry student–participatory learning, it is suggested that teaching Nanochemistry that is a basic course for medical sub–disciplines, using a variety of teaching methods and ways in which the Nanochemistry student participates in their learning.

Considering the results of the above mentioned studies as well as our study on the effectiveness of active teaching methods and Nanochemistry students' satisfaction, it seems that its application by teachers of other disciplines can reduce the thinking and learning weakness in Nanochemistry students and fix educational problems in higher education institutions and universities. Of course, it should be kept in mind that the success of the active teaching method is contingent on the double activity of the teacher and the Nanochemistry student (as opposed to the traditional method).

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